DOMINION DIAMOND

May 8, 2015

Mackenzie Valley Environmental Impact Review Board
200 Scotia Centre
P.O. Box 938
Yellowknife, NWT
X1A 2N7

Attention: Chuck Hubert, Senior Environmental Assessment Officer

Re: EA1314-01 Jay Project, Dominion Diamond Corporation Developer's Assessment Report – Responses to Undertakings

Dear Mr. Hubert:

Accompanying this letter, Dominion Diamond is pleased to provide the responses to the undertakings received as part of the Jay Project Technical Sessions, held April 20 to April 24, 2015 in Yellowknife, NWT.

MVEIRB provided a combined Commitment, Homework and Undertaking document, on April 24, 2015. The responses included with this submission correspond to undertakings addressed to Dominion Diamond within this document, considering the following:

- Dominion Diamond is providing responses to undertakings #1 to #24 in this document (Document Code Identifiers DAR-MVEIRB-UT-01 to DAR-MVEIRB-UT-24). Note that undertakings #17 and #23 were addressed to other parties, so responses for those are not provided.

- In response to Undertaking #5, a Draft Wildlife Road Mitigation Plan is included with this package.

- During Day 2 (April 22, 2015) of the Technical Sessions, Dominion Diamond committed to providing a response for an additional undertaking from MVEIRB Technical Advisor Anne Gunn. This response is included in this package as Undertaking #25 (Document Code Identifier DAR-MVEIRB-UT-25).

For Commitment #4, Dominion Diamond committed to submit draft plans or existing management plans (e.g., those under review by Wek'èezhìı Land and Water Board) that may be used for reference by MVEIRB. The relevant plans have been submitted for inclusion on the Review Board public registry. Additional draft plans will be provided to MVEIRB as appropriate through the Environmental Assessment review process.

We are committed to continue to work diligently with the MVEIRB and other parties to provide information and responses in a timely manner throughout the remainder of the process. Once again, we would like to thank the MVEIRB staff for hosting the Technical Sessions as part of this process.

Regards,

Richard Bargery
Manager, Permitting Jay Project
Dominion Diamond Corporation

Undertaking Number:	DAR-MVEIRB-UT-01
Source:	Undertakings from Day 2 (April 21) of the Technical Sessions
Subject:	Caribou – Roads and Utilities
DAR Section(s):	Traffic (Appendix C submitted with responses to Round 1 IRs)

Request:

DDEC is to provide a rough map with the location of berms along the Jay road where caribou crossings will not be located. Include total length of roads and proportion that are caribou crossings.

Response:

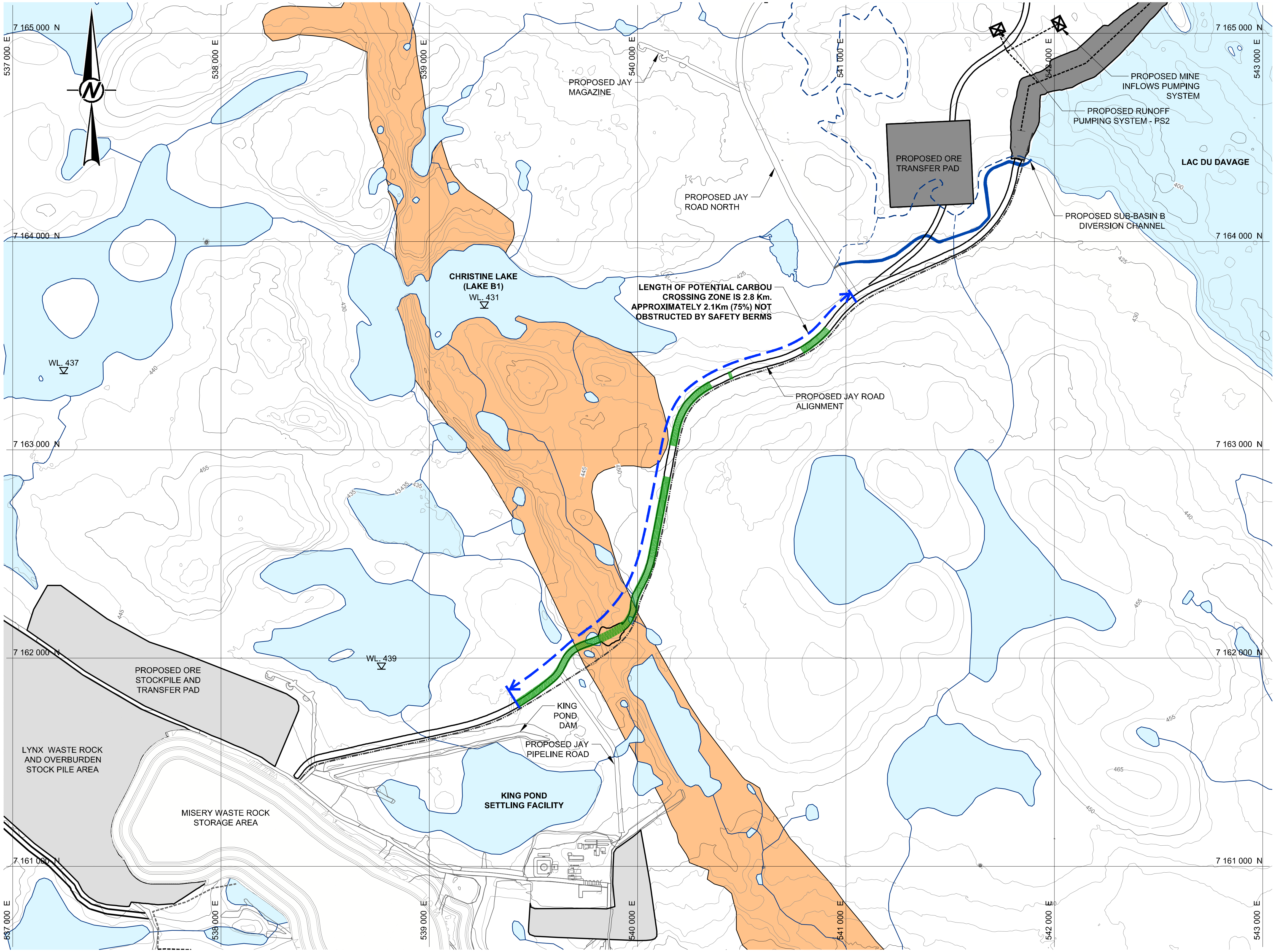
As described in the response to numerous Information Requests, the main section of the Jay Road (i.e., roughly between King Pond Dam and the approach to the active operations area at Lac du Sauvage, a distance of 2.8 kilometres) will be constructed with frequent and wide caribou crossings that will respect the communities' identification of the importance of this area for caribou movement.

However, no caribou crossings will be constructed where raised safety berms (estimated to be 700 metres [m]) are required for compliance with Worker's Compensation Board of the NWT and Nunavut (WCB NWT and NU) Mine Health and Safety Regulations (1995). According to the regulations, safety berms are required where fill thickness exceeds 3 m. Where possible, the roads for the Jay Project will minimize the use of fill material. Fill thickness is based on various factors, including topography, road geometry, and thaw sensitive soils. Approximately 75 percent of the road alignment is estimated to not require berms.

Map 1-1 shows the portion of the Jay Road, between King Pond Dam and the active mining area, taken as the junction between the Jay Road and North Jay Road, potentially available for the construction of caribou crossings, based on the estimated location of road safety berms.

Portions of the pipeline will require visual inspection (i.e., joints, valves, vents, drains); at these specific locations, caribou crossings will also not be constructed. The pipeline will be strategically designed to reduce the number of locations that cannot be constructed as caribou crossings.

Detailed design of the pipelines and road will be conducted during the detailed design stage of the Project to confirm locations where caribou crossings can and will be constructed.



PLAN
SCALE: A

0 400 800 1,200
SCALE: A METRES

LEGEND

- WATERBODY
- WATERCOURSE
- EXISTING SHORELINE OF DEWATERED AREA
- ROAD
- POTENTIAL CARIBOU CROSSING ZONE
- JAY ROAD NOT OBSTRUCTED BY SAFETY BERMS (APPROXIMATE)
- PROPOSED PUMPING SYSTEM
- PROPOSED POWER LINE
- WATER LEVEL ELEVATION
- ESKER (APPROXIMATE)

JAY PROJECT FOOTPRINT

- PROPOSED SUB-BASIN B DIVERSION CHANNEL
- PROPOSED JAY PROJECT INFRASTRUCTURE

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.

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.

REV	DATE	DESCRIPTION	DRW	DES	CHK	RVW
0	2015-05-06	DOC NO. DAR-MVEIRB-UT-1	CLY	JK	FE	FE

SEAL / PERMIT

NOT FOR CONSTRUCTION

CLIENT: DOMINION DIAMOND

CONSULTANT: Golder Associates

PROJECT: 13-1328-0041.3300.20

JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE: JAY ROAD ESTIMATED BERM LOCATIONS

DRAWING No. 1-1 SHEET No. 1 OF 1

SHEET SIZE ANSI D

References:

WCB NWT and NU (Worker's Compensation Board of the Northwest Territories and Nunavut). 1995. Consolidation of Mine Health and Safety Regulations R-125, 1995. Available at: http//www.wscc.nt.ca/YourWSCC/Resources/Documents/Mines%20Health%20and%20Safety/Regus/NUMineRegulations.pdf.

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-02
Source:	Undertakings from Day 2 (April 21) of the Technical Sessions
Subject:	Caribou – Roads alternatives
DAR Section(s):	2

Request:

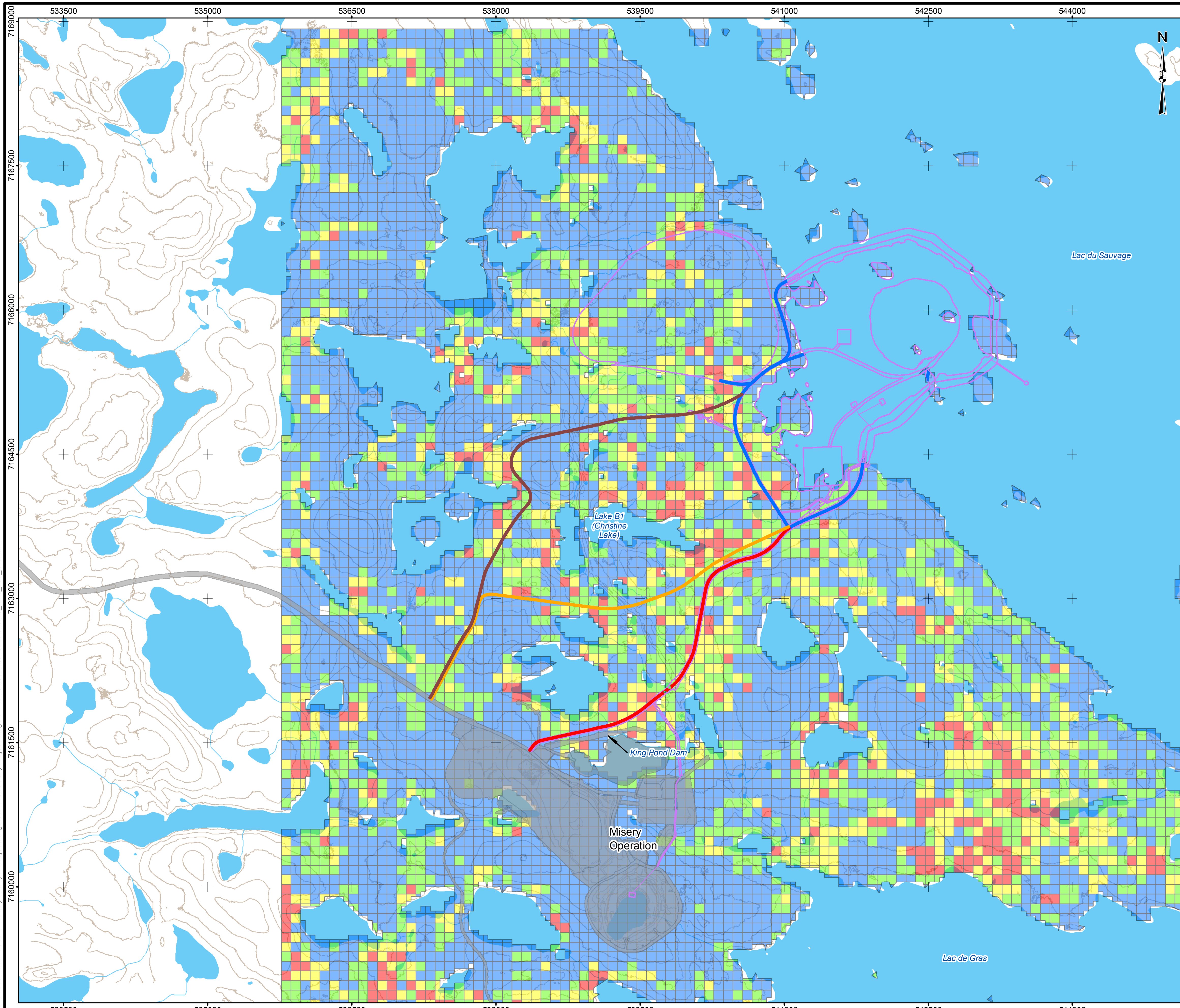
DDEC is to conduct a full analysis for road alternative (#4) proposed by the MVEIRB technical advisor Dr. Anne Gunn, as was done for the other proposed roads; to be submitted as an addendum to table 28.1 and 28.2 to the Review Board and posted on the Public Registry.

Response:

As part of the alternatives assessment in the Developer's Assessment Report (DAR), three alignments for the Jay Road were evaluated. It was recognized that each alignment would also provide the corridor for the power line, and three pipelines associated with water management for the Jay Project. Therefore, a single, optimal alignment for the road, pipelines, and power line was investigated. The assessment was completed prior to the caribou distribution mapping information being available and prior to the 2014 field work (included in the Sable Addendum [Dominion Diamond 2014]).

Information Requests (DAR-MVEIRB-IR-95 and DAR-IEMA-IR-28) requested the alternatives assessment be updated to include caribou trail distribution mapping information. Therefore, an updated assessment for the three road corridors was presented within the responses to these Information Requests. Based on discussions held during the Technical Sessions, Dominion Diamond agreed to expand the alternatives assessment presented in DAR-MVEIRB-IR-95 and DAR-IEMA-IR-28 to include a fourth corridor alignment (Alternative 4). The first three alignments previously evaluated are shown on Map 2-1 as Alternatives 1, 2, and 3. The fourth alignment, that is now being evaluated, is shown on Map 2-2. This uses the general alignment suggested during the technical sessions by the Mackenzie Valley Environmental Impact Review Board (MVEIRB) technical advisor with a few minor modifications to meet construction and operation requirements.

Table 2-1 presents the approximate distribution of grid cells crossed by each of the road alignments, in terms of high (red squares), medium (yellow squares), and low (green squares) historic caribou trail classification. For the Alternative 3 alignment, the number shown in brackets represents the entire number of grid cells crossed in each category. The number outside of the bracket represents the number of grid cells crossed by Alternative 3 alignment, excluding those cells also intersected by the King Pond Dam.



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LEGEND

- EKATI MINE FOOTPRINT (MISERY OPERATION)
- PROPOSED JAY FOOTPRINT
- ELEVATION CONTOUR (10 m INTERVAL)
- WATERCOURSE
- WATERBODY

CARIBOU TRAIL CLASSIFICATION

- NONE
- LOW
- MEDIUM
- HIGH

JAY ROAD ALTERNATIVES

- ROAD COMMON TO ALTERNATIVES 1, 2, AND 3
- ALTERNATIVE 1
- ALTERNATIVE 2
- ALTERNATIVE 3

NOTES

ROAD, PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN. POTENTIAL QUARRY MAY BE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA

REFERENCE

JAY PROJECT CONCEPTUAL ENGINEERING REPORT, EKATI MINE, DOC#: 1313280041-E14037-R-REV0-4060, DATED: MAY 13, 2014
JAY PROJECT DESIGN BASIS MEMORANDUM FOR PRE-FEASIBILITY DESIGN OF PROJECT ROADS AND PIPELINE BENCHES, DOC#: 1313280041-E14031-TM-REVD-2020, DATED: AUGUST 1, 2014
LIDAR DATA OBTAINED FROM AURORA, 2013
WATER OBTAINED FROM CANVEC © NATURAL RESOURCES CANADA, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-2

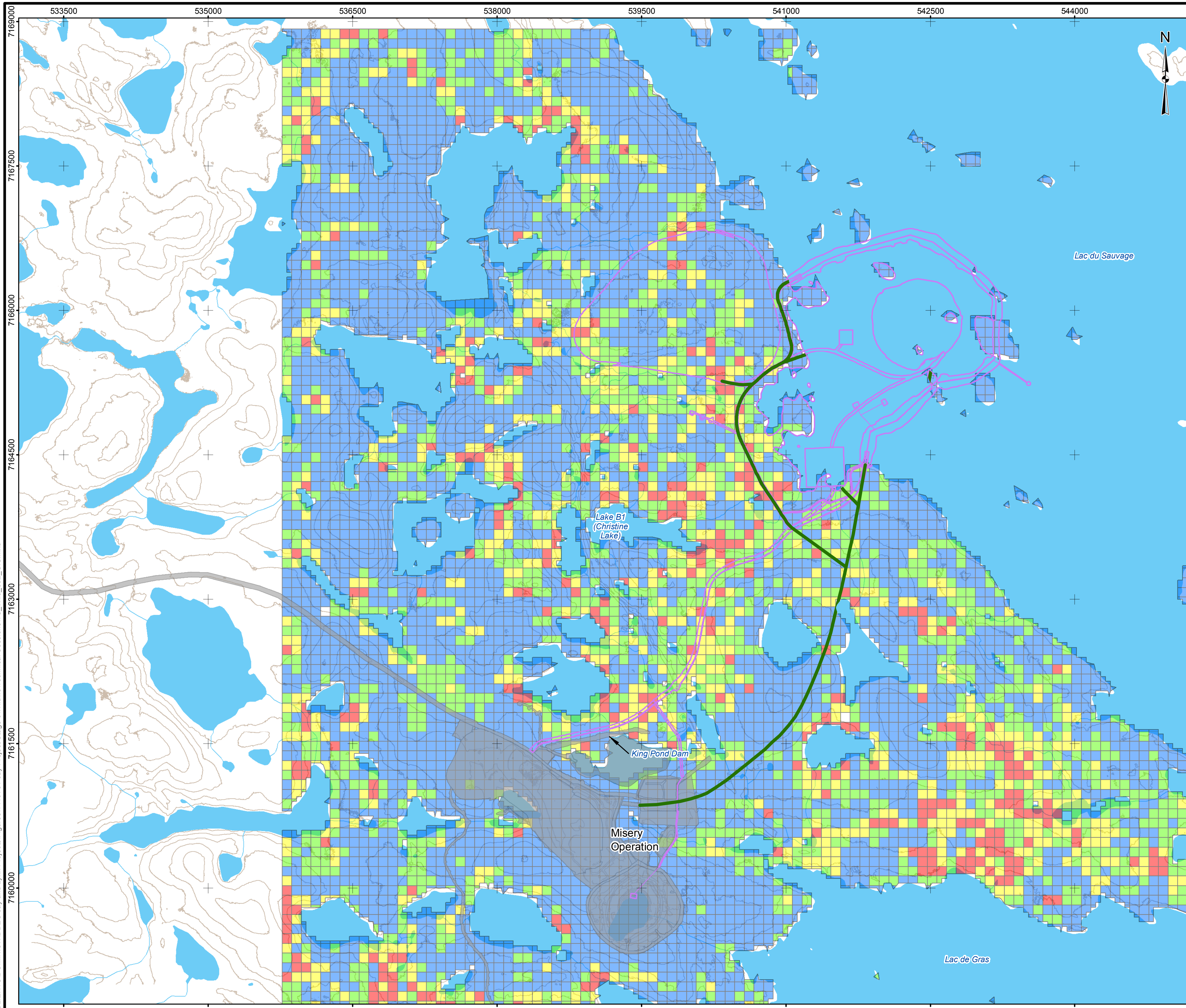
1 0 1
SCALE 1:40,000 KILOMETRES

PROJECT
DOMINION DIAMOND™
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
HISTORIC CARIBOU TRAIL USE AND JAY ROAD ALTERNATIVES 1 TO 3

Golder Associates

PROJECT		1419751	FILE No. TS_Wild_001_GIS	
DESIGN	CM	29/04/15	SCALE AS SHOWN	REV 0
GIS	EN/LS	05/05/15		
CHECK	FE	05/05/15	MAP 2-1	
REVIEW	FE	05/05/15		



LEGEND

- EKATI MINE FOOTPRINT (MISERY OPERATION)
- PROPOSED JAY FOOTPRINT
- ELEVATION CONTOUR (10 m INTERVAL)
- WATERCOURSE
- WATERBODY

CARIBOU TRAIL CLASSIFICATION

- NONE
- LOW
- MEDIUM
- HIGH

JAY ROAD ALTERNATIVES

- ALTERNATIVE 4

NOTES

ROAD, PIPELINES, AND POWER LINE ARRANGEMENT TO BE DETAILED AS PART OF FEASIBILITY DESIGN. APPROXIMATE CORRIDOR WIDTHS ARE SHOWN. POTENTIAL QUARRY MAY BE REQUIRED WITHIN THE FOOTPRINT OF THE PROPOSED JAY WASTE ROCK STORAGE AREA

REFERENCE

JAY PROJECT CONCEPTUAL ENGINEERING REPORT, EKATI MINE, DOC#: 1313280041-E14037-R-REV0-4060, DATED: MAY 13, 2014
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LIDAR DATA OBTAINED FROM AURORA, 2013
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DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-2

1 0 1
SCALE 1:40,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE

HISTORIC CARIBOU TRAIL USE AND JAY ROAD ALTERNATIVE 4

Golder Associates

PROJECT	1419751	FILE No. TS_Wild_002_GIS	
DESIGN	CM	29/04/15	SCALE AS SHOWN REV 0
GIS	EN/LS	05/05/15	MAP 2-2
CHECK	FE	05/05/15	
REVIEW	FE	05/05/15	

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Table 2-1 Estimated Frequency of Historic Caribou Trail Distribution Cells Crossed by Road Corridor Alignments

Caribou Trail Distribution Ranking	Estimated Frequency			
	Alternative 1	Alternative 2	Alternative 3[(a)]	Alternative 4
Red	4	8	5 (9)	3
Yellow	15	11	16 (20)	4
Green	28	33	24 (27)	17
Total	47	52	45 (56)	24

a) Values outside the brackets represent grid cells crossed by Alternative 3 alignment, excluding those also contacted by King Pond Dam. Values inside the brackets represent grid cells crossed by the entire alignment.

There are two considerations in interpreting the historic caribou trail density classifications. First, it is important to recognize that the frequency or activity level of use of the trails is not known. For example, just north of the King Pond there are visible caribou trails; however, the quality and frequency of use of these trails has likely decreased since the construction of the Misery operations, and in particular, the King Pond Dam. Second, the appearance and subsequent detectability of caribou trails varies based on ground conditions. Trail density classification is constrained by detectability and the possibility of false classification of low or zero densities of trails exists.

As noted in both the preamble and response to Information Request DAR-MVEIRB-IR-92, the main caribou migration route in the local area of the Project is in a northwest to southeast orientation towards the Narrows (outlet of Lac du Sauvage into Lac de Gras). At this scale, the pattern of low, medium, and high density cells supports the overall movement of caribou through the local area. The four road alternatives are in an approximately east-west direction to connect the Misery Road to the Jay Pit, and as such, each alternative will intersect the main caribou migration path. While Alternative 4 has more cells where zero caribou trails were detected (Maps 2-1 and 2-2), all caribou migrating through the area to the Narrows will need to cross whatever road alternative is selected. Consequently, each Alternative alignment is predicted to have similar effects on caribou movement due to the same amount of traffic that will operate on the road, irrespective of which alternative is selected.

Irrespective of the selected alignment, the general dimensions of the road, pipelines, pipeline berm, and power line will be the same for each alternative. As discussed in undertaking DAR-MVEIRB-UT-01, the main section of the Jay Road (i.e., roughly between King Pond Dam and the approach to the active operations area at Lac du Sauvage) will be constructed with frequent and wide caribou crossings. Table 2-2 presents a comparison of design aspects for each alignment.

Table 2-2 Comparison of Route Alignments

Design Aspects	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Total Fill (m^3)	832,000	802,000	626,000	800,000
Total Road Length (km) [(a)]	11.7	10.6	9.9	10.8
Haul Distance (km) [(b)]	7.7	7.0	7.6	8.9
Maximum Gradient (%)	7.4	8.5	6.6	9.0
Pipeline Length (km)	10	8.8	5.6	5.1
Number of Watercourse Crossings	3	2	2	3

a) New road length.
b) From pit crest to common point on Misery Road.
km = kilometres; m^3 = cubic metres;% = percent.

As per the request, the alternatives assessment for the combined route selection (road, pipelines, and power line) has been updated with results summarized on Table 2-3. The following types of information have been considered in the evaluation:

- length of road (shorter road length is positive in terms of economic and environmental factors);
- length of pipeline (shorter length is positive in terms of economic factors);
- length and height of esker crossing;
- area of esker disturbed;
- road grades (flatter route is positive in terms of economic and environmental factors, and results in fewer areas that require berms be constructed along the roadway, and therefore, less of a potential physical barrier to wildlife movement; where berms are required, caribou crossings will not be constructed);
- footprint of the mine and proximity to disturbed areas;
- fragmentation of habitat;
- location of waterbodies, stream, and drainage crossings and potential to affect fish and/or fish habitat;
- proximity to archaeological sites;
- visual impact to the esker;
- ability to reclaim the esker during closure;
- input from the Impact Benefit Agreement (IBA), community members during engagement meetings and site visits to the esker conducted during the summer of 2014;
- amount of fill material required for construction;
- caribou migration routes (information gathered from Traditional Knowledge, mapped historic caribou trails in 2013 (Map 12.2-5 of the DAR; and Map 4.2-4 of Dominion Diamond [2014]);

- relation to high, medium, and low historic caribou trail distribution trail mapping (Map 2-1 and Map 2-2 and values shown in Table 2-1);
- closure and reclamation; and,
- diesel fuel usage and associated greenhouse gas emissions.

Alternative 3 remains the overall preferred alignment for the road, pipeline, and power line, based on the highest total score. Alternative 4’s environmental benefits in terms of caribou trail density in the area crossed are offset by other environmental concerns, such as, length of safety berms and length of esker disturbance (Table 2-3).

Alternative 4 also has two very significant downsides. First, it has a steep maximum grade that may not be technically feasible for large payload haul trucks to climb. Reducing haul truck payload would increase the frequency of haul truck traffic, an undesirable outcome. Second, it passes through the Misery Camp, increasing potential concerns for Health and Safety, traffic management, and comfort of staff in camp.

Table 2-3 Jay Road, Pipeline, and Power Line Corridor Alternatives Assessment for Route Selection - Updated Results

Account	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Technical Feasibility	• Alternative 1 has the second shallowest maximum grade. • Requires additional fill/cut for crossing the esker. • Requires the most fill for construction.	• Alternative 2 has the second steepest maximum grade. • Requires the most fill/cut for crossing the esker. • Requires the second most fill for construction, approximately equal with Alternative 4.	• Alternative 3 has the shallowest maximum grade. • Requires the least fill/cut for crossing the esker. • Requires the least fill for construction.	• Alternative 4 has the steepest maximum grade. • Requires some additional fill for crossing the esker. • Requires the second most fill for construction, approximately equal with Alternative 2.
Relative Scores	2	1	3	1
Economic Viability	• Alternative 1 requires the longest section of new road, pipeline, power line, and most fill. • Alternatives 1 and Alternative 3 have similar haul distances, which are longer than Alternative 2, shorter than Alternative 4. • Alternative 1 has the longest pipeline alignment. • Alternative 1 grade is second shallowest.	• Alternative 2 requires less road length and fill than Alternative 1, approximately equal with Alternative 4, but more than Alternative 3. • Alternative 2 has the shortest haul distance. • Alternative 2 has the second most length of pipeline. • Alternative 2 second steepest grade.	• Alternative 3 requires the shortest section of new road and the least amount of fill. • Alternatives 1 and Alternative 3 have similar haul distances, which are longer than Alternative 2. • Alternative 3 has the second shortest pipeline. • Alternative 3 grade is the shallowest.	• Alternative 4 requires less road length and fill than Alternative 1, approximately equal with Alternative 2, but more than Alternative 3. • Alternative 4 has the longest haul distance. • Alternative 4 has the shortest pipeline. • Alternative 4 has the steepest grade.
Relative Scores	1	2	3	1
Environmental Considerations	• Alternative 1 is the furthest from the Misery Camp and existing disturbed land. It has the greatest extension of area of environmental impact, and largest fragmentation of land by development (largest footprint). • All Alternatives cross two of the significant caribou trails identified during the 2013 aerial survey (DAR Map 12.2-5) north of Christine Lake. • Alternative 1 crosses one of the Traditional Knowledge caribou paths (Map 4.2-4 Sable Addendum). • Alternative 1 and Alternative 2 have marginally fewer high and medium density caribou trails than Alternative 3 (Map 2-1). • Alternative 1 crosses approximately 150 m of esker, with an elevation of 10 m (longest crossing, intermediate elevation). • Alternative 1 and Alternative 2 disturb more of the esker. • Alternative 1 has the medium grade between alternatives, would have the medium amount of road length requiring berms (areas without caribou crossings). • Alternative 1 requires three watercourse crossings. • Alternative 1 is estimated to have the second highest diesel fuel usage and GHG emissions (combination of road length and grades). • Alternative 1 is estimated to have the second highest dust generation, based on road length. • Alternative 1 and Alternative 2 have similar work for reclamation of the esker.	• Alternative 2 and Alternative 4 are mid-way between Alternative 1 and Alternative 3, in terms of existing disturbed land, fragmentation of land by development, and footprint. • All Alternatives cross two of the significant caribou trails identified during the 2013 aerial survey (DAR Map 12.2-5) east of Christine Lake. • Alternative 1 and Alternative 2 have marginally fewer high and medium density caribou trails than Alternative 3 (Map 2-1). • Alternative 2 crosses approximately 130 m of esker, with an elevation of 15 m (intermediate length of esker, highest elevation). • Alternative 1 and Alternative 2 disturb more of the esker. • Alternative 2 has the second highest grade, so would likely require the second most berms (areas without caribou crossings). • Alternative 2 requires two watercourse crossings. • Alternative 2 and Alternative 3 are estimated to have lower diesel fuel usage and GHG emissions (combination of road length and grades). • Alternative 2 is estimated to have the least dust generation, based on road length. • Alternative 1 and Alternative 2 have similar work for reclamation of the esker.	• Alternative 3 and Alternative 4 are most proximal to Misery Camp. Alternative 3 requires the least extension of area of environmental impact and fragmentation of land by development (smaller footprint). • All Alternatives cross two of the significant caribou trails identified during the 2013 aerial survey (Map 12.2-5) east of Christine Lake. • Alternative 3 has marginally more high and medium density caribou trails than Alternative 1 and 2 (Map 2-1). • Alternative 3 crosses approximately 80 m of esker, with an elevation change of 6 m (shortest). • Alternative 3 has the least disturbance to the esker. • Alternative 3 has the lowest grade, so would require the least amount of berms (areas without caribou crossings). • Alternative 3 requires two watercourse crossings. • Alternative 2 and Alternative 3 are estimated to have lower diesel fuel usage and GHG emissions (combination of road length and grades). • Alternative 3 is estimated to have the second least dust generation, based on road length. • Alternative 3 requires the least amount of work to reclaim the esker.	• Alternative 2 and Alternative 4 are mid-way between Alternative 1 and Alternative 3, in terms of existing disturbed land, fragmentation of land by development, and footprint. Closest to the Narrows. • All Alternatives cross two of the significant caribou trails identified during the 2013 aerial survey (DAR Map 12.2-5) southeast of Christine Lake. • Alternative 4 crosses the least high and medium density caribou trails (Map 2-2). • Alternative 4 crosses approximately 450 m of esker, with an elevation of 4 m (longest length of esker, shortest elevation). • Alternative 4 has an intermediate disturbance to the esker. • Alternative 4 has the highest grade, so would likely require the most berms (areas without caribou crossings). • Alternative 4 requires three watercourse crossings. • Alternative 4 is estimated to have the highest diesel fuel usage and GHG emissions (combination of road length and grades). • Alternative 4 is estimated to have the most dust generation, based on road length. • Alternative 4 is estimated to require more work to reclaim the esker than Alternative 3 and less than Alternatives 1 and Alternative 2.
Relative Scores	2	2	2	2
Social and Economic Considerations	• One unmitigated archaeological site of low significance is located within 150 m of Alternative 1. • Traffic does not pass through Misery Camp.	• No archaeological sites have been identified within 150 m of Alternative 2. • Traffic does not pass through Misery Camp.	• No archaeological sites have been identified within 150 m of Alternative 3. • Traffic does not pass through Misery Camp.	• Proximity of archaeological sites is unknown. • Closest to the Narrows. • Haul traffic (construction and operations) would pass through Misery Camp, increasing potential concerns for Health and Safety, traffic management, and comfort of staff in camp.
Relative Scores	2	3	3	1
Total Scores	7	8	11	5

DAR = Developer's Assessment Report; m = metre; GHG = greenhouse gas.

References:

Dominion Diamond. 2014. Jay Project Developer’s Assessment Report Sable Addendum. Prepared by Golder Associates Ltd., December 2014. Yellowknife, NWT, Canada.

Undertaking Number:	DAR-MVEIRB-UT-03
Source:	Undertakings from Day 2 (April 21) of the Technical Sessions
Subject:	Dust, light, noise – zone of influence
DAR Section(s):	12

Request:

DDEC is to provide information regarding light pollution mitigation strategies from other industrial and mining sites and their applicability to Jay Project.

Response:

Examples of mitigation used at other industrial and mine sites to limit effects of light pollution that could apply to the Jay Project includes utilization of fully shielded lighting fixtures, lighting design that involves tilt and orientation and meets the required light levels to ensure worker health and safety onsite while minimizing luminous flux, and where possible, dark colours on buildings and other structures. Another mitigation option includes the use of switches or motion detectors in high illumination areas not occupied on a continuous basis (i.e., to light the area only when occupied).

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-04
Source:	Undertakings from Day 3 (April 21) of the Technical Sessions
Subject:	Caribou – Cumulative Effects
DAR Section(s):	12

Request:

DDEC is to include Jay underground as an RFD case as it may contribute to cumulative effects on caribou (further to Homework #13) by May 8th.

Response:

The Final Terms of Reference (TOR) for the Jay Project (Project) was issued by the Mackenzie Valley Environmental Impact Review Board (MVEIRB) on July 17, 2014, and the Developer's Assessment Report (DAR) was submitted to the MVEIRB on November 6, 2014. In accordance with the TOR, the DAR provided an analysis and assessment of cumulative effects from the Project and previous, existing, and reasonably foreseeable developments on caribou.

Section 6.5 of the DAR defines the assessment cases used to analyze effects from the Project, and in combination with previous, existing, and reasonably foreseeable developments. The Reasonably Foreseeable Development (RFD) Case includes the Base and Application case plus the cumulative effects of future projects that have a reasonable level of certainty to be developed at the time of completing the assessment (approximately six months prior to the filing date). A list of reasonably foreseeable developments was identified and each was described in the DAR (Section 6.5.2.4). The DAR and additional supplemental work have provided a comprehensive analysis of reasonably foreseeable developments.

At the time of writing the DAR, Dominion Diamond did not include any underground production from the Jay Pit. Underground mining of the Jay kimberlite pipe (Jay pipe) will only occur if economic conditions are favourable and if there is enough identified resource to make underground mining feasible (DAR Section 3.5.4.3; DAR-MVEIRB-IR-79). Significant exploration during the open pit mining phase of the Jay Project would be required to adequately assess the feasibility of underground mining, including drilling to characterize the Jay pipe at depth and analysis to demonstrate reasonable prospects of eventual economic extraction. As a result, underground mining at the Jay Pit was not included as a RFD in the DAR for the Jay Project (DAR Section 6.5.2.4; DAR-MVEIRB-IR-79). The following are largely unknown components with respect to underground mining of the Jay pipe:

- whether the economics would be favourable;
- timing and duration of the project;
- physical footprint;
- mining methods;

- water management;
- underground access; and,
- construction practices.

Although the potential for underground mining at the Jay Pit is uncertain at this time, the following provides a summary of the potential additional cumulative effects from underground mining activities on caribou. Because project description and engineering information for underground mining of the Jay pipe is unknown, the assessment necessarily included a range of assumptions. From the outset, addition of underground mining at the Jay Pit to the RFD Case for caribou would result in changes to the Residual Effects Analysis section, but all other sections and conclusions in the DAR would remain unchanged.

Pathway analysis identifies and assesses the linkages between project components or activities, and the correspondent changes to the environment and potential residual effects (after mitigation) to barren-ground caribou. In the DAR, all effects pathways from the Project on caribou that were related to changes in soil and vegetation quality from air and dust deposition and alterations in surface water, and direct mine-related mortality were determined to be no linkage or secondary (Section 12.3.2.2; Table 12.3-1). It is assumed that for the Jay underground RFD Case for caribou, environmental design features and mitigation implemented for the Jay Project would also be applied to the Jay underground mine, where appropriate and practicable (e.g., avoidance and deterrent actions for limiting risk of mortality and injury to caribou, noise and dust suppressants, and mine rock and waste management practices). Although details regarding mine water management for a potential underground mine are not available, it is also assumed that the water management plan associated with the underground mine would result in no linkage or localized negligible effects to caribou and caribou habitat. Therefore, there are no predicted changes in the no linkage and secondary pathways analysis related to caribou with the addition of underground mining at the Jay Pit.

The following primary pathways identified in the DAR were assessed for cumulative effects from previous, existing, and reasonably foreseeable developments, including the Jay Project (and underground mining of the Jay Pit).

- Direct loss and fragmentation of habitat from the Project footprint causes changes in caribou abundance and distribution.
- Sensory disturbance (lights, smells, noise, dust, viewscape) and barriers to movement causes changes to caribou distribution and behaviour, and changes to energetics and reproduction.
- Increased traffic on the Misery Road and Jay Road and the above-ground power line along these roads may create barriers to caribou movement, change migration routes, and reduce population connectivity.

Changes to direct loss and fragmentation of habitat from potential underground mining is predicted to result in a minor and localized change to habitat loss and fragmentation of caribou habitat in the effects study area. At the regional scale, the change in caribou habitat would be ecologically non-measurable, and has likely already been assessed in the DAR because of the buffer placed around the anticipated Project footprint and overestimation of habitat loss.

Above-ground activities associated with underground mining of the Jay Pit in the RFD Case are assumed to be similar to those that occur during the open pit mining phase. For example, the amount of ore to be hauled during underground mining activities is expected to be similar or less than that during open pit mining. An underground mining phase may be associated with a decrease in the magnitude and geographic extent (i.e., zone of influence) of effects on caribou relative to that predicted in the DAR because sensory disturbance from underground activities may be less compared to open pit mining. For example, underground mining will create less noise and dust relative to initial stages of open pit mining. In the DAR, the magnitudes of residual (after mitigation) effects from sensory disturbance and increased traffic on the Jay and Misery roads were predicted to be moderate. The magnitudes and spatial extent of residual effects from sensory disturbance and increased traffic on the Jay and Misery roads during an underground mining phase are predicted to be similar or less than the Jay open pit phase, independent of the population phase of the Bathurst caribou herd.

The DAR describes the mitigation policies, practices, and procedures that will protect caribou from harm and that will enable their continued movement though the Ekati Mine site. Because of the importance of the esker for caribou movement as identified through community engagement, the portion of the Jay Road that cuts through the esker will be constructed as a caribou crossing (DAR-IEMA-IR-27). The pipelines will be covered over with crushed rock along this section of road, except where there are valves or joints that require visual inspection for safe operation. Dominion Diamond will strategically construct the pipelines to reduce the number of joints or valves through the esker crossing (Wildlife Road Mitigation Plan).

Dominion Diamond also proposes to construct an increased number of caribou crossings along the main section of the Jay Road (i.e., roughly between King Pond Dam and the approach to the active operations area at Lac du Sauvage) (DAR-IEMA-IR-27). This main section of the Jay Road will be constructed with frequent and wide caribou crossings that will respect the communities' identification of the importance of this area for caribou movement (Wildlife Road Mitigation Plan). Caribou crossings will not be built in areas where raised safety berms are required by the Mines Inspector, or at locations where there are necessary joints and valves in the pipelines that require visual inspection for safe operation. This approach also makes beneficial use of 'lessons-learned' from the original Misery Road, where caribou crossings were only installed after construction of the road.

Dominion Diamond is proposing to increase early monitoring of caribou movement with the aid of satellite collar maps obtained from the Government of the Northwest Territories. This would provide advanced warning of when caribou may be approaching the Ekati Mine. Dominion Diamond also proposes to construct additional kimberlite stockpile areas so that the Ekati Mine can operate through brief road closures if this is necessary to allow caribou to move through the mine site (Wildlife Road Mitigation Plan). A staged approach to mitigation will be used, along with the overall hierarchical structure of mitigation (i.e., avoidance, minimize, reclaim and offset/compensation).

It is assumed that mitigation policies, practices, and procedures that will implemented during open pit mining would also be implemented during underground mining at the Jay pipe. As such, the frequency and likelihood of effects on caribou from sensory disturbance and increased traffic on the Jay and Misery roads with the Jay underground in the RFD Case are anticipated to be the same as that predicted in the DAR (Section 12.6.2, Table 12.6-2). That is, cumulative effects from sensory disturbance and increased traffic on the Jay and Misery roads are still anticipated to be continuous and highly likely to occur.

Similarly, as above-ground Project activities are expected to be similar during the open pit and underground mining phases of the Project, the geographic extent and reversibility of cumulative effects will be the same as those predicted in the DAR (i.e., regional extent and reversible).

Underground mining at the Jay Pit would extend operations and closure of the Project past 2029 and 2033, respectively. Therefore, the effects on caribou from sensory disturbance and increased traffic on the Jay and Misery roads will be of longer duration than that predicted in the DAR when including the Jay underground in the RFD Case. Effects would still be reversible, but would occur for a longer duration than predicted in the DAR. That is, instead of residual effects being reversed between 2038 and 2043, effects on caribou would be reversed within 5 to 10 years from the end of closure of underground mining activities at the Jay Pit. The increased duration of residual effects from underground mining of the Jay Pit in the RFD Case would not change the conclusions in the DAR; the Wildlife Road Mitigation Plan would still be active and result in no increases to the magnitude and geographic extent of effects. The incremental and cumulative effects from the Project (including Jay Pit underground mining) and other developments would not have a significant influence on the ability of the Bathurst caribou herd to be self-sustaining and ecologically effective.

Undertaking Number:	DAR-MVEIRB-UT-06
Source:	Undertakings from Day 3 (April 22) of the Technical Sessions
Subject:	Water – hydrogeology
DAR Section(s):	8

Request:

DDEC will provide a summary of 2015 hydrogeology results and qualitatively describe how these updates align with previous predictions to the Review Board for inclusion on the public registry by August 1st, 2015.

Response:

The following will be provided by August 1, 2015:

- Map showing the locations of boreholes drilled in the 2014 and 2015 field programs.
- Documentation of field procedures and quality assurance/quality control (QA/QC).
- Summary of results of 2015 hydrogeology testing.
- Summary of testing results in context of geology and structure.
- Summary of results of Westbay sampling in late 2014 and April 2015.
- Comparison of the results of groundwater quality and hydraulic conductivity between 2014 and 2015.
- A qualitative evaluation to indicate how the new data aligns with Reasonable Estimate (Reference) Case and the Environmental Assessment (EA) Conservative Scenario.

Undertaking Number:	DAR-MVEIRB-UT-07
Source:	Undertakings from Day 3 (April 22) of the Technical Sessions
Subject:	Water – Hydrology (Model Design)
DAR Section(s):	8

Request:

DDEC is to validate the hydrologic model for the Desteffany Lake outlet for the years possible (in order to increase the certainty of accuracy of the model) by May 8th.

Response:

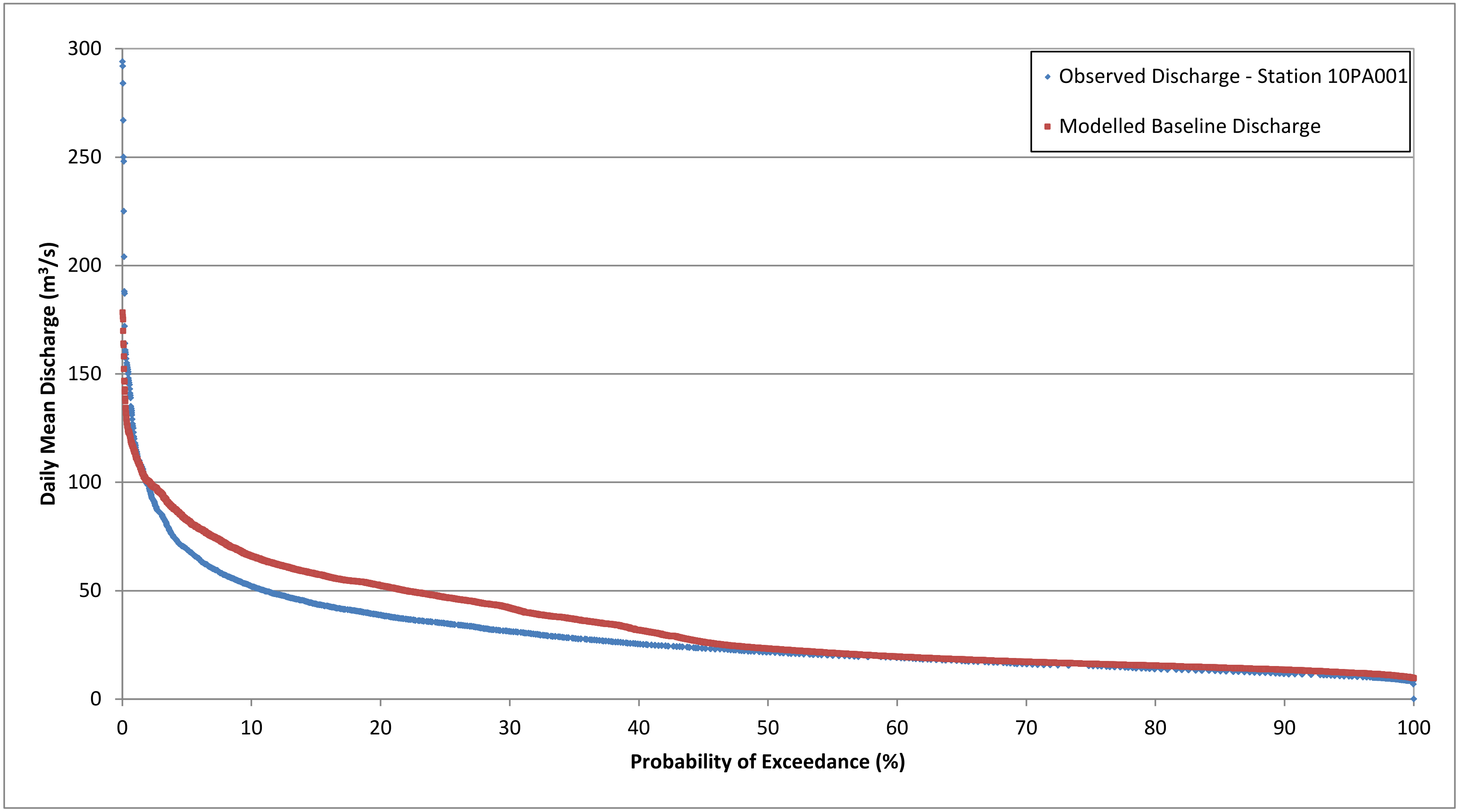
Introduction

The regional hydrology water balance model presented in the Hydrology Baseline Report (Annex X of the Developer's Assessment Report [DAR]) and Section 8 of the DAR has been validated qualitatively against observed hydrographs to validate timing and magnitude, including at the Desteffany Lake outlet. The model is not expected to predict or match hydrograph data to specific years, dates, or individual basins, because actual runoff for any given year may not correspond to the derived site-specific meteorological inputs. Rather, the model is intended to predict statistics (monthly and return period values) over the period of record for the volume and timing of flows, and the timing and variation in water levels based on the derived meteorological inputs applied to the entire basin.

To further evaluate the model performance, the modelled results for the outflow from Desteffany Lake are qualitatively (hydrographs and Percent (%) Exceedance Curves) and quantitatively (performance statistics for monthly and daily values) compared to observed outflow from Desteffany Lake as reported at the Environment Canada Station 10PA001 (Coppermine River below Desteffany Lake) (Environment Canada 2014). Observed discharge data from Station 10PA001 covers the entire hydrological year (both freshet peak flows and base flows) for most years over the long-term period of record (1994 to 2013).

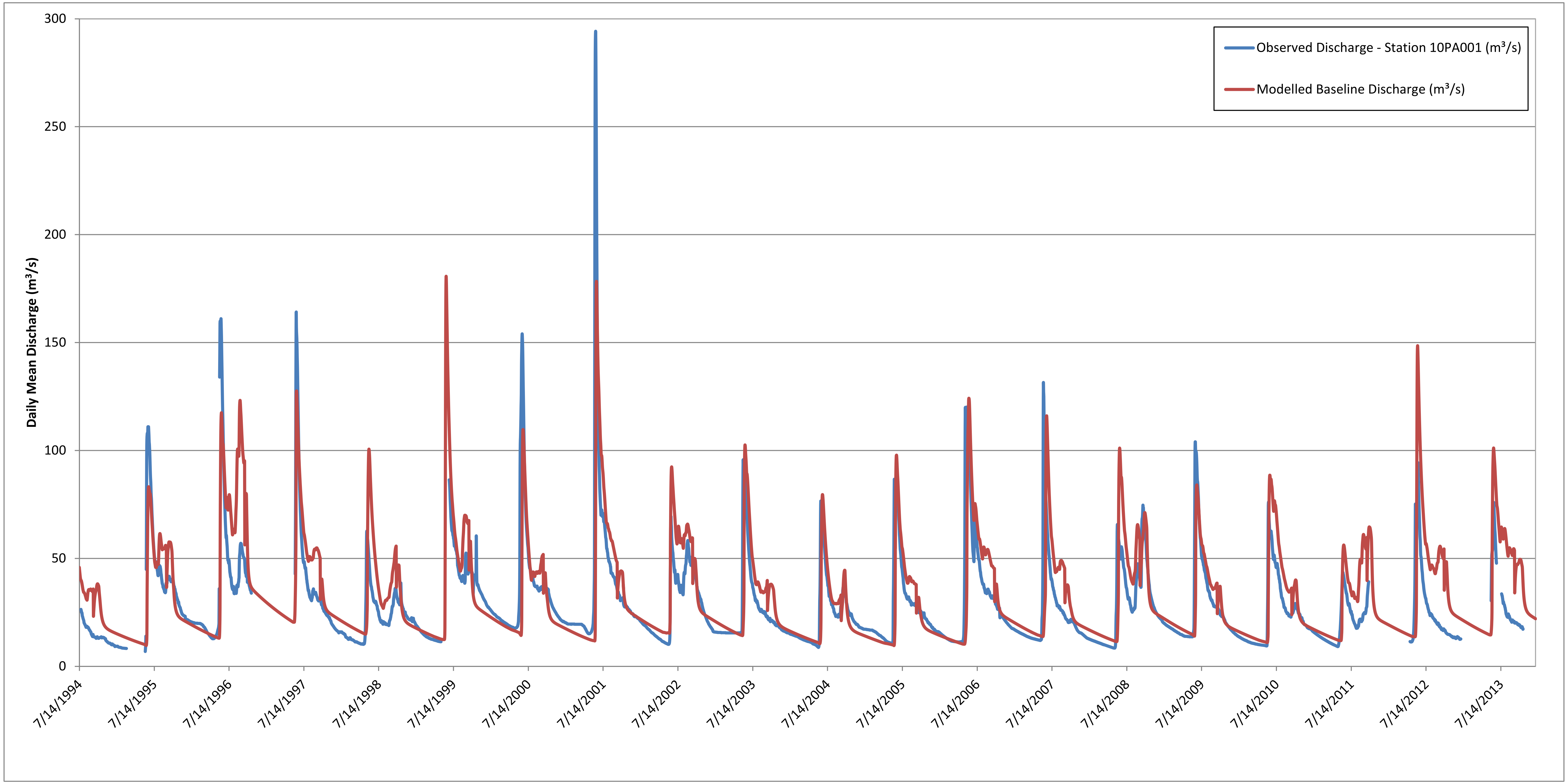
Qualitative evaluation of model performance at the Desteffany Lake outlet, consisting of graphical techniques of percent exceedance probability curve plots (Figure 7-1) and hydrographs (Figure 7-2), is shown in the Qualitative Model Evaluation section below, and quantitative (statistical) evaluation of model performance at the Desteffany Lake outlet is provided in the Quantitative Model Evaluation section below. The data used to validate the model at the Desteffany Lake outlet have been provided as part of the response to undertaking DAR-MVEIRB-UT-13 and the associated file '*DAR-MVEIRB-UT-13(Supporting Excel File).xlsx'.*

Figure 7-1 Desteffany Lake Outlet Discharge Percent Exceedance Probability Curve (Observed and Modelled Discharge)



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

Figure 7-2 Desteffany Lake Outlet Discharge Hydrograph (Observed and Modelled Discharge)



m^3/s = cubic metres per second.

Qualitative Model Evaluation

Review of Figure 7-1 indicates that percent exceedance probability curves for concurrent daily mean observed and modelled data sets have similar shape and magnitude. Agreement is observed in the upper and lower portion of the curves, with some divergence for the percent exceedance for moderate flows in the range of 25 to 100 cubic metres per second.

Review of Figure 7-2 indicates that the modelled timing of peak freshet flows and the falling limb of the hydrograph and magnitudes of base flows are in agreement with the observed data. In addition, the predicted peak flow magnitudes appear to be in general agreement. The model is not expected to match peak flow magnitude exactly as derived site-specific meteorological inputs are not available, but rather represent long term characteristics of peak flows. Further evaluation of peak flow predictions are summarized in Table 7-1.

Based on the qualitative (graphical) evaluation of model performance, Figures 7-1 and 7-2 indicate that the modelled discharges on the Coppermine River at the Desteffany Lake outlet appear to represent the observed discharges with general agreement. Objective numerical metrics are used to evaluate statistical model performance in the Quantitative Model Evaluation section below.

Quantitative Model Evaluation

In addition to the graphical evaluation of model performance completed above, a quantitative or statistical evaluation of model performance at the outlet of Desteffany Lake compared to long-term records was completed. This evaluation includes statistics to assess the:

- Model performance in modelling the overall hydrograph shape;
- Model performance of hydrograph peaks; and,
- Model performance in reproducing streamflow volumes.

1) Model performance in modelling the overall hydrograph shape:

   a) Coefficient of Efficiency (Nash-Sutcliffe Coefficient) of Daily (CE_{DF}) and Monthly (CE_{MF}) Flows:

$$CE_{DF} = 1 - \left[\frac{\sum_{h=1}^{n}\left(Q_h - \hat{Q}_h\right)^2}{\sum_{h=1}^{n}(Q_h - \bar{Q}_{DF})^2}\right]$$

$$CE_{MF} = 1 - \left[\frac{\sum_{i=1}^{m}\left(Qm_i - \hat{Q}m_i\right)^2}{\sum_{i=1}^{m}(Qm_i - \bar{Q}m_{MF})^2}\right]$$

   b) RMSE-observations standard deviation ratio (*RSR*) of daily and monthly flows:

$$RSR_{DF} = \frac{RMSE}{STDEV_{obs}} = \left[\frac{\sqrt{\sum_{h=1}^{n} \left(Q_h - \hat{Q}_h\right)^2}}{\sqrt{\sum_{h=1}^{n} (Q_h - \bar{Q}_{DF})^2}} \right]$$

$$RSR_{MF} = \frac{RMSE}{STDEV_{obs}} = \left[\frac{\sqrt{\sum_{i=1}^{m} \left(Qm_i - \hat{Q}m_i\right)^2}}{\sqrt{\sum_{i=1}^{m} (Qm_i - \bar{Q}m_{MF})^2}} \right]$$

2) Model performance of hydrograph peaks:
   a) Average percent error in annual maximum peaks (*APEP*):

$$APEP = \frac{1}{p} = \sum_{j=1}^{p} \frac{\hat{Q}_j - Qmax_j}{Qmax_j} \times 100$$

3) Model performance in reproducing streamflow volumes:
   a) Percent bias of daily($PBIAS_{DF}$)/monthly($PBIAS_{MF}$) flow volumes:

$$PBIAS_{DF} = \frac{1}{n} = \sum_{h=1}^{n} \frac{\hat{Q}_h - Q_h}{Q_h} \times 100$$

$$PBIAS_{MF} = \frac{1}{m} = \sum_{i=1}^{m} \frac{\hat{Q}m_i - Qm_i}{Qm_i} \times 100$$

   b) Percent bias of annual flow ($PBIAS_{AV}$) volumes (for complete years only):

$$PBIAS_{AV} = \frac{1}{l} = \sum_{k=1}^{l} \frac{\hat{V}a_k - Va_k}{Va_k} \times 100$$

Where:

- *n* is the sample size for the daily flow record (both observed and modelled congruent series);
- *m* is the sample size for the monthly flow record (both observed and modelled congruent series);
- *p* is the sample size for the annual maximum peak flow record (both observed and modelled congruent series);
- *l* is the sample size for the annual volume record (both observed and modelled congruent series);
- Q_h is the observed mean daily flow and $\hat{Q}_h$ is the modelled mean daily flow in day *h;*
- $\bar{Q}_{DF}$ is the mean of the observed mean daily flows;
- $\bar{Q}m_{MF}$ is the mean of the observed mean monthly flows;
- Qm_i is the observed mean flow and $\hat{Q}m_i$ is the modelled mean flow in month *I;*
- RMSE is the Root Mean Square Error;
- $STDEV_{obs}$ is the Standard Deviation of the observed data set;
- $\hat{\hat{Q}}_j$ is the modelled annual peak daily flow and $Qmax_j$ is the observed annual peak daily flow in year *j;* and,
- $\hat{V}a_k$ is the modelled annual flow volume and Va_k is the observed annual flow volume in year k.

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The above statistical performance metrics were chosen to provide an overall model performance evaluation based on well-used metrics (Krause et al. 2005; Moriasi et al. 2007; Weber et al. 2006). In addition to providing the metric value, an evaluation of model performance based on the individual metric is provided based on a literature review (Krause et al. 2005; Moriasi et al. 2007).

Based on the quantitative (statistical) evaluation of model performance, Table 7-1 indicates that the modelled discharge hydrograph on the Coppermine River at the Desteffany Lake outlet is satisfactory in matching the observed discharge hydrograph.

Table 7-1 Statistical Evaluation of Model Performance

Performance Metric	Sample Size[a]	Daily	Monthly	Annual	Model Performance Rating[b]
Coefficient of Efficiency, NSE [-]	6,318 D 214 M	0.40	0.56	-	Satisfactory
RMSE-observations standard deviation ratio [-]	6318 D 214 M	0.78	0.66	-	Satisfactory
Percent Bias [%][c]	6,318 D 214 M 12 Y[d]	18	18	13	Satisfactory
Average percent error in annual peaks [%][e]	19 Y	-	-	8.7	Good

a) Sample size includes concurrent records of observed and modelled data, D= days, M=months, and Y=years.
b) Model performance rating based on literature review compiled in Krause et al. 2005 and Moriasi et al. 2007.
c) Positive bias indicates a bias above observed data.
d) Only complete data years were included in the annual data sets for comparison.
e) Analysis of annual peaks includes all years with observed freshet peak flows (excludes 1994 partial year).

Summary

The regional hydrology water balance model was validated against the long-term (complete hydraulic year) observed flow data at the Environment Canada Station 10PA001 (Coppermine River below Desteffany Lake). Based on both the qualitative (graphical) and quantitative (statistical) model evaluation techniques recommended in Moriasi et al. 2007, the model simulation for the flows at the Desteffany Lake outlet are assessed as satisfactory in predicting the timing and magnitude of flows, and therefore, is appropriate for assessing the potential effects of the Project.

References:

Environment Canada. 2014. Water Survey of Canada. Retrieved from Hydrometric Data – 10PA001 Coppermine River below Desteffany Lake: Available at: http://www.wateroffice.ec.gc.ca/search/search_e.html?sType=h2oArc. Accessed on March 3, 2014.

Krause P, Boyle, DP, Bäse F. 2005. Comparison of different efficiency criteria for hydrological model assessment. Adv. Geosci. 5: 89-97.

Moriasi DN, Arnold JG, Van Liew MW, Binger RL, Harmel RD, Veith T. 2007. Model evaluation guidelines for systematic quantification of accuracy in watershed simulations. Transactions of ASABE, American Society of Agricultural and Biological Engineers, 50(3); 885-900.

Weber F, Perreault L, Fortin V. 2006, Measuring the performance of hydrological forecasts for hydropower production at BC Hydro and Hydro-Quebec, Amer. Met. Soc. 18th Conference on Climate Variability and Change, Atlanta, GA, USA.

DOMINION DIAMOND

Undertaking Number: DAR-MVEIRB-UT-08

Source: Undertakings from Day 3 (April 22) of the Technical Sessions

Subject: Water – Water Quality

DAR Section(s): 8

Request:

DDEC is to provide a comparison of the volumes of Lac de Gras and Snap Lake (including residency time/turnover of water in Lac de Gras) and the total volumes of effluent that will be discharged into these lakes by May 8th.

Response:

Table 8-1 provides the requested information.

Table 8-1 Summary of Snap Lake and Lac de Gras Hydrological Parameters[a]

Parameter	Lac de Gras	Snap Lake
Lake Volume (Mm^3)[b]	6,209	100
Average Annual Outflow (Mm^3/year)	633	6.2
Average Residence Time (year)[c]	10	16
Total Misery Pit Discharge to Lac du Sauvage (Mm^3) [d]	45	-
Total Long Lake Containment Facility Discharge (Mm^3)[e]	358	-
Total Diavik Mine Discharge to Lac de Gras (Mm^3)[f]	281	-
Total Snap Lake Mine Discharge to Snap Lake (Mm^3)[g]	-	357
Total Natural Runoff Volume (Mm^3)[h]	30,549	115

Notes:

a) The mine discharges and natural runoff volumes were based on monitored data, when monitored data were available (i.e., between 2002 and 2014), and on modelled predictions in the future (i.e., between 2015 and 2050).

b) The volume of Lac de Gras was sourced from the hydrodynamic and water quality model of Lac de Gras (Appendix 8F of the DAR). The volume of Snap Lake was sourced from the hydrodynamic and water quality model of Snap Lake (De Beers 2013a).

c) The residence time was calculated as the quotient of the lake volume and the average annual outflow.

d) Misery Pit discharge to Lac du Sauvage was predicted to occur from August 2024 to December 31, 2029.

e) Ekati Mine operations in the Koala watershed discharge via the Long Lake Containment Facility (LLCF) into Leslie Lake, and then through Moose, Nero, Nema, Martine, and Slipper lakes (BHP Billiton 2013). Discharge from the LLCF was based on monitored data from January 1999 to December 2014 and on model predictions from January 2015 to January 2050 (ERM Rescan 2015).

f) Diavik Mine discharge to Lac de Gras was based on monitored data from January 2002 to December 2013 (WLWB 2014) and on flows presented in the DDMI Water Management Plan Version 13 from January 2014 to December 2023 (DDMI 2014).

g) Snap Lake Mine discharge to Snap Lake was based on monitored data from June 2004 to August 2013 (MVLWB 2013) and on lower bound model predictions from September 2013 to December 31, 2028 (De Beers 2013b).

h) Total natural runoff was summed from January 1, 1999 to December 31, 2049 for Lac de Gras and from January 1, 2004 to December 31, 2028 for Snap Lake.

Mm^3 = million cubic metres; - = not applicable.

References:

BHP Billiton (BHP Billiton Canada Inc.). 2013. Ekati Diamond Mine 2012 Aquatic Effects Monitoring Program, Part 2 – Data Report, Version 1.1. Prepared for BHP Billiton Canada Inc. by Rescan Environmental Services Ltd., Yellowknife, NWT, Canada, September 2013.

DDMI (Diavik Diamond Mines Inc.) 2014. DDMI Water Management Plan Version 13. December 30, 2014.

De Beers. 2013a. Snap Lake Hydrodynamic and Water Quality Model Report. Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

De Beers. 2013b. Snap Lake Site Model Water Balance Report. Submitted to the Mackenzie Valley Land and Water Board. Yellowknife, NWT, Canada.

ERM Rescan (ERM Rescan Environmental Services Ltd.). 2015. Long Lake Containment Facility Discharge Related to the Jay Project. Submitted to Dominion Diamond Ekati Corporation, Yellowknife, NWT, Canada.

MVLWB (Mackenzie Valley Land and Water Board). 2013. Water Licence MV2011L2-0004 Monthly SNP Reports from July 2012 to August 2013 and Water Licence MV2001L2-0002 Monthly SNP Reports from June 2004 to June 2012.

WLWB (Wek'èezhìi Land and Water Board). 2014. Water License W2007L2-0003 Monthly SNP Reports from November 2007 to December 2012 and Water Licence N7L2-1645 Monthly SNP Reports from March 2002 to October 2007 .

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-09
Source:	Undertakings from Day 3 (April 22) of the Technical Sessions
Subject:	Hydrogeology
DAR Section(s):	8

Request:

DDEC will examine publically available information on pumping test data from Dewey's Fault, specifically the type of testing that was conducted in the Diavik case and identify the potential for conducting such testing at Ekati and its relevance for the Jay case.

Response:

From a review of publically available information for Diavik Diamond Mine (Diavik Mine) pumping test data (Bieber et al. 2006, provided here as Attachment 9A), the Diavik Mine experience has shown that the most reliable method of assessing significant features such as enhanced permeability zones in northern mine pits was observations undertaken during pit excavation. Observations of inflow quantity, location of inflow, and structure in the pit walls, in the early stages of the Diavik Mine 154 pit development, and calibrating the numerical hydrogeological model to these observations yielded an estimated transmissivity of Duey's Fault of 1 x 10^{-3} m^2/s (Bieber et al. 2006). A borehole for bulk sampling of the kimberlite intersected Duey's Fault and provided a fortuitous opportunity for a pumping test. A pumping test conducted in this borehole yielded an equivalent value of the transmissivity (Bieber et al. 2006) and confirmed the results of the model calibration. This experience illustrates that a pumping test added limited information beyond that gained by operational observation.

Based on the above information, Dominion Diamond will undertake observations of inflow quantity, location of inflow, and structure in the Jay Pit walls during operations that will identify the location and transmissivity of enhanced permeability zones. These monitoring procedures will be developed during the permitting phase.

References:

Bieber C, Chorley D, Zawadzki W, Reinson J. 2006. Hydrogeologic Data Collection and Development of Conceptual Models to Predict Mine Inflow Quantity and Quality at Diavik Diamond Mine, NWT. 59th Canadian Geotechnical Conference and 7th Joint CGS/IAH-CNC Groundwater Specialty Conference, Vancouver, BC, Canada. M6-B Data Collection II.

ATTACHMENT 9A

HYDROGEOLOGIC DATA COLLECTION AND DEVELOPMENT OF CONCEPTUAL MODELS TO PREDICT MINE INFLOW QUANTITY AND QUALITY AT DIAVIK DIAMOND MINE, NWT

HYDROGEOLOGIC DATA COLLECTION AND DEVELOPMENT OF CONCEPTUAL MODELS TO PREDICT MINE INFLOW QUANTITY AND QUALITY AT DIAVIK DIAMOND MINE, NWT

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ABSTRACT
Current mining of two kimberlite pipes at the Diavik Diamond Mine requires reasonably accurate estimates of groundwater inflow quality and quantity over the life of mine. Prior to mining, from 1995 to 1999, three conceptual hydrogeologic models were developed for the mine. The results of the numerical model, developed from each successive conceptual model, were used to develop field programs to address data gaps and/or to more accurately assess the most sensitive parameters.

RÉSUMÉ
Une estimation relativement précise de la qualité et quantité des écoulements souterrains est nécessaire pendant la période d'exploitation minière des deux cheminées de kimberlites à la mine de diamants Diavek. De 1995 à 1999, avant l'initiation de l'exploitation, trois modèles hydrogéologiques conceptuels furent développés pour la mine. Les résultats du modèle numérique, construit à partir des modèles conceptuels, ont servi à développer les programmes de terrain visant à combler le manque de données et/ou à évaluer de façon plus précise les paramètres les plus sensibles.

1. INTRODUCTION

The Diavik Diamond Mine is located on a 20-sq-km island in Lac de Gras, 300 kilometres northeast of Yellowknife, Northwest Territories of Canada (Figure 1). The mine is an unincorporated joint venture between Diavik Diamond Mines Inc. (DDMI; 60%) and Aber Diamond Limited Partnership (40%). Both companies are headquartered in Yellowknife. DDMI is a wholly owned subsidiary of Rio Tinto, which is headquartered in London, England, and Aber Diamond Limited Partnership is a wholly owned subsidiary of Aber Diamond Corporation of Toronto, Ontario. DDMI is the operator of the project.

Figure 1. Site Location

Presently DDMI is mining the A154 South and A154 North kimberlite pipes through the A154 open pit (Figure 2). To allow planning, engineering, and implementation of sufficient water handling infrastructure, reasonably accurate estimates of groundwater inflow quality and quantity over the life of mine are required. Infrastructure includes in-pit pumps and pipelines, a water storage facility and a water treatment plant. Because of the remote location of the mine and the need to transport large equipment and bulk materials on the winter ice road from Yellowknife, advanced planning is critical.

The mine is presently evaluating the feasibility of mining more ore underneath the open pit via an underground mining operation. In addition, construction of a second water retention dike is currently underway, which will allow open pit and underground mining of a third ore body called the A418 kimberlite pipe (Figure 2). These additional mine workings will increase the total mine inflows and further stress the existing mine water handling systems, which further emphasizes the need for reasonably accurate predictions of inflows and quality.

This paper presents a historical development of the conceptual and numerical hydrogeologic models used to predict mine inflow for the A154 area. In particular, it examines the changes in the models resulting from the discovery of a fractured rock zone (FRZ) associated with Dewey's Fault, which extends through the two pipes and out beneath Lac de Gras and the influence of this highly permeable zone on groundwater inflow to the pit. The pit is developed in competent and relatively low permeable predominantly metamorphosed Archaean granitic country rocks, with some interspersed biotite schists. Lac de Gras provides a significant recharge boundary to the system as it borders the open pit.

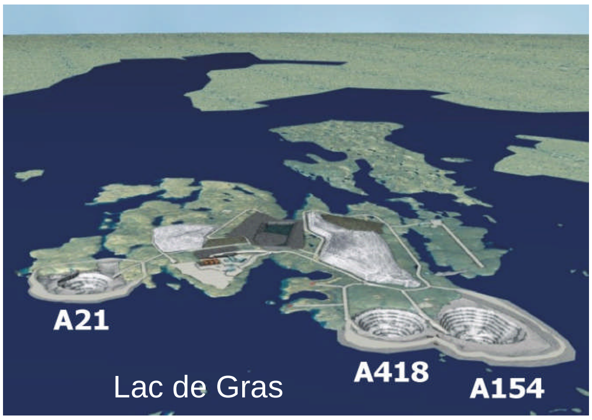

Figure 2. Conceptual Representation of the Mine Workings at the End of Mining

2. PRE-MINING CONCEPTUAL MODELS

2.1 1996 Field Data

The 1996 conceptual model for the site was based on air photo lineaments and bathymetry, structural data from geotechnical drilling investigations, packer testing at 15 to 60 m intervals along the length of eleven boreholes, measurements of discharge from flowing boreholes drilled along the exploratory decline, and data from four thermistors and pressure transducers installed at various depths along one borehole.

These data indicated that up to 4 potential shearing orientations are associated with brittle fault zones. The most prominent shear feature identified was a northwesterly trending feature between the A154 North and A154 South pipes.

During excavation of the exploratory decline, which was advanced from the permafrost under the East Island into the unfrozen A154S pipe under the lake, flow rates and shut-in pressures were measured in cover holes advanced ahead of the face. When high groundwater inflows were encountered each borehole was grouted immediately after it was completed. Over most of the portion of the decline advanced through country rock, total inflow was less than 80 L/min with the exception of a discrete feature located near to the A154S pipe. Flow from this structural feature varied from 150 L/min to 400 L/min. The feature was grouted where it was encountered in declines and drifts.

Air photo and bathymetry data were used to identify a number of trending lineaments. One borehole inclined at 45 degrees from the horizontal, GTH-23, was advanced from the decline into an interpreted fault zone located between the A154S and A154N pipes. Measurements of the shut-in pressure and the discharge rate for various intervals throughout the boreholes were used to determine hydraulic conductivity. The fault zone was encountered from a depth of 34 m to the end of the borehole at 137 m depth with inflows ranging from 10 L/min to 3000 L/min.

2.2 1996 Conceptual Model

Based on the field program described above, a conceptual model was developed that consisted of the following hydrostratigraphic units: lakebed sediments, near surface weathered rock, competent country rock, kimberlite, and fault zones in the country rock. The shallow competent country rock was inferred to be weakly fractured with a fairly uniform hydraulic conductivity of approximately 10^{-8} m/s to 10^{-7} m/s. A reduction in hydraulic conductivity of country rock was assumed to take place at depth due to an expected reduction in fracture aperture as a result of increased vertical loading. Such reductions in hydraulic conductivity with depth have been observed at other locations in the Canadian Shield (Stevenson et al., 1996 a & b, Ophori et al., 1996, Ophori and Chan, 1994). Based on results of packer testing, the hydraulic conductivity of the kimberlite was estimated to be between 5×10^{-8} m/s and 5×10^{-6} m/s.

Three steeply dipping fault zones were interpreted to be present based largely on lineaments in air photographs and bathymetry. These zones are as follows: a northeast trending feature to the east of the A154S pipe corresponding to a surface lineament up to 200 m wide, a northwest tending feature running through the A154 N and S pipes corresponding to a surface lineament up to 20 m wide, and a north-northwest trending feature to the south of the A418 Pipe also corresponding to a surface lineament up to 20 m wide.

Based on field investigations at the site and an adjacent property, permafrost conditions were inferred to be 240 m deep beneath the East Island. The depth of the permafrost was inferred to decrease towards the lakeshore and beneath the lake itself a thawed zone exists. Hydrogeologically, permafrost is considered to be virtually impermeable. Although a thin thawed zone referred to as the active layer occurs at the surface in the warmer months, this flow is negligible.

Hydraulic head data collected during packer testing and the pressure transducers installed in one borehole indicated that prior to mining the groundwater under Lac de Gras was near to hydrostatic. These conditions were likely the result of the presence of the lake acting as an extensive constant head boundary and the absence of recharge through permafrost on the islands and the mainland.

During mining the open pits and underground mine workings act as sinks for groundwater flow (Figure 3).

Water is induced to flow through the lakebed sediments, dikes, and the bedrock into the open pits and underground workings. The hydraulic conductivity of the inferred fault zones would result in much of the groundwater inflow into the mine occurring through these zones.

Based on the 1996 conceptual model, a numerical hydrogeologic model of the site was constructed using MODFLOW (McDonald and Harbaugh, 1988). Because of the near hydrostatic conditions beneath Lac de Gras prior to mining, meaningful calibration of this model was not possible with the data available at that time.

Results of the numerical model indicated that model predictions of inflow to the proposed mine were most sensitive to the width and hydraulic conductivity of the fault zones included in the model. Model predictions were found to be significantly less sensitive to the hydraulic conductivity of the kimberlite and the relatively competent country rock, and to the depth and extent of permafrost.

Based on the results of the modelling, field investigations were recommended to determine if the surface lineaments corresponded to a significant hydrogeologic feature of high permeability and to determine the width of the zones if they were found to be present.

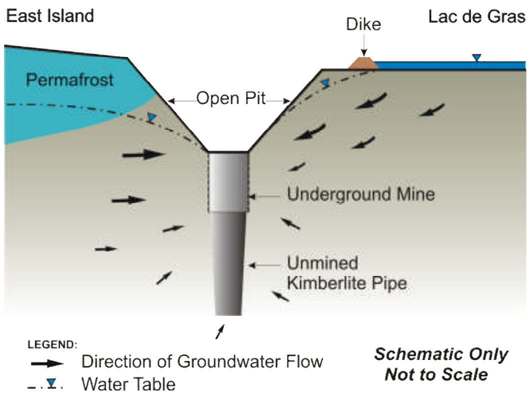

Figure 3. Conceptual Model of Groundwater Flow During Mining

2.3 1997 Field Data

The 1997 field investigations included geotechnical logging of 19 boreholes, six of which were drilled from the lowest level of the exploratory decline to the A154S pipe. In thirteen of these boreholes, packer testing was conducted at approximately 40 m intervals while thermistor strings were installed in four of the boreholes. In addition, a flow recession test was conducted in the exploratory decline using boreholes drilled from the decline.

The flow recession test was conducted on an apparent thin FRZ associated with a diabase dike running between the 154N and S pipes. The test consisted of allowing one borehole to flow and measuring the pressure drop in two adjacent boreholes. Time-drawdown and recovery measurements were used to calculate the hydraulic conductivity of the fractured zone. This analysis yielded a hydraulic conductivity value of approximately 3×10^{-5} m/s. These data used together with drilling conducted from the surface; however, suggested that this FRZ was associated with a diabase dike and limited to the area between the two pipes.

Surface drilling across all other surface lineaments indicated that these features were not likely highly permeable. In addition, a review of the air photo lineaments indicated that several of the features corresponded to “boulder trains” rather than structural discontinuities.

Following the drilling program undertaken in the 1997 field season, a general structural geology review was undertaken to identify FRZs based on Rock Quality Designation (RQD), core photographs, and fracture characteristics data in all boreholes that had been drilled at that time. Zones with enhanced fracture density relative to background were identified as FRZs. Three types of fractured systems were identified during this process: fractured rock with a significant fracture frequency, diabase dike contacts and kimberlite dike contacts. Data from all boreholes drilled at the site including delineation boreholes were then used to determine an average fractured rock zone spacing at the site. This analysis indicated that the average fractured rock zone spacing was 110 m and the average width was 4 m. Based on observations in the exploratory decline and the observed relationship with diabase dikes, the fractured rock zones were assumed to be steeply dipping.

2.4 1998 Conceptual Model

The conceptual model of the site that was developed following the 1997 field season included four major hydrostratigraphic units: relatively competent country rock, fractured rock zones, kimberlite and thick diabase dikes. Lakebed sediments and weathered bedrock units were not included as major hydrostratigraphic units in this model as it was assumed that during construction of the dike, these sediments would be stripped and/or grouted. The geometric mean of the results of all packer testing conducted in each of these stratigraphic units was used to determine large-scale hydraulic conductivities.

Fractured rock zones were incorporated in the conceptual model as two steeply dipping near orthogonal sets at spacings indicated from the structural data (Figure 4). These sets were assumed to be oriented roughly parallel to the major diabase dikes identified at the site: one trending north-northeast and the other north-north-west. The fractured rock zones in the model intersected the A154N and S pipes and the A418 pipe. Because the lateral and vertical continuity of fractured rock zones could not be determined from field data, fractured rock zones were assumed to continuous across the model domain. This assumption would likely result in conservatively high inflows.

Diabase dikes that were less than 2 to 5 metres were found to be relatively highly fractured with a hydraulic conductivity similar to fractured rock zones. On the other hand, diabase dikes with widths greater than 5 to 10 metres were still found to be fractured, but the short fractures and blocky nature resulted in a lower hydraulic conductivity. The diabase dike to the east of the kimberlite pipes was assumed to behave as a low permeability barrier to groundwater flow through the competent rock.

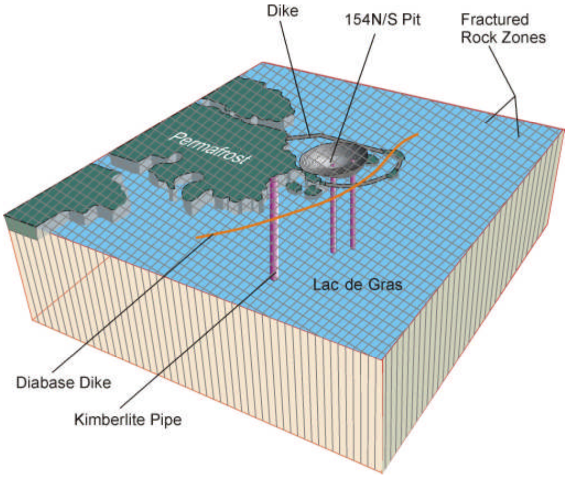

Figure 4. 1998 Conceptual Model

Packer tests conducted in the competent bedrock collected up to and including the 1997 field season were limited to less than 330 m depth. Although a reduction in the hydraulic conductivity of this unit was expected, these packer testing results did not show any trend in hydraulic conductivity with depth. Therefore, the hydraulic conductivity of bedrock was assumed to remain constant with depth in this conceptual model.

The results of a permafrost model for the site (Nixon, 1997a, Nixon 1997b) were used to revise the extent of permafrost in the 1998 conceptual model. Consequently, the depth of permafrost under the East Island was increased from 240 m to up to 390 m. Permafrost was also included in the model to a depth of 60 m underneath the small islands located to the east of the East Island.

2.5 Geochemical Data

In the Canadian Shield, the Total Dissolved Solids (TDS) in groundwater generally increases with increasing depth. Results of chemical analyses of deep saline water collected from several mines in the Canadian Shield were presented in Frape and Fritz (1997).

A review of geochemical data collected for the Diavik site was also conducted by Blowes and Logsdon (1997) and resulted in the determination of a Diavik TDS-depth profile similar to the profile presented in Frape and Fritz (1997). Both the site profile and the Frape and Fritz (1997) profiles are presented in Figure 5. The profile is based on Diavik site-specific data collected at depths up to 350 m and supplemented with data collected at the Echo Bay Lupin mine between 800 and 1300 m depth The Echo Bay Lupin mine is located approximately 100 km north of the site. Based on measurements of tritium concentrations, none of the site-specific samples showed evidence of dilution by modern groundwater such as drilling fluids or lake water.

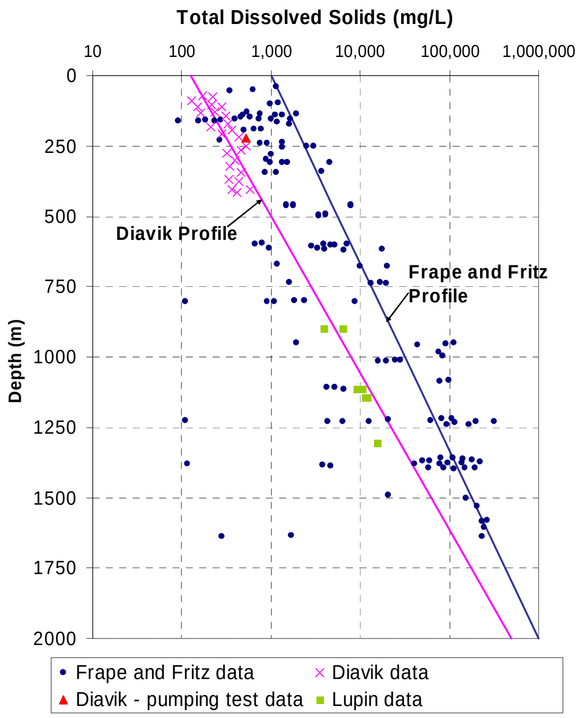

Figure 5. TDS-Depth Profile

2.6 1998 Numerical Model

Based on the 1998 conceptual model, a numerical hydrogeologic model of the site was constructed using MODFLOW. Initially a variable density model was used to assess the effects of density on the transport of deeper brackish water up into the mine. This modelling indicated that the density effects on transport were negligible compared to the hydraulic effects; therefore, a single density transport model, MT3D (Zheng, 1990), was used to simulate transport of higher TDS water from depth.

Fractured rock zones were simulated in the model as thin planar features of higher hydraulic conductivity at spacing similar to those determined from the review of the structural data.

The numerical model for the site was calibrated to inflows recorded during development of the exploratory decline. Results of the 1998 numerical model indicated that the model predictions of inflow to the proposed mine were most sensitive to the width and hydraulic conductivity of the fault zones included in the model. Model predictions were found to be significantly less sensitive to the hydraulic conductivity of the kimberlite and the relatively competent country rock, and to the depth and extent of permafrost.

Based on the results of the 1998 model, it was recommended that hydraulic conductivity testing and chemical analyses in boreholes at depths greater than 330 m be undertaken to constrain the TDS and hydraulic conductivity-depth profiles. In addition, it was recommended that flowmeter and fluid logging be undertaken to assess if the thin fractured rock zones identified in the review of the borehole logs were actually significant hydrogeologic features.

2.7 1999 Field Data

In the 1998 field season, twenty additional boreholes were drilled at the site. A total of 75 packer tests were conducted along the length of fifteen of these holes. A downhole camera survey was conducted in five boreholes. Temperature logging was conducted in four boreholes and flowmeter logging was conducted in one borehole. Results of all packer tests conducted from 1996 to 1998 were compiled into a database of over 800 tests.

Following the 1998 field season, the results of downhole camera, temperature, and flowmeter logging together with packer testing and visual inspection were used to investigate the hydrogeologic significance of fractured rock zones. Of the four boreholes in which fluid logging was undertaken (nearly 1300 m of logging) only two features of hydrogeologic significance were identified. A significant feature was one that was identified through the fluid and flowmeter logging as a flow anomaly and had a corresponding high hydraulic conductivity from the packer tests. Both features were found to be approximately 3 m wide. This result suggested that significant fractured rock zones at the site are much more widely spaced than previously assumed. Observations of flow made during the advancement of the exploratory decline reinforced this conclusion as only one major inflow was observed during development of the decline for the full 600 m of the decline completed in unfrozen ground.

2.8 1999 Conceptual Model

In the third conceptual model for the site, country rock was characterized as a single hydrostratigraphic unit with a bulk hydraulic conductivity value. Given the apparent size and spacing of the fractured rock zones determined from the 1999 field program, and considering the scale of the proposed mine, it was concluded that these zones were effectively included in the bulk hydraulic conductivity of the country rock. Consequently, these zones were not explicitly included in the model. The 1999 conceptual model, therefore, consists of three main hydrostratigraphic units: country rock, kimberlite, and diabase dike. However, it was also concluded that fractured rock zones that are significant hydrogeologic features may be present at the site but have not been intersected in drilling; therefore, as a sensitivity, a number of such features at various orientations were simulated in the model to assess their affect on mine inflow.

Based on analysis of the entire packer testing results for the country rock up to 570 m depth and observed hydraulic conductivity reductions with depth at other sites in the Canadian Shield (Stevenson et al., 1996 a & b, Ophori et al., 1996, Ophori and Chan, 1994) the hydraulic conductivity of country rock was assumed to decrease with depth. Sufficient packer testing data to establish the hydraulic conductivity-depth profiles for the diabase dike and kimberlite units were not available for the site; therefore, conservatively low reductions in hydraulic conductivity with depth were assumed.

The numerical hydrogeologic model that was developed based on the 1999 conceptual model was constructed using MODFLOW and MT3DMS (Zheng and Wang, 1998) codes. As with the 1998 model, the 1999 numerical model was calibrated to inflows to the exploratory decline. The 1999 numerical model was used to predict inflows to the open pit and underground mines at the site during the feasibility stage of mine planning.

Based on the model results and available field data, it was recommended that mine inflow quality and quality, as well as hydraulic head and groundwater quality in monitoring wells to be installed near the mines, be monitored and reviewed on a continuous basis during mining. These data were to be used as a basis for comparison with the model predicted values and the model recalibrated, if necessary. The model would then be used for long-range planning of water management.

3. OBSERVATIONS DURING MINING

Open pit mining of the A154 N and S kimberlite pipes was initiated in 2002. After approximately one and a half years of mining, groundwater inflows to the A154N/S pit were approximately two times greater than predicted by the base case model. This discrepancy was within the range of the expected uncertainty in predicted pit inflow due to the uncertainty in model parameters; however, model simulations were conducted to determine the source of the observed discrepancy. Multiple explanations for the difference between observed and predicted inflows were proposed at that time, including uncertainty in the hydraulic conductivity of shallow competent bedrock, flow through shallow sediments, a high conductivity pathway created by the flooded exploration decline, and a highly permeable fractured rock zone.

Preliminary model simulations were conducted to assess the most likely source of the large inflows. Results of these simulations indicated that the most likely source of the greater than predicted inflows was a highly permeable FRZ associated with a fault zone, referred to as Dewey's Fault (Figure 6). This fault zone was uncovered during mining and a survey of seepage in the A154 N/S conducted in late 2003 suggested that at least 50% of groundwater inflow to the pit originated from this feature.

Figure 6. The FRZ associated with Dewey's Fault in the wall of the A154N/S Pit

4. CONCEPTUAL MODEL 2004

In mid-2004, a fourth revision to the conceptual model and corresponding numerical model for the site was undertaken. This included the incorporation of shallow sediments, weathered bedrock, a permeable FRZ associated with Dewey's Fault, and the as-built configuration of the dike around A154N/S pit into the numerical model for the site (Figure 7).

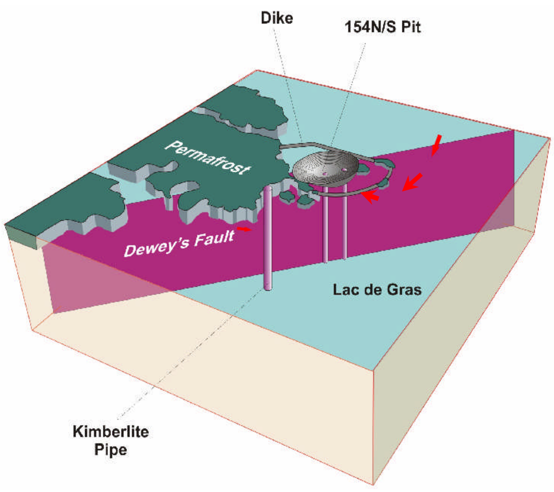

Figure 7. Conceptual Model 2004

The initial hydraulic properties for the weathered bedrock and shallow sediments were based on the results of hydrogeologic testing. The contribution of these components to pit inflow was found to be significant only in the very early stages of mining.

In preliminary simulations, the FRZ associated with Dewey's Fault was assumed to be 30 m wide with a hydraulic conductivity of 3×10^{-5} m/s from the ground surface to 500 m depth. Beyond 500 m depth, the hydraulic conductivity of the fault was assumed to be 1×10^{-5} m/s. Based on these modelling results in was recommended that additional testing be undertaken in the FRZ associated with Dewey's Fault to accurately assess its hydrogeologic properties and width.

5. DEWEY'S FAULT

The field program to investigate the hydrogeologic properties of Dewey's Fault included core logging and the collection of fluid temperature and electrical conductivity, caliper, optical and acoustic televiewer logs. In addition, both packer tests and a pumping test were performed in the fault zone.

The results of the field investigations indicated that the FRZ associated with Dewey's Fault is about 100 m wide and the inclination is approximately vertical. The FRZ does not consist of a uniform highly permeable zone, but is composed of sparsely spaced highly permeable discontinuities within a lower permeability pseudo-matrix. The fracture spacing in Dewey's Fault was found to be virtually identical to that of the relatively competent bedrock. Depending on the orientation of a borehole drilled within the FRZ, none or many of these highly permeable fractures would be intersected. In addition, as shown on Figure 8, the probability distributions for the hydraulic conductivities measured from packer testing in the FRZ and the country rock overlap to a large degree. Because of the nature and distribution of fractures within Dewey's Fault it was found that all the logging data (televiewer, core logging, and fluid logging) needed be used together in order to identify the FRZ. Figure 9 shows an example of a data synthesis plot that includes all these data for one of the boreholes and the identification of the FRZ associated with Dewey's Fault as a zone of enhanced hydraulic conductivity.

The late 2004 re-calibration of the numerical hydrogeologic model involved revisions to the original numerical model of the site so that the model predicted water quality and quantity matched the measured values in the groundwater inflow to the A154 Pit. During calibration, the progress of mining was simulated using as-build pit shells provided by DDMI for October 2003, March 2004, and July 2004. The model was also calibrated to the response observed during hydrogeologic testing of Dewey's Fault that was undertaken in 2004, water level drawdowns measured in piezometers along the dike perimeter since the initiation of mining in the A154N/S pit and to observations made during seepage surveys conducted in October 2003 and July 2004.

During model calibration, the model was run repeatedly and the model parameters were adjusted until model predictions were in reasonably good agreement with field observations and measurements. During calibration, the hydraulic conductivity of the competent bedrock at the site was virtually unchanged from the value used in the 1999 model.

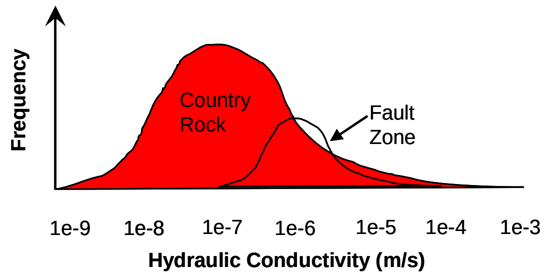

Figure 8. Conceptual Representation of the Results of Packer Testing

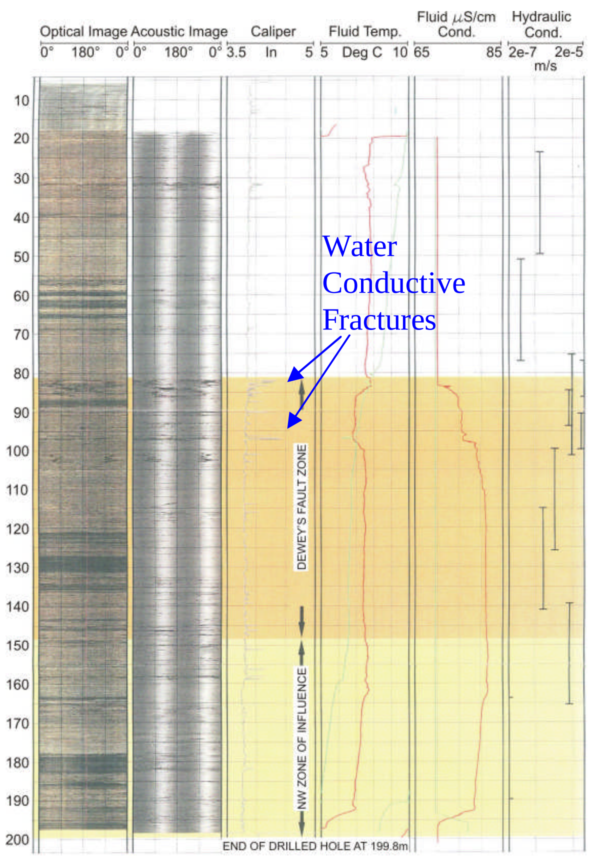

Figure 9. Borehole Data Synthesis Plot

An evaluation of the predictive capabilities of the site-scale model was performed in 2005. In this evaluation the numerical model that was calibrated in late 2004 was used to predict inflows to the 154N/S Pit and the hydraulic heads in the pit walls for 2005. These predictions were then compared to the observed values for 2005. If the predicted and observed values were similar then the model was considered to be verified and capable of providing reasonably accurate predictions of future mine inflows and hydraulic heads. These model simulations were done *without* any modification to hydrogeologic parameters that were used in the model calibration of late 2004.

A comparison of model predicted quantity and quality of inflow to the A154 N/S Pit to the observed values up to the end of 2005 indicated that the model provided an accurate predictive tool for inflow quantity and quality.

6. DISCUSSION

The development of the conceptual hydrogeologic models and their corresponding numerical models for the Diavik Project followed a logical and usually effective methodology. The results of each successive model were used to direct future field investigations. The aim of each of these investigations was to develop a more accurate hydrogeologic model.

Once mining began at Diavik, it was found that the final pre-mining model underestimated the quantity of groundwater inflow to the mine. Although the hydraulic conductivity of the relatively competent country rock was found to be reasonably accurate, a narrow FRZ (representing less than 10% of the open pit wall) of enhanced permeability resulted in nearly twice as much inflow as was predicted by the final pre-mining model.

Testing during mining indicated that the FRZ was not a zone of uniform high permeability but was comprised of highly permeable vertical fractures that were sparsely spaced within the zone. These characteristics made it difficult to detect this zone using only core logging and packer tests in individual boreholes. Rather several downhole investigative methods including core logging, packer testing, televiewer and fluid logging, were used together to identify a zone of enhanced permeability associated with Dewey's Fault.

7. ACKNOWLEDGEMENTS

The writers would like to acknowledge the contribution of a number of individuals to this paper. They include Gord MacDonald and Scott Wytrychowski both of DDMI and Dr. Leslie Smith, Professor at U.B.C.

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DOMINION DIAMOND

Undertaking Number: DAR-MVEIRB-UT-10

Source: Undertakings from Day 4 (April 23) of the Technical Sessions

Subject: Water – Jay Pit (Model Inputs)

DAR Section(s): 8

Request:

DDEC is to review the Diavik pre-mitigation (prior to 2008) wet sump ammonia and nitrate water quality results and provide a recommendation as to whether their incorporation into the water quality model for the Misery pit is worthwhile by May 8 (further to Homework #15).

Response:

Available ammonia and nitrate monitoring results from the Diavik Diamond Mine (Diavik Mine) were collated from the following sources:

- Surveillance Network Program (SNP) monitoring locations 1645-49 (A154 pit) and 1645-50 (A418 pit) from 2002 until 2012; and,
- Sump monitoring locations in the A154 pit from 2003 to 2005 (Golder 2003, 2004, 2005).

Ammonia and nitrate concentrations collected from the above sources are presented in Figures 10-1 and 10-2, respectively. The reference median ammonia and nitrate concentrations derived from the Ekati sump data used in the Jay Project (Project) water are included in the figures. For discussion purposes, median concentrations from the listed sample populations are as follows:

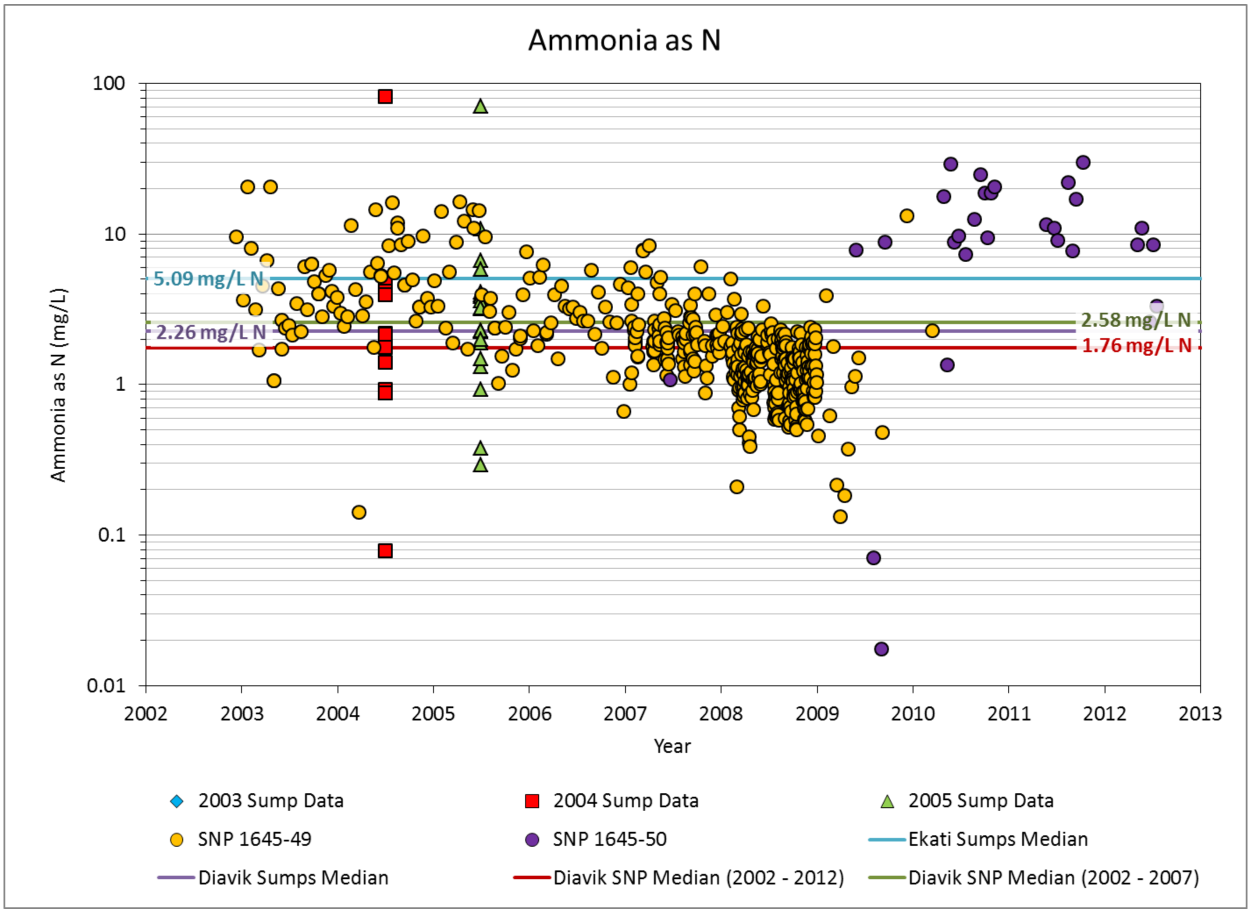
- Pit A154 sump monitoring locations (ammonia = 2.26 milligrams per litre as nitrogen (mg N/L); nitrate = 4.67 mg N/L);
- Diavik SNP locations (ammonia = 1.76 mg N/L; nitrate = 5.5 mg N/L); and,
- Diavik SNP locations prior to 2008 (ammonia = 2.58 mg N/L; nitrate = 5.8 mg N/L).

The median ammonia (5.09 mg N/L) and nitrate (22.6 mg N/L) concentrations used in the Jay Project water quality model are higher than the respective ammonia and nitrate median concentrations in all three of the above listed populations. Therefore, the values used in the Project water quality model represent a more conservative input in comparison to the values observed in sump monitoring and SNP sampling at the Diavik Mine.

Although there is scatter in the ammonia and nitrate concentrations in samples collected from the Diavik Mine (Figures 10-1 and 10-2), use of a median to represent ammonia and nitrate concentrations in the Jay Pit is considered reasonable since minewater is not directly discharged to Lac du Sauvage from the Jay Pit. Pumping of Jay Pit inflows to the bottom of the Misery Pit is expected to result in a mixed concentration of peak and trough ammonia and nitrate concentrations, resulting in a discharge concentration that will be closer to the median observed concentrations during operations. Therefore, it is not considered necessary to update the water quality model to consider ammonia and nitrate concentrations greater than those considered in the Developer's Assessment Report, or for the less conservative median concentrations observed in operational monitoring samples collected at the Diavik Mine.

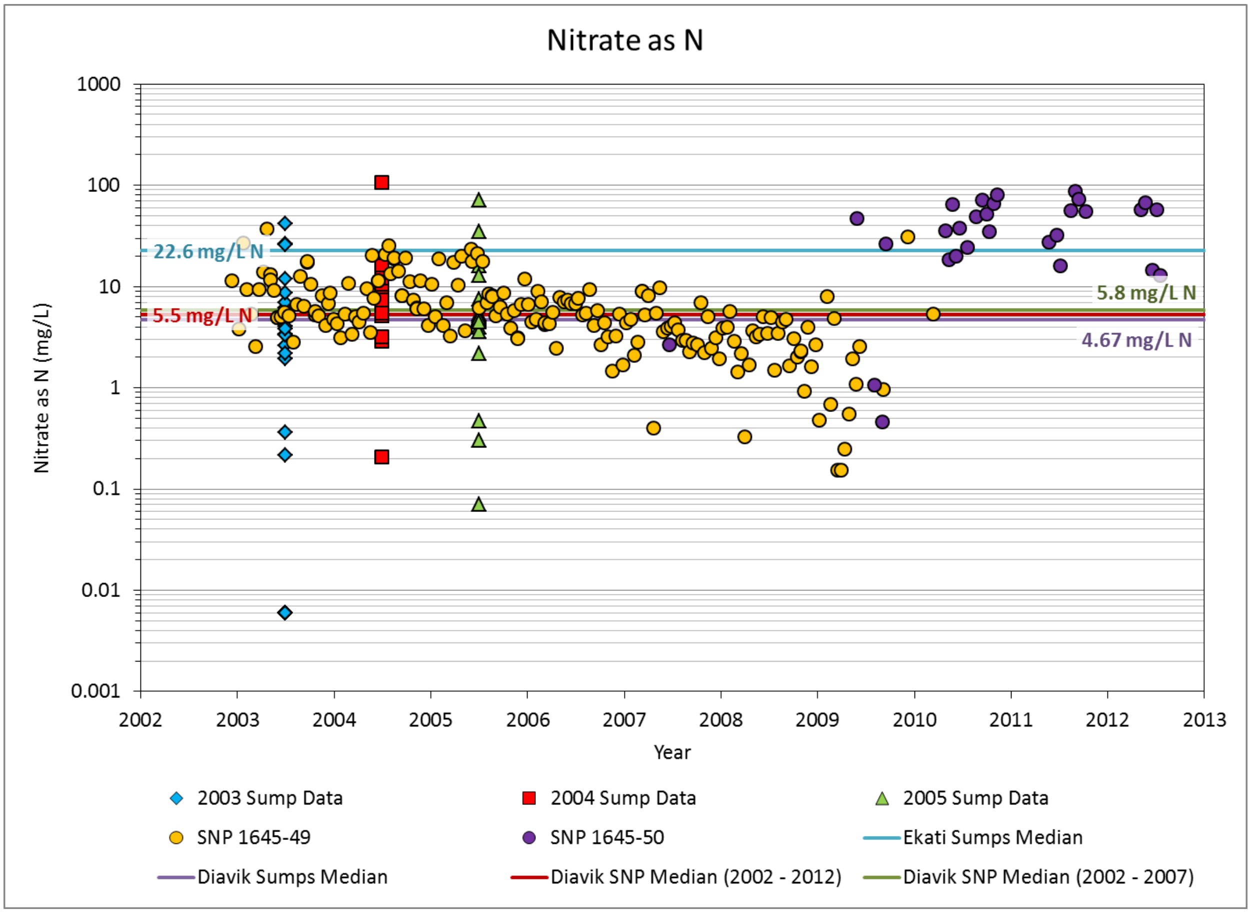
It is recognized that water quality modelling is based on several inputs and assumptions, all of which have inherent variability and uncertainty. However, the design of the Project water management plan facilitates monitoring for a period of five years before discharge occurring. If observed concentrations are greater than predicted and represent a risk to the receiving environment, adaptive management will be implemented to reduce the risks of any impacts to surface water quality in the receiving environment.

Figure 10-1 Diavik Mine – Results of Operational Monitoring with Comparison to the Median Ekati Sump Concentration – Ammonia



N = nitrogen; mg/L = milligrams per litre; SNP = Surveillance Network Program

Figure 10-2 Diavik Mine – Results of Operational Monitoring with Comparison to the Median Ekati Sump Concentration – Nitrate



N = nitrogen; mg/L = milligrams per litre; SNP = Surveillance Network Program

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DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-11
Source:	Undertakings from Day 4 (April 23) of the Technical Sessions
Subject:	Water – Closure
DAR Section(s):	DAR-GNWT-IR-52 (Table 52-2)

Request:

DDEC is to provide water chemistry data for LDS stations 1-12 for the period concurrent with discharge from the King Pond Settling Facility in order to evaluate the potential for differences between reference and baseline conditions; DDEC will provide the station water quality data for the following Lac de Gras stations referenced in Table 52-2 from GNWT-IR-52: BHPS1- BHPS3; LDG40-LDG49.

Response:

Water quality data collected in Lac du Sauvage and Lac de Gras, representing the baseline condition, are provided in electronic format (excel) in file '*DAR-MVEIRB-UT-11(Supporting Excel File).xlsx*' (Table 11-1 and Table 11-2). These data represent monitoring data collected in 2004, 2006, and 2010 to 2012 for Lac du Sauvage (Rescan 2007, 2011, 2012; ERM Rescan 2013) and 1995 to 2000 for Lac de Gras (DDMI 2001).

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DOMINION DIAMOND

Undertaking Number: DAR-MVEIRB-UT-12

Source: Undertakings from Day 3 (April 22) of the Technical Sessions

Subject: Water – Closure

DAR Section(s): 8

Request:

DDEC is to evaluate the post-closure predictions at the outflow of Misery pit with reasonable case estimate and its implications on significance determinations by May 8th.

Response:

Once the Misery Pit is back-flooded at closure, it is expected to overflow on an annual basis in the post-closure period. Assuming average climate conditions, approximately 70,000 cubic metres (m^3) per year is expected to discharge to Lac de Gras (Golder 2015) through the outflow channel that was in place prior to pit development (Interim Closure and Reclamation Plan [ICRP]; BHP Billiton [2011]). Of this annual discharge, approximately 5,000 cubic metres per day (m^3/d) on average is expected during freshet conditions (over 10 days in June), and approximately 500 m^3/d over three weeks during September on average (July and August are net evaporation months). Closure requirements for the Misery Pit are included in the ICRP; overflow to Lac de Gras will only be permitted when the pit lake's surface water quality meets water licence criteria (BHP Billiton 2011).

Water quality of the overflow from Misery Pit for the Jay Project assessment was projected from a series of integrated water quality models, which included the Misery Pit hydrodynamic model; its influence on Lac de Gras through small annual flows from the backflooded pit in post-closure was included in the Lac de Gras hydrodynamic model (Golder 2015). There are two important aspects of the modelling work that are relevant to this response:

1. The water quality models used in the DAR were developed with assumptions that provide conservatism so as to not underestimate potential impacts
2. The Misery pit hydrodynamic modelling is necessarily based on a number of general source-term assumptions that can be revised with site-specific monitoring data collected over the 10-years of Jay Project operations, if necessary.

The water quality of the overflow from Misery Pit used as a source input to the Lac de Gras hydrodynamic model was set to the modelled mixolimnion water quality of the back-flooded Misery Pit. The mixolimnion is the upper layer of a meromictic lake, lying above the chemocline or pycnocline, where the water is mixed by the wind, stratifies thermally but overturns at least once per year within this zone, and has a lower density than the underlying more dense layer, or monimolimnion. At closure, the Misery Pit is back-flooded with approximately 60 metres (m) of freshwater, which represents approximately 16.8 million m^3 and 40% of the overall pit volume. As described in Section 8G2.4.2.1 of Appendix 8G of the DAR, and Section 2.1.1.1.1 of the Compendium of Supplemental Water Quality Modelling (Golder 2015) of the Jay Project, the elevation of the mixolimnion decreases over time, as a result of a thickening of the pycnocline; the depth of the pycnocline is not projected to change appreciably over time, but the total dissolved solids (TDS) gradient between the mixolimnion and monimolimnion is projected to reduce slightly (see Figure 2.1; Golder 2015). At the end of the modelling period, 200 years, the depth of the mixolimnion decreases to 55 m, which represents approximately 15 million m^3 volume.

As a result of the modelling assumptions, water quality within the mixolimnion changes over time from conditions similar to the freshwater source in Lac de Sauvage to higher TDS conditions, primarily due to the projected gradual upward diffusion of TDS from the monimolimnion to the mixolimnion over time. This change in water quality could be caused by physical processes in the mixolimnion particularly during open water conditions (e.g., water column mixing processes primarily from surface winds). The upward movement of water results in additional TDS being transported from the higher TDS monimolimnion to the mixolimnion, providing a more conservative estimate of mixolimnion concentrations, as is appropriate for the environmental assessment.

Review of the modelled water quality constituent data for the mixolimnion over the 200-year modelling period projects a change over time of water quality conditions due to the upward flux of TDS and other constituents from the monimolimnion to the mixolimnion. Projected maximum dissolved constituent concentrations at various snapshots over the modelling period in open water conditions provided an estimate of the potential water quality of pit overflow that would flow towards Lac de Gras. Over the time represented by the snapshots, a number of the water quality constituents in the Misery Pit mixolimnion are projected to increase above generic guidelines for the protection of aquatic life, trophic status, wildlife, or aesthetic drinking water:

- Reasonable Estimate Case
  - copper after 10 years following closure (back-flooding);
  - chloride, total phosphorus, and manganese after 50 years;
  - total dissolved solids after 100 years; and,
  - aluminum, iron, and nickel after 200 years.

The guidelines have been used for comparison, and the modelled constituent results higher guidelines do not necessarily indicate potential to result in adverse effects.

From an aquatic ecosystem perspective, following back-flooding, poor physical connectivity and intermittent flows between Lac de Gras and the Misery pit lake are not expected to support active migration of fish (i.e., natural barriers are present within the outflow channel with areas of diffuse and subsurface flows, which would likely not be sufficient to support fish movement for the entire distance from Lac de Gras to the pit lake). As described in the approved ICRP for the Ekati Mine, and in the responses to Information Requests DAR-IEMA-IR-50 and DAR-LKDFN-IR-06, reclamation of the Misery open pit is not intended to create fish habitat post-closure; however, water quality at this site is expected to be safe for use by fish, wildlife, and people (BHP Billiton 2011; Dominion Diamond 2014). For this reason, the Ekati Mine ICRP contains a research project to develop pit lake-specific water quality criteria for the pit lakes, which will require approval of the Wek’eezhii Land and Water Board.

The hydrodynamic modelling and water quality assessment in the DAR concluded that there are no significant impacts to water quality as a result of the Project, which included the assessment of overflow from the Misery pit lake to Lac de Gras. Notwithstanding the overflow, the Misery Pit represents a very small surface area compared to the surface water in the Lac de Gras watershed (i.e., <0.0025%) and the overflow volume to Lac de Gras represents a very small proportion of the Lac de Gras annual through flow (i.e., 0.001%). There is some ongoing conservatism in the Reasonable Estimate Case, and sufficient time for monitoring in Misery Pit during operations to confirm that water quality is acceptable and safe for wildlife and people, and to allow for adaptive management of the mine water management plan to mitigate the projected higher constituent concentrations in the mixolimnion of Misery Pit if they occur. For example, should monitoring results indicate pit water quality is tracking unacceptably beyond DAR predictions, pumping more Misery Pit water into the Jay Pit at closure is a potential mitigation option. There is sufficient space in the Jay Pit for this consideration (the Jay Pit has a 120 m freshwater cap). This mitigation strategy could substantially reduce the water quality constituent concentrations in the mixolimnion of Misery Pit.

References:

BHP Billiton Canada Inc. (BHP Billiton). 2011. Ekati Diamond Mine Interim Closure and Reclamation Plan. Prepared for the Wek’èezhii Land and Water Board. 842 pp.

Dominion Diamond (Dominion Diamond Ekati Corporation). 2014. Ekati Diamond Mine 2014 Closure and Reclamation Progress Report. Prepared for the Wek’éezhii Land and Water Board. 154 pp.

Golder (Golder Associates Ltd.). 2015. Jay Project Compendium of Supplemental Water Quality Modelling. Prepared for Dominion Diamond Ekati Corporation. Yellowknife, NWT, Canada.

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-13
Source:	Undertakings from Day 4 (April 23) of the Technical Sessions
Subject:	Hydrology Modelling
DAR Section(s):	DAR-GNWT-IR-33 (Figure 33-2 and Figure 33-3)

Request:

DDEC is to provide input (excel) data used to plot hydrographs (figure 33-2, 33-3, GNWT-IR-33) and compare Desteffany Lake and LDG outlets (amends Undertaking #7)·

Response:

Input data used to plot Figure 33-2 (Desteffany Lake Outlet Modelled and Measured Discharges) and Figure 33-3 (Lac de Gras Modelled vs Measured Water Level) included in DAR-GNWT-IR-33 are provided in electronic format (excel) in file '*DAR-MVEIRB-UT-13(Supporting Excel File).xlsx'*.

The source of observed Lac de Gras water level data is from Diavik Diamond Mines Inc. (DDMI 2013), as described in Section F3.3.2 of Appendix F Annex X of the Developer's Assessment Report (DAR), and the observed Desteffany Lake outlet discharge data are from Environment Canada Station 10PA001 (Environment Canada 2014), as described in Section 8D3.1.5 of Appendix 8D of the DAR. Sources of modelled data are model output of the Desteffany Lake and Lac de Gras watersheds completed by Golder Associates Ltd. for Annex X of the DAR and Section 8 of the DAR.

References:

DDMI (Diavik Diamond Mines Inc.). 2013. Water Level Data for Lac de Gras at the East Island North Inlet. Spreadsheet provided to Golder Associates Ltd. by Dan Guigon, Diavik Diamond Mines Inc.

Environment Canada. 2014. Water Survey of Canada. Retrieved from Hydrometric Data – 10PA001 Coppermine River below Desteffany Lake: Available at: http://www.wateroffice.ec.gc.ca/search/search_e.html?sType=h2oArc. Accessed on March 3, 2014.

Undertaking Number:	DAR-MVEIRB-UT-14
Source:	Undertakings from Day 4 (April 23) of the Technical Sessions
Subject:	Water Quality
DAR Section(s):	8 (Table 8.7-1)

Request:

DDEC is to provide a clear and understandable description of how the specific criteria included in Table 8.7-1 of the DAR relate to this overall definition of significance, specifically:

1) Does this definition apply to all time periods? Or only post-operations?;

2) Why would multiple constituents have to be in exceedance of water quality guidelines have in order to meet the threshold for significance?; and

3) The local boundary is established as the outlet of Lac de Gras; why was this chosen as the end of the local assessment boundary instead of, for example, the outlet of LDS or any of the small lakes between the LLCF and LDG?.

Response:

1) Does the definition of significance (as provided in Table 8.7-1 of the DAR) apply to all time periods or only post-operations?

As described in the Developer's Assessment Report (DAR), and in response to Information Request DAR-MVEIRB-IR-06, significance is determined by evaluating how the Jay Project (Project) could affect the assessment endpoint (i.e., the maintenance or suitability of water to support a healthy and sustainable ecosystem, or the continued opportunity for the traditional use of water, including use as a drinking water source), or as such, the end users (i.e., aquatic biota, wildlife, and humans). The determination of significance to the assessment endpoint was applied to all Project phases (i.e., construction, operation, closure, and post-closure) within the effects study area (Lac de Gras watershed).

The assessment approach for the Project was to evaluate if a change in concentration of water quality constituents (i.e., a numerical value), as a result of Project activities, would result in a significant adverse effect to the assessment endpoint and thus directly affect an end user. For example, this would include a change in water quality such that there is a prolonged exceedance of a screening value (tied to a guideline) that has predicted effects to aquatic health and/or resulting effects to the sustainability of the aquatic ecosystem, and/or changes to water that would prevent continued traditional use or drinkability of the water) through all Project phases.

2) Why would multiple constituents have to be in exceedance of water quality guidelines have in order to meet the threshold for significance?

In the response to Information Request DAR-MVEIRB-IR-6, Dominion Diamond indicated that a significant adverse effect would be a substantial change to water quality through elevated concentrations of multiple constituents such that aquatic ecosystems and or ecological function in Lac du Sauvage and Lac de Gras is no longer maintained, or that the water in these waterbodies is no longer safe to drink. While this statement is derived on the basis that a combination of multiple constituents exceeding thresholds is considered to represent a higher potential risk than one elevated constituent concentration, the exceedance of multiple water quality constituents is not a requirement for the determination of significance to water quality in the receiving environment. Should a change in a water quality constituent be shown to exceed a screening value by a sufficient magnitude (e.g., severity or intensity of change), such that negative aquatic health, wildlife health, or human health effects were predicted over a wide geographic extent, for a prolonged period of time, a significant impact would be determined.

As described in Section 8.5.4.1.2 of the DAR, the maximum projected constituent concentration at each Project phase, at each of the assessment nodes in Lac du Sauvage and Lac de Gras, was screened against a guideline or benchmark value. If the modelled maximum concentration under any Project phase exceeded a screening value, the constituent was identified for further review by water quality, aquatic health (Section 8.5.5), and fish and fish habitat (Section 9). The water quality projections were also carried forward into a wildlife health and/or human health risk assessment (February 2, 2015 supplemental submission). The exceedance of a screening value may indicate the potential for adverse effects, but not the likelihood that they will occur, or that a significant impact will occur.

3) The local boundary is established as the outlet of Lac de Gras; why was this chosen as the end of the local assessment boundary instead of, for example, the outlet of LDS or any of the small lakes between the LLCF and LDG?

As described in the DAR, in the response to adequacy review DAR-MVEIRB-20, and as presented at the April 2015 Technical Sessions, the effects study area for water quality is the area within the baseline study area where Project activities could potentially have direct or cumulative effects to the assessment endpoint (aquatic and biological receptors and end users) and to the extent where measureable effects are anticipated to occur. The effects study area takes into consideration Lac du Sauvage, Lac de Gras, and numerous small lakes within the watershed that are connected to these larger lakes.

For purposes of the environmental assessment, the downstream boundary of the effects study area was set at the outlet of Lac de Gras (see Map 8-15, Section 8, DAR). This area, which includes Lac du Sauvage, the Lake C1 watershed, the Christine Lake watershed, Lac de Gras, and the Koala watershed which drains into Slipper Bay of Lac de Gras (includes the existing Ekati Mine operations and the Long Lake Containment Facility), is considered appropriate as it encompasses lakes identified as having importance for traditional use in addition to those lakes where measureable effects are anticipated to occur.

Throughout the DAR, and in response to various information requests, modelled water quality projections have been presented for numerous locations throughout the assessment area. To that end, predicted changes to water quality have been assessed at these various locations over the temporal timeline of the Project (e.g., the assessment nodes in Lac du Sauvage and Lac de Gras, and Christine, Counts, Vulture, Nema, Cujo, and Slipper lakes) and not just at terminus of the effects study area (the outlet of Lac de Gras).

Undertaking:	DAR-MVEIRB-UT-15
Source:	Undertakings from Day 4 (April 23) of the Technical Sessions
Subject:	Phosphorus loading to Lac du Sauvage
DAR Section(s):	Section 8, Appendix 8F

Request:

DDEC is to provide data for total loads in all periods for all phosphorus loading sites in Lac du Sauvage (similar to those found in figure 61-1, MVEIRB-IR-61, but for Lac du Sauvage specifically).

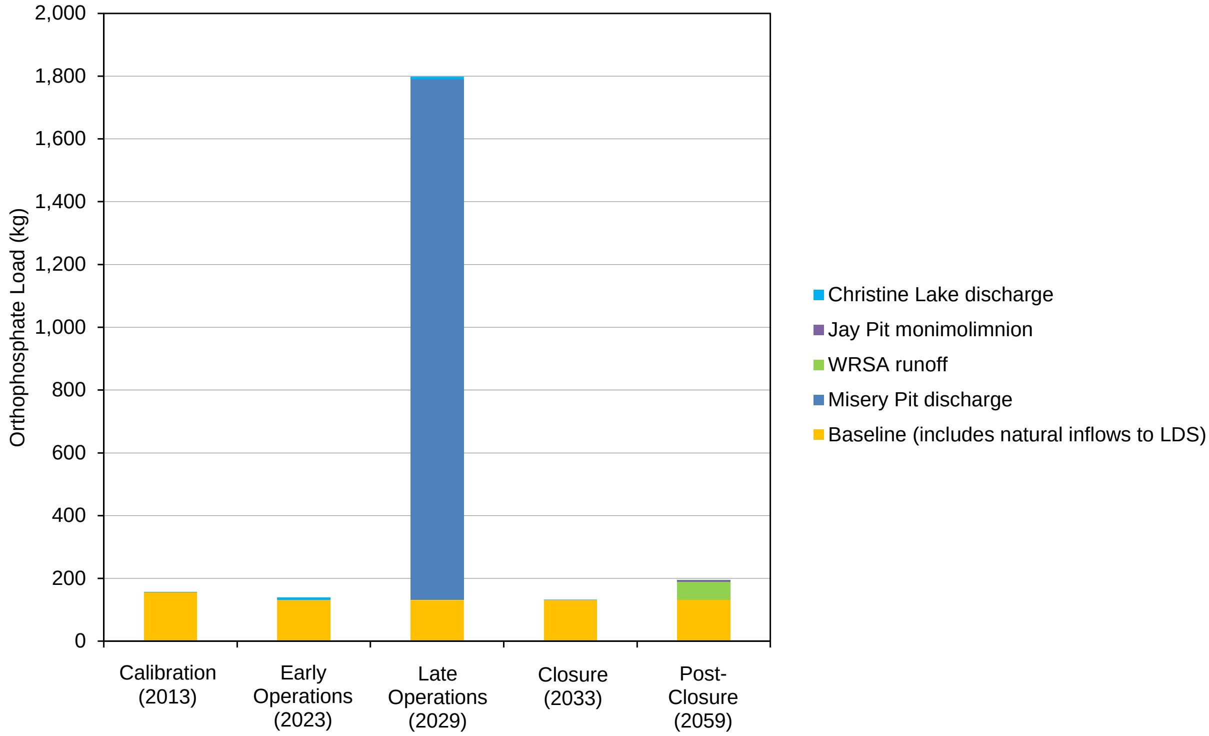
Response:

Similar to the response presented for information request MVEIRB-IR-61 for Lac de Gras, the sources of orthophosphate to Lac du Sauvage were modelled as follows:

- Baseline: includes tributary and non-point source inflows from the Lac du Sauvage watershed. Baseline contributions were represented by median orthophosphate concentrations from water quality monitoring results for Lac du Sauvage collected between 2004 and 2013 for the open-water season (Appendix 8F, Table 8F2.2-2 in the Developer's Assessment Report [DAR]). This input source is not Project-related and is applied in the Base Case and the Application Case.
- Misery Pit discharge: The Misery Pit discharge to Lac du Sauvage is active during the late operations period. During late operations, the Misery Pit discharge includes runoff from the waste rock storage area (WRSA) to the Jay sump. This input source is only Jay Project-related and is only applied in the Application Case.
- Waste rock storage area runoff: The WRSA runoff is active during the post-closure period. This input source is only Project-related and is only applied in the Application Case.
- Load from the Jay Pit monimolimnion: includes movement of mass from the Jay Pit monimolimnion upward into Lac du Sauvage. The Jay Pit monimolimnion load is active during the post-closure period. This input source is only Project-related and is only applied in the Application Case.
- Christine Lake discharge: includes baseline inflows and mine-related inflows from the Ekati Mine operation in the King-Cujo watershed. It was assumed that the Christine Lake discharge is active during the calibration, early operations, late operations, closure, and post-closure periods. This input source is not Project-related.

The relative loadings of orthophosphate to Lac du Sauvage from these five sources (i.e., baseline, Misery Pit, WRSA runoff, Jay Pit monimolimnion, and Christine Lake) are included in Figure 15-1 and Table 15-1 for individual years representative of the model calibration period (2013), early operations (2023), late operations (2029), closure (2033), and post-closure (2059).

Figure 15-1 Annual Orthophosphate Load to Lac du Sauvage for the Updated Assessment Case[(a)]



a) The updated assessment case included changes made to inputs for the pit lake hydrodynamic models, the site water quality model, the regional water balance model, and the Lac du Sauvage and Lac de Gras hydrodynamic and water quality models. These changes were made following submission of the DAR to provide supporting information during the environmental assessment review process. A description of the changes and the model results are presented in Golder (2015).

kg = kilograms; LDS = Lac du Sauvage; WRSA = waste rock storage area.

Table 15-1 Annual Orthophosphate Load to Lac du Sauvage for the Updated Assessment Case[(a)]

Source	Annual Orthophosphate Load (kg)				
	Calibration (2013)	**Early Operations (2023)**	**Late Operations (2029)**	**Closure (2033)**	**Post-Closure (2059)**
Baseline (includes natural inflows to Lac du Sauvage)	155	131	131	131	132
Misery Pit discharge	0	0	1,658	0	0
WRSA runoff	0	0	0	0	57
Jay Pit monimolimnion	0	0	0	0	5
Christine Lake discharge	1.5	9	9	1	1
Total	**156.5**	**140**	**1,798**	**132**	**195**

a) The updated assessment case included changes made to inputs for the pit lake hydrodynamic models, the site water quality model, the regional water balance model, and the Lac du Sauvage and Lac de Gras hydrodynamic and water quality models. These changes were made following submission of the DAR to provide supporting information during the environmental assessment review process. A description of the changes and the model results are presented in Golder (2015).

kg = kilograms; WRSA = waste rock storage area.

As shown in Figure 15-1 and Table 15-1, during early operations, the largest source of orthophosphate load to Lac du Sauvage is predicted to be from baseline inflows, because during early operations, Project minewater is stored within Misery Pit (i.e., no discharges from Misery Pit during the early operations phase). During late operations, the largest source of orthophosphate load to Lac du Sauvage is predicted to be from the Misery Pit discharge. Note that modelling of orthophosphate concentrations in the Misery Pit discharge involved conservative assumptions so it is expected that the modelled results are overestimated. During the closure and post-closure periods when the Misery Pit discharge to Lac du Sauvage has ceased, the largest source of orthophosphate load to Lac du Sauvage is predicted to be from baseline inflows. As mentioned above, and discussed in the DAR, the loads of orthophosphate to Lac du Sauvage were used to project concentrations of orthophosphate and total phosphorus in the lake.

References:

Golder (Golder Associates Ltd.). 2015. Jay Project - Compendium of Supplemental Water Quality Modelling. Submitted to Mackenzie Valley Environmental Impact Review Board. April 2015.

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-16
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Wildlife
DAR Section(s):	3

Request:

DDEC is to review the ICRP to clarify the project's closure objectives specifically in regards to lichen re-colonization and re-vegetation.

Response:

The Ekati Mine Interim Closure and Reclamation Plan (ICRP; BHP Billiton 2011) provides the reclamation goal that encompasses all aspects of the Ekati Mine, including facilities that may be introduced or used by the Jay Project. The reclamation goal is the result of a multi-year working group process conducted by the Wek'èezhìı Land and Water Board, and it is embedded into the Ekati Mine Water Licence as the definition of "Reclamation". As such, the reclamation goal should be relied on for the Jay Project. Closure objectives are more specific statements that are designed to achieve the reclamation goal. The closure objectives are organized according to the six mine components described in the ICRP, and according to seven specific topic areas, as shown on Figure 16-1 (Figure 1.4-1 from the ICRP).

Lichen colonization and revegetation is relevant to waste rock storage areas (WRSAs) and to pads and roads, which are addressed in the ICRP as part of the "Buildings and Infrastructure" component. It is not practical to consider active revegetation (i.e., planting) of lichen, and this is not included in the ICRP. Therefore, the following discussion pertains to natural lichen colonization of reclaimed areas. Natural colonization is expected to take place over a timeframe in the order of decades because of the slow rate of dispersion and growth.

The specific reclamation objectives that are most relevant to lichen colonization of WRSAs, pads, and roads as listed in the ICRP (pages 5-100 and 5-168) include the following:

- native vegetation used for rehabilitation work;
- remaining surface areas are safe for wildlife use;
- wildlife are using the Ekati claim block; and,
- community land use expectations and traditional knowledge have been considered in the closure planning.

The Ekati Mine ICRP provides the following information relevant to lichen colonization:

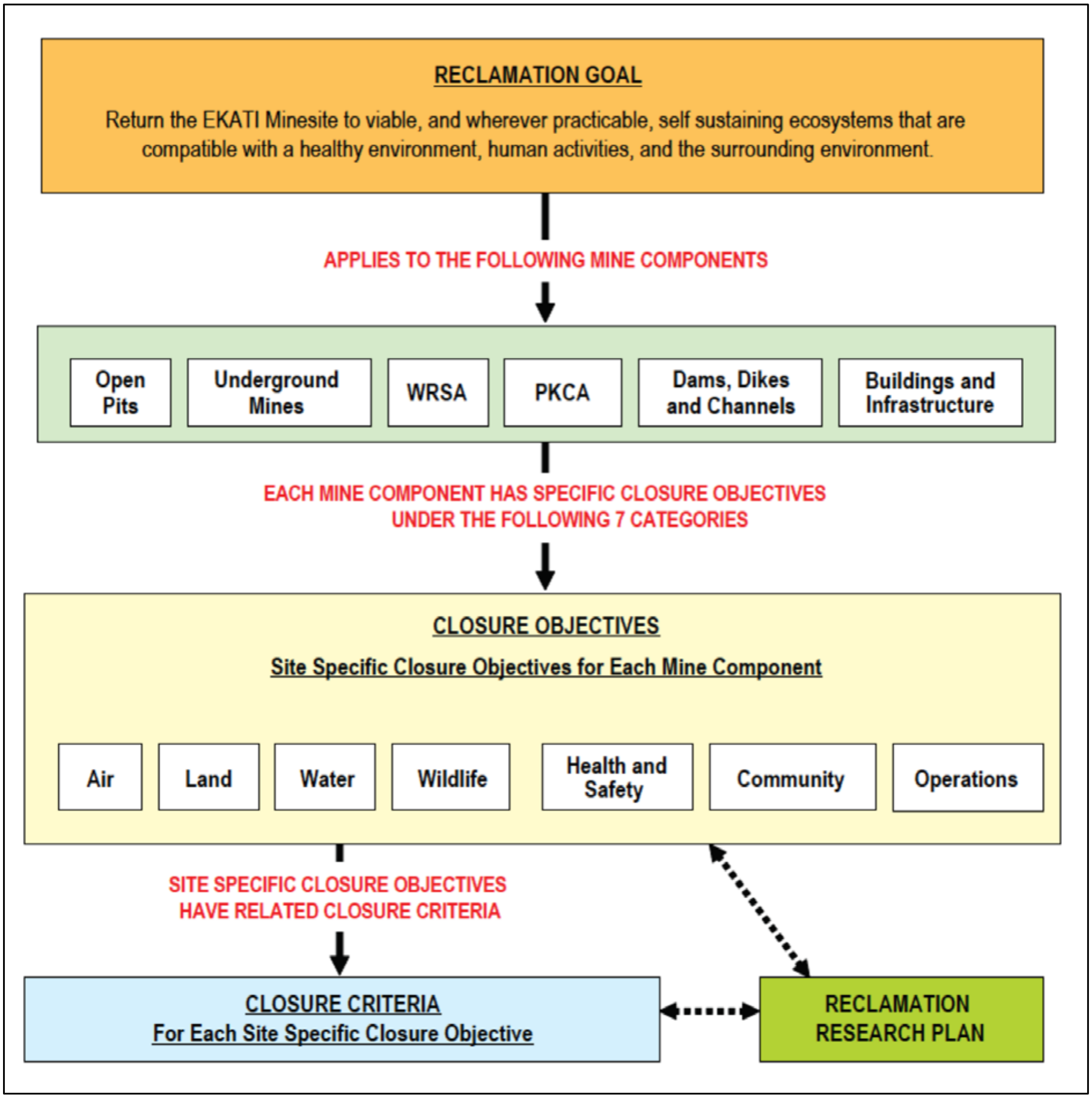
- (page 5-166) "Natural colonization is expected to be the principal means for vegetation recovery on the roads and airstrip."

- (page 5-166) "… the roughened pad will provide habitat for the more xeric vegetation such as dwarf birch, crowberry, willow, grasses, sedges, lichens and xeric mosses."
- (page 5-166) "An assessment of remaining surfaces will be conducted and selected sites will be landscaped to encourage natural vegetation through trenching and boulder placement to create depressions for snow capture and plant colonizes to collect and propagate."
- (page 5-170) "Areas such as those with exposed bedrock or large boulder sites are not expected to support vegetation for at least several decades, due to the poor physical properties for supporting plants. Initial colonizers in these locations will be lichens and xeric mosses."

The ICRP specifically addresses lichen colonization of reclaimed WRSA, pad, and road surfaces as described above. Areas immediately adjacent to roads where lichen and other vegetation could be affected by dust deposition are addressed in Dominion Diamond's responses to Information Request DAR-YKDFN-IR-04 (part 2) and Technical Session Homework #10. In those responses, Dominion Diamond described that the vegetation species composition could shift away from lichen immediately adjacent to roads, and that it was uncertain whether the species composition would return to the pre-disturbance condition.

Dominion Diamond understands from its community engagement program that the area to be crossed by the Jay Road and containing the Jay WRSA is an important caribou movement corridor, and that lichen are an important food for caribou. In respect of the community engagement, Dominion Diamond has modified the design of the Jay Road to incorporate extensive caribou crossings, and has modified the approach to construction of the WRSA to provide for progressive construction of wildlife egress ramps (rather than waiting until closure). These measures mitigate risks to caribou movement both during and after operations. Dominion Diamond finds that the reclamation objectives described in the ICRP related to lichen colonization, combined with the design modifications to the Jay Road and Jay WRSA, are appropriate for reclamation of the Jay Road, pads, and WRSA.

Figure 16-1 ICRP Reclamation Framework (Figure 1.4-1 of the Ekati Mine ICRP)



PKCA = processed kimberlite containment areas; WRSA= waste rock storage areas.

References:

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

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-18
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Internal Policy on Occupational Health and Safety regarding Air Quality
DAR Section(s):	7, 14

Request:

DDEC is to report on if portions of their internal policy on occupational health and safety regarding air quality may be made available.

Response:

The attached internal policies relate to occupational health and safety regarding air quality (Attachment 18A).

- Occupational Hygiene Procedure
  - The Dominion Diamond Occupational Hygiene Procedure is the basis for implementing a comprehensive occupational hygiene program at Dominion Diamond to reduce the risk of occupational diseases or illnesses. The Procedure describes how occupational hygiene exposures are to be anticipated, identified, evaluated and controlled, and provides information to departments, supervisors, Dominion Diamond employees, and contractors to allow for informed decision-making regarding exposure to chemical, biological, physical, and ergonomic hazards in the workplace.

- Monitoring and Measurement
  - This Standard outlines Dominion Diamond's approach to monitoring and measurement of health, safety, and environmental (HSE) performance for activities, products, and services that can have a significant HSE impact.

- Sampling Strategy for Exposure Agents
  - This procedure is a guide for health and safety professionals initiating a sampling strategy for exposure agents such as noise, dust, and chemicals.

ATTACHMENT 18A

1. Occupational Hygiene Procedure

2. Monitoring and Measurement

3. Sampling Strategy for Exposure Agents

EKA PRO 1834 Occupational Hygiene Procedure

Version:	2.0
Replaces:	1.0
Creation Date:	2011-07-10
Scheduled Review Date:	2014-07-12
Review Date:	2014-01-10
Document Team Members:	Occupational Hygienist
Document Owner:	Head, Health and Safety
Document Approver:	Head, Health and Safety
Related Documents:	NWT Mine Health and Safety Regulations
Key Contacts:	Team Leader - Occupational Health and Hygiene
Change Requests:	Team Leader - Occupational Health and Hygiene
Brief Description:	This document defines the performance requirements of the DDEC Occupational Hygiene Procedure

Table of Contents

Occupational Hygiene Procedure 1

1.0 Intent 3

2.0 Application 3

3.0 Reducing Occupational Exposures at DDEC 3

3.1 Roles and Responsibilities 3

3.1.1 Occupational Hygiene Team 3

3.1.2 Managers 4

3.1.3 Superintendents and Team Leaders 4

3.1.4 Employees 4

3.2 Anticipation of Health Hazards 5

3.3 Identification of Exposures 5

3.4 Evaluating Exposures 5

3.4.1 Classifying Exposures 6

3.4.2 Re-evaluation of Exposures 6

3.5 Exposures Common to the DDEC Work Environment 6

3.6 Control of Occupational Exposures at DDEC 7

3.6.1 Exposure Control Plans 7

3.6.2 Establishing Priorities 7

3.6.3 Implementation of Controls 7

3.6.4 Maintenance of Controls 8

3.7 Health Surveillance 8

3.9 References 8

3.10 Glossary 8

4.0 Appendix 10

Approval signatures record .... **Error! Bookmark not defined.**

1.0 Intent

This document defines the performance requirements of the DDEC Occupational Hygiene Procedure. The DDEC Occupational Hygiene Procedure supports Dominion Diamond's goal of Zero Harm by controlling those environmental factors and stresses, arising in or from the DDEC work place that may cause illness, injury, or discomfort.

The DDEC Occupational Hygiene Procedure is the basis for implementing a comprehensive occupational hygiene program at DDEC to reduce the risk of occupational diseases or illnesses. The Procedure describes how occupational hygiene exposures are to be anticipated, identified, evaluated and controlled, and provides information to departments, supervisors, Dominion Diamond employees and contractors to allow for informed decision-making regarding exposure to chemical, biological, physical and ergonomic hazards in the workplace.

The DDEC Occupational Hygiene Procedure meets or exceeds the legislated requirements made under the Northwest Territories *Mine Health & Safety Act* and *Mine Health and Safety Regulations*. Additionally, every effort will be made to implement best practices in occupational hygiene principles in accordance with internationally recognized Procedures.

The Occupational Hygiene Procedure is supported by additional procedures, programs and work instructions.

2.0 Application

This Procedure applies to all employees, contractors and visitors to DDEC worksites and facilities.

3.0 Reducing Occupational Exposures at DDEC

To help reduce the risk of hazardous exposures, ensure regulatory compliance, and improve working conditions, appropriate occupational hygiene practices will be applied to DDEC operations in accordance with the following tenets:

- Anticipation of health hazards;
- Identification and or recognition of health hazards;
- Evaluation of magnitude of health hazards according to internationally or nationally recognized Procedures; and
- Implementation of control strategies to eliminate or reduce health hazards using the hierarchy of control.

3.1 Roles and Responsibilities

3.1.1 Occupational Hygiene Team

The Occupational Hygiene Team is responsible for:

- Developing and maintaining Occupational Hygiene Procedures, Procedures and Work Instructions;
- Assisting with identifying exposures to hazardous agents;
- Performing qualitative and quantitative assessments of exposures; considering all routes of exposure (e.g. inhalation, ingestion, dermal absorption) and reporting the results of exposure assessments to the DDEC workforce;

- Assisting departments with scoping exposure control planning projects;
- Recommending appropriate control technologies;
- Identifying applied/original research to support implementation of controls;
- Advising on performance criteria for controlling exposures to hazardous agents – e.g. Occupational Exposure Limits, "real-world" noise attenuation factors for hearing protection, filter efficiencies, capture velocities for particulates etc.;
- Advising on health effects associated with hazardous agents;
- Supporting development of Exposure Control Plans;
- Reporting, on a quarterly basis, the number of employees and contractors being exposed above the action limit for hazardous agents; and
- Preparing and delivering Hygiene awareness and education.

3.1.2 Managers

Managers are responsible for:

- Ensuring that Exposure Control Plans are developed, implemented, and updated;
- Implementing control strategies to address exposures at DDEC using the hierarchy of control; and
- Ensuring resources are available for the implementation and maintenance of controls.

3.1.3 Superintendents and Team Leaders

Supervisors are responsible for:

- Ensuring that Risk Assessments consider occupational exposures and any required controls of exposure hazards;
- Notifying the Hygiene Team when recommended controls have been implemented so that assessments can be made to determine effectiveness of controls;
- Reporting breaches to the control plan in First Priority as an event;
- Ensuring controls are being used and operational;
- Ensuring a preventive maintenance plan is developed for all engineered controls; and
- Ensuring hearing protection and respiratory protection are used where required.

3.1.4 Employees

Employees, contractors, and visitors are responsible for:

- Undergoing site-inception training (TRACESS) for occupational hygiene modules the hazards of exposure
- Using the assigned protective equipment in an effective and safe manner
- Setting up the operation in accordance with the site-specific plan
- Following established work procedures as directed by the supervisor

- Reporting any unsafe conditions or acts to the supervisor, including exposure incidents

3.2 Anticipation of Health Hazards

Occupational health hazards can best be minimized by work-place design that controls contaminants as much as possible. When new projects are commissioned, occupational exposure hazards must be considered and, where applicable, exposure controls integrated into new projects at the design stage. Common exposures that must be considered include, but are not limited to, the following:

- Noise;
- Whole Body Vibration;
- Hand-Arm Vibration; and
- Diesel Engine Exhaust Emissions.

3.3 Identification of Exposures

Exposures are identified in the following ways:

- Review of all work areas and activities at DDEC to identifying hazards, potential exposures and work activities or tasks that have the potential to result in exposures;
- Results from baseline surveys of all work areas or operations to identify and evaluate potential health risks from exposures;
- Analysis of proposed new designs, operations, processes, materials, or equipment before use to determine potentially hazardous exposures;
- Analysis of any changes (both proposed and completed) in operations, processes, materials, control equipment, work practices, or personnel that have the potential to cause new or additional hazardous exposures.
- Results from periodic surveys or exposure monitoring;
- Complaints from employees or contractors; and
- Material Safety Data Sheets for controlled products.

3.4 Evaluating Exposures

Once identified, occupational exposures will be evaluated to determine where controls are required to prevent adverse health effects in exposed groups. Most exposures at DDEC are evaluated by Similarly Exposed Group ("SEG"). A SEG is a group of people, generally performing the same task for the same period of time, such that exposure measured on any one person within the group will be representative of the exposure of the whole group. All employees and contractors at DDEC are assigned into a SEG upon hire DDEC.

Exposure evaluations will be based on a combination of:

- Occupational Exposure Limits for the agent:
  - Occupational Exposure Limits ("OELs") established under this document (3.4.1 Classifying Exposures);

- The American Conference of Governmental Industrial Hygienists (“ACGIH”) Threshold Limit Values (“TLVs”) for Chemical Substances and Physical Agents; and
- Northwest Territories Workers’ Safety and Compensation Commission regulatory Requirements.

Where occupational exposure limits do not exist, other recognized Procedures and professional judgment will be used to determine at which point hazard controls are required.

- Recognized occupational hygiene practices; and
- Professional judgement.

3.4.1 Classifying Exposures

Action Limit

The action limit is 50% of the OEL. Exposures at DDEC will be classified as either below the action limit or above the action limit. Where the exposure results cannot be clearly interpreted, further exposure assessment will be required.

Exposures below the Action Limit

Exposures that have been either quantitatively or qualitatively assessed as unlikely to exceed 50% of an OEL will be deemed acceptable. However, recommendations for controls may still be made to address worker comfort or due diligence obligations.

Exposures above the Action Limit

Where exposures have been qualitatively or quantitatively identified as likely to exceed the Action Limit, implementation of, or modification to, hazard controls must be made and an Exposure Control Plan must be developed as per EKA PRO 1844 Exposure Control Plan Procedure.

3.4.2 Re-evaluation of Exposures

Exposures must be re-evaluated when:

- A process change may affect levels of exposures;
- There is a change to the Dominion Diamond OELs; and
- There is a change to OELs established by credible agencies (e.g. ACGIH, AIHA).

3.5 Exposures Common to the DDEC Work Environment

Exposure risks common to the DDEC work environment will be assessed on an ongoing basis. These exposures may also be subject to a regularly scheduled monitoring program.

Exposures common to the DDEC work environment include, but are not limited to the following agents and corresponding OELs:

- Diesel Engine Exhaust Emissions (Underground) ; monitored as Diesel Particulate Matter (as elemental carbon);
- Respirable crystalline silica (Underground);

- Inhalable Particulate (Underground and in the Process Plant);
- Respirable Particulate (Underground);
- Whole Body Vibration (Mobile Equipment); and
- Noise (Common to most areas of the DDEC worksite).

Other exposures that are encountered in the DDEC work environment will require evaluation on an individual basis beginning with a walk-through survey by the Hygiene Team. The walk-through survey will include a technical review of the operations and materials in a workplace used to more clearly identify potential health hazards and help guide an assessment of their severity.

3.6 Control of Occupational Exposures at DDEC

3.6.1 Exposure Control Plans

Where exposures are identified as exceeding the Action Limit, Exposure Control Plans must be developed and implemented as set-out in the Exposure Control Plan Procedure EKA PRO 1844.

3.6.2 Establishing Priorities

Where more than one intolerable exposure has been identified in a work area, those exposures that pose the greatest risk or hazards will be addressed first. The priority for addressing identified substances/agents will be based on:

- the severity of health effects if exposure occurs;
- frequency of exposure;
- number of individuals who are exposed; and
- the extent to which level existing controls are in place.

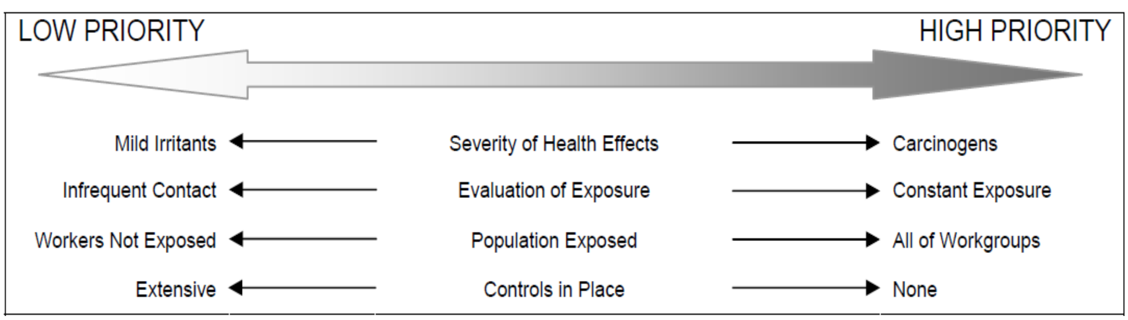


Figure 1 – Illustration of DDEC Occupational Hygiene Priorities

3.6.3 Implementation of Controls

The hierarchy of control must be to reduce or eliminate exposures. Prioritization of exposures requiring controls is based on potential health consequences and the number of people exposed.

3.6.4 Maintenance of Controls

The success of exposure control technologies relies on the continued maintenance of controls; it is essential that maintenance of controls is factored into planning, scheduling and budgeting in order to protect the health of the DDEC workforce. Controls that address occupational exposures must also be included in the Preventive Maintenance schedule.

3.7 Health Surveillance

Where exposures are above the Action Limit, each member of the SEG will be required to undergo appropriate medical monitoring until such time that controls have been implemented to reduce exposures to tolerable levels. Team Lead or Supervisor will be requested to identify each member of the SEG. Medical monitoring will be conducted in accordance with the EKA PRO.1811 DDEC Medical Screening & Health Surveillance Procedure.

3.9 References

A Strategy for Assessing and Managing Occupational Exposures, Third Edition. 2006. American Industrial Hygiene Association.

TLVs and BEIs Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. 2013. American Conference of Governmental Industrial Hygienists.

Fundamentals of Industrial Hygiene, 5th Edition. 2001. Plog, B.A. National Safety Council Press.

Guide for the adjustment of permissible exposure values (PEVs) for unusual work schedules: 3rd edition revised and updated. 2008.

3.10 Glossary

TERM	DEFINITION
Action Limit	50% of an Occupational Exposure Limit. Exposures at DDEC that have been qualitatively or quantitatively evaluated as exceeding the Action Limit require exposure control plans.
Biological Hazard	Any biological organism that is infectious or pathological to humans.
Chemical Hazard	Any chemical capable of causing bodily injury or illness.
Ergonomic Hazard	Arises from a physical factor within the environment that harms the musculoskeletal system.
Exposure Control Plan	A written action plan that specifies precautionary measures taken to reduce or eliminate exposures to health hazards in the workplace.
Health Hazard	A factor or stress that can cause sickness, impaired health or significant discomfort.

TERM	DEFINITION
Occupational Hygiene	The science and art devoted to the anticipation, recognition, evaluation and control of those environmental factors or stresses arising from the workplace that may cause sickness, impaired health and well-being, or significant discomfort among workers or among the citizens of the community.
Occupational Exposure Limit	The concentration of a substance or agent, exposure to which, according to current knowledge, should not cause adverse health effects nor cause undue discomfort to nearly all workers.
Physical Hazard	Arises from the interaction of matter and energy related to the science of physics such as sound, light and radiation that could result in an occupational injury or illness.
Respirator	A device to protect the wearer from inhalation of harmful substances.
Similarly Exposed Group (“SEG”)	A group of people, generally performing the same task for the same period of time, such that exposure measured on any one person within the group will be representative of the exposure of the whole group. The term Homogenous Exposure Group is frequently used and is interchangeable with Similar Exposure Group.

4.0 Appendix

Approvals Framework

Approvals for the Procedure including related documents:

APPROVAL SIGNATURES RECORD			
REVIEWER ROLE	**NAME**	**SIGNATURE**	**DATE**
Team Leader - Occupational Health and Hygiene	Gary Rizzolo		JUNE 24, 2014
APPROVED BY			
Head of Health & Safety	Mike Lowing		June 24, 2014

HSE STA 15 Monitoring and Measurement

Version:	1.0
Replaces:	N/A
Creation Date:	2014-06-04
Scheduled Review Date:	2017-06-04
Review Date:	N/A
Document Team Members:	Head of Health and Safety Superintendent - Environment Operations Team Leader - Risk and Safety
Document Owner:	Head of Health and Safety
Document Approver:	President and Chief Operating Officer
Related Documents:	• British Standards Institute OHSAS 18001:2007 Occupational Health and Safety Management Systems – Requirements • International Standards Organization ISO 14001:2004 Environmental Management Systems – Requirements with Guidance for Use • DDC Sustainable Development Policy • HSE STA 05 Objectives, Targets and Programs • HSE STA 16 Evaluation of Compliance • HSE STA 17 Incident Investigation, Nonconformity, and Corrective and Preventive Action • HSE STA 18 Control of Records • Procedures for Calibration and Maintenance of Monitoring Equipment • Register of Health and Safety Legal and Other Requirements • Register of Environmental Legal and Other requirements • Environmental Database • Annual Objectives, Targets and Programs • Training Matrix • Workplace Inspections • Reports (e.g., Environmental, Occupational Health, Industrial Hygiene and Performance Monitoring)
Key Contacts:	Head of Health and Safety Superintendent - Environment Operations Team Leader - Risk and Safety

Change Requests:	Head of Health and Safety
Brief Description:	This Standard outlines DDEC's approach to monitoring and measurement of health, safety and environmental (HSE) performance for activities, products and services that can have a significant HSE impact. It addresses establishment of leading and lagging indicators, internal and external reporting, tracking of performance in meeting objectives and targets, workplace inspections and job observations, calibration of monitoring equipment and maintenance of records.

Table of Contents

HSE STA 15 Monitoring and Measurement 1

1.0 Purpose 4

2.0 Scope, Background and Context 4

3.0 Responsibilities 4

4.0 Requirements 5

4.1 Monitoring Approach 5

4.2 Leading and Lagging Indicators 6

4.3 Required Regulatory Monitoring and Reporting of Regulatory Noncompliance 6

4.4 Performance Monitoring & Reporting 6

4.5 Tracking Conformance with Objectives, Targets and Management Programs 7

4.6 Workplace Inspections 7

4.7 Maintenance and Calibration of Equipment 7

4.8 Monitoring Records 7

4.9 Checklists 7

5.0 Definitions 7

Appendix 8

Approval Signatures Record 8

Revision History 8

1.0 Purpose

This Standard outlines DDEC's approach to monitoring and measurement of HSE performance aligned with requirements of ISO 14001 and OHSAS 18001.

2.0 Scope, Background and Context

Compliance with this Standard is a requirement of all employees and contractors. It applies to operations at the Ekati Diamond Mine, Sorting and Valuation Facility and Yellowknife Office.

HSE performance monitoring and measurement is a fundamental requirement to ensure continuous improvement of the DDEC HSE Management System. Monitoring includes both leading and lagging indicators.

3.0 Responsibilities

a) President and Chief Operating Officer / Operations Management Team

i. Ensure that appropriate monitoring and measurement processes are established, implemented and maintained to reduce risk and comply with legal and other requirements, in accordance with the ISO 14001 and OHSAS 18001 requirements,
ii. Monitor progress toward achieving established HSE objectives and targets, and
iii. Promote the application of both leading and lagging indicators.

b) Head of Health and Safety

i. Ensures that monitoring, measurement and calibration procedures are established, implemented and maintained according to ISO 14001 and OHSAS 18001 Standards, and
ii. Ensures that performance reports are prepared and communicated to management (e.g., performance toward achieving established objectives and targets, implementation of the HSE Management System, and conformance in conducting required workplace inspections, etc.).

c) Superintendent – Environment Operations

i. Supports the Head of Health and Safety in establishing, implementing and maintaining monitoring, measuring and calibration procedures and performance reporting.

d) Supervisors

i. Ensure that workers, within their areas of responsibility, conduct monitoring, measuring and calibration activity according to established procedures, and
ii. Ensure that monitoring activity, measurements and calibrations are documented and appropriate records maintained.

e) Occupational Health and Safety Committee

i. Periodically reviews performance in complying with established objectives and targets, and
ii. Conducts and documents periodic workplace inspections/tours according to regulatory and site requirements.

f) Employees and Contractors

i. Conduct assigned monitoring, measurement and calibration activity according to applicable procedures and record appropriate data/information, and

ii. Notify their supervisor if problems occur when conducting monitoring, measuring and calibration activity.

4.0 Requirements

4.1 Monitoring Approach

4.1.1 As required by ISO 14001 and OHSAS 18001, DDEC monitors on a continual basis key characteristics of its activities, products and services that can have a significant impact on people or the environment.

4.1.2 Monitoring parameters include both qualitative and quantitative measures using leading (proactive) and lagging (reactive) indicators (see *HSE STA 05 Objectives, Targets and Programs*).

4.1.3 DDEC conducts a variety of monitoring programs necessary to meet regulatory requirements, including site permits, certificates and licenses. Results / data are recorded, documented, tracked and reported as required (see *HSE STA 16 Evaluation of Compliance* and the *Environmental Database*).

4.1.4 All personnel play an important role in collecting monitoring data and contributing to achieving established objectives and targets (*See HSE STA 05 Objectives, Targets and Programs)*.

4.1.5 DDEC monitors the effectiveness of controls, and in critical areas, quality assurance and quality control procedures are established to help ensure that data generated is reliable and accurate.

4.1.6 The following are examples of DDEC's environmental monitoring programs:

a) Air
   i. Air emission release (e.g., tonnes of greenhouse gases), and
   ii. Ambient concentrations of key parameters in (e.g., Suspended Particulate).

b) Water
   i. Emission releases to aquatic environment (e.g., kg of ammonia),
   ii. Concentrations of key parameters in effluent and receiving watercourse (e.g., mg/L of ammonia), and
   iii. Aquatic effects monitoring (e.g., impacts to invertebrates, fish, zooplankton and phytoplankton).

c) Wastes
   i. Waste sent off site for recycle or disposal.

4.1.7 DDEC conducts occupational health or industrial hygiene monitoring programs to assess dusts, gas and noise levels in the workplace and worker exposure compared with established NWT Mines Act limits and standards.

4.1.8 The following are examples of DDEC performance monitoring:

a) Performance in meeting the DDC Sustainable Development Policy and implementing programs for meeting DDEC's HSE annual objectives and targets,

b) Performance in delivering HSE training according to a defined Training Matrix,

c) Performance in implementing operational controls (i.e., including Ekati Procedures, Work Instructions, Job Hazard Analyses, etc.), and

d) Effectiveness in managing significant HSE risks identified in the hazard and aspects register or other risk assessments.

4.1.9 DDEC has established an incident reporting process which includes a corrective and preventive action follow up component. Considerable attention is given to recording and investigating near-miss incidents which provide learning opportunities for control improvements (see *HSE STA 17 Incident Investigation, Nonconformity and*

Corrective and Preventive Action).

4.2 Leading and Lagging Indicators

4.2.1 Where practical, monitoring and measurement should include both leading indicators (proactive initiatives) and lagging indicators (reactive performance statistics).

4.2.2 The following are examples of various DDEC **leading** indicators monitored by DDEC:

a) Number of workplace inspections,
b) Environmental monitoring,
c) Medical surveillance and workplace hygiene monitoring,
d) Number of near misses reported and effectiveness of follow up for those with high potential for harm,
e) Number of employees successfully completing training,
f) Number of risk assessments conducted, and
g) Number audits conducted.

4.2.3 The following are examples of various DDEC **lagging** indicators monitored by DDEC:

a) First aids,
b) Medical aids,
c) Lost time incidents,
d) Total recordable incidents,
e) Modified work,
f) Property damage,
g) Nonconformities,
h) Orders issued,
i) Spills, and
j) Noncompliance with regulations, licenses, approvals, permits, certificates, etc.

4.3 Required Regulatory Monitoring and Reporting of Regulatory Noncompliance

4.3.1 The Head of Health and Safety and Superintendent – Environment Operations shall provide support to operations personnel in ensuring that inspections are completed as required by legal or other requirements, or as specified by HSE programs and procedures.

4.3.2 Where regulations, permits, licenses, agreements or other requirements necessitate the measurement of various HSE parameters (e.g. monitoring data, safety data, emissions data, etc.), these parameters shall be recorded and tracked in accordance with the requirements.

4.3.3 Findings from inspections shall be documented, reported as required and appropriate corrective actions taken.

4.3.4 Where monitoring and measurement activities identify regulatory noncompliance or show indications of trends that could lead to exceeding regulatory limits or declining HSE performance, the applicable manager shall be notified by the accountable persons and corrective action plans developed.

4.3.5 Managers shall address legal non-compliance situations immediately and ensure that appropriate reporting, investigation and corrective action is initiated.

4.4 Performance Monitoring & Reporting

4.4.1 The Head of Health and Safety, with support from the Superintendent - Environment Operations is accountable to ensure that HSE performance reports are prepared and issued on a frequency determined by senior management.

4.5 Tracking Conformance with Objectives, Targets and Management Programs

4.5.1 The implementation of Management Programs to meet established Objectives and Targets should be monitored and reviewed at a minimum of a quarterly basis.

4.5.2 The review should evaluate performance in meeting objectives and targets, including recognition of achievements and identification of issues or obstacles.

4.6 Workplace Inspections

4.6.1 Supervisors will conduct and document Workplace Inspections as described by relevant procedures; this will help to ensure that workplaces are well maintained.

4.6.2 Corrective actions arising from Workplace Inspections are to be documented and addressed in a timely manner.

4.7 Maintenance and Calibration of Equipment

4.7.1 Calibration and maintenance procedures shall be consistent with manufacturers' specifications for monitoring equipment used by DDEC; where specifications are unknown procedures should be developed to maintain required accuracy and precision.

4.7.2 Any person using monitoring equipment is responsible for its accuracy and calibration.

4.7.3 Results of calibration applied to ensure accuracy of equipment shall be documented.

4.7.4 Calibration and maintenance procedures should include record keeping requirements and the retention times required for the records; if not mentioned, default time to maintain calibration records is recommended to be 2 years.

4.8 Monitoring Records

4.8.1 Records associated with monitoring activity shall be maintained as appropriate to the nature and the subject areas being monitored (See *HSE STA 18 Control of Records*).

4.8.2 Records shall be available for examination by authorized personnel and auditors.

4.9 Checklists

4.9.1 Forms, checklists and templates should be developed as necessary to support implementation and monitoring of the operational controls.

5.0 Definitions

Calibration: Process of checking or ensuring that a monitoring instrument or process is functioning according to design and information provided is valid.

Lagging Indicator: A measure that reflects past performance (reactive performance statistics).

Leading Indicator: A measure that helps predict future performance (proactive initiatives).

Measuring and Monitoring: Qualitative or quantitative methods used to determine the status of business activities, progress towards achieving objectives and targets and regulatory compliance.

Performance: Measurable results of the HSE Management System, related to the company's control of HSE risks, based on the Sustainable Development Policy and objectives and targets.

Appendix

Not applicable.

Approval Signatures Record

REVIEWER ROLE	NAME	SIGNATURE	DATE
Document Owner:			
Head of Health and Safety	Mike Lowing		2014-06-05
Document Approver:			
President and Chief Operating Officer	Chantal Lavoie		2014-6-6

Revision History

REVISION	DATE	SECTION(S)	CHANGES / COMMENTS

EKA PRO 1840 Sampling Strategy for Exposure Agents

Version:	2.0
Replaces:	1.0
Creation Date:	2011-11-27
Scheduled Review Date:	n/a
Review Date:	2014-03-30
Document Team Members:	Occupational Hygienist
Document Owner:	Head, Health & Safety
Document Approver:	Head, Health & Safety
Related Documents:	CSA Standard Z107.56-94: Procedure for the Measurement of Occupational Noise Exposure EKA PRO.1839 Hearing Loss Prevention Program EKA STA.1834 Occupational Hygiene Standard EKA STA.1844 Exposure Control Plan Procedure
Key Contacts:	Occupational Hygienist
Change Requests:	Team Leader - Occupational Health and Hygiene
Brief Description:	Intended for occupational hygienists on setting out a sampling strategy

Table of Contents

1.0 Intent 4

2.0 Application 4

3.0 Making the Decision to Sample 4

3.1 Purpose of Sampling 4

3.2 Qualitative and Quantitative Surveys 5

3.3 Defining Similar Exposure Groups (SEGs) 7

3.4 Sampling Duration & Frequency 7

3.5 Sample Size 8

3.6 Random Sample Selection 9

3.7 Field, Transport & Lab Blanks 10

3.8 Communication with the Workforce 10

4.0 Accountabilities 10

5.0 Appendices 11

Appendix 1.0 Approvals Framework 11

Appendix 2.0 Track Changes ..... Error! Bookmark not defined.

Figures

Figure 1: Good Practice Guidance on Occupational Health Risk Assessment 7

Figure 2: Example tree diagram of temporal variables that may affect sample results. 8

Figure 3: Recommended number of samples for a population (NIOSH). 8

Figure 4: Decision Tree 9

1.0 Intent

This procedure is a guide for health and safety professionals initiating a sampling strategy for exposure agents such as noise, dust and chemicals.

2.0 Application

This procedure applies to hygienists and H&S advisors. It is intended to be applied to the design of sampling strategies for chemical, physical and biological substances. It does not, however, apply to ergonomic and psychosomatic stresses – which require other distinctive strategies. This document is intended to be a supplement to professional judgment and knowledge.

This procedure focuses on the statistical approach for a *clustered random sampling* (clustered by SEGs) strategy.

3.0 Making the Decision to Sample

National and provincial jurisdictions dictate that when there is a reasonable concern of worker exposure to hazardous agents, sampling for that substance allows for quantification of the exposure. Quantification assists with risk assessment and exposure control planning.

A reasonable concern may be presented as a complaint, an order from the Workplace Safety and Compensation Commission (WSCC), a change in work procedure, process or equipment, historical data, decrease in the occupational exposure limit (OEL) or professional judgment of a hygienist. However, when the exposure is obviously excessive, sampling is a wasted exercise. Resources will then be applied towards immediate control of that substance, after which follow-up sampling would determine the effectiveness of controls.

3.1 Purpose of Sampling

A sampling strategy is designed based on one of the following purposes:

a) **Baseline monitoring:** This includes assessments for newly-created SEGs or SEGs which have no prior exposure data.

b) **Maintenance monitoring:** Continuously monitoring exposure levels when previous assessments identify SEGs (see 3.3 for the definition) that are exposed to greater than 50% OEL to an agent.

c) **Reassessments:** Required when new exposure controls are implemented, when an OEL is lowered by the ACGIH or other standard-setting body; when there is a change in process/operation, or when there is a change or modification of equipment that could alter exposure levels.

d) **Complaint-response:** To address a complaint raised about a work environment.

e) **Exposure source investigation:** To discover the source of exposure/contaminant.

3.2 Qualitative and Quantitative Surveys

The below figure is a decision tree that guides the reasoning behind conducting either qualitative or quantitative survey.

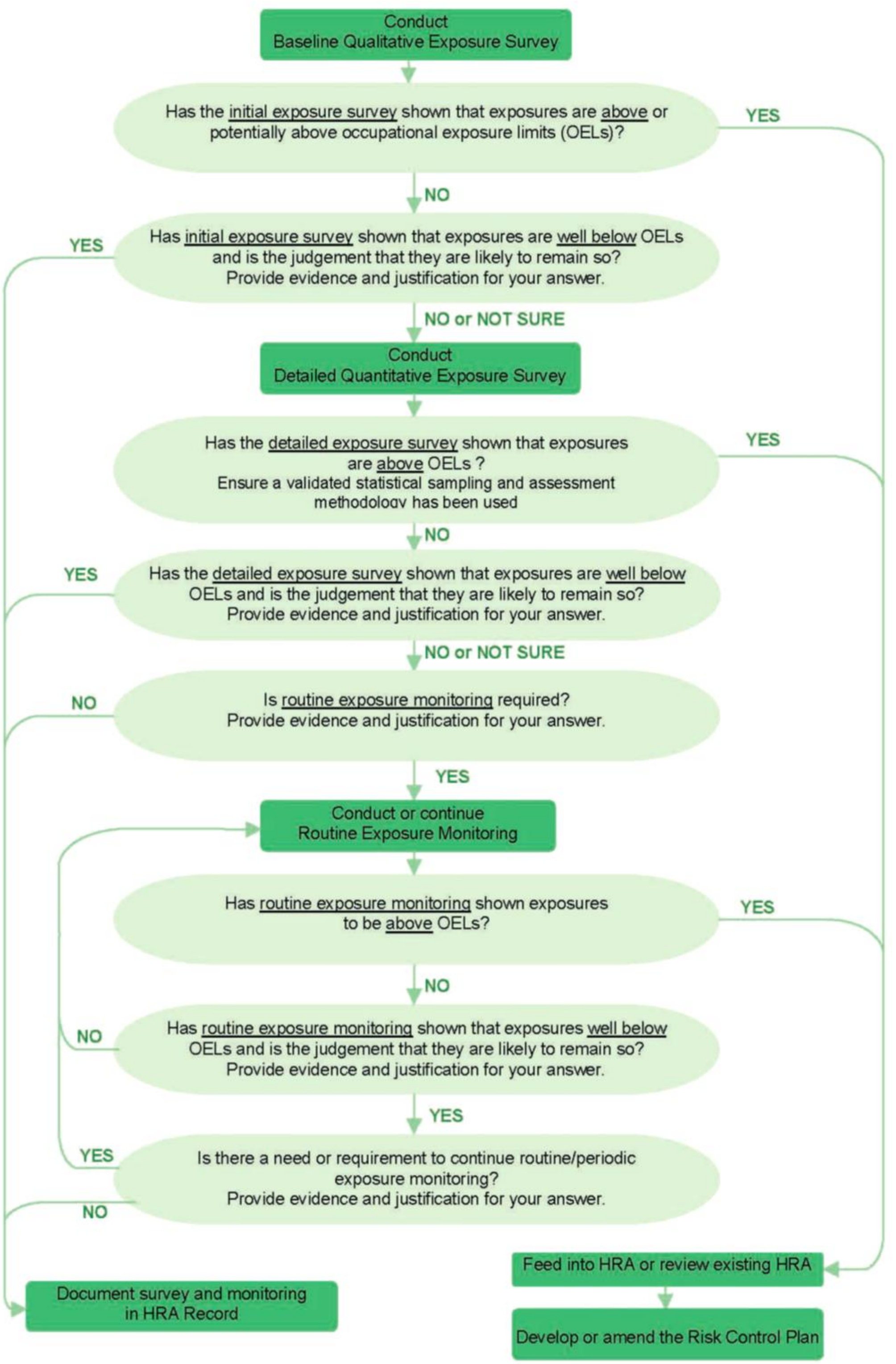

Conduct
Baseline Qualitative Exposure Survey
Has the initial exposure survey shown that exposures are above or potentially above occupational exposure limits (OELs)?
YES
NO
Has initial exposure survey shown that exposures are well below OELs and is the judgement that they are likely to remain so? Provide evidence and justification for your answer.
YES
NO or NOT SURE
Conduct
Detailed Quantitative Exposure Survey
Has the detailed exposure survey shown that exposures are above OELs ? Ensure a validated statistical sampling and assessment methodology has been used
YES
NO
Has the detailed exposure survey shown that exposures are well below OELs and is the judgement that they are likely to remain so? Provide evidence and justification for your answer.
YES
NO or NOT SURE
Is routine exposure monitoring required? Provide evidence and justification for your answer.
NO
YES
Conduct or continue
Routine Exposure Monitoring
Has routine exposure monitoring shown exposures to be above OELs?
YES
NO
Has routine exposure monitoring shown that exposures well below OELs and is the judgement that they are likely to remain so? Provide evidence and justification for your answer.
NO
YES
Is there a need or requirement to continue routine/periodic exposure monitoring? Provide evidence and justification for your answer.
YES
NO
Feed into HRA or review existing HRA
Develop or amend the Risk Control Plan
Document survey and monitoring in HRA Record

Figure 1: Good Practice Guidance on Occupational Health Risk Assessment

(International Council on Mining & Metals)

3.3 Defining Similar Exposure Groups (SEGs)

As defined in EKA PRO 1844, most exposures at Ekati are evaluated by Similarly Exposed Group ("SEG"). A SEG is a group of people, generally performing the same task for the same period of time, such that exposure measured on any one person within the group will be representative of the exposure of the whole group.

SEGs designated by the Hygiene Team are not necessarily the same as official job titles. Thus, classification of SEGs during the course of sampling, data recording & analysis, and in communication of data is highly important and should be as consistent as possible in each media of communication. A listing of Ekati's "Hygiene SEGs" is found in Appendix 2 of EKA PRO 1844 Exposure Control Plan Procedure.

3.4 Sampling Duration & Frequency

Personal, full-shift sampling is considered the gold standard of sampling and applies to ongoing monitoring. It is preferred over other duration types and shall be done to characterize SEG exposures. Other sampling durations are possible (partial shift, 24 hours, spot sampling); these alternative durations will depend on the Purpose of Sampling (see 3.1).

Area sampling will only be used to achieve carefully defined objectives. Sometimes, it is a good surrogate for personal sampling. For example, an operator works from a space that he/she does not move away from e.g. inside heavy mobile equipment. Careful exceptions can be made at the hygienist's discretion. The same statistical principles apply to area sampling.

The frequency of reassessments is subject to discretion, given the toxicokinetics (mechanism of injury, acuteness of injury, route of exposure) of the agent of concern. If exposure levels are stable over time and are not expected to change, sampling frequency may be lengthened. In all cases, the following rules apply:

a) Highly hazardous agents (e.g. strong oxidizers, strong acids/bases, sensitizers, extreme irritants, radioactive material, highly reactive material) that cause acute injury, illness, or symptoms shall be monitored on a more frequent basis;

b) The sample frequency shall not be greater than 3 years for SEGs that have exposures at Action Limit a.k.a. 50% Occupational Exposure Limit (OEL) or greater, with the exception of noise, at which the sample frequency is 5 years or fewer; and

c) A minimum sample size of 8 is to be collected, with the exception of physical agents.

During sampling, they Hygiene Team shall account for seasonal variation. They shall also be aware that events can happen at unpredictable or irregular intervals (e.g. Emergencies, shutdowns), requiring different approaches. Figure 2 shows a breakdown of the temporal factors to consider when creating a sampling strategy.

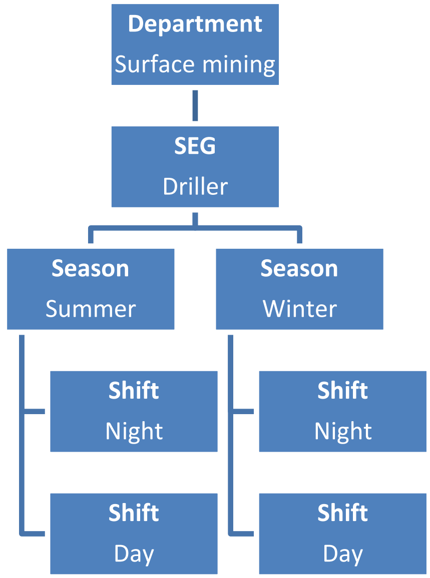


Figure 2: Example tree diagram of temporal variables that may affect sample results.

3.5 Sample Size

Due to the Law of Diminishing Returns, the American Industrial Hygiene Association (AIHA) recommends a minimum of 6 samples per SEG, with a maximum of 10 valid samples (A Strategy for Assessing and Managing Occupational Exposures 3rd ed, 2006). An alternate method is referenced from NIOSH (Figure 3) but shall only be adopted in exceptional cases.

Table 2 Number of samples to be taken (AIHA Strategy for Occupational Hygiene Assessment)

Samples to be taken (n)	9	10	11	12	13	14	15	16	17	18	19	20	21	22
For Groups of Size (n)	11 12	13	14	15 16	17 21	18 22 23	19 24	20 25 26 31	27 32 33	28 29 34 35 41 42	30 36 37 43 44	38 39 45 46	40 47 48	49 50

Note : If N <= 10, then n = N, but minimum n = 6

Figure 3: Recommended number of samples for a population (NIOSH).

Based on historical data at EKATI, 8-10 valid samples is sufficient for assessing SEGs and will allow for a GSD<2.5 in most cases. The NIOSH-recommended sample size (Figure 3) ensures that the top 90% of the real range in exposure levels will be captured, but at Ekati, that aim can be achieved with smaller sample sizes.

The IHstat spreadsheet or other statistical tool shall be used for data analysis. Analysing the results of each SEG for Standard Deviation will help determine whether the amount of variation within the results is acceptable and whether more samples are needed. Standard Deviation is optimally no more than 3 (for normally distributed data) and no more than 2.5 (for log-normally distributed data). Either the arithmetic mean or Upper Confidence Limit (UCL) will be assessed (at the hygienist's discretion) to evaluate the degree of exposure – the choice of the two metrics depends on professional judgment surrounding the sample size, knowledge of job task or environment, etc.

When there is too much variation, 2-3 more samples may be collected to dilute variation. Avoid voiding a sample unless there is clear indication that it is erroneous. SEGs may also be split into two distinct SEGs, and then re-analysed to determine if this results in better representation of a group's exposure. If so, further investigation is necessary to identify the cause(s) that contributes to the difference. See Figure 4 for a decision tree on sample collection. Figure 4 is only a guide; the hygienist should use professional judgment to supplement the guide.

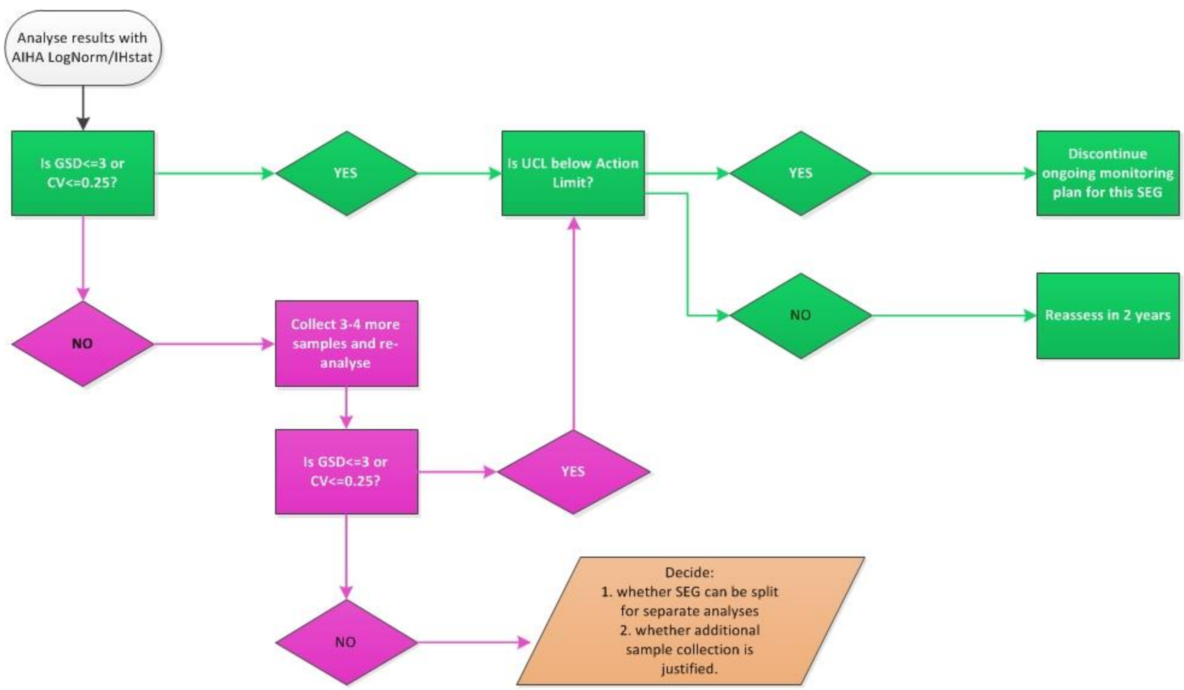


Figure 4: Decision Tree

After the first set of analysis, follow this decision tree to decide how or if sample collection will proceed.

3.6 Random Sample Selection

The dates when samples will be collected will be randomly selected to minimize selection bias. A random date generator (click to follow link) will be used to generate dates.

To achieve efficiency, a reassessment of sample sets (defined as 8-10 samples per SEG per for atmospheric agents, or 1-3 samples for noise) shall be collected over a spread of 2 years. During sample analysis, results from the full spread of those years will be aggregated.

Project-based sample sets (for example, to evaluate performance after implementation of an exposure control), however, should be collected over no more than 4 months.

3.7 Field, Transport & Lab Blanks

Blanks insure against errors in exposure quantification induced by media contamination, cross-contamination or environmental factors. Blanks will be collected based on recommendations of the relevant sampling procedure provided by the National Institute for Occupational Safety and Health and the UK Health and Safety Executive.

3.8 Communication with the Workforce

The outcome of sampling is communicated to the individual and to the work group. Dominion Diamond Ekati Corporation employees receive letters for their sample results sent to their home addresses, while contractors receive their letters at site. Communication to the work group occurs on at least an annual basis and takes the form of presentations accompanied by posters. Every effort should be made to ensure that communication is effective, and reaches as many in the work group as can be arranged. The design of this communication should promote a general understanding of the sample results, accompanied by visual reminders posted at the work site.

4.0 Accountabilities

POSITION TITLE	ROLE	DESCRIPTION OF ACCOUNTABILITY
Occupational Hygienist	Reviewer	Manage and update content of this procedure.
Team Leader - Occupational Health and Hygiene	Reviewer, Approver	Ensure compliance with this procedure.
Head, Health and Safety	Final Approver	Ensure compliance with this procedure.

5.0 Appendices

Appendix 1.0 Approvals Signatures Record

APPROVAL SIGNATURES RECORD			
REVIEWER ROLE	**NAME**	**SIGNATURE**	**DATE**
Team Leader - Occupational Health and Hygiene	Gary Rizzolo	[signature]	JUNE 24, 2014
APPROVED BY			
Head of Health & Safety	Mike Lowing	M. Lowing	June 24, 2014

DOMINION DIAMOND

Undertaking Number: DAR-MVEIRB-UT-19

Source: Undertakings from Day 5 (April 24) of the Technical Sessions

Subject: Air Quality

DAR Section(s): Traffic (Appendix C submitted with responses to Round 1 IRs)

Request:

DDEC is to submit a current list of the truck fleet in operation at Ekati and their model years and type; to be submitted to the Review Board and posted on the Public Registry.

Response:

A list of the mine truck fleet in operation at the Ekati Mine, as of April 29, 2015, is provided in Table 19-1.

Table 19-1 Summary of Ekati Mine Truck Fleet, as of April 29, 2015

Ekati Unit Number	Model	Year of Acquisition
TKD7471	CAT 777 F	2010
TKD7472	CAT 777 F	2010
TKD7473	CAT 777 F	2010
TKD7474	CAT 777 F	2010
TKD7475	CAT 777 F	2010
TKD7476	CAT 777 F	2010
TKD7477	CAT 777 F	2010
TKD7478	CAT 777 F	2010
TKD7479	CAT 777 F	2010
TKD7480	CAT 789 C	2003
TKD7481	CAT 789 C	2003
TKD7482	CAT 789 C	2003
TKD7483	CAT 777 F	2011
TKD7484	CAT 777 F	2011
TKD7485	CAT 777 F	2011
TKD7486	CAT 777 F	2011
TKD7487	CAT 777 F	2011
TKD7488	CAT 777 F	2011
TKD7489	CAT 777 F	2011
TKD7490	CAT 777 F	2011
TKD7491	CAT 777 F	2011
TKD7492	CAT 777 G	2014
TKD7493	CAT 777 G	2014
TKD7494	CAT 777 G	2014

Table 19-1 Summary of Ekati Mine Truck Fleet, as of April 29, 2015

Ekati Unit Number	Model	Year of Acquisition
TKD7495	CAT 777 G	2014
TKD7496	CAT 777 G	2014
TKD7497	CAT 777 G	2014
TKD6805	Western Star Dual Powered Road Train	2015

Undertaking Number:	DAR-MVEIRB-UT-20
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Air Quality
DAR Section(s):	7

Request:

DDEC will update the map from the overall air quality model with information from the dustfall monitors adjacent to the Ekati airport.

Response:

Dispersion modelling in the Developer's Assessment Report (DAR) did not include fugitive dust from the Ekati Mine airstrip, as discussed in the response to Information Request DAR-IEMA-IR-40. Particulate emissions associated with the airstrip were not included in the modelling due to the intermittent nature of the aircraft take-off and landing activities that result in air emissions as well as a lack of standardized methodology to accurately quantify these emissions. The effects of the fugitive dust emissions associated with aircraft take-off and landing are not expected to be higher than the existing effects at the Ekati Mine because the Jay Project operations phase is not expected to increase the amount of air traffic at the airstrip. However, to account for the fugitive dust from this source, dustfall measurements from stations near the airstrip are included with the modelled predictions and presented in this undertaking with the understanding that dustfall measurements from these stations are not equivalent to modelled Total Suspended Particulate (TSP), as discussed below.

Three dustfall stations near the Ekati airstrip monitored dustfall during the summer months from 2012 to 2014 (nominally mid-June to mid-September) as discussed in the Ekati Diamond Mine 2014 Air Quality Monitoring Program Report (ERM 2015). The dispersion modelling for the DAR included TSP, which is particulate matter nominally less than 100 micrometres in aerodynamic diameter. Dustfall includes all sizes of dust that settle into the dustfall jars, including size fractions larger than TSP. However, dust larger than TSP settles out very quickly, so the larger size fractions measured as part of the total dustfall would primarily be from sources proximal to the dustfall stations themselves. Even if these larger size fractions make up a small percentage of the particles in the dustfall measurements they may comprise a larger portion of the total mass measured, so a comparison of total dustfall to TSP can only be made by assuming that total dustfall is a conservative approximation of TSP. Dustfall measurements taken at the airstrip stations include dust from other sources such as haul roads which have already been accounted for in the dispersion modelling; therefore, using the dustfall measurements from the airstrip stations to account strictly for airstrip emissions is a conservative approach.

Dustfall in summer months is expected to be higher than in other seasons, since natural mitigation in colder periods of the year prevents dust from being emitted from surficial sources such as haul roads or the airstrip at the same rate as during the summer, mainly due to being ice and snow bound (Golder 2012). Mitigation rates are approximately 95 percent on active surfaces during winter, and near total mitigation would be expected on non-active surfaces. As peak dustfall normally occurs during summer and only these months have been measured at the airstrip dustfall stations, the non-summer months have been assumed to have zero dustfall to estimate an annual average dustfall rate at these stations. This approach is reasonable, as summer dustfall is expected to be highly weighted with respect to the annual mean, and similar to method used for the modelled emissions whereby natural mitigation highly reduces wintertime fugitive dust emissions from active sources.

The recorded dustfall rates from 2012 to 2014 at the three airstrip stations, and the estimated annual average dustfall rates are presented in Table 20-1.

Table 20-1 Dustfall Rates at Airport Dustfall Stations

Station	Mean Summer Dustfall Rate ($mg/dm^2/d$)			Estimated Annual Dustfall Rate ($mg/dm^2/d$)
	2012	2013	2014	
Air-P125	0.4	1.0	1.4	0.2
Air-P162	0.5	1.0	1.7	0.3
Air-P280	1.3	1.6	2.6	0.5

Source: ERM 2015.
$mg/dm^2/d$ = milligrams per square decimetre per day.

The annual dustfall rates from the airstrip dustfall stations (Table 20-1) have been included with the modelled annual average TSP deposition rates as though they were modelled values of TSP deposition at the station locations and are shown in Maps 20-1, 20-2, and 20-3, updated from the response to DAR-LKDFN-IR-10. There is no appreciable change to the distribution or magnitude of the predicted deposition rates observed after including the airstrip dustfall station data in the modelled results.

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY

DEPOSITION (mg/dm²/d)

- 0 to <0.017 (BLANK)
- 0.017 to <0.170
- 0.170 to <0.425
- 0.425 to <0.850
- 0.850 to <1.275
- 1.275 to <1.700
- 1.700 to <3.400
- 3.400 and Above
- DUSTFALL MONITORING STATION

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-20

5 0 5
SCALE 1:250,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
BASE CASE ANNUAL AVERAGE TOTAL SUSPENDED PARTICULATE DEPOSITION

Golder Associates

PROJECT		1419751	FILE No. POSTDAR_IR_Air_011_GIS
DESIGN	DC	04/03/15	SCALE AS SHOWN REV 1
GIS	SBM	05/05/15	
CHECK	AP	05/05/15	MAP 20-1
REVIEW	CM	05/05/15	

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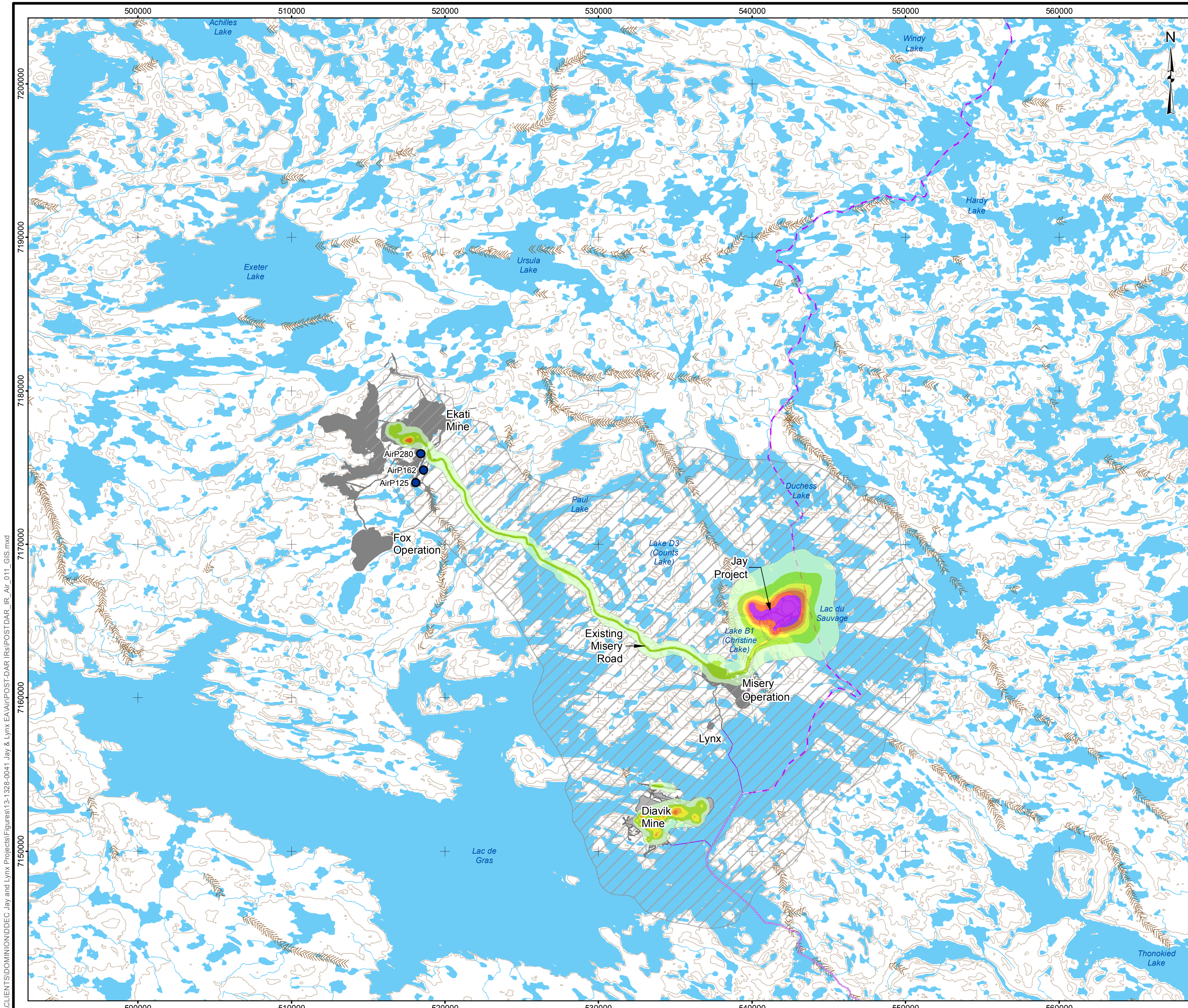

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY

DEPOSITION (mg/dm²/d)

- 0 to <0.017 (BLANK)
- 0.017 to <0.170
- 0.170 to <0.425
- 0.425 to <0.850
- 0.850 to <1.275
- 1.275 to <1.700
- 1.700 to <3.400
- 3.400 and Above
- DUSTFALL MONITORING STATION

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-20

5 0 5
SCALE 1:250,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
APPLICATION CASE ANNUAL AVERAGE TOTAL SUSPENDED PARTICULATE DEPOSITION

Golder Associates

PROJECT		1419751	FILE No. POSTDAR_IR_Air_011_GIS	
DESIGN	DC	04/03/15	SCALE AS SHOWN	REV 1
GIS	SBM	05/05/15	MAP 20-2	
CHECK	AP	05/05/15		
REVIEW	CM	05/05/15		

LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY

DEPOSITION (mg/dm²/d)

- 0 to <0.017 (BLANK)
- 0.017 to <0.170
- 0.170 to <0.425
- 0.425 to <0.850
- 0.850 to <1.275
- 1.275 to <1.700
- 1.700 to <3.400
- 3.400 and Above
- DUSTFALL MONITORING STATION

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-20

5 0 5
SCALE 1:250,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
CONSTRUCTION CASE ANNUAL AVERAGE TOTAL SUSPENDED PARTICULATE DEPOSITION

Golder Associates

PROJECT		1419751	FILE No. POSTDAR_IR_Air_011_GIS	
DESIGN	DC	04/03/15	SCALE AS SHOWN	REV 1
GIS	SBM	05/05/15	MAP 20-3	
CHECK	AP	05/05/15		
REVIEW	CM	05/05/15		

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DOMINION DIAMOND

References:

ERM (ERM Consultants Ltd.). 2015. Ekati Diamond Mine: 2014 Air Quality Monitoring Program. Prepared for Dominion Diamond Ekati Corporation by ERM Consultants Canada Ltd.: Yellowknife, Northwest Territories.

Golder (Golder Associates Ltd.). 2012. Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada. Submitted to De Beers Canada Inc. Available at http://www.reviewboard.ca/upload/project_document/EIR0607-001_Road_Dust_Emission_Study_-_De_Beers_Canada.PDF.

Undertaking Number:	DAR-MVEIRB-UT-21
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Air Quality
DAR Section(s):	Appendix 7B

Request:

DDEC will confirm if the 80% control efficiency rate for emissions mentioned in Appendix 7B of the DAR was incorporated in the CALPUFF model.

Response:

A road dust control efficiency of 80 percent (%) was assumed and included in the CALPUFF dispersion modelling for all haul roads at the Ekati Mine and the Jay Project during the snow and ice-free season (June to September). Dispersion modelling was performed to predict particulate concentrations (in addition to other compounds of interest) and particulate deposition rates in the Study Area resulting from Project emissions. The 80% road dust control efficiency was derived from Environment Canada's National Pollutant Release Inventory Unpaved Industrial Road Dust Calculator, which states that the control efficiency for chemical suppressants is 80% (Environment Canada 2010). Chemical suppressant (DL-10) is not applied in areas of high volume traffic that are subject to flooding or within 30 metres of open waterbodies or streams, in accordance with the Government of the Northwest Territories standards (GNWT 2013). These areas are a proportionally small length of the haul roads receiving chemical dust suppressant and do not affect the overall effectiveness of dust suppression on the road as a whole, as they receive road watering in lieu of chemical dust suppressant. Environment Canada's National Pollutant Release Inventory Unpaved Industrial Road Dust Calculator states that road watering more than twice a day would result in a control efficiency of 70% (Environment Canada 2010).

For snow or ice season (January to May; October to December), it was assumed that the effect of ice and snow will have a road dust control efficiency of 95% on all haul roads based on a study conducted at the De Beers Canada Inc. Snap Lake and Victor mines (Golder 2012).

References:

Environment Canada. 2010. Unpaved Industrial Road Dust Calculator. Available at https://www.ec.gc.ca/inrp-npri/9C8F5570-19B6-4E37-97DB-290D4CE28153/UnpavedIndustrialRoadDustCalculator_e_18_Nov_2008.xls. Accessed: April 2015.

Golder (Golder Associates Ltd.). 2012. Determination of Natural Winter Mitigation of Road Dust Emissions from Mining Operations in Northern Canada. Submitted to De Beers Canada Inc. Available at http://www.reviewboard.ca/upload/project_document/EIR0607-001_Road_Dust_Emission_Study_-_De_Beers_Canada.PDF. Accessed: September 10, 2014.

GNWT (Government of the Northwest Territories) 2013. Guideline for Dust Suppression. Environment Division, Yellowknife, NWT, Canada.

DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-22
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Air Quality
DAR Section(s):	7

Request:

DDEC will provide a description of the geographic boundary of the assessment endpoint for air quality (i.e. the GNWT air quality guidelines).

Response:

The air quality assessment for the Developer's Assessment Report (DAR) used the disturbance boundary of the Jay Project (Project) for the application of the Ambient Air Quality Standards (AAQS). The *Guideline for Ambient Air Quality Standards in the Northwest Territories* (GNWT-ENR 2014) (the guideline) does not explicitly define where the AAQS are geographically applicable, except through the generalized statement "throughout all of the Northwest Territories". The guideline does indicate that the standards are harmonized with other Canadian jurisdictions. The definition of geographic applicability of air quality standards in other Canadian jurisdictions are also often not fully defined, but are usually applied at and beyond the industrial fenceline or disturbed area of a project. The following are examples of provincial air quality modelling guidelines that follow this interpretation:

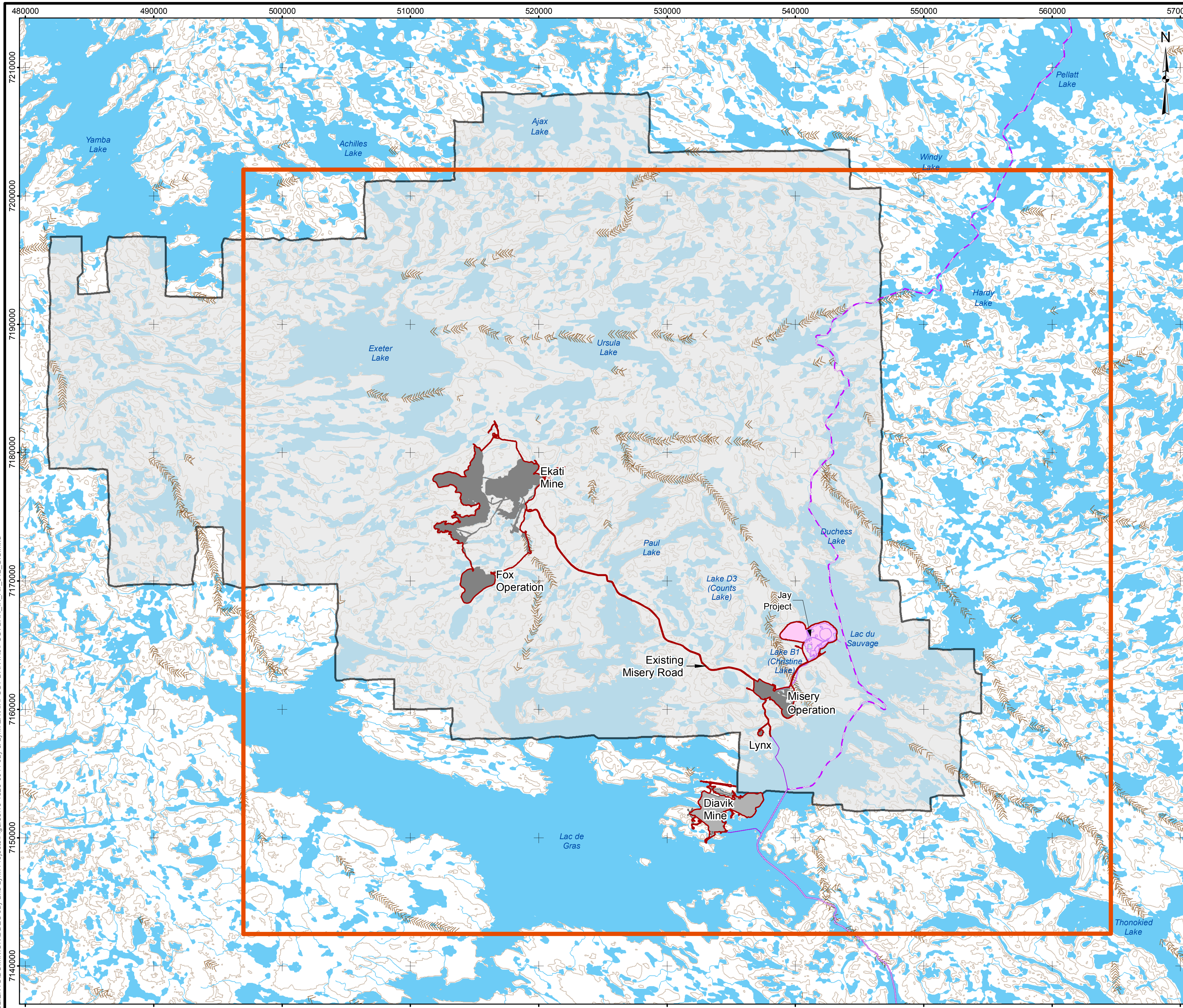
- British Columbia (BC). "Although the areas of applicability of the BC ambient air quality objectives are not defined, often they are applied to areas where there is no public access (i.e., beyond the plant boundary)." The plant boundary is determined to be "the facility fenceline or the perimeter of the disturbed area that defines where public access is restricted." (BCMOE 2008).
- Alberta. "The areas of applicability of the Alberta Ambient Air Quality Objectives are not defined; however, often they are applied to areas where there is public access (i.e., beyond the facility boundary). The facility boundary is determined by the facility fence line and/or the perimeter of disturbed area that defines where public access is restricted." (ESRD 2013).
- Saskatchewan. "The ambient air quality objectives apply to areas where there is limited public access (i.e., outside the plant boundary). The plant boundary is typically defined as the facility fenceline or the perimeter of the area disturbed by the operation of the facility." (SKMOE 2012).
- Ontario. "Property boundaries are typically delineated in projects and model results are not required within those areas. However, receptors must be placed along the plant boundary to demonstrate compliance at the nearest reportable geographic locations to the sources." (ONMOE 2009).

As the Northwest Territories (NWT) does not have an air dispersion model guideline to define application of the NWT AAQS, it is reasonable to interpret the application of the AAQS similarly at fenceline or disturbance boundaries of projects, given that the AAQS are stated to be harmonized with other Canadian jurisdictions. The use of the disturbance boundary is the approach in the DAR, although earlier assessments at the Ekati Mine have used the claim block boundary as the point at which the standards applied (Rescan 2006). The disturbance area boundary approach to applying the standards is more conservative than using the claim block boundary, as the disturbance area is often immediately adjacent to emission sources while the claim block boundary is more distant from emission sources. As the disturbance boundary is often immediately adjacent to emission sources, such as along the Misery Road and other haul roads and mine activity locations, predicted concentrations would be expected to be higher at the disturbance boundary as compared to the more distant claim block boundary.

Further to the harmonization with the provinces, the Government of the Northwest Territories Mine Health and Safety Regulations (Section 9.02) states that employees shall not be exposed to airborne chemical or physical substances in excess of those specified in the 1994-1995 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices published by the American Conference of Governmental Industrial Hygienists (GNWT 2015). These thresholds differ (are higher) than the AAQS. The mine regulations are consistent with the interpretation that the NWT AAQS apply at and beyond the project boundary. The NWT AAQS have been applied to industrial development using this interpretation for other air quality assessments in the NWT, such as for the Gahcho Kué Project (De Beers 2010, 2012), and the DAR is consistent with this approach.

The air quality significance is not solely based on magnitude, which is based on compliance with the NWT AAQS as stated in the DAR (see Table 7.6-1). Other considerations such as likelihood, uncertainty, geographic extent, duration of the effect, frequency of the effect, and the reversibility of the effect were included in the significance determination. Dominion Diamond believes that the significance definition chosen for air quality was appropriate, as all air quality effects were local in geographic extent and compliant within the Local Study Area, all effect durations were considered to be medium-term, all effects were reversible and wold cease with the completion of the Project, no reversible effects were long-term and no effects above the NWT AAQS were irreversible or long-term.

Map 22-1 shows the boundary of the disturbance area for which the NWT AAQS were applied for the assessment of the Jay Project, as well as the claim block boundary.



LEGEND

- EKATI MINE FOOTPRINT
- DIAVIK MINE FOOTPRINT
- PROPOSED JAY FOOTPRINT
- WINTER ROAD
- TIBBITT TO CONTWOYTO WINTER ROAD
- NORTHERN PORTION OF TIBBITT TO CONTWOYTO WINTER ROAD
- ELEVATION CONTOUR (20 m INTERVAL)
- ESKER
- WATERCOURSE
- WATERBODY
- LOCAL STUDY AREA
- EKATI CLAIM BLOCK
- PROJECT FENCE LINE

REFERENCE

NATIONAL TOPOGRAPHIC BASE DATA (NTDB) 1:250,000
CANVEC © NATURAL RESOURCES CANADA, 2012
NATURAL RESOURCES CANADA, CENTRE FOR TOPOGRAPHIC INFORMATION, 2012
DATUM: NAD83 PROJECTION: UTM ZONE 12N

DOCUMENT

DAR-MVEIRB-UT-22

5 0 5
SCALE 1:300,000 KILOMETRES

PROJECT
DOMINION DIAMOND
JAY PROJECT
NORTHWEST TERRITORIES, CANADA

TITLE
GEOGRAPHIC BOUNDARY OF THE AIR QUALITY ASSESSMENT ENDPOINT CRITERIA

Golder Associates

PROJECT		1419751	FILE No. POSTDAR_IR_Air_012_GIS	
DESIGN	DC	01/04/15	SCALE AS SHOWN	REV 2
GIS	SBM	05/05/15	MAP 22-1	
CHECK	AP	05/05/15		
REVIEW	CM	05/05/15		

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References:

BCMOE (British Columbia Ministry of the Environment). 2008. Guidelines for Air Quality Dispersion Modelling in British Columbia. Victoria, British Columbia. Available at http://www.env.gov.bc.ca/epd/bcairquality/reports/pdfs/air_disp_model_08.pdf. March 2008.

De Beers (De Beers Canada Inc.). 2010. Gahcho Kué Project Environmental Impact Statement Section 11.4. Available at: http://www.reviewboard.ca/upload/project_document/EIR0607-001_EIS_Section_11_4__Air_Quality_1294678879.PDF. Accessed: February 6, 2014.

De Beers. 2012. Gahcho Kué Project Air Quality & Emissions Monitoring & Management Plan. Available at: http://www.mvlwb.ca/Boards/mv/Registry/2005/MV2005L2-0015/MV2005C0032 - MV2005L2-0015 - De Beers Gahcho Kué - Air Quality and Emissions MMP - Version 2 - Jun30_14.pdf. Accessed: September 1, 2014ESRD (Alberta Environment and Sustainable Resources Development). 2013. Air Quality Model Guideline. Available at http://environment.alberta.ca/01004.html. September 1, 2014.

ESRD (Alberta Environment and Sustainable Resource Development). 2013. Air Quality Model Guideline. Air Quality Branch, Edmonton, AB, Canada. Available at: http://www.environment.alberta.ca/01004.html. Accessed: April 27, 2015.

GNWT (Government of the Northwest Territories). 2015. Mine Health and Safety Act. Mine Health and Safety Regulations. Available at https://www.justice.gov.nt.ca/en/files/legislation/mine-health-and-safety/mine-health-and-safety.r1.pdf.

GNWT-ENR (Environment and Natural Resources, Government of the Northwest Territories). 2014. Guideline for Ambient Air Quality Standards in the Northwest Territories. Yellowknife, NWT, Canada, 5 pp.

ONMOE (Ontario Ministry of the Environment). 2009. Air Dispersion Modelling Guideline for Ontario. Available at http://www.ontario.ca/document/guideline-11-air-dispersion-modelling-guideline-ontario. March 2009.

Rescan (Rescan Environmental Services Ltd.). 2006. Ekati Diamond Mine CALPUFF Air Dispersion Modelling Assessment, October 2006.

SKMOE (Saskatchewan Ministry of the Environment). 2012. Saskatchewan Air Quality Modelling Guideline. Available at http://www.environment.gov.sk.ca/adx/aspx/adxGetMedia.aspx?DocID=55efb669-d96a-4722-b0bc-bd3173208616&MediaID=c8a3dcd8-c42c-4445-ad91-9d6800edb26a&Filename=Saskatchewan+Air+Quality+Modelling+Guideline.pdf&l=English. March 2012.

Undertaking Number:	DAR-MVEIRB-UT-24
Source:	Undertakings from Day 5 (April 24) of the Technical Sessions
Subject:	Community and Public Concerns
DAR Section(s):	DAR-IEMA-IR-37 and DAR-LKDFN-IR-08

Request:

DDEC will provide a table of the issues identified in DDEC's response to IRs IEMA 37 and LKDFN 8 that organizes these issues by intervening group.

Response:

In addition to the Developer's Assessment Report (DAR) references identified in Table 24-1, Dominion Diamond aims to include and directly address community concerns through ongoing engagement. To engage community members, actively demonstrate existing monitoring programs, and provide hands-on experience, community representatives observe and participate in site activities designed to determine whether mine activities have effects on the environment, wildlife, or their habitats, and if so, how to mitigate these effects. Active participation in these programs provides an opportunity for communities and participants to provide feedback on how the Ekati Environment Department conducts its monitoring programs at the Ekati Mine. Since Dominion Diamond acquired the Ekati Mine, the focus of the Community Engagement Programs has been on Aboriginal engagement in the environmental monitoring programs. The overall intent of the Community Engagement Programs are to demonstrate and provide hands-on experience for community members (Elders, adults, and youth) so that they may gain a general awareness, as active participants, on how the Ekati Environment Department conducts its day-to-day, site-based, environmental monitoring programs.

Site-based traditional knowledge (TK) and community engagement programs related to the environmental monitoring programs, include:

- youth and Elder participation in fish sampling and assessment programs for the Aquatic Effects Monitoring Program (AEMP) (every three years);
- youth and Elder visits for caribou monitoring as part of the Wildlife Effects Monitoring Program (WEMP) (annual);
- community participation in wolverine and grizzly bear DNA (deoxyribonucleic acid) field programs as part of WEMP (varying schedules);
- community participation in group workshops and site visits to demonstrate and discuss air quality, dust, and vegetation monitoring, and other specific topics of interest (annual);
- Caribou and Roads program with Kugluktuk Elders group as part of the WEMP (annual to 2008);
- Winter Road tours;
- archaeological site visits; and,
- vegetation for closure planning workshops with youth and Elders (2013).

Table 24-1 Community Concerns Addressed in the Developer's Assessment Report

Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Project Footprint	LKDFN[1] YKDFN[2] KIA[3] Kugluktuk NSMA[4] Tłı̨chǫ	Size of the Jay-Cardinal Project Footprint.	The Cardinal kimberlite pipe was further evaluated during the drilling program in winter 2014 and a concept for a Jay-only mining operation was developed. The conceptual design for the Jay Project (Project) (Golder 2014a) was used to support the Project Description Addendum for the Jay Project, which Dominion Diamond submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in June 2014 (Dominion Diamond 2014).	2.1
Air Quality	LKDFN YKDFN KIA Kugluktuk NSMA Tłı̨chǫ	Effects of the Project on air quality.	Air quality assessment in Section 7 of the Developer's Assessment Report (DAR). Traditional Knowledge (TK) considered in pathway screening. Assessment considered emissions of sulphur dioxide (SO_2), nitrogen oxide (NO_X), carbon monoxide (CO), and particulate matter ($PM_{2.5}$, total suspended particulates [TSP]) from construction equipment, mining operations and processing equipment, and vehicle fleet; and, fugitive dust emissions from mining activities, material movement and storage, drained lakebed, and haul roads. Mitigation to reduce effects includes: follow general management approaches for air emissions from the Project: Project mine equipment and haul vehicles will be regularly maintained to reduce emissions and maximize fuel efficiency; low sulphur (15 parts per million by weight [ppmw]) diesel will be used in fleet vehicles; and site road topping surfaces will be regularly maintained for operational efficiencies and to minimize fuel consumption; and energy conservation initiatives such as maintaining site road topping surfaces for energy efficiency will be undertaken. At the Ekati Mine, community participation in group workshops and site visits are carried out annually to demonstrate and discuss air quality, dust, and vegetation monitoring, and other specific topics of interest.	7.3.2, 7.4
	LKDFN YKDFN KIA Kugluktuk NSMA Tłı̨chǫ FRMC[5]	The effects of dust on the vegetation and water in and around Lac de Gras (i.e., the impacts of dust on the caribou food in the area of the mines, such as moss, lichen, and muskeg and accumulation or deposition of dust in water).	Air quality assessment in Section 7 of the DAR. TK considered in pathway screening. Assessment considered fugitive dust emissions from mining activities, material movement and storage, drained lakebed, and haul roads. Results passed on to vegetation and water quality teams for their assessments. Community participation in group workshops and site visits are carried out annually to demonstrate and discuss air quality, dust, and vegetation monitoring, and other specific topics of interest. Mitigation to reduce effects includes the following management practices: water spray and chemical suppressant application to control dust emissions on haul roads during summer or non-frozen season; and, managing vehicle speed to limit road dust from vehicle wheel entrainment.	7.2.4, 7.3.2.2
	LKDFN YKDFN KIA NSMA Tłı̨chǫ FRMC	Dust affecting animal migration (e.g., avoidance of the Project by local game due to dust), small furbearing animals, birds, hatching birds and birthing animals, vegetation, fish (and specifically in the Lac de Gras area).		
	LKDFN YKDFN KIA NSMA Tłı̨chǫ FRMC	Cumulative effects of dust on the entire environment, including lakes, plants, fish, and the wildlife - How the impacts of dust could rise through the food chain, affecting more wildlife in the area.	Results from the air quality assessment passed on to vegetation and water quality teams for their assessments, which are then is considered in barren-ground caribou, wildlife, fish and fish habitat assessment. Ambient air quality monitoring program will be used to guide adaptive management strategies and the implementation of mitigation, if and as required, to maintain exposure to particulate matter ($PM_{2.5}$) levels below those that would be of concern.	7.4.2.2.4, 7.4.2.2.5

[1] Łutsel K'e Dene First Nation
[2] Yellowknives Dene First Nation
[3] Kitikmeot Inuit Association
[4] North Slave Métis Alliance
[5] Fort Resolution Métis Council

Table 24-1 Community Concerns Addressed in the Developer's Assessment Report

Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Water –Quality and Quantity	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ DKFN[6]	Changing water levels and the impact on wildlife.	Changes to surface water quantity (including changes to flows and water levels) assessed in Section 8 of the DAR. TK considered in pathway screening. Results passed on to the vegetation, wildlife and fish and fish habitat teams for their assessments. Mitigation to reduce effects includes the mine water management plan. The water management plan includes environmental design features and mitigation to reduce the potential for effects to water levels and water flows: enhancing water recycling opportunities on site, containment of mine site water, use of dikes and diversion channels, appropriately designed cross-drainage structures for mine site roads, and planned pumped discharge rates (for dewatering activities) to avoid adverse erosion at lake outlets and channels. Monitoring will be conducted at specified lake outlets and channels (including the Lac du Sauvage Narrows) for evidence of erosion, and for monitoring of flow rates and water levels. Adaptive management, consistent with that currently applied at the Ekati Mine, will be implemented at the Jay Project should unacceptable effects be observed.	3, 8.3, 8.4.2, Appendix 3A, Appendix 8D
	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ NWTMN[7]	Impacts of development on the quality of water (i.e., quality of water in the Coppermine watershed). These include dust generation and deposition, leakage or release of contaminants from tailings ponds, spills and leaks to downstream environments, quality of water that may affect fish health, quality of water in pits, reconnection of pits to downstream environments, and linkage of effects on quality of plants and health of animals such as caribou.	Changes to surface water quality assessed in Section 8 of the DAR. TK considered in pathway screening. Results passed on to the fish and fish habitat team for their assessments, as well as wildlife and culture. Environmental design features and mitigation to reduce the potential for effects to water quality in the downstream environment were developed as an integral part of the Project's design through an iterative process between the Project's engineering and environmental teams to avoid or mitigate adverse effects. Mitigation to reduce or eliminate potential effects to water quality include spill management, explosives management (both for storage and use), sediment and erosion controls around altered drainage and construction areas (including the use of silt curtains), dust suppression on the roads, use of the Long Lake Containment Facility for process water management, use of the mined-out pits for containment of operational minewater on site for the first five years of operations (i.e., no discharge until about mining operation year 5), use of an engineered diffuser to enhance dispersion and mixing of released minewater in the environment (i.e., to reduce peak plume concentrations), and use of the mined-out pits in post-closure to store minewater with higher total dissolved solids (TDS).	8.2.6, 8.3, 8.4.2, 8.7.2
	LKDFN YKDFN NSMA Tłįchǫ	The stagnation of water in the pits if they remain isolated after closure and the overflow of that water during freshet.	Changes to surface water quality assessed in Section 8 of the DAR. Hydrodynamic models of the pits were developed. At closure, the mined-out pits will be back-flooded with freshwater sourced from local lakes to form a freshwater cap over the minewater remaining at the bottom of the pits. The freshwater cap will be of sufficient depth to prevent mixing of the higher TDS water at the bottom and the freshwater at the top. The Misery pit lake will be reconnected to the downstream environment (i.e., allowed to spill over). Before the pit lakes are connected to the downstream environment, water quality must meet acceptable criteria. Monitoring will be conducted in the pit lakes and in the receiving environments to validate the predictions, confirm that water quality in the pits meets discharge limits, and confirm that there are no negative effects in the receiving environment.	8.5.4.2, Appendix 8G
Water –Quality and Quantity (con't)	LKDFN KIA Tłįchǫ	Accessibility of the tailings ponds and waste rock storage area (WRSA) to animals and the potential health impacts it could create.	Effects on caribou and wildlife assessed in Sections 12 and 13 of the DAR. TK considered in pathway screening. Wildlife risk assessment completed and submitted as part of the adequacy review submission. The presence of wildlife at site will be monitored as part of a Wildlife Effects Monitoring Program and animals will be deterred. Wildlife deterrent actions will be implemented by knowledgeable and trained personnel. The goal of these deterrents is to manage wildlife encounters in ways that will keep both humans and animals safe.	12.3.2.2.2 13.3.2.2.1 Wildlife risk assessment
	YKDFN KIA NSMA	Impacts of spills on birds and other animals.	Changes to surface water quality assessed in Section 8 of the DAR. TK considered in pathway screening. Results passed on to wildlife teams. Mitigation to minimize effects from spills include the following. During the construction, operation, and closure phases of the Jay Project, all reasonable measures will be taken to avoid spills, and all regulations will be followed for the storage, handling, and disposal of materials, consistent with practices already in place at the Ekati Mine. The Spill Contingency Plan that is currently in place at the Ekati Mine will be extended for the Project, and will include information on actions that will be followed to respond to spills in the Project area. Complementary plans under the Water Licence and Land Use Permit for the Ekati Mine will also be extended to describe storage, handling, and spill clean-up of hazardous and non-hazardous material specific to the Project (e.g., Waste Management Plan, Hazardous Waste Management Plan, Hydrocarbon-impacted Material Management Plan).	8.4.2

[6] Deninu K'ue First Nation
[7] Northwest Territories Métis Nation

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Caribou	LKDFN YKDFN KIA NSMA Tłįchǫ FRMC	Caribou spending reduced time in the calving grounds as a result of increasing development activity, and habitat disturbance putting the very young animals at risk.	Effects on caribou assessed in Section 12 of the DAR. TK considered in pathway screening. The increased sensitivity of the Bathurst herd in some seasons, especially the calving season, is acknowledged. The analyses in the DAR were conducted separately for each season to maximize the predicted effects of the Project and other development on the range used in each season. The Project will use existing infrastructure at the Ekati Mine to minimize newly disturbed caribou habitat. Both the Project and the Existing Ekati Mine infrastructure are well removed from the Bathurst herd calving grounds.	12.4.2.3, 12.6.2
	LKDFN YKDFN KIA Tłįchǫ DKFN NWTMN	Impacts of noise on caribou near the mine and winter road.	Effects on caribou assessed in Section 12 of the DAR. TK considered in pathway screening. Residual effects on Bathurst caribou are analyzed using measurement indicators (e.g., habitat quantity and fragmentation, habitat quality, survival, and reproduction). Changes in habitat quality, movement, and behaviour include influences from noise, lights, dust deposition, viewscape), and the presence of vehicles and people. The combination of direct (physical footprint) and indirect (noise, dust, viewscape and other sensory disturbances) effects can create a zone of influence (ZOI) around the Project that can change the behaviour and occurrence of caribou (Section 12.2.2.2). Mitigations include: • Wildlife always have the right-of-way • A minimum flying altitude of 600 metres (m) above ground level (except during takeoff and landing, and during field work) will be maintained for cargo, passenger aircraft, and helicopters outside of the Project site. • Modified traffic patterns and road closures will be used as necessary to protect caribou and people. • Noisy equipment will use mufflers or be housed inside. • Vehicles will be maintained regularly to prevent excessive noise.	12.2.2.2, 12.2.2.3, 12.3.2.2, 12.4.2.2
	Tłįchǫ	Potential for the smell of oil and gas from developments overpowering the smell of food that would normally guide caribou to the best range.		
	LKDFN	The number of bulls hunted by outfitters.	Description of sport hunting camps for caribou provided in Section 12.2 of the DAR. Effects on caribou assessed in Section 12 of the DAR. TK considered in pathway screening. Effects of hunting on the Bathurst caribou herd discussed in Section 12.3.	12.2.2.3, 12.2.2.4, 12.3.2.2
	YKDFN KIA NSMA Tłįchǫ	Potential contamination from traffic on the roads, particularly due to spills and accidents.	Effects on caribou assessed in Section 12 of the DAR. TK considered in pathway screening. Mitigation related to spills on roads include: vehicles will be regularly maintained to minimize leaks and spills; spill Response Plan will be in effect; the integrity and performance of the pumping and pipeline systems will be monitored throughout the Project construction and operations phases to prevent the unintentional release of minewater to the environment.	12.3.2.2.1
	LKDFN YKDFN KIA NSMA Tłįchǫ DKFN NWTMN FRMC	Impacts that mining developments are having on the caribou herds, their health, and their migration patterns (i.e. infrastructure inhibiting the movement of caribou through the Ekati Mine site).	Effects on caribou assessed in Section 12 of the DAR, including predicted losses of preferred habitat among the four seasonal ranges and migration patterns. Wildlife risk assessment completed and submitted as part of the adequacy review submission. From 2011 to 2012, motion detection wildlife cameras were used to investigate caribou interactions with the Misery Road and other mine site roads. Traffic will be managed including suspension to allow large groups of caribou to move through the Ekati Mine area. The DAR also describes the mitigation policies, practices and procedures that will protect caribou from harm and that will enable their continued movement though the Ekati Mine site. For example, Dominion Diamond has proposed to increase early monitoring of caribou movement by working with the Government of the Northwest Territories (GNWT) to access satellite collar maps. This provides advanced warning of when caribou may be approaching the Ekati Mine. Also, Dominion Diamond proposes to construct additional kimberlite stockpile areas so that the Ekati Mine can operate through brief road closures if this is necessary to allow caribou to safely move through the mine site. The frequency of road reconnaissance surveys, modification of traffic patterns, and road closures would reflect the number and group composition of caribou near the mine site, which is a hierarchical approach. Other mitigation measures include designing the portion of the road that crosses (cuts through) the esker as a caribou crossing, and as such, the pipelines will be buried, with the exception of any valve or joint. Design will be advanced to minimize the need for joints or valves through the esker crossing. Other portions of the Jay Road will also be constructed as caribou crossings except where road height requires side berms, where surface conditions preclude caribou use, or where maintenance access is essential for pipe valves. Caribou crossings will be designed so that the side slopes of the road are flatter and have finer crushed rock. In the caribou crossing areas, the pipelines will also be covered with fine gravel material; however, valves and pipeline joints will not be covered. Once the road is constructed, monitoring, including by Aboriginal community members, will be implemented to assess the effectiveness and extent of the constructed caribou crossings; modifications can be incorporated based on the outcome of monitoring through adaptive management.	12.3.2.2.1, 12.4.2.2.2 Wildlife risk assessment
	LKDFN YKDFN KIA NSMA Tłįchǫ	The presence of the large open pits.	Caribou mitigation in the vicinity of open pits has included the installation of 'snow' fence in the Beartooth and Pigeon areas. In response to concerns about impacts on caribou and other wildlife as a result of the Ekati project, Inokhok (stone marker) were built at strategic locations around the mine site and made more visible by adding flagging tape, by making them larger, or by painting "hats" on them. Fences were also constructed to deflect and protect caribou from mining at the Beartooth Pit, Pigeon Pit, Misery Camp, and airstrip. Monitoring at the Ekati Mine indicates no caribou injuries or mortalities associated with open pits have occurred.	12.3.2.1.4

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Caribou (con't)	LKDFN YKDFN KIA NSMA Tłįchǫ DKFN NWTMN FRMC	Caribou's ability to travel.	Effects on caribou assessed in Section 12 of the DAR. The permeability of roads to caribou was monitored by recording snow track patterns along the side of the Misery Road at the Ekati Mine during the northern migration, and wildlife camera monitoring. To determine the energetic cost of a deflection movement, two hypothetical routes that avoided the Project, Misery Road, and the Ekati or Diavik mine infrastructure were assumed and compared to seven alternate caribou paths determined by TK. Modified traffic patterns and road closures will be used as necessary to mitigate barrier effects to caribou. The implementation of modified traffic patterns and road closures is also expected to limit the effect of increased traffic from the Jay Project on caribou movement through the Ekati Mine area.	12.2.1.1.4, 12.2.2.2, 12.3.2.2, 12.4.2.2.2, 12.4.2.3
	LKDFN YKDFN KIA NSMA Tłįchǫ DKFN FRMC	Declining caribou numbers and shifting migration patterns.	Effects on caribou assessed in Section 12 of the DAR, and includes discussion of the decline in the barren-ground caribou herds in the Northwest Territories (NWT). An energetics model was included in the DAR which included a deflection cost that assumed caribou would not cross the Misery and Jay roads (i.e., a complete barrier effect), and would be required to travel using longer alternate routes to continue migration through the Lac de Gras area. Subsequent to the DAR, an assessment was made of temporal trends in seasonal range use and migration patterns. This was completed in response to the MVEIRB Jay Project Adequacy Review Item 8.2 and was submitted as DAR-MVEIRB-9.	12.2.2.3, 12.4.2.3, 12.4.3, 12.6.2
	LKDFN YKDFN NSMA	Caribou mortalities near Ekati.	Effects on caribou assessed in Section 12 of the DAR, and includes mine-related wildlife mortalities in the NWT. Mine-related mortalities are monitored in several ways. Personnel undergo environmental orientation and are required to report all wildlife incidents (including mortalities) they observe. Environmental data collection programs also occur at the mine sites, such as wildlife monitoring, water quality sampling, and dust and vegetation monitoring programs. Any wildlife mortalities located during these monitoring or sampling events are reported to environmental personnel. Mitigations will include the following: • Roads and the Sub-Basin B Diversion Channel will be constructed with caribou crossings that reduce risk of injury related to coarse road fill. • Blasting in the pit and quarry, if necessary, will be carefully planned and controlled to minimize fly rock that might injure caribou. • The use of guy wires for power poles will be minimized as much as feasible, and those guy wires that are required will be made more visible with coloured plastic sleeves to reduce risk of injury to caribou. • Ramps to facilitate the access and egress of wildlife from the WRSA will be constructed for closure. Wildlife deterrent actions will be implemented by knowledgeable and trained personnel. The goal of these deterrents is to manage wildlife encounters in ways that will keep both humans and animals safe.	12.2.1.4.1, 12.2.2.4.1, 12.2.2.4.3, 12.3.2.1.2, 12.3.2.2.2
Culture	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ DKFN	Community well-being, culture and identity.	The assessment endpoints for the Traditional Land Use (TLU) valued component (VC) centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. Involvement of potentially affected Aboriginal groups in monitoring programs. Regular involvement with, meetings, updating, and communication of the results of monitoring plans to potentially affected Aboriginal groups. Mitigation measures as described in the Maximizing Benefits and Minimizing Impacts Key Lines of Inquiry (KLOI) (Section 14): • Points of hire or fly points in all rural local study area (LSA) communities. • Source construction labour preferentially from point of hire or fly point communities (including Yellowknife). • Maintain priority hiring and contracting for Northerners and Northern Aboriginals. • Transition existing Ekati operations workforce to the Project operations. • Provide a first responder medical station at the accommodation camp facilities to meet workers' medical needs while at site, to limit the demand for governmental health facilities for work related injuries. • First aid training. • Driver training and enforcement of a driver code of conduct, to control speeds and encourage considerate driving. • Support Community Liaison Coordinator positions to work with communities throughout the Project • Offer drug and alcohol programming and other counselling to employees and their immediate families. • Offer Employee and Family Assistance Program to employees and their immediate family members.	14.1.4.2, 14.6 15.2.2, 15.3.2, 15.4.1.2.1, 15.4.1.2.4
	YKDFN NSMA Tłįchǫ NWTMN	Impacts on human health.	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. Involvement of potentially affected Aboriginal groups in monitoring programs. Regular involvement with, meetings, updating, and communication of the results of monitoring plans to potentially affected Aboriginal groups. Dominion Diamond intends to mitigate this concern through the involvement of potentially affected Aboriginal groups in their monitoring programs (i.e., Wildlife Effects Monitoring Program [WEMP], Aquatic Effects Monitoring Program [AEMP], Air Quality Monitoring Program [AQMP]) and through the communication of the results of these monitoring programs to each community through meetings and other engagement opportunities.	15.2.2, 15.3.2, 15.4.1.1.5, 15.4.1.2.1

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Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Culture (con't)	YKDFN KIA Tłįchǫ DKFN	The impacts on improved access to traditional hunting areas.	The only new access route associated with the Jay Project will be the Jay Access Road. This road will not be available for use by the public, and will not allow for any increased access into the area for harvesting.	15.3.2, 15.4.1.1.1
	NSMA	Ability to participate in the fall and spring hunts (waterfowl and caribou) in the Ek'atì area	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. • The Project maximizes the use of the existing infrastructure to reduce the environmental footprint as much as possible. • The esker will be sloped to allow for continued use by caribou. • Siting and construction of the Project will be planned to avoid environmentally sensitive areas (e.g., critical wildlife habitat, rare plants and wildlife species, and wetlands) as much as possible. • Wildlife will be actively deterred from areas of risk. • The WEMP implemented at the Ekati Mine will include the Jay Project. • Animals will be deterred from entering the diked area where most fly rock will occur (until pit is too deep for escape of fly rock). • Project activities will be completed in accordance with the Migratory Bird Convention Act. • If lake water level increases are to occur during migratory bird breeding season, then vegetation removal will be completed before nesting season, or nest searches will be completed before construction. • If nests are found during nest searches, mitigation will be applied to avoid incidental take of nesting individuals. • Habitat changes will be monitored as part of the WEMP. • Periodic review of the WEMP and engagement with potentially affected Aboriginal groups. • Construction of caribou ramps and crossings at strategic points along the Misery Road. • Road closures during peak caribou migration throughout the Ekati Mine site. • Use of truck convoys with wildlife monitor escorts to reduce periods of traffic along the roads. • Vehicles will be restricted to designated roads and prepared work areas (recreational use of off-road vehicles is prohibited). • Hazards will be fenced to prevent wildlife interaction. • Continued use of measures currently in place to minimize human-wildlife interactions. Wildlife will be actively deterred from areas of risk. • Final reclamation will be completed so that the landscape is safe for wildlife use. • Additional mitigations as described in the Caribou KLOI and Wildlife and Wildlife Habitat SON (Sections 12 and 13).	15.2.2, 15.3.2, 15.4.1.2.1
	Tłįchǫ NWTMN	Protection of drinking water and continued use of water for traditional and non-traditional activities.	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. • A Lac du Sauvage Dewatering Plan will be prepared for the Wek'èezhìı Land and Water Board (WLWB) that will include flow rates and locations. • Reduced pumping rates will be implemented during low-flow periods to preserve downstream flow levels. • Operational discharge will meet the discharge criteria for water quality. • Discharge water will be regularly sampled and monitored as part of the Water Licence Surveillance Network Program. • The AEMP implemented at the Ekati Mine will include the Jay Project. • Regular involvement with, meetings, updating, and communication of the results of the AEMP to potentially affected Aboriginal communities. • At closure, natural water levels in Lac du Sauvage will be re-established. • Other mitigations as described in the Water Quantity and Quantity KLOI (Section 8).	15.2.2, 15.3.2

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Culture (con't)	LKDFN YKDFN KIA NSMA Tłįchǫ DKFN	The potential negative impacts of development on their ability to trap (i.e., ongoing ability to trap foxes in the area).	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. The Project maximizes the use of the existing infrastructure to reduce the environmental footprint as much as possible. • The esker will be sloped to allow for continued use by caribou. • Siting and construction of the Project will be planned to avoid environmentally sensitive areas (e.g., critical wildlife habitat, rare plants and wildlife species, and wetlands) as much as possible. • Wildlife will be actively deterred from areas of risk. • The WEMP implemented at the Ekati Mine will include the Jay Project. • Animals will be deterred from entering the diked area where most fly rock will occur (until pit is too deep for escape of fly rock). • Periodic review of the WEMP and engagement with potentially affected Aboriginal groups. • Construction of caribou ramps and crossings at strategic points along the Misery Road. • Road closures during peak caribou migration throughout the Ekati Mine site. • Use of truck convoys with wildlife monitor escorts to reduce periods of traffic along the roads. • Vehicles will be restricted to designated roads and prepared work areas (recreational use of off-road vehicles is prohibited). • Hazards will be fenced to prevent wildlife interaction. • Continued use of measures currently in place to minimize human-wildlife interactions. Wildlife will be actively deterred from areas of risk. • Final reclamation will be completed so that the landscape is safe for wildlife use. • Additional mitigation measures as described in the Caribou KLOI and Wildlife and Wildlife Habitat SON (Sections 12 and 13).	15.2.2, 15.3.2, 15.4.1.2.1
	YKDFN KIA NSMA Tłįchǫ NWTMN	Availability of fish in the Ek'atì area.	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. • The Project footprint disturbance area will be limited to the extent practical. • A diversion channel will be constructed to maintain habitat corridors between Lac du Sauvage and waterbodies in the small contributing sub-basins around the diked area. • A fish-out will occur according to Fisheries and Oceans Canada (DFO) guidance, and with engagement of the Ekati Mine Impact Benefit Agreement (IBA) groups. • An offsetting plan will be developed with DFO and with engagement of the Ekati Mine IBA groups. • The dike and dewatering area will be positioned away from known spawning locations. • The road route alignment will minimize stream crossings and avoid sensitive habitat as feasible. • Culverts will be designed to allow for fish passage where appropriate. • The AEMP implemented at the Ekati Mine will include the Jay Project. • Diversions will be designed to take into account fish movement. • A Lac du Sauvage Dewatering Plan will be prepared for the WLWB that will include flow rates and locations. • Direct discharge flow rates will be developed and maintained such that there are no measurable changes to fish habitat. • During pumping of water from areas that contain fish, appropriately sized fish screens that meet DFO guidelines will be fitted to pumps to limit fish impingement and entrainment. • In-stream works will either be avoided or limited to when watercourses are not flowing, where possible. • Where possible, construction will take place during the winter to minimize disturbance to soils and vegetation, and runoff to local waterbodies. • A closure plan for back-flooding dewatered areas will be developed. • Natural, local water will be used to back-flood dewatered areas. • Water quality will be monitored during the back-flooding period. • Back-flooding will be managed so that there will be no measurable effects to fish habitat at downstream locations in the Coppermine River. • Surface water will be diverted to the pit and dewatered area at a rate that does not significantly alter downstream flow rates. • During pumping of water from areas that contain fish, appropriately sized fish screens that meet DFO guidelines will be fitted to pumps to limit fish impingement and entrainment. • Additional mitigation measures as described in the Fish and Fish Habitat KLOI (Section 9).	15.2.2, 15.3.2. 15.4.1.2.2
	KIA Tłįchǫ	Potential effects of climate on the ecology of the species that Aboriginal groups rely on for cultural values and subsistence harvests.	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities.	15.2.2, 15.3.2

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Culture (con't)	YKDFN KIA Tłįchǫ	Changes in available plant populations or communities.	The assessment endpoints for the TLU VC centre on the protection of continued opportunities to participate in culturally important uses of the land, such as traditional harvesting activities. • The Project footprint disturbance will be limited to the extent possible, while maintaining safe construction and operation practices. • The site access road route will follow existing roads and/or trails to the extent possible, to limit land clearing. • Banks and vegetated areas will be stabilized, if disturbed. • Where possible, construction will take place during the winter to minimize disturbance to soils and vegetation, and runoff to local waterbodies. • Progressive reclamation will begin as early as possible, starting with areas that are no longer needed for mine operations. Reclamation activities will continue throughout the life of the mine. • Lake shorelines will be assessed for erosion potential, and mitigation will be applied for areas identified with high potential for erosion/generation of suspended sediments/contaminant release. • The AEMP implemented at the Ekati Mine will include the Jay Project. • Dust suppression will be applied as appropriate to roads, the airstrip, and laydown areas. • Disturbed areas will be reclaimed and the surface stabilized. • Reclamation objectives will reflect the local native vegetation communities. • Additional mitigations as described in the Vegetation SON (Section 11).	11.6.2.3, 15.2.2, 15.3.2, 15.4.1.2.3
	LKDFN YKDFN KIA NSMA Tłįchǫ	Impacts on archaeological sites, specifically grave sites.	The assessment endpoint for the heritage resources VC is the continued protection of archaeological or historic sites, burial sites, artifacts, and other objects of historical, cultural, or religious significance. • The Project footprint disturbance will be limited to the extent possible, while maintaining safe construction and operation practices. • The site access road route will follow existing roads and/or trails to the extent possible, to limit land clearing. • The new access road will be as narrow as possible, while maintaining safe construction and operation practices.	15.2.1.4, 15.2.2, 15.3.2, 15.4.1.2.4, 15.4.2, 15.4.3
Fish and Fish Habitat	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ NWTMN	The overall sustainability of fish populations.	Effects on fish and fish habitat assessed in Section 9 of the DAR. TK considered in pathway screening. The maintenance of self-sustaining and ecologically effective fish populations are assessment endpoints for the fish VCs, which would maintain the ongoing productivity of fisheries important to the Aboriginal groups in NWT and Nunavut. VCs included fish species that are an important cultural, subsistence, and economic resource for people in the NWT and Nunavut. The selection of the boundary for effects study areas (ESAs) for the fish VCs was based on the biological properties of the fisheries unit under examination. A Conceptual Offsetting plan, developed based on input from DFO and local Aboriginal communities, is provided in the DAR.	9.1.3, 9.3, 9A
	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ	The potential impacts draining Lac du Sauvage would have on spawning habitat and fish populations.	Effects on fish and fish habitat assessed in Section 9 of the DAR. TK considered in pathway screening. The assessment used three complementary methods and resulting datasets to describe baseline conditions and to evaluate the direct effects to shoal habitat (i.e., as potential spawning locations for fish VCs). To reduce effects to spawning habitat and fish populations, the spatial extent of the mine footprint will be minimized, where possible. For describing baseline conditions of fisheries in Lac du Sauvage, hydroacoustic data on fish densities were combined with species composition data collected primarily from the use of short-duration gill net sets to predict densities and total abundance of fish in Lac du Sauvage. This approach provides a reliable description of baseline conditions for predicting effects. A detailed dike construction plan will be developed and implemented for dike construction and breaching, and will include information relevant to mitigation, inspection, monitoring, and corrective action if necessary. Erosion and sediment control measures will be implemented (e.g., installation of silt curtains) for turbidity control. Indirect effects to spawning habitat through changes in water quality in Lac du Sauvage and Lac de Gras during the operational period and closure are evaluated and described. Appropriately-sized fish screens will be placed on all water intake pipes (e.g., during back-flooding) in fish-bearing waterbodies to minimize potential harm to fish. A Conceptual Fish-Out Plan, developed according to DFO guidance and with feedback from the local Aboriginal communities, is provided.	9.2.3.3, 9.2.4.1.1, 9.3.2.1.2, 9.3.2.2.2, 9.4.3.1.1, 9.4.3.1.2, 9.4.3.2.2, 9.4.3.2.3, 9B

Table 24-1 Community Concerns Addressed in the Developer's Assessment Report

Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Fish and Fish Habitat (con't)	LKDFN YKDFN KIA Kugluktuk NSMA Tłı̨chǫ NWTMN	The long-term impacts on fish health as a result of lost habitat and changes in migration patterns (protecting the sediment, vegetation, and migration routes for the resident species is important to maintain the fish health and productivity in the area).	Effects on fish and fish habitat assessed in Section 9 of the DAR, including changes in migration patterns. The proposed Sub-Basin B Diversion Channel will be designed to create a temporary fish passage corridor to facilitate movement of spawning Arctic Grayling from Lac du Sauvage to upstream tributary reaches in Stream B1 (above Lake B0 and Stream B0) and Stream Ac35 during the period of mine operations (i.e., 10 years). It is expected that this design will also provide a corridor for other species that use habitat in the affected streams. To prevent potential barriers to fish passage at any of the proposed road crossings of the channel or upstream, culverts will be designed and installed in such a manner to maintain adequate flows and velocities for fish passage, using appropriate federal and territorial guidelines. Potential effects on fish health from changes to water quality and lake ecosystem productivity are assessed for the early operations, closure, and closure phases (Section 8.5.5). Related environmental design features and mitigation practices are listed under water quality. Direct and indirect effects from the Jay Project footprint on riparian habitat are assessed. The spatial extent of the mine footprint will be minimized, where possible, to reduce effects to riparian habitat and fish populations. During back-flooding, the seasonal timing and pattern of lake level fluctuation will be maintained such that effects to riparian habitat will be minor. A Conceptual Offsetting Plan, developed with DFO and local Aboriginal communities, is provided in the DAR.	8.5.5 9.3.2.1.3, 9.3.2.2.2, 9.4.3.1.1, 9.4.3.1.3, 9.4.3.2, 9.4.3.3.1, 9A
	YKDFN KIA	Impacts of spills on fish.	Effects on fish and fish habitat assessed in Section 9 of the DAR. The potential effects of spills (i.e., fuels, petroleum products, reagents) to habitat quality through a change in surface water quality are assessed. Mitigation identified in the existing Ekati Mine Spill Contingency Plan and environmental design features will be in place to limit the frequency and extent of spills that have potential to occur during Project activities.	9.3.2.2.1
	LKDFN YKDFN KIA Kugluktuk NSMA Tłı̨chǫ	Impacts of blasting, dust, sedimentation during runoff, and increased metals and nutrients on fish.	The potential effects of the use of explosives on fish are assessed. Mitigation measures will be implemented to minimize the effects of blasting in the Jay open pit on fish VCs in nearby waterbodies (i.e., Lac du Sauvage). For example, blasting operations will follow DFO's "Guidelines for the Use of Explosives in or Near Canadian Fisheries Waters" (Wright and Hopky 1998) for setback distances from fish-bearing waterbodies. In addition, blasting and excavation will occur in the dewatered areas of Lac du Sauvage where no water or fish will be present. The indirect effects to fish habitat quality through changes in air and dust emissions (including sulphur dioxide, nitrogen oxides, and particulate matter) and subsequent deposition are assessed. A suite of mitigation practices will be considered, including dust suppression measures on roads, the development of operational procedures for equipment, the use of industry-standard emission control systems. Release of sediment through changes in hydrology from surface disturbance, and erosion related to the construction of watercourse crossings are assessed. A suite of environmental design features and mitigation practices will be considered. For example, erosion and sediment control management practices (e.g., silt fences, runoff management) applicable to northern environments and already in place at the Ekati Mine will be used during construction around disturbed areas, where appropriate. Instream works will either be avoided or limited to when watercourses are not flowing, where possible. Potential effects on fish health from changes to water quality and lake ecosystem productivity are assessed for the early operations, closure, and closure phases. Related environmental design features and mitigation practices are listed under water quality.	9.3.2.2.1, 9.3.2.2.2 9.3.2.2.1, 9.3.2.2.2, 9.4.3.2

Table 24-1 Community Concerns Addressed in the Developer's Assessment Report

Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Wildlife and Wildlife Habitat	LKDFN YKDFN KIA Kugluktuk NSMA	Impacts of dust on migratory and non-migratory wildlife.	Air quality assessment in Section 7 of the DAR considered fugitive dust emissions from mining activities, material movement and storage, drained lakebed, and haul roads. Results passed on to vegetation and wildlife teams for their assessments. Specifically with respect to dust control, the largest emissions are transport related. Dominion Diamond will manage dust and particulate emissions by continuing and evolving the following management practices: water spray and chemical suppressant application to control dust emissions on haul roads during summer or non-frozen season; and, managing vehicle speed to limit road dust from vehicle wheel entrainment.	7.2.4, 7.3.2.2
	NSMA	Impacts as a result of potential contaminant spills.	Spills considered in the water quality assessment (Section 8) and well as wildlife (Section 13). The existing Spill Contingency Plan in place for the Ekati Mine will be expanded to include the Jay Project. • Regular equipment maintenance (e.g., regular checks for leaks) will continue. • Drip trays and/or absorbent pads are used during servicing and refuelling. • Hazardous substances are stored and handled on site in accordance with applicable regulations. • Fuel is stored at a central bulk fuel farm at the Ekati main camp and at satellite fuel farms located at Misery, Fox, and Koala North. Fuel tanks are housed within bermed areas. • The Project will follow Ekati's standard policies in the event of a spill; spill response training is provided and updated. • Soil and snow affected by hydrocarbon spills will continue to be handled in accordance with the existing Hydrocarbon-impacted Materials Management Plan and soil will be remediated in the landfarm or shipped off-site. • Dewatering and mine water management in the Wastewater and Processed Kimberlite Management Plan (WPKMP) will include the pipelines used for ongoing water management of the Jay Pit. • Mine water and fine processed kimberlite slurry pipelines will be monitored and inspected throughout construction (i.e., dewatering of diked area), operations, and closure. Additional mitigation will be applied, if required. • Any leaks or spills identified along the pipelines will be addressed and clean-up, if required, will be implemented following the existing Spill Contingency Plan.	13.3
	NSMA	Small furbearers will be affected through destruction of their habitat and subsequent displacement.	Wildlife assessment in Section 13 of the DAR, included an assessment of habitat for wolves and wolverines. Esker habitat is preferred at the home range scale for wolves in the North Slave Region, possibly because it provides suitable denning habitat. The assessment estimated the removal of esker habitat, relative to the 2014 Baseline Condition in the wolf ESA, as well as changes to den occupancy and productivity in the wolf ESA. For wolverine, the assessment estimated the removal of preferred wolverine habitats, relative to the 2014 Baseline Condition.	13.2.2.4.2, 13.3.2.2.2, 13.4.5.1.2
	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ	Impacts of roads and other developments on bear denning habitat, specifically any construction that affects eskers.	Wildlife assessment in Section 13 of the DAR, included an assessment of habitat for grizzly bear habitat and dens. Jay-specific mitigations include: • Only one access road crosses the Lac du Sauvage esker. • The Jay WRSA is set back 200 m from the Lac du Sauvage esker.	13.2.1.2.3, 13.2.2.6.1, 13.3.2.2
	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ	Concerns about grizzly bears being attracted to mines because of smells.	Wildlife assessment in Section 13 of the DAR (including attractants to site [smells]). In 2011, community participants in the WEMP Community Engagement Program helped Ekati staff identify 23 habitat locations around the Ekati Mine for establishing plots for the grizzly bear DNA Program that is designed to assess and monitor the distribution and occupancy of grizzly bears near the mine. Environmental design features and mitigation strategies have been established to reduce the numbers of carnivores attracted to the Project (Table 12.3-1). A Waste Management Plan as approved by the WLWB is in place that works in concert with the WEMP to effectively manage various types of wastes, including wildlife attractants. These strategies include the following: • Workers and visitors to the site are educated about the importance of proper waste management practices. • People are educated on the risks associated with feeding wildlife and careless disposal of food garbage. • Separate bins are located throughout facilities on-site for immediate sorting of domestic waste. • Food waste is stored inside for transport directly to the incinerator for incineration. • Incinerator ash from combustion of kitchen and office waste is stored inside and transported to the landfill. • The landfill is covered regularly with crushed or mine rock. • Ongoing review of the efficiency of the waste management program and improvement through adaptive management.	12.3.2.2.2

Table 24-1 Community Concerns Addressed in the Developer's Assessment Report

Valued Component (VC) or Subject of Note (SON)	Community	Concerns Expressed by Aboriginal Communities in the TLU and TK Baseline and DAR	How Concerns were Addressed in the DAR	Subsection of DAR
Soils and Vegetation	LKDFN YKDFN KIA Kugluktuk	Difficulty for vegetation to re-grow in the barrenlands	Vegetation assessment in Section 11 of the DAR, and considered closure. In 2013 participants in the vegetation workshop suggested that Ekati should make the tailings beaches wavy with little hills at closure so that the plants can grow more easily. Further, that Ekati should include fine clays and soils on the waste rock piles to support vegetation growth, till the lands to encourage progressive regrowth and even moisture distribution, and limit the transplanting of sedges to 10% of the source material (Dominion Diamond 2013). Research completed at the Mine has indicated that recontouring disturbed sites and surface roughening (e.g., deep ripping, placement of large rocks) creates microsites that are favourable for seed germination and natural colonization of adjacent tundra plant species (BHP Billiton 2012). 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, reclamation research, and closure of other areas of the Ekati Mine. The terrestrial area that contains the Project footprint is considered a permanent disturbance on the landscape because of the expected long time for vegetation to recover, and it is not known what the reclaimed landscape will look like in the future. The Ekati Mine Interim Closure and Reclamation Plan (ICRP) works to facilitate and promote this nature of natural colonization of disturbed areas.	10.4, 11.3.2.2.2, 11.4.2.2.2 11A
	LKDFN YKDFN KIA Kugluktuk NSMA Tłįchǫ	Effects of dust on the vegetation	The vegetation assessment (Section 11) considered the results of the air quality assessment with respect to dust. The area receiving dust deposition extending beyond the Project footprint was considered. Dust deposition on vegetation has been observed to cause a shift in the plant community, where sensitive species (e.g., *Sphagnum* moss and lichen) are removed and more tolerant species (e.g., haircap moss, Bryum moss, cottongrass and willow) increase (Everett 1980; Walker and Everett 1987; Farmer 1993; Auerbach et al. 1997; Grantz et al. 2003; Golder 2014b). Environmental design features and mitigation have been incorporated into the Project to reduce potential effects from dust deposition (Table 11.3.1). For example, dust suppression will be applied as appropriate to roads, airstrip, and laydown areas and speed limits are established on all roads to reduce the production of dust. These environmental design features and mitigation, which should reduce dust deposition, have not been incorporated into the modelling; thus, the modelling results provide conservative estimates of deposition rates (Section 7.4). Because of the conservatism used for the air quality modelling, it is expected that the actual dust deposition from the Project will be lower than predicted, closer to the concentrations measured currently at the Ekati Mine.	7.4, 11.3.2.2.2

Recently, the Ekati Mine supported two specific community-based TK projects that include the following:

- the What'aa Eskers Research Project with the Tłįchǫ that involved the study of properties of natural eskers close to Mesa Lake, Northwest Territories for the purpose of identifying community-based concepts that may be useful in planning, construction and reclamation of mine waste rock piles; and,
- a TK Research project for the Project that reviewed previous TK research and community site visits to work with an archaeologist on identifying locations of cultural significance at the Project site.

Additionally, Ekati Mine staff regularly participate in community-based meetings and workshops to discuss questions and concerns about ongoing mining activities and monitoring programs.

Dominion Diamond will continue its community engagement activities for the Jay Project and for the Ekati Mine in general, as described in the *Ekati Mine Engagement Plan* approved by the Wek'èezhìi Land and Water Board. Dominion Diamond's engagement will continue to solicit and implement community suggestions for improving the tracking and communication of concerns or questions raised.

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DOMINION DIAMOND

Undertaking Number:	DAR-MVEIRB-UT-25
Source:	Undertakings from Day 2 (April 21) of the Technical Sessions (Previously Unnumbered)
Subject:	Historic Traffic Volumes on the Misery Road
DAR Section(s):	Traffic (Appendix C submitted with responses to Round 1 IRs)

Request:

Historic traffic volumes on the Misery Road from annual freight transport associated with the Tibbitt to Contwoyto Winter Road and ore haul traffic from the Misery Pit, as it relates to potential road deflections.

Response:

The following provides supplemental information related to historic traffic volumes on the Misery Road, related to:

- freight movement, associated with the annual operation of the Tibbitt to Contwoyto Winter Road; and,
- ore haul traffic along the Misery Road.

Table 25-1 presents information regarding total Tibbitt to Contwoyto Winter Road Traffic, operating days, and the component associated with the operation of the Ekati Mine. Table 25-1 also presents Misery Road traffic in terms of the total freight traffic and time in minutes between freight vehicles, associated with the operation of the Tibbitt to Contwoyto Winter Road. It is important to note that the freight traffic is limited to approximately an 8 to 10-week period each year (typically between mid-January and early April), depending on ice conditions.

Table 25-1 Winter Road Traffic Data

Year	Tibbitt to Contwoyto Winter Road Statistics					Ekati Mine Statistics		
	Operating Period	Days	Total Tonnes Hauled (north bound)	Number of Truck Loads (north bound)	Number of Backhauls[a] (south bound)	Ekati Number of Truck Loads (north bound)	Ekati Total Freight Loads on Misery Road	Minutes Between Freight on Misery Road
1997	Jan 21 – Apr 15[b]	84	100,000	3,500	—	3,500	7,000	17.3
1998	Jan 19 – Apr 4[b]	75	82,000	2,543	—	2,543	5,086	21.2
1999	Jan 28 – Mar 31[b]	62	57,000	1,844	—	1,844	3,688	24.2
2000	Feb 1 – Mar 22[c]	50	111,090	3,703	135	3,703	7,406	9.7
2001	Feb 4 – Mar 24 [c]	48	245,586	7,981	201	6,000*	12,000*	5.8
2002	Jan 26 – Apr 16[d]	80	256,915	7,735	433	6,000*	12,000*	9.6
2003	Feb 1 – Apr 2[d]	60	198,818	5,243	883	4,500*	9,000*	9.6
2004	Jan 28 – Mar 31[d]	63	179,144	5,091	165	4,000*	8,000*	11.3
2005	Jan 26 – Apr 5[d]	69	252,533	7,607	243	3,434	6,868*	14.5
2006	Feb 5 – Mar 26[d]	49	177,674	6,841	469	3,152	6,304*	11.2
2007	Jan 27 – Apr 9[d]	72	330,002	10,922	818	4,200*	8,400*	12.3
2008	Jan 29 – Mar 31[d]	62	245,585	7,484	890	2,231	4,462	20.0
2009	Feb 1 – Mar 22[d]	49	173,195	4,847	530	1,663	3,326	21.2
2010	Feb 4 – Mar 21[d]	45	120,020	3,508	429	1,460	2,920	22.2
2011	Jan 28 – Mar 31[d]	62	239,000	6,832	530	1,967	3,934	22.7
2012	Feb 1 – Mar 31[d]	59	210,188	6,551	648	2,272	4,544	18.7
2013	Jan 30 – Mar 31[e]	60	223,206	6,071	454	1,737	3,474	24.9
2014	Jan 31 – Apr 1	61	—	—	—	2,385	4,770	18.4
2015	Jan 31 – Apr 1	60	—	—	—	2,197	4,394	19.7

* Specific traffic volume data for the Ekati Mine operation between 1997 and 2004, and 2007 are not available. Therefore, assumed values are shown, based on an understanding of overall winter road statistics.

a) Backhaul trucks refer to loaded return trips; all trucks return to Yellowknife whether they have a load to back haul or not.

b) Source: Tibbitt to Contwoyto Winter Road (TCWR) Joint Venture (2009) combined with Mesher et.al. (2008).

c) Source: TCWR Joint Venture (2013a), Developer's Assessment Report (DAR) Table 12.3-2.

d) Source: Joint Venture (2014), DAR Table 16.3-1.

e) Source: TCWR Joint Venture (2013b), DAR Table 12.3-2.

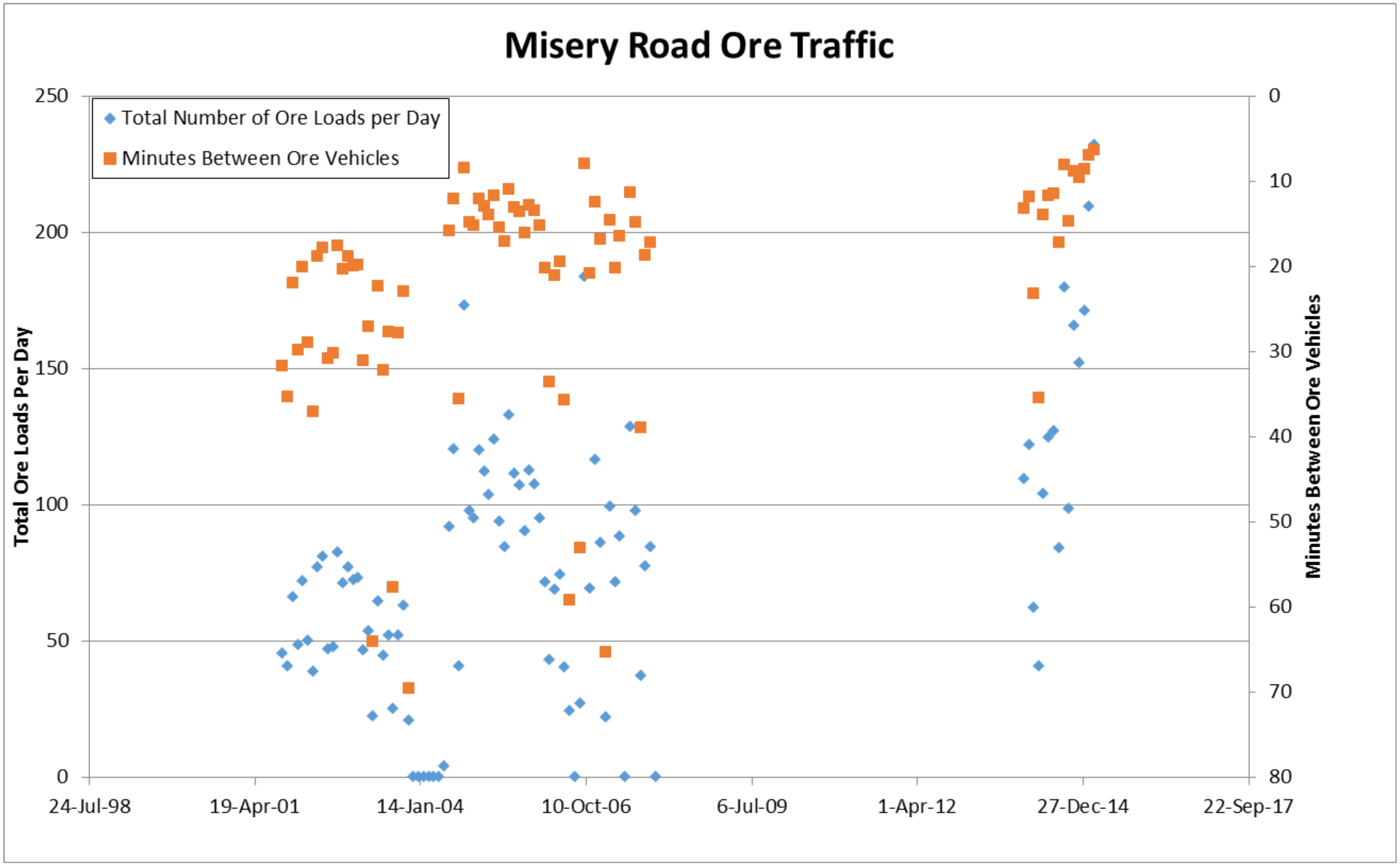
Figure 25-1 presents the ore haul traffic on the Misery Road, based on the Ekati Mine monthly record of vehicle trips to the Ekati processing plant. The figure shows the average daily total ore traffic volume on the Misery Road and the average time in minutes between ore haul vehicles. This assumes ore haul traffic occurs evenly throughout the month and throughout the 24 hours of each day. Hauling of ore from the Misery Pit to the Ekati processing plant occurred between:

- October 2001 and November 2003;
- July 2004 and November 2007, excluding the months of August 2006 and June 2007; and,
- January 2014 and March 2015.

These data (Figure 25-1) show that there have been extended periods of time in the past when the average time between haul trucks was similar to or more frequent than the projections for the Jay Project (12.5 to 13 minutes).

Past and current practice at the Ekati Mine has been to use smaller payload vehicles such as Caterpillar 777 and Haulmax 3900 trucks with a capacity of 75 to 90 tonnes. The Jay Project proposes to use high-capacity long-haul trucks with a capacity of 210 to 220 tonnes, dramatically reducing round trips required to move the larger volume of ore. Dominion Diamond began operating these high-capacity trucks on the Misery Road in April 2015 and intends to phase them in to their ore haulage operations over the next several years.

Figure 25-1 Misery Road Traffic Associated with Ore Transport Provided on a Monthly Basis



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