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Joseph Mackenzie, Chair
Wek'èezhìi Land and Water Board
PO Box 32
Wekweètì, NT X1A 3S3
Canada

11 February 2019

Dear Mr. Mackenzie:

Subject: DDMI Response to WLWB IRs re: Water Licence W2015L2-0001 Amendment Request for the Deposition of Processed Kimberlite to Mine Workings

Diavik Diamond Mines (2012) Inc. (DDMI) submitted an application on June 1, 2018 to the Wek'èezhìi Land and Water Board (WLWB or 'the Board') to amend Water Licence W2015L2-0001 to allow for the deposition of Processed Kimberlite (PK) into mine workings (Application or Proposal). As part of the WLWB's preliminary screening process for the Application, the Board held a technical session from January 16-17, 2019 and, subsequently, issued Information Requests (IRs) to parties on January 23, 2019. DDMI is pleased to provide WLWB with its response to the IRs (IR# 1 to 5, 7 to 12, 14, and 15).

DDMI wishes to highlight the following points:

- A summary table of our assessment of potential environmental impacts and proposed mitigations in all areas relevant to the PK to Mine Workings Proposal was provided in section 10 of the Application Form for the Amendment to the Water Licence submitted to the Board on June 1, 2018.
- The Technical Session provided DDMI with a much better understanding of the WLWB's information requirements to support its decision making process at the Preliminary Screening stage.
- We appreciate the need for additional evidence to support the Preliminary Screening for fish as was raised by WLWB Staff, and believe we have addressed key outstanding issues in this submission.
- A conservative (or precautionary) approach was used in the design of the PK to Mine Workings Proposal and in the assessment of potential for impacts to the environment.
- We believe that the additional IR responses attached provide clear evidence that the proposed deposition of PK to mine workings is not likely to cause significant adverse environmental impacts to water and all aquatic life.

DDMI has carefully considered WLWB's *IR #10 for DDMI* and reviewer concerns regarding the adequacy of the information provided for the component of the Application related to the re-mining of PK from the Processed Kimberlite Containment (PKC) Facility. DDMI now requests that the option to re-mine PK from the PKC Facility be removed from the scope of the Review of the Application. DDMI may formally re-engage with stakeholders, including the WLWB, regarding this option in future.

DMMI wishes to thank WLWB and all other reviewers for their ongoing input in ensuring that the proposed PK to Mine Workings is robust and protective of the environment. DDMI believes, based on available information, stakeholder engagement, professional judgment, effectiveness of mitigation and monitoring proposed, and commitments made within the Application and throughout the review to date, that the PK to Mine Workings is not likely to cause significant adverse impacts to the environment. Also, DDMI has not identified significant public concern regarding the Proposal. DDMI's level of confidence in the conclusions regarding the PK to Mine Workings is high.

The balance of this letter, information provided by DDMI throughout the review of the PK to Mine Workings Proposal and the enclosed response to the IRs provide further rationale for our conclusions.

DDMI's complete response to the IRs, including related attachments, has been uploaded to the Board's Online Review System. Please do not hesitate to contact the undersigned if you have any questions related to this submission.

Sincerely,

Sean Sinclair
Superintendent, Environment

cc: Anita Ogaa, WLWB
Anneli Jokela, WLWB

IR #1 for DDMI

To provide an updated Table 8 (i.e., Table 8: A418 Potential Decant Volumes – 9,260 mRL from Attachment 1 of the Amendment Application) that provides operational water volume amounts based on a lower dry density of fine PK (based on a range of dry density estimates that is foreseeable in the future).

DDMI Response to IR #1

The original and updated tables of potential decant volumes for the A418 pit are presented below.

Table 1a: A418 Potential Decant Volumes – 9,260 mRL Decant

End of Year	Total FPK slurry (m^3)	Settled total volume (m^3)	Excess slurry water (m^3)	Groundwater inflow (m^3)	Total volume in year (m^3)	Decant volume (m^3)
2022	5,343,859	2,170,943	3,172,916	796,368	6,140,227	115,345
2023	4,147,288	1,684,836	2,462,452	796,368	4,943,656	4,943,656
2024	2,963,274	1,203,830	1,759,444	796,368	3,759,642	3,759,642
2025	419,582	170,455	249,127	796,368	1,215,950	1,215,950

Assumes FPK dry density of 0.8 t/m^3

Table 2b: A418 Potential Decant Volumes – 9,260 mRL Decant

End of Year	Total FPK slurry (m^3)	Settled total volume (m^3)	Excess slurry water (m^3)	Groundwater inflow (m^3)	Total volume in year (m^3)	Decant volume (m^3)
2022	8,015,789	2,170,943	5,844,846	796,368	8,812,157	2,787,275
2023	6,220,932	1,684,836	4,536,096	796,368	7,017,300	7,017,300
2024	4,444,911	1,203,830	3,241,081	796,368	5,241,279	5,241,279
2025	629,373	170,455	458,918	796,368	1,425,741	1,425,741

Assumes FPK dry density of 0.6 t/m^3

The values in Table 8a (presented in original Application) are based on a dry density of 0.8 t/m^3 and estimates are expected to provide an accurate assessment of operational decant water volumes for planning purposes. Table 8b presents recalculation of operational decant water volumes based on a lower fine processed kimberlite (FPK) dry density of 0.6 t/m^3. An FPK dry density of 0.6 t/m^3 is representative of the lower range of observed historical values and is considered a more conservative estimate of future expectations. The dry density of slimes (extra fine processed kimberlite) is as low as 0.4 t/m^3; however, the dry density estimates for FPK encompass properties for the extra fine processed kimberlite component.

The increase in operational decant water that would need to be managed based on the lower dry density estimate is 0.2 to 2.7 Mm^3/year or 6.4 Mm^3 between 2022 and 2025. The operational treatment capacity of the North Inlet Water Treatment Plant is 33 Mm^3/year, or 131 Mm^3 between 2022 and 2025. The increase in operational decant water management would have a negligible impact to the Site Water Balance and any variability could be managed with current Water Management infrastructure.

The results from Processed Kimberlite (PK) Laboratory Consolidation Testing (H2 2019) will be used along with field results from the PK trials (ongoing) to derive the most applicable densities. These values will be applied in the final Processed Kimberlite Containment in Mine Working Design Report and in all associated Management Plan updates.

IR #2 for DDMI

To provide the report on the fatal flaw assessment that was completed by DDMI. Alternatively, if it is not possible to provide the report, DDMI is to provide a detailed summary of the fatal flaw assessment including but not limited to: the objectives of the assessment; the methods used to conduct the assessment; an explanation of the flaws that were considered; the results of the fatal flaw assessment; and the conclusions drawn from the assessment.

DDMI Response to IR #2

Two potential risks associated with the placement of fine processed kimberlite (FPK) and water in the A418 void were identified as being related to (a) water inflow risks to mining and dewatering efforts in A154S and A154N and (b) geotechnical stability risks within A154S and A154N as a result of an increase in pore pressure from A418 FPK deposition (see Figure 1).

For DDMI's planning purposes, Golder Associates Ltd. was enlisted to complete a geotechnical fatal flaw assessment of in-pit disposal of FPK in A418.

The scope of work entailed:

- Compilation of past reports from external independent consultants;
- Review of historical and current pit walls stability using monitoring data (Prisms, TDR, crackmeters, MPBX and radar data) and interpretation;
- Review of the major known discontinuities (faults, diabase dykes, joint sets);
- Review of known areas of geotechnical concern (A418 West Wedge and Southeast High Pore Pressure Zone, and A154 9160 bench and Granite Wedge);
- Review of the conceptual location of the bulkheads;
- Analysis and assessment of the change in stability conditions due to water pressure increase post FPK deposition; and
- Reporting.

The work assessed the water inflow and geotechnical risk associated to an increase in pore pressure with three A418 filling scenarios:

- 9,260 mRL nominated FPK filling elevation,
- 9,360 mRL midpoint elevation, and
- 9,420 mRL –Lac de Gras elevation.

The hydrogeological assessment informed the geotechnical work and found that:

- The hydrogeological connection between the A154 North and South pipes and A418 pipe appears to be stronger at shallower depth (up to 8,975 mRL elevation) and reduced at depth, likely controlled by a lower hydraulic conductivity along the different structures, and a better rock mass quality;
- Because of the effects of the A154 dewatering prior to development of the A418 pit, interactions between the pits could not be quantified during initial development of the A418 pit;
- Recent drilling in the underground A154-D8825 Middle dewatering gallery intersected very little water compared to higher galleries, and there are no responses observed in the A418 area;
- Responses at the deepest piezometers in A418 (8,810 mRL elevation) however, were observed during activation of the underground A154-D8925 Middle and A154-S8925 South galleries; and
- Total flow rates have changed little since 2011 and will need to be maintained through to end of mining. Flow rates to A154 will increase when A418 is flooded.

The assessment concluded the following:

- The effects of filling the A418 void with FPK and water on the depressurization at the A154N and A154S pipes resulted in additional pumping and additional water pressure in A154S, if additional water quantity and pressures can be handled the option does not appear to significantly affect mining.
- Mitigation includes maintaining/replacing all A154 drainage galleries below 8,975 mRL and continued operation of the A418 SE well field during the filling period to the 9,420 mRL elevation. In addition, a drainage gallery was recommended to be excavated in a haulage drift in close proximity to the A-Ramp to limit the inflows from Lyndon’s Fault to the A154 area.
- From a hydrogeological perspective, filling A418 with FPK/water did not represent a fatal flaw.

An evaluation of potential mitigation options was undertaken by DDMI and concluded that drilling of north-westerly orientated drain holes from a temporary drilling bay out of C-Ramp at an elevation of 9,010 mRL would be able to intercept flows to the west of A154S. This drilling bay would be to replace existing drilling bays S9000, S8975 DWG and possibly S8925 DWG that are already decommissioned. A preliminary design of the drilling bay indicates that development would be approximately 100m although this would be subject to optimization.

The geotechnical assessment assumed that drainage in the A154 underground is effective at handling the additional inflow and water pressures at the A154 pipes and that all the drainage galleries on the 8975 mRL elevation and below remain active and effective. The assessment concluded that conservative estimates of the water table in the southwest wall of the A154 pit for each of the three filling elevations considered were:

- With the water level in the A418 at 9,260 mRL, the water table does not pose a risk to stability;

- For the case with the A418 pit full of water (9,420 mRL), there is the potential that pressures will be unacceptably high and seepage zones may be present in the A154 pit wall; and
- Half way between these two extremes, the stability of the A154 pit walls will depend on the actual measured pressure increase.

In terms of the A418 pit, the assessment concluded that, with the exception of the southeast wall, water pressures in the wall are expected to be less than or equal to the water pressures in the flooded workings. In the southeast wall, water pressures are elevated due to a sub-horizontal enhanced permeability zone that is connected to Lac de Gras and will continue to remain elevated until the void is filled to lake level. The depressurization wells commissioned in this area in late 2017 will need to be maintained until the void is completely filled to lake level in order to ensure stability of the A418 wall and A418 dike.

Overall the geotechnical assessment concluded that, with mitigation measures in place so that water pressures are maintained equal to or below existing values, the filling of the A418 void with FPK/water does not pose a geotechnical fatal flaw.

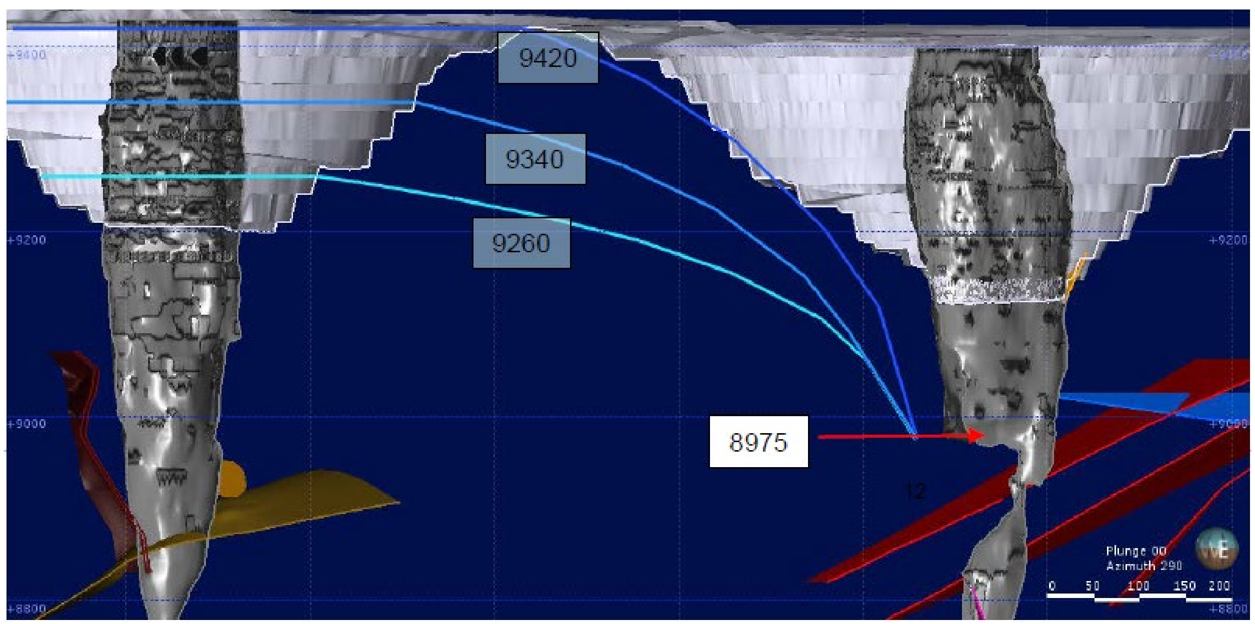

Figure 1: Section view of the A418 pit (left) and A154S (right) (looking Northwest). Representation of water elevation scenario in A418 and the impact of water pressure increase in A154 pit wall.

IR #3 for DDMI

To provide volume estimates for the open space versus tunnels of the A418 Mine workings.

DDMI Response to IR #3

The estimated volume of the A418 mine voids in development tunnels that are below 9260 m elevation is around 0.15 Mm^3 as compared to open space estimated volume of around 6.1 Mm^3.

IR #4 for DDMI

To provide an evaluation of the potential impacts on water quality, during operations and at closure, as a result of displacement of deposited PK materials throughout void spaces that may be created by incomplete filling of the mine tunnels.

DDMI Response to IR #4

The processed kimberlite (PK) deposition concept is to deposit directly into the open mine void at the center of the A418 underground and allow PK to fill from the bottom up and PK to flow into the adjacent development tunnels. As noted in response to *IR #3 for DDMI* there is a relatively small (<3%) volume within the tunnels compared with the open space within the A418 mine workings. It is acknowledged that PK may not flow into all areas of the development tunnels and there may be some areas that may not be completely filled with PK. These possible unfilled areas within the development tunnels would fill with water if they do not fill with PK. The water would come from the PK slurry, groundwater or a combination of both. Over time it is possible that PK may later flow or settle into these unfilled areas as the PK thickness within the open mine void consolidates. As consolidation/displacement occurs, pore water and water from any unfilled areas in the development tunnels will be released to the surface. The quality of the water within any unfilled tunnel areas and the quality of PK pore water are expected to be comparable so there would be no impact to operational decant water quality or post closure pit lake water quality if there was more or less water released from any development tunnel areas that were not filled with PK.

IR #5 for DDMI

To provide the results of the following modeling scenarios for A418:

Scenario 2-a: Base Case as described below:

- Water Cap Depth = 150 m
- Deposited PK volume = 5 Mm3 (i.e., porewater volume from current consolidation model*0.17)
- Porewater chemistry = 350 mg/L TDS (with other parameters based on a representative statistic on saturated PKC samples as presented in Moncur and Smith, 2014)
- Reclaim pond size = based on a depth of 5 m (i.e., this is the depth of the pore water assumed to be sitting at the bottom of the pit before the filling period starts and which is expected to fully mix with the lake water used to fill the pit).

Results to be presented:

- Hydrodynamic results (presented for top section, 40m depth, and bottom section)

- Concentrations of water quality constituents (including ammonia) in the event of unanticipated mixing at year 100.

Scenario 3-a: Base Case described in Scenario 2-a, with the following changes:

- Add an additional volume of 5 Mm3 of PK slimes to the deposits (i.e., porewater volume from current consolidation model*0.34)
- Porewater chemistry = calculated based on the combined concentration of PK slimes and fine PK (50% of volume is fine PK and 50% of volume is PK slimes). The fine PK water TDS = 350 mg/L (with other parameters based on a representative statistic on saturated samples in Moncur and Smith 2014; PK slimes chemistry is to be extracted from representative porewater samples in Moncur and Smith, 2014).

Results to be presented:

- Hydrodynamic results (presented for top section, 40m depth, and bottom section)
- Concentrations of water quality constituents (including ammonia) in the event of unanticipated mixing (confirm depth of water ≤150m).

Scenario 4-a: Base Case described in Scenario 2-a, with the following change:

- Update initial conditions to include a reclaim pond size based on a depth 15 m (i.e., this is the depth of the pore water assumed to be sitting at the bottom of the pit before the filling period starts and which is expected to fully mix with the lake water used to fill the pit).

Results to be presented:

- Hydrodynamic results (presented for top section, 40m depth, and bottom section)
- Concentrations of water quality constituents (including ammonia) in the event of unanticipated mixing at year 100.

Scenario 5-a:

If scenario 2-a shows any exceedances under the unanticipated mixing conditions, DDMI is to model early closure based on a lower volume (2.5 Mm3) of deposited PK material.

If any water quality results from the above modeled scenarios show exceedances of any of the AEMP benchmarks, DDMI is to: (1) describe the likelihood of such occurrences, and (2) describe proposed mitigations.

DDMI Response to IR #5

Model Assumptions

- Unless otherwise noted, the modelling assumptions are as described in Golder (2018) for the A418 Development Case (Scenario 1a).

- The A418 Development Case (Scenario 1a) was modified as per *IR #5 for DDMI* specifications listed above with the following exceptions/clarifications.

    1. Scenario 2a Pore Water Chemistry. During the Technical Session, WLWB Staff and Reviewers frequently referenced pore water from “fresh PK” as opposed to pore water from weathered in situ PK beaches in the PKC assumed in Golder (2018). The suggestion in *IR #5 for DDMI* was to use in situ beach pore water results only from saturated zones within the PKC. DDMI further reviewed the

data presented in Moncur and Smith (2014) and recommend that a better representation of "fresh PK" pore water chemistry can be obtained from the results of the PK slurry at the point of discharge to the PKC. This would be the better representation of chemistry of water that would be released into the mine workings along with the PK. The "Fresh" PK slurry water chemistry is shown in Attachment-1 and compared with the in situ beach saturated zone results. "Fresh" PK slurry water chemistry was used to represent PK pore water chemistry in Scenario 2a. Actual pore water chemistry assumed in Scenario 2a is presented in Attachment-2.

2. Scenario 3a Pore Water Chemistry. As requested, DDMI extracted results from in situ sampling of PKC slimes (extra fine processed kimberlite) from the PKC barge reported in Moncur and Smith (2014). These results are compared with other pore water results in Attachment-1. The PKC slimes water quality were assumed for modelling of pore water release from deposited PK slimes. Scenario 3a includes deposition of operational PK (deposited directly from the Process Plant) and slimes dredged from the PKC and re-deposited in the mine workings. For the modelling the pore water chemistry is assumed to be a 50:50 mix of measured PKC Slimes and "Fresh" PK pore water (described in 1 above). Please refer to Attachment-3 for actual pore water chemistry assumed in Scenario 3a.

3. Water chemistry for nitrogen forms were incomplete in Moncur and Smith (2018) as the focus of this investigation was PK geochemistry where the source of nitrogen is understood to be blasting residue rather than PK geochemistry. The importance of including all forms of nitrogen (ammonia, nitrate and nitrite) was expressed during the Technical Session and included as a requirement in *IR #5 for DDMI*. To remedy the short comings of the Moncur and Smith (2014) data with regard to nitrogen, DDMI reviewed Dominion Diamond Mine's Beartooth pit nitrogen monitoring results and concluded that these results for PK supernatant would be a reasonable analogue for PK pore water as they are expected to be driven primarily by blasting residue and therefore largely independent of the kimberlite ore body geochemistry. Beartooth monitoring results were considered the best analog for these data and they have been used as the basis for nitrogen pore water chemistry in all Scenarios modelled as part of this IR response. Please refer to Attachment-2 for assumed pore water nitrogen chemistry for all modelled scenarios.

4. During the review of source data used to estimate model inputs for pore water quality, DDMI identified a possible issue with results for silver, particularly from the in situ sampling of PKC slimes and slurry. We have compared these results against measured data for supernatant water at Dominion Diamond Mine's Beartooth pit where silver concentrations are consistently below detection limits of 0.02 ug/L. DDMI is currently not confident in the in situ slimes/slurry results for silver. For all Scenarios modelled as part of this IR response, pore water silver concentrations have been assumed to be 0.24 ug/L silver based on results for the saturated zone of in situ PK. Please refer to Attachment-2 for assumed pore water nitrogen chemistry for all modelled scenarios.

5. Golder (2018) incorrectly reported the AEMP Benchmark for silver as 0.1 ug/L. The correct value should be 0.25 ug/L. The correct value is shown in Attachment-1.

6. Based on the remaining storage capacity after accounting for the requested material volumes in Scenario 3a, the water depth for Scenario 3a was assumed to be 111 m for the calculation of concentration under unanticipated mixing.

Prediction Results

Attachment-3 lists the predicted water quality results for each of the three (3) scenarios (2a, 3a and 4a). Results are presented for the top surface layer and at 40 m of depth. Also shown in Attachment-3 are the Aquatic Effects Monitoring Program (AEMP) benchmarks. Predicted surface water quality remains below AEMP benchmarks for all parameters at both surface and 40 m depth. Scenario 5a was not modelled as this scenario was only to run if AEMP benchmarks were exceeded in Scenario 2a, which they were not.

As also shown in the previous sensitivity analysis (DDMI response to EMAB-14), surface water quality is relatively insensitive to pore water quality under meromictic conditions because the upward flux of constituents is very small compared to the water exchange with Lac de Gras. Specifically, neither the addition of 5 Mm^3 of closure slimes (Scenario 3a) nor the addition of 10 m of initial decant water (Scenario 4a) materially changed the predicted surface water quality relative to results for the revised Development Base Case (Scenario 2a). The calculation of water chemistry based on the modelled tracer is thought to be highly conservative because the current model framework forces water upward rather than forming a deep pool of higher density water in the centre of the PK deposit over time, which is expected to occur over time.

Results are also provided graphically in:

- Contour plot of Total Dissolved Solids and Tracer (see Attachment-4)
- Time series plots of Total Dissolved Solids (top, 40 m, bottom; see Attachment-5)
- Time series plots of tracer concentrations (top, 40 m, bottom; see Attachment-6)

Unanticipated Mixing Scenario

At the Technical Session, DDMI's Geotechnical Engineer explained that filling the underground mine voids in A418 with PK material would improve pit wall stability in the lower sections of the mine and that filling the open-pit with water would eliminate wall pore-water pressure improving pit wall stability. A pit wall failure of sufficient magnitude to fully mix the A418 pit lake was described as very rare.

Regardless, *IR #5 for DDMI* requested that model results also be presented for an unanticipated mixing event. Table 4 presents these results for this unlikely scenario under each of the three (3) modelled Scenarios (2a, 3a and 4a). Predicted fully mixed water quality remained below AEMP Benchmarks in all Scenarios and for all parameters with the single exception of nitrite in Scenario 3a. The predicted fully mixed nitrite concentration under this unlikely scenario is 0.065 mg/L (see Attachment-7) compared with the AEMP Benchmark of 0.06 mg/L.

Further Discussion - Nitrite

In addition to the fully mixed scenario being very rare in the first place, there are two (2) other conservative aspects of the nitrite results that should be considered.

1. The AEMP Benchmark for nitrite of 0.06 mg/L is from the Canadian Council of Ministers of the Environment (CCME) (1987). Appropriately, the value is based on the most sensitive species – salmonids. Neither the CCME nor the AEMP Benchmark consider the modifying effect of the chloride ion (Nordin and Pommen 1986; EIFAC 1984; BC MOE 2009). With chloride in the 6-8 mg/L range (as predicted in Attachment-7) the AEMP Benchmark for nitrite would increase by about four-fold to 0.24 mg/L (BC MOE 2009). Predicted nitrite concentrations would not exceed a chloride adjusted AEMP benchmark in any of the unanticipated mixing cases.

2. Nitrite is an intermediate nitrogen form that would not remain for very long in an oxygenated environment where it would rapidly oxidize to a significantly less toxic nitrate form. The process of nitrite oxidation is well understood, and a numerical model has been developed for Snap Lake, which would have fairly similar environmental conditions as Lac de Gras and a fully overturned pit lake water column. The model was calibrated to northern environments to arrive at kinetic rates, and it was subsequently reviewed under the water license process and then peer-reviewed (Snow and Vandenberg 2015). The model indicates that the nitrite concentration in an overturned pit lake would have a half-life of less than one month.

Nitrite released from PK or Slimes pore water is very unlikely to cause a significant environmental impact because:

a) the unanticipated event itself is expected to be very rare;

b) the appropriate AEMP Benchmark with consideration of chloride toxicity modification would be 0.24 mg/L rather than 0.06 mg/L and no predicted surface concentrations are expected to exceed this value even with complete mixing; and

c) nitrite is expected to rapidly oxidize to nitrate in an oxygenated environment like the surface of a pit lake and no longer have the potential to cause toxicity to aquatic life.

Uncertainty with silver

As noted under exception/clarification #4, there is some uncertainty with measured in situ silver. DDMI expects that this uncertainty will eventually be resolved following the consolidation testing underway at the University of Alberta. DDMI conducted some additional calculations to assist Reviewers in considering the relevance of this uncertainty to the potential for significant environmental effects. Results reported here for Scenario 2a, 3a and 4a combined with the results and sensitivity analysis conducted in response to previous IRs demonstrate that predicted pit lake surface water quality under meromictic conditions is not sensitive to pore water concentrations and predicted concentrations of all water quality parameters, including silver, remain below AEMP benchmarks and well below concentrations that might result in significant adverse impacts. The only model scenario that was shown to be sensitive to the pore water concentration of silver was for the very rare "what if" case of unanticipated full mixing in Scenario 3a. If pore water concentrations were about 10 times greater than the upper 75th percentile of the in situ measured results (or 100 times greater than supernatant monitoring results from Dominion Diamond Mine's Beartooth pit) and a very rare event caused complete mixing of the water column, then predicted silver concentrations could approach the 0.25 ug/L AEMP Benchmark. While it will be important to better understand expected pore water chemistry for all parameters, including silver, any uncertainty is not expected to materially change the conclusion of no significant environmental impact.

References

BC MOE (British Columbia Ministry of Environment). 2009. Water quality guidelines for nitrogen (nitrate, nitrite and ammonia). Overview report update. Water Stewardship Division. Prepared by Nordin RN and Pommen LW. September 2009.

EIFAC (European Inland Fisheries Advisory Commission). 1984. Commission Working Party on Water Quality Criteria for European Freshwater Fish, water quality criteria for European freshwater fish. Report on Nitrite and freshwater fish. EIFAC Technical Paper 46: 19 p.

Nordin RN, Pommen LW. 1986. Water quality criteria for nitrogen (nitrate, nitrite and ammonia). Technical Appendix. Ministry of Environment and Parks. British Columbia. November 1986.

Snow, A., and J. Vandenberg. 2016. Simple but effective model calibration for nitrite in northern lakes. Integrated Environmental Assessment and Management 12:821–822.

IR #7 for DDMI

To provide an evaluation of potential impacts on all aquatic life as a result of the AEMP benchmark exceedances that are predicted to occur for a period of up to two years under the unanticipated mixing scenario (see exceedances predicted in response to EMAB-6b).

DDMI Response to IR #7

DDMI predicts that surface water quality will remain below AEMP Benchmarks for all parameters at both surface and 40 m depth under all modelled scenarios (see DDMI Response to IR #5), and concludes that resulting surface water quality from the deposition of PK in Mine Workings is not likely to cause significant adverse impacts to aquatic life.

IR #8 for DDMI

To provide a summary of available information and literature that supports egress behaviour by fish in response to adverse conditions (including low dissolved oxygen) and chemical avoidance behaviour by fish. This explanation is to include a consideration of the likelihood of fish to be able to escape through breaches in the dyke.

DDMI Response to IR #8

Egress behaviour was evaluated in the context of an unanticipated lake overturn. For context, both the conceptual and numerical models suggest that this will not occur, so the following text addresses a “what if” or “worst-case” scenario.

The diked area has been designed to provide suitable conditions for fish upon closure of the A418 pit including water quality conditions within the pit to support healthy populations of fish. Fish habitat features of the A418 pit will include four (4) key habitat zones or types (i.e., the inside edge of the dike [0-2 m depths], reclaimed shoreline, the pit shelf [3-5 m depths], and the pelagic zone [i.e., open water]) which were created with the intention of providing spawning, rearing, and foraging habitat for various species. The design also includes dike breaches with a planned depth of 2 m, to limit access of predator species to the pit shelf and to encourage the use of the habitat by young-of-the-year and small-bodied fish species (e.g., Slimy Sculpin). The final design of the pit lake habitat will consider the depth of the dike breaches to provide egress for fish from the pit shelf habitat throughout the year (i.e., if winter ice thickness equals or exceeds 2 m, the depth of the dike breaches will be re-assessed at closure during final design to allow fish access in all seasons).

The surface water quality of the A418 pit will not be adversely affected at post-closure. As discussed in the previous response to the second round of IRs from the Environmental Monitoring Advisory Board (please see EMAB #30), we do not expect increased productivity as a result of nutrient enrichment in the surface waters of the pit (as per Attachment 1 to the original report, Figure A-1, A-4 and A-7; e.g., phosphorus); therefore, we also do not anticipate dissolved oxygen (DO) depletions in the surface water of the pit. Furthermore, recent modelling results as an outcome of the January 2019 Technical Session indicate that Aquatic Effects Monitoring Program (AEMP) benchmark exceedances will not occur above 40 m depths (except for nitrite, under the unanticipated mixing scenario; see DDMI Response to *IR #5 for DDMI*). Should an unanticipated mixing event occur, the intermediate zone of the pit lake would, therefore, be expected to experience low DO with the potential to affect the quality of habitat for fish. Anoxia is not a plausible condition because under a worst-case scenario, the oxygenated surface waters would mix with anoxic deep waters, yielding a low but non-zero dissolved oxygen condition. If the mixing is wind-driven, the same process would entrain dissolved oxygen throughout the water column as part of the mixing process. Although the duration of the hypothetical period of low DO is unknown at this time, changes in DO concentrations may be within the range of natural fluctuations in DO that occur in Lac de Gras and other natural lakes.

Baseline DO monitoring completed at the Diavik Diamond Mine has shown that while Lac de Gras is generally well oxygenated during summer, there are some areas of decreased DO during ice-cover conditions due to natural processes in the lake. Specific locations assessed during ice-cover conditions reported substantial DO gradients with low DO levels (2 to 4 mg/L) within 1 to 2 m of the bottom of the lake. These were natural occurrences (i.e., documented prior to operation of the Mine). In addition, concentrations were frequently below both acute and chronic Canadian Council of Ministers of the Environment (CCME) DO guidelines (please see EMAB #30) at water depths greater than 10 m. These conditions were confirmed during several years of baseline and early operational monitoring and have also been consistently observed during operational monitoring under the AEMP. These results indicate the existence of naturally low oxygen conditions in Lac de Gras. Also confirmed during baseline and early operational monitoring, including AEMP monitoring, is the presence of healthy fish populations in Lac de Gras as evidence of fish exhibiting avoidance behavior of low DO areas in Lac de Gras under natural conditions.

Fish utilize numerous strategies to mitigate the impacts of hypoxia, including physiological adjustments, morphological adaptations, molecular defences and behavioural modifications (Richards et al. 2009). The most immediate strategies to minimize acute hypoxic stress are behavioural adaptations such as avoidance (Kramer 1987). It is well established that like most aquatic animals, including fish, have the sensory capacity to detect and avoid waters with low oxygen levels with a number of species exhibiting horizontal or vertical avoidance behavior, even at the larval stage (Wu 2002, Suther et al; 1986, Rudstam and Magnuson 1985). Whether from an oxygen demand in the PK slurry at the bottom of the pit or from decomposition of long-term deposition of detrital matter in natural areas of the lake, fish are expected to move elsewhere to avoid the volumes that remain well stratified at the lake bed as oxygen is depleted over time. Researchers have shown that Lake Trout typically do not utilize deep-water bottom substrate where DO concentrations can be low (less than 4 mg/L; Plumb and Blanchfield 2009).

Additional evidence that fish will avoid areas of low oxygen is available in the literature. Aku et al. (1997) used low DO as a barrier to restrict Cisco (Coregonus artedi) movement and cited numerous reports that established hypoxia as a barrier to fish movement. Both maximum and median depth distributions of Cisco became shallower in concert with hypolimnetic oxygen depletion (Aku et al. 1997); in other words, Cisco changed their depth/habitat preference in response to low DO. A literature review by Kramer (1987) discussed behavioural responses of fish to low DO, including (1) changes in activity, (2) increased use of air breathing, (3) increased use of aquatic surface respiration, and (4) vertical or horizontal habitat changes. Fish will choose whichever combination of responses are available to them which minimize their energetic costs and meet their oxygen demands, while also possibly affecting their risk of predation or competition for food sources (Kramer 1987). These reports support the statement that fish would practice avoidance behavior and move to more habitable water if low DO conditions were present in the pit lakes at depth.

Behaviour plays a role in the ability of fish to adapt to changing environmental conditions, and responses can depend on the ability to detect those changes (Beitinger and Freeman, 1983). All fish possess chemical discrimination abilities; chemicals may be detected directly (e.g., as irritants, or by specialized nerve cells) or indirectly (e.g., by causing changes in metabolic rate). Studies have demonstrated avoidance behaviour in fish in response to pH gradients (e.g., Peterson et al. 1989), metals (e.g., Moreira-Santos et al. 2009), and other anthropogenic effluents (e.g., pesticides, salts, mixtures; Tierney 2016). Fish have also demonstrated attraction behaviours in response to thermal discharges (e.g., McInerny 1990), and other stimuli (e.g., pesticides [Saglio et al. 2001 as cited by Tierney 2016]). Both avoidance and attraction behaviours may be mediated by olfaction (i.e., smell; Hidaka, H. and Tatsukawa, R. 1989), visual cues, or other mechanisms (e.g. gustation [i.e., taste]; Jobling 1995).

At present, no fish behaviour studies specific to nitrite (i.e., the only AEMP benchmark exceedance expected above 40 m under the unanticipated mixing scenario) in natural systems are known to exist. It is, therefore, not known if fish would perceive nitrite at the modelled concentrations in the pit lakes as a trigger for avoidance behavior (and subsequently move out of the area to areas with better water quality); however, should an unanticipated mixing event occur, it is reasonable to expect fish to practice avoidance behaviour in response to the low DO conditions under that scenario, and in so doing also avoid exposure to changes in water quality (e.g., elevated nitrite).

Summary

In the unlikely event that turnover was to occur in the pit lakes, a period of low DO could occur (the duration of which is unknown) with accompanying changes in water quality. It is reasonable to expect fish present in the pelagic zone to leave the area (i.e., practice avoidance behaviour) in response to decreases in DO, and this behaviour is supported by the literature cited above. At present, no fish behaviour studies specific to nitrite in natural systems are known to exist; however, a concomitant decrease in DO would be expected to drive fish from the pelagic habitat in the pit under an unanticipated mixing scenario. Finally, pit lake habitat design (i.e., dike breaches of sufficient depth to allow fish movement even under winter conditions) would allow for safe egress from the pits during all seasons.

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IR #9 for DDMI

To summarize the rationale, with evidence, supporting DDMI’s argument regarding limited use of the pit lake by fish at depths below 40 m. This is to include the results of DDMI’s fish tagging study.

DDMI Response to IR #9

Pelagic fishes such as Lake Trout (Salvelinus namaycush), Lake Whitefish (Coregonus clupeaformis) or Cisco (Coregonus artedi) do not occupy the entire water column. Their restricted vertical distributions may be related to several factors, such as temperature, dissolved oxygen, light, interactions with other species, and prey availability (Rudstam and Magnuson 1985, Aku et al 1997). In stratified lakes, dissolved oxygen (DO) concentration (Aku et al 1997) and temperature (Rennie et al 2015) can have a strong influence on vertical distributions, particularly during summer. As discussed in the previous response to the second round of IRs from EMAB (please see EMAB #28), the hydrodynamic model results indicate that for the A418 pit lake, the thermocline will be located approximately 5 to 15 m below surface, depending on the season. Below the seasonal thermocline, temperatures are predicted to be uniform at less than 5˚C. Dissolved oxygen was not modelled, but based on lake circulation that was modelled, conditions are expected to remain fully oxygenated to a depth of at least 40 m in the pit lakes.

A thorough review of lake habitat requirements of fishes occurring in the Northwest Territories (NT) and Nunavut (NU) was completed by Richardson et al. in 2001, which includes considerations of all freshwater fish species in the NT and NU, and is not replicated herein. The current review focused on Lake Trout, Lake Whitefish and Cisco and their specific use of pit lake deep (i.e., >40 m) habitat.

Lake Trout are usually pelagic and inhabit the hypolimnion (Scott and Crossman 1998) or the base of the thermocline (Evans 2007). The vertical distribution of Lake Trout is driven by temperature, but also DO. Upward Lake movement can occur in response to low dissolved oxygen concentrations in deeper waters (Evans et al 1996, Evans 2007). Optimal Lake Trout conditions are generally DO concentrations greater than 6.0 mg/L and temperatures less than 10°C (Dillon et al 2003). Lake Trout do not always occupy all depths that have suitable habitat (e.g., adequate temperatures and dissolved oxygen) (Plumb and Blanchfield 2009). In Plumb and Blanchfield (2009), most of the Lake Trout captured in a 20.7 m deep lake were distributed between depths of 6 and 15 m. In Mackenzie-Grieve and Post (2006), 83% of Lake Trout that were studied remained above the thermocline, which was at 40 to 45 m. In the absence of their preferred prey, pelagic schooling fish (i.e., Cisco), Lake Trout will eat zooplankton, benthic invertebrates, and littoral fishes, therefore occupying littoral or epilimnetic habitats even if temperatures aren't optimal (Morbey et al 2006).

Lake Trout have large home range sizes and the population in Lac de Gras have specifically been demonstrated to range over long distances in Lac de Gras. In a 2014 pit tagging study completed by DDMI and reported in their annual AEMP report (Golder 2016), fish were documented regularly moving between Lac de Gras and Lac du Sauvage and were concluded to spend time in both lakes. Nine (9) Lake Trout tagged in the study were documented up to 20 km away from their original tagging location, further demonstrating a large home range (Golder 2016). This study supports the statement that while Lake Trout may use the pit lake as thermal refuge in the warm summer months, they are not expected to exclusively inhabit the pit lake, and will instead continue to range throughout Lac de Gras and Lac du Sauvage.

Lake Whitefish, as a benthic invertivore, typically occupy the lake bed at different lake depths in response to changes in the macroinvertebrate community (Rennie et al 2015). Cisco, a pelagic species in Lac de Gras, can also occupy different lake depths, displaying vertical migrations in response to predators such as Lake Trout. For example, Cisco in Lake Superior have strong behavioral responses to light levels in relation to both predator (i.e., Lake Trout) avoidance and with prey (i.e., zooplankton) abundance, respectively (Hrabik et al 2006). Aku et al. (1997) studied Cisco distributions in a lake (maximum depth 60 m), where the deepest waters of the hypolimnion were anoxic. In the water column, Cisco were most abundant between 7 and 17 m depths, where temperature and DO concentrations were within the preferred ranges.

In the A418 pit lake, it is expected that light, dissolved oxygen and food availability (e.g., zooplankton, benthic invertebrates, schooling fish) will be limited below depths of 40 m. Lake Trout, Lake Whitefish, and Cisco are not expected to occupy areas in the water column where DO concentrations are not preferred. As described in the previous response to the second round IRs from EMAB (i.e., #30), a period of low DO could occur under unanticipated mixing scenarios. Fish present in the pelagic zone would be expected to leave the area (i.e., practice avoidance behaviour). Under the Development Case, no significant DO depletions are expected to occur in the surface water, except near the interface with the PK (at depths greater than 40m), where biota are not expected to live.

Please also see DDMI's response to *IR #8 for DDMI* for additional information on fish responses to low dissolved oxygen.

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IR #10 for DDMI

To confirm whether DDMI wishes for the Board to consider the re-mining of PK from the PKC Facility and the resulting implications to PKC Facility closure, as part of the current Amendment Application. If yes, DDMI is to provide sufficient information to allow the Board to conduct a preliminary screening, including but not limited to: a description of the proposed activities (e.g., description of procedures relating to re-mining and relocation of slimes, change of closure plan, etc.); an assessment of potential environmental and socio-economic impacts; and proposed and available mitigations related to this activity.

DDMI Response to IR #10

The option to place extra fine processed kimberlite from the PKC Facility into mine workings was included in DDMI's application (the Application) submitted on June 1, 2018 to the Wek'èezhìi Land and Water Board (WLWB) to amend Water Licence W2015L2-0001 to allow for the deposition of Processed Kimberlite (PK) into mine workings. This option was presented in Section 3.3.6 (Options for PKC Facility Closure Relating to A418 PK Storage) of the Application.

DDMI has carefully considered WLWB's *IR #10 for DDMI* to confirm whether DDMI wishes for the Board to consider the re-mining of PK from the PKC Facility, and the resulting implications to PKC Facility closure, as part of the current Amendment Application. DDMI requests that the WLWB not consider the re-mining of PK from the PKC Facility, and the resulting implications to PKC Facility closure, as part of the current Amendment Application at this time. For clarity, DDMI notes that mine working deposition aspects of PK re-mined from the PKC facility continue to form part of the current Amendment Application.

DDMI plans to continue to evaluate feasibility/practicality of moving extra fine processed kimberlite from the PKC Facility to the mine workings as part of ongoing operations and closure planning. DDMI may formally re-engage with stakeholders, including the WLWB, regarding this option in future.

IR #11 for DDMI

To provide an update to the "Studies and Report Schedule" that was provided as Attachment #10 in DDMI's responses to the public review of DDMI's Response to the WLWB Information Request, submitted by DDMI on January 8, 2019. This update is to include the two changes discussed during the Technical Session: (1) the removal of the fatal flaw assessment in 2020, and (2) the change in the PK lab consolidation testing results from H1 of 2019 to H2 of 2019.

DDMI Response to IR #11

DDMI's revised schedule of studies and reports is presented below:

Studies & Reports Schedule	Complete	2019		2020		2021		2022		2023		2024		2025
		H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1	H2	H1
Pit Lake Water Quality Modelling - Preliminary[1]	■													
Pit Lake Water Quality Modelling - PK to Mine Working			■	■										
Pit Lake Water Quality Modelling - Slimes to Mine Working					■									
PK Laboratory Consolidation Testing			■											
Hydrogeological and Geotechnical Fatal Flaw Assessment - PK to Mine Working	■													
Hydrogeological and Geotechnical Assessment - PK to Mine Working			■											
Mine Working Bulkhead Concept Review	■		■											
Processed Kimberlite Containment in Mine Working Design Report[2]				■										
Processed Kimberlite Facility Management Plan - Update for PK to Mine Working[2]						■								
Water Management Plan & Water Balance - Update for PK to Mine Working[2]						■								
Contingency Plan - Update for PK to Mine Working[2]						■								
Waste Management Plan - Update for PK to Mine Working[2]						■								
Slimes Removal from PKC - Feasibility Assessment				■										
PKC Closure Options Assessment - Dry Cover vs Wet Cover					■									
Closure and Reclamation Plan[2]								■						
Operations PK to Mine Working								■	■	■	■	■	■	■

Note:

1. Assessment complete and findings summarized in Amendment Application. No formal report prepared for distribution.
2. Studies & Reports proposed as submission requiring WLWB approval.

IR #12 for DDMI

To provide a list of the studies and plans currently included in Water Licence W2015L2-0001 that have been completed but are being proposed for retention by DDMI for compliance. DDMI is to provide rationale for why each of the studies and plans should be retained for compliance purposes.

DDMI Response to IR #12

Proposed for Retention

Part F, Item 17 - Drainage Control and Collection System Design Report: While construction of this system is complete, this Item may be useful to evaluate compliance against the design; in particular, referencing this Item would be useful should a Drainage Control and Collection System modification be required under Part H of the License.

Insufficient Rationale for Retention

Part F, Item 10, 11, 12, 13, 14, 15 & 21 – Items related to the Design and Construction of A21: Construction of the A21 Dike was completed on 20 October 2018. At the time of the Amendment Application, the A21 Dike was not complete and these items were applicable to evaluate compliance. With A21 Construction complete, DDMI can no longer provide sufficient rationale to retain these items and is not opposed to removing them from the License. This removal would also apply to **Schedule 5, Item 3 & 7**.

Part H, Item 17 – Mount Polley Report Evaluation: DDMI recognizes that this report is complete and is not applicable to the evaluation of compliance. DDMI cannot provide sufficient rationale to retain this item and is not opposed to removing it from the Water License.

Part H, Item 18 – North Inlet Hydrocarbon Investigation Report: DDMI recognizes that this report is complete and is not applicable to the evaluation of compliance. DDMI cannot provide sufficient rationale to retain this item and is not opposed to removing it from the Water License. This also applies to **Schedule 6, Item 7**.

Part H, Item 19 – North Inlet Sludge Management Report: DDMI recognizes that this report is complete and is not applicable to the evaluation of compliance. DDMI cannot provide sufficient rationale to retain this item and is not opposed to removing it from the Water License. This also applies to **Schedule 6, Item 8.**

IR #14 for DDMI

To outline its post-closure monitoring program and explain how it addresses PK deposition into Mine workings as proposed by DDMI in its Amendment Application.

DDMI Response to IR #14

Two types of post-closure monitoring programs are planned:

1. Performance monitoring specific to the open pit, underground and dike area; and
2. Environmental effects monitoring which would include combined effects from all post-closure areas.

Details on DDMI’s post-closure monitoring program are presented in Attachment-8.

IR #15 for All Parties

To identify what additional information, if any, is necessary to inform the preliminary screening determination of the Amendment Application. If any, please provide rationale for why this information is needed.

DDMI Response to IR #15

DDMI believes that the information presented in the Amendment Application and additional information provided to date, including DDMI's IR responses in this submission, demonstrate clear evidence that the proposed deposition of PK to mine workings is not likely to cause significant adverse environmental impacts to all aquatic life and water. DDMI bases this conclusion on the following:

1. A conservative (or precautionary) approach was used in the design of the PK to Mine Workings Proposal and in the assessment of potential for impacts to the environment. This approach included the development of conservative assumptions (i.e., assumptions that err on the side of over-stating the magnitude, duration, geographic extent, frequency, and likelihood of an impact; for example, conducting sensitivity analysis for scenarios ranging from plausible to improbable) and the design of mitigation measures that are more than adequate for reducing impacts to acceptable levels (for example, the proposed minimum 50 m freshwater cap for pit lakes).

2. We have run several model scenarios with predicted water quality in the surface 40 m column of flooded pits remaining below Aquatic Effects Monitoring Program (AEMP) benchmarks for all but the most implausible or very rare scenarios, provided a minimum water cover of 50 m is applied. DDMI has committed to a minimum water cover depth of at least 50 m.

3. Water quality remaining below AEMP benchmarks in the surface 40 m of the pit lakes is clear evidence of no significant adverse impact. The Comprehensive Study Report for the Diavik Diamonds Project (Canadian Environmental Assessment Agency, 1999) defined a significant adverse impact as being high magnitude, irreversible and extending to throughout Lac de Gras. The predicted water quality results are consistently low magnitude (below benchmarks) and remain local to the East Island. AEMP benchmarks were developed to be protective of all aquatic life including fish.

As part of the preliminary design process for the proposed PK to Mine Workings, DDMI engaged with a wide range of stakeholders, including our Participation Agreement partners (Tlicho Government; Lutselk'e Dene First Nation; Yellowknives Dene First Nations; North Slave Metis Alliance; Kitikmeot Inuit Association) and potentially impacted communities. The potential for impacts, proposed mitigation measures, the acceptability of residual impacts, and how mitigation might be enhanced were discussed during these stakeholder engagements. DDMI's stakeholder engagement efforts included in-person meetings, teleconferences, and open houses.

Based on the outcomes of the engagement sessions and the broad support for the PK to Mine Workings proposal from our Participation Agreement partners and communities, DDMI believes that the proposal is not likely to cause significant public concern.

<u>Reference</u>

Canadian Environmental Assessment Agency. 1999. Comprehensive Study Report, Diavik Diamonds Project.

ATTACHMENT-1

Comparison of water chemistry used as basis for assumption of future pore water chemistry from PK deposited to mine workings.

			In situ PKC Beach Pore Water[1]				In situ PKC Beach Pore Water[2] Saturated Only				In situ PKC Beach Pore Water[3] Un-saturated Only				"Fresh" PK Slurry[4]			In situ Slimes Sampled from PKC barge[5]			
Parameter	Unit	Benchmark	Average	25th%tile of PK Pore Water Data	75th%tile of PK Pore Water Data	Number of Samples	Average	25th%tile of PK Pore Water Data	75th%tile of PK Pore Water Data	Number of Samples	Average	25th%tile of PK Pore Water Data	75th%tile of PK Pore Water Data	Number of Samples	Average	Data Range	Number of Samples	Average	25th%tile of PK Pore Water Data	75th%tile of PK Pore Water Data	Number of Samples
Calcium	mg/L	-	209	15	413	55	133	12	150	27	282	87	437	28	12	1.6 - 21	3	11	8	13	23
Chloride	mg/L	120	149	89	156	53	148	92	127	25	145	84	186	29	63	33 - 86	3	39	31	43	23
Fluoride	mg/L	0.12	0.14	0.0	0.0	53	0.4	<0.4	<0.4	25	0.4	<0.4	<0.4	29	0.14	<0.1 - 0.17	2	0.059	0.056	0.063	6
Magnesium	mg/L	-	412	19	677	55	241	13	191	27	578	126	968	28	7.2	2.2 - 16	3	27	21	33	23
Potassium	mg/L	-	166	49	290	55	117	41	135	27	213	127	297	28	138	66 - 176	3	56	42	68	23
Sodium	mg/L	52	155	61	235	55	115	56	131	27	194	89	264	28	85	43 - 109	3	54	46	63	23
Sulfate	mg/L	100	2315	112	4283	53	1327	57	969	25	3088	679	4887	29	208	59 - 329	3	197	162	234	23
Phosphate, Ortho	mg/L-P	-	0.059	<0.065	<0.13	53	0.065	0.033	0.131	25	0.065	0.033	0.131	29	0.031	<0.1 - 0.09	2	0.032	0.06	0.13	23
Phosphorus	mg/L	-	0.065	< 0.01	< 0.035	55	0.035	<0.003	<0.035	27	0.10	<0.01	0.063	28	0.035	<0.035 - <0.035	2	0.039	<0.035	<0.035	18
Aluminum	µg/L	87	153	21	93	55	172	24	80	27	134	18	140	28	0.14	<0.2 - 0.0054	3	2.8	<0.2	1.7	23
Antimony	µg/L	33	5.4	4.6	6.5	55	5.8	5.0	6.9	27	5.1	4.2	6.1	28	18	5.2 - 28	3	2.7	0.9	4.3	23
Arsenic	µg/L	5	3.0	2.2	3.7	55	3.0	2.3	3.7	27	3.1	2.2	3.5	28	5.9	1.6 - 11	3	4.8	3.1	6.1	23
Barium	µg/L	1000	449	124	438	55	452	72	432	27	446	150	434	28	155	81 - 264	3	51	43	58	23
Beryllium	µg/L	-	0.27	< 0.02	< 0.08	55	0.24	<0.08	<0.08	27	0.25	<0.25	<0.25	28	0.59	<0.03 - 0.59	3	3.3	<0.03	0.2	23
Boron	µg/L	1500	56	44	73	55	51	38	70	27	61	47	74	28	71	48 - 105	3	30	<0.2	50	23
Cadmium	µg/L	0.1	0.92	0.28	1.18	55	0.78	0.2	1.18	27	1.06	0.62	1.1	28	0.2	0.082 - 0.3	3	0.51	0.13	0.72	23
Cobalt	µg/L	-	5.6	0.52	7.35	55	1.6	0.4	2.3	27	9.4	2.5	9.8	28	0.19	0.17 - 0.2	3	0.15	<0.01	0.16	23
Copper	µg/L	2	8.6	3.0	11.8	55	7.5	2.5	7.7	27	9.8	4.2	13.8	28	2.6	<0.07 - 3.8	3	1.0	0.4	1.1	23
Iron	µg/L	300	234	18	171	55	97	15	76	27	366	32	310	28	1.4	<0.2 - 3.8	3	63	2	31	23
Lead	µg/L	1	0.88	0.16	0.79	55	0.65	0.14	0.56	27	1.09	0.38	0.83	28	0.51	0.068 - 1	3	0.28	0.02	0.23	23
Lithium	µg/L	-	3.8	2.1	5.2	55	2.9	1.4	4.0	27	4.6	2.5	6.9	28	5.0	5 - 5	1	-	0	0	0
Manganese	µg/L	-	82	11	116	55	31	6	38	27	131	21	173	28	0.34	<0.07 - 0.92	3	6.1	1.9	7.9	23
Molybdenum	µg/L	73	504	213	679	55	452	155	562	27	555	320	683	28	242	189 - 278	3	385	330	430	23
Nickel	µg/L	25	189	8.8	267.1	55	78	5	90	27	296	69	380	28	2.5	1.4 - 4.3	3	10	6	13	23
Selenium	µg/L	1	18	1.8	27.5	55	5	<0.2	2	27	23	8	34	28	0.72	0.72 - 0.72	1	0.5	0.08	0.58	22
Silicon	µg/L	2100	2605	<700	3880	55	2000	<200	<2000	27	3245	2386	4432	28	2781	2300 - 2300	3	1626	864	1182	23
Silver	µg/L	0.25	0.41	<0.004	0.314	55	0.24	<0.05	0.27	27	0.55	0.0	0.38	28	Note 6			Note 6			
Strontium	µg/L	30000	6701	< 1000	12510	55	4306	500	5118	27	8753	2446	12705	28	298	0.56 - 840	3	349	284	389	23
Sulfur	µg/L	-	782981	43195	1382000	55	474037	30575	364900	27	1080890	255600	1691750	28	92090	78180 - 106000	2	54820	47730	66130	7
Thallium	µg/L	0.8	0.65	0.26	0.72	55	0.5	0.25	0.46	27	0.8	0.32	0.89	28	0.16	<0.006 - 0.25	3	0.11	<0.07	0.06	23
Tin	µg/L	73	7.3	3.1	9.4	55	5.2	1.7	5.7	27	9.3	4.9	11.0	28	4.1	0.38 - 11	3	1.6	0.0	2.1	23
Titanium	µg/L	-	1.8	< 0.2	< 2.0	55	2.0	<2	<2	27	2.0	<2	<2	28	0.25	<0.2 - 0.34	3	1.1	0.0	0.3	23
Uranium	µg/L	15	1.1	0.061	1.099	55	0.7	0.0	0.1	27	1.6	0.3	2.0	28	0.2	0.058 - 0.45	3	0.56	0.01	0.8	17
Vanadium	µg/L	-	1.9	0.64	2.34	55	1.1	0.5	1.5	27	2.6	1.5	3.0	28	1.4	<0.03 - 2.8	3	1.3	0.0	2.1	23
Zinc	µg/L	30	348	15	321	55	130	10	113	27	557	64	418	28	2.5	7.4 - 7.4	3	136	1	13	23

1 Data from Moncur and Smith (2014) - assumed as basis for modelling pore water quality in Golder (2018)
2 Results summary for only samples from (1) with saturated conditions
3 Results summary for only samples from (1) with un-saturated conditions
4 Results from direct sampling of PK slurry as discharged to the PKC - 1 sample from each of 2009, 2012, 2013.
5 *In situ* slimes samples were collectedin 2009, 2010 and 2011 from piezometers installed at depths from 10-75 ft beneath the water surface at the PKC Reclaim barge
6 DDMI is not confident in the in situ slimes/slurry results and for the current modelling have assumed a slimes/slurry pore water quality of 0.24ug/L based on results for the saturated zone of in situ PK.

ATTACHMENT-2

Pore water chemistry assumed for the Technical Session IR-5

Parameter	Unit	Benchmark	Chemistry assumed for PK Pore Water	Chemistry assumed for Slimes Pore Water
Calcium	mg/L	-	12	11
Chloride	mg/L	120	63	39
Fluoride	mg/L	0.12	0.14	0.059
Magnesium	mg/L	-	7.2	27
Potassium	mg/L	-	138	56
Sodium	mg/L	52	85	54
Sulfate	mg/L	100	208	197
Nitrite as nitrogen	mg/L	0.06	0.6	0.6
Nitrate as nitrogen	mg/L	3	16.8	16.8
Ammonia	mg/L	4.7	2.2	2.2
Phosphate, Ortho	mg/L-P	-	0.031	0.032
Phosphorus	mg/L	-	0.035	0.039
Aluminum	µg/L	87	0.14	2.8
Antimony	µg/L	33	18	2.7
Arsenic	µg/L	5	5.9	4.8
Barium	µg/L	1000	155	51
Beryllium	µg/L	-	0.59	3.3
Boron	µg/L	1500	71	30
Cadmium	µg/L	0.1	0.2	0.51
Cobalt	µg/L	-	0.19	0.15
Copper	µg/L	2	2.6	1.0
Iron	µg/L	300	1.4	63
Lead	µg/L	1	0.51	0.28
Lithium	µg/L	-	5.0	-
Manganese	µg/L	-	0.34	6.1
Molybdenum	µg/L	73	242	385
Nickel	µg/L	25	2.5	10
Selenium	µg/L	1	0.72	0.5
Silicon	µg/L	2100	2781	1626
Silver	µg/L	0.25	0.24	0.24
Strontium	µg/L	30000	298	349
Sulfur	µg/L	-	92090	54820
Thallium	µg/L	0.8	0.16	0.11
Tin	µg/L	73	4.1	1.6
Titanium	µg/L	-	0.25	1.1
Uranium	µg/L	15	0.2	0.56
Vanadium	µg/L	-	1.4	1.3
Zinc	µg/L	30	2.5	136

ATTACHMENT-3

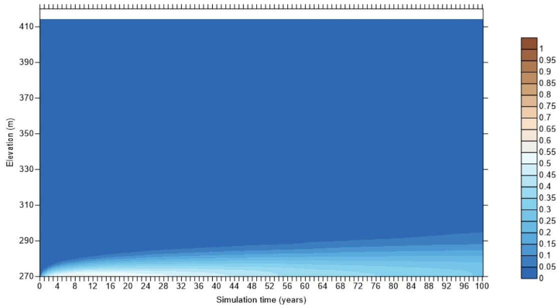
Predicted Maximum Daily Concentrations in the Surface Water (Top Section and at 40m) of A418 Pit Lake over 100-year Period after Closure

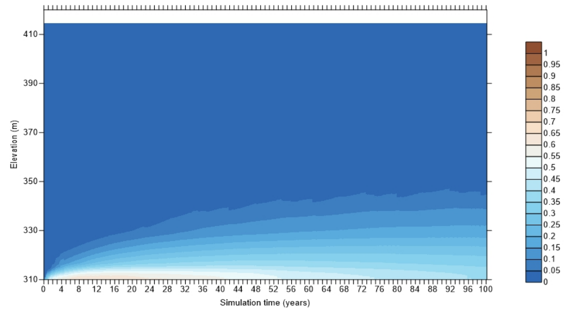
Parameters	Unit	Benchmark	Scenario 2-a (Development Case, 150 m Water Cap)		Scenario 3-a (111 m Water Cap)		Scenario 4-a (Development Case, 150 m Water Cap)	
			Top Section	at Depth of 40 m Below Surface	Top Section	at Depth of 40 m Below Surface	Top Section	at Depth of 40 m Below Surface
Calcium	mg/L	-	2.6	2.6	2.6	2.7	2.6	2.6
Chloride	mg/L	120	3.5	3.5	3.6	3.7	3.5	3.5
Fluoride	mg/L	0.12	0.034	0.034	0.034	0.034	0.034	0.034
Magnesium	mg/L	-	1.2	1.2	1.2	1.2	1.2	1.2
Potassium	mg/L	-	1.1	1.1	1.3	1.4	1.1	1.1
Sodium	mg/L	52	3.1	3.1	3.2	3.3	3.1	3.1
Sulfate	mg/L	100	4.0	4.0	4.4	4.7	4.0	4.0
Nitrite as nitrogen	mg/L	0.06	0.001	0.001	0.0022	0.0031	0.00099	0.0011
Nitrate as nitrogen	mg/L	3	0.061	0.063	0.096	0.12	0.061	0.064
Ammonia_N	mg/L	4.7	0.038	0.038	0.043	0.046	0.038	0.039
Phosphate, Ortho	mg/L	-	0.0016	0.0016	0.0017	0.0017	0.0016	0.0016
Phosphorus	mg/L	-	0.0036	0.0036	0.0036	0.0037	0.0036	0.0036
Aluminum	µg/L	87	6.3	6.3	6.3	6.3	6.3	6.3
Antimony	µg/L	33	0.039	0.041	0.058	0.073	0.039	0.042
Arsenic	µg/L	5	0.28	0.28	0.29	0.3	0.28	0.28
Barium	µg/L	1000	3.5	3.5	3.7	3.8	3.5	3.5
Beryllium	µg/L	-	0.0052	0.0053	0.0097	0.0126	0.0052	0.0053
Boron	µg/L	1500	2.9	2.9	3.0	3.1	2.9	2.9
Cadmium	µg/L	0.1	0.0029	0.0029	0.0037	0.0042	0.0029	0.0029
Cobalt	µg/L	-	0.017	0.017	0.017	0.017	0.017	0.017
Copper	µg/L	2	0.59	0.59	0.6	0.6	0.59	0.59
Iron	µg/L	300	4.1	4.1	4.2	4.2	4.1	4.1
Lead	µg/L	1	0.0034	0.0035	0.0042	0.0048	0.0035	0.0035
Lithium	µg/L	-	2.0	2.0	-	-	2.0	2.0
Manganese	µg/L	-	3.3	3.3	3.3	3.3	3.3	3.3
Molybdenum	µg/L	73	0.96	0.99	1.6	2.1	0.97	1.0
Nickel	µg/L	25	0.77	0.77	0.78	0.79	0.77	0.77
Selenium	µg/L	1	0.02	0.02	0.021	0.022	0.02	0.02
Silicon	µg/L	2100	187	187	191	194	187	187
Silver	µg/L	0.25	0.0026	0.0026	0.0031	0.0034	0.0026	0.0026
Strontium	µg/L	30000	35	35	36	36	35	35
Sulfur	µg/L	-	1601	1612	1745	1852	1605	1617
Thallium	µg/L	0.8	0.0012	0.0012	0.0014	0.0016	0.0012	0.0012
Tin	µg/L	73	0.012	0.012	0.017	0.021	0.012	0.013
Titanium	µg/L	-	0.51	0.51	0.51	0.51	0.51	0.51
Uranium	µg/L	15	0.12	0.12	0.12	0.12	0.12	0.12
Vanadium	µg/L	-	0.1	0.11	0.11	0.11	0.1	0.11
Zinc	µg/L	30	0.21	0.21	0.38	0.48	0.21	0.21

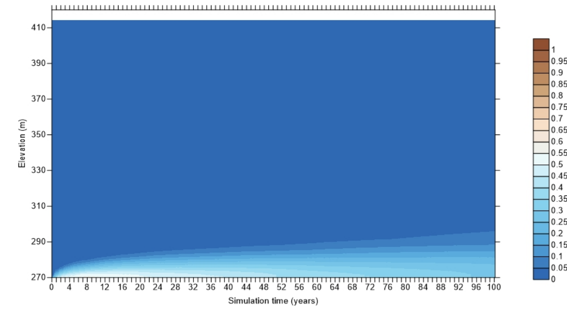
ATTACHMENT-4

Scenario 2-a (Development Case, 150 m Water Cap) | **Scenario 3-a (111 m Water Cap)** | **Scenario 4-a (Development Case, 150 m Water Cap)**

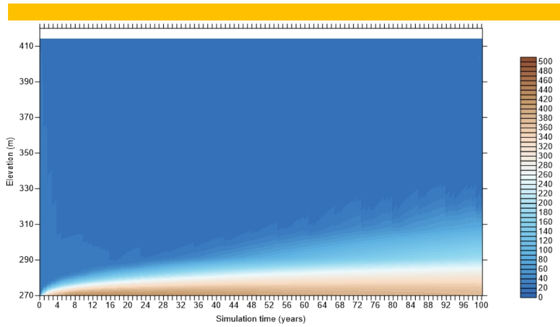
Tracer Plots

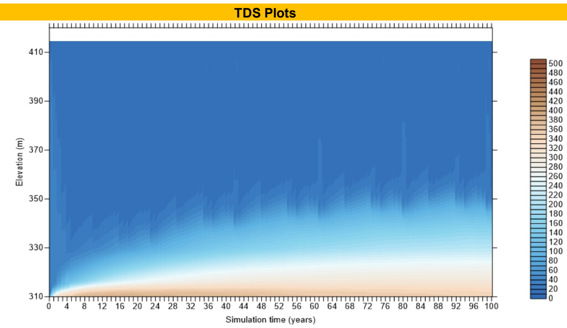


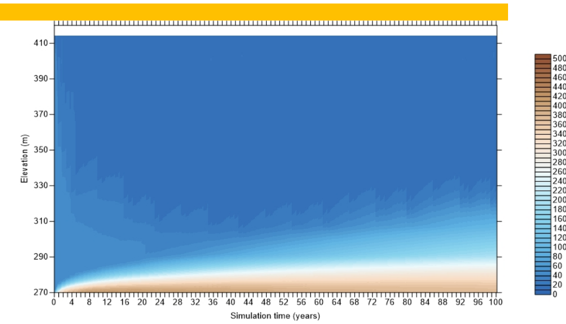




TDS Plots

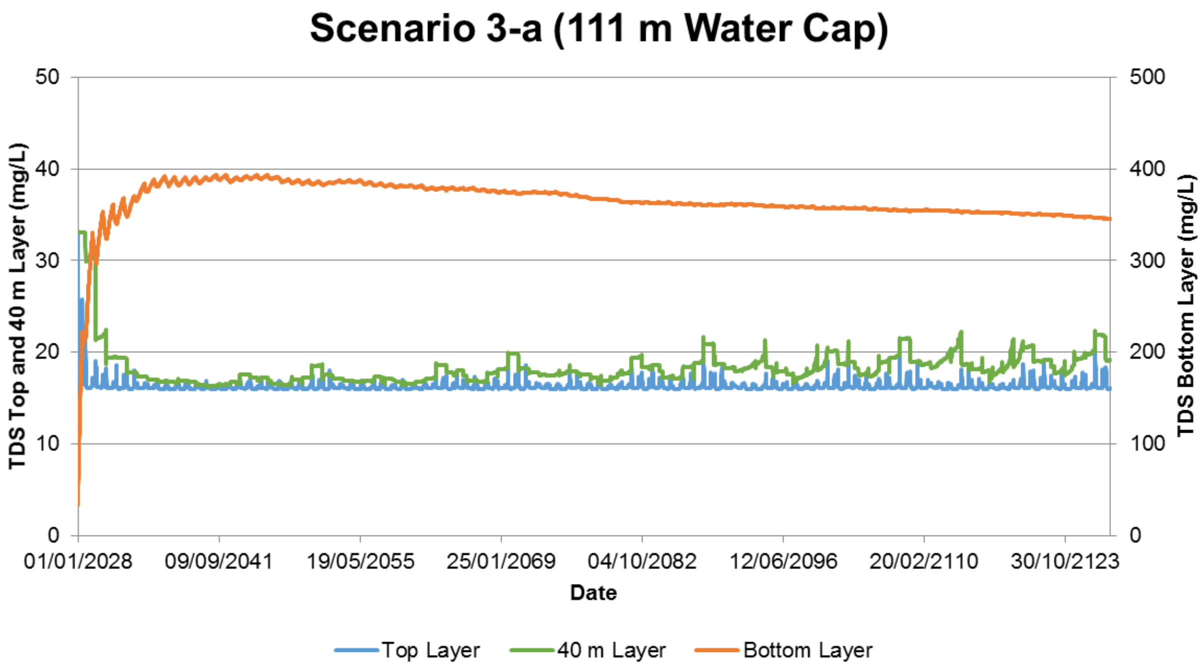


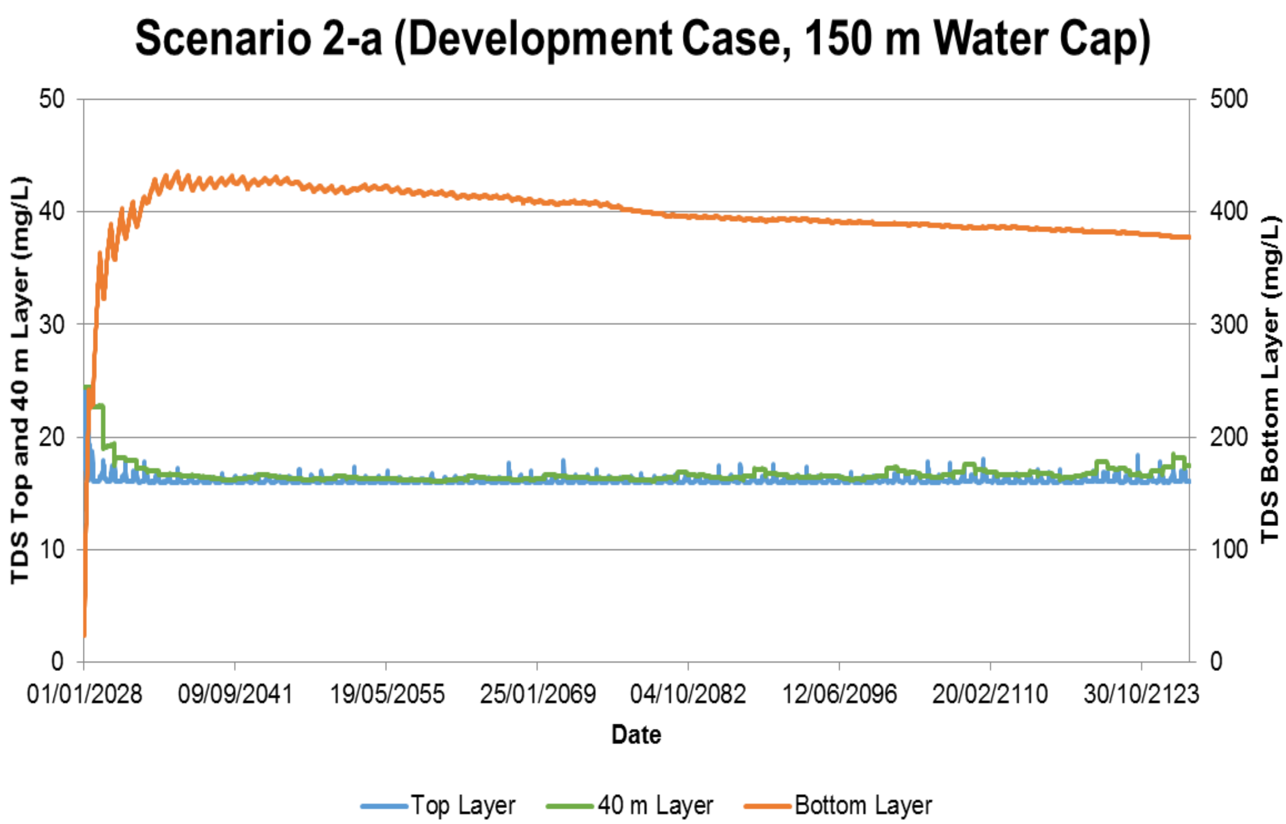


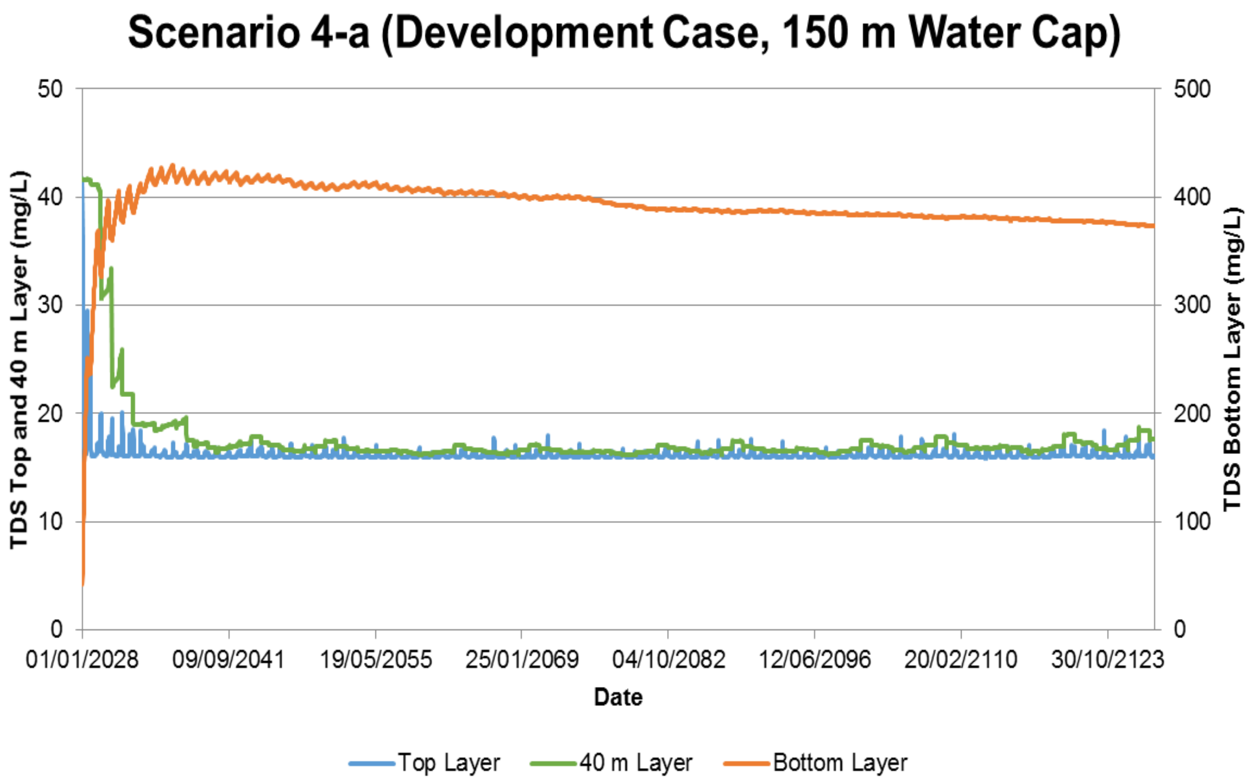


ATTACHMENT-5

Time series Plots of Total Dissolved Solids (TDS)



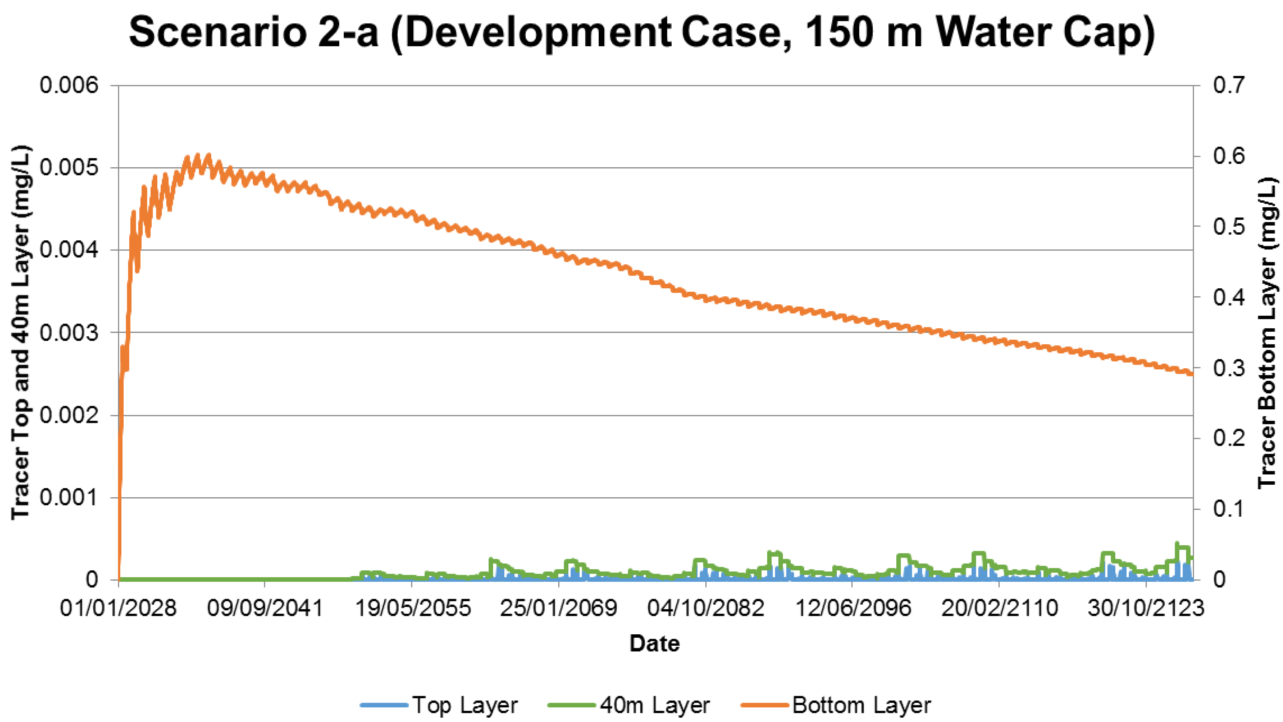


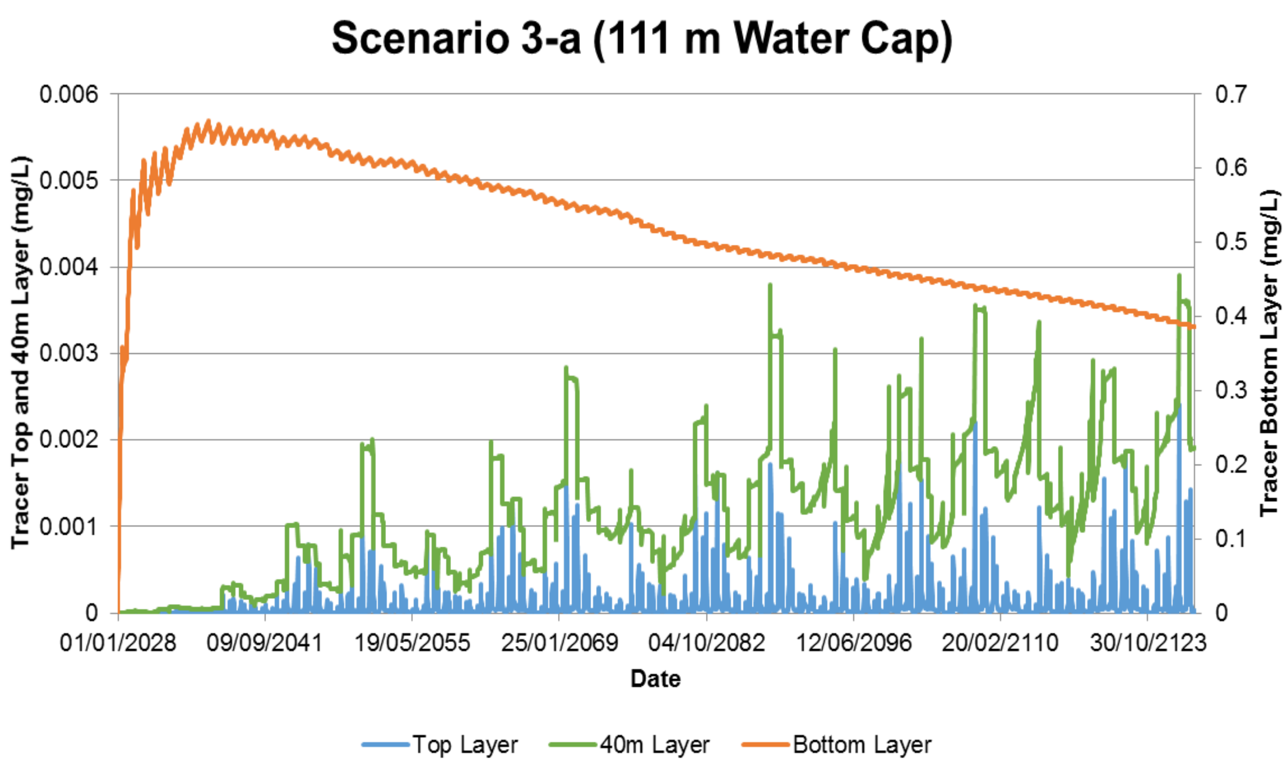


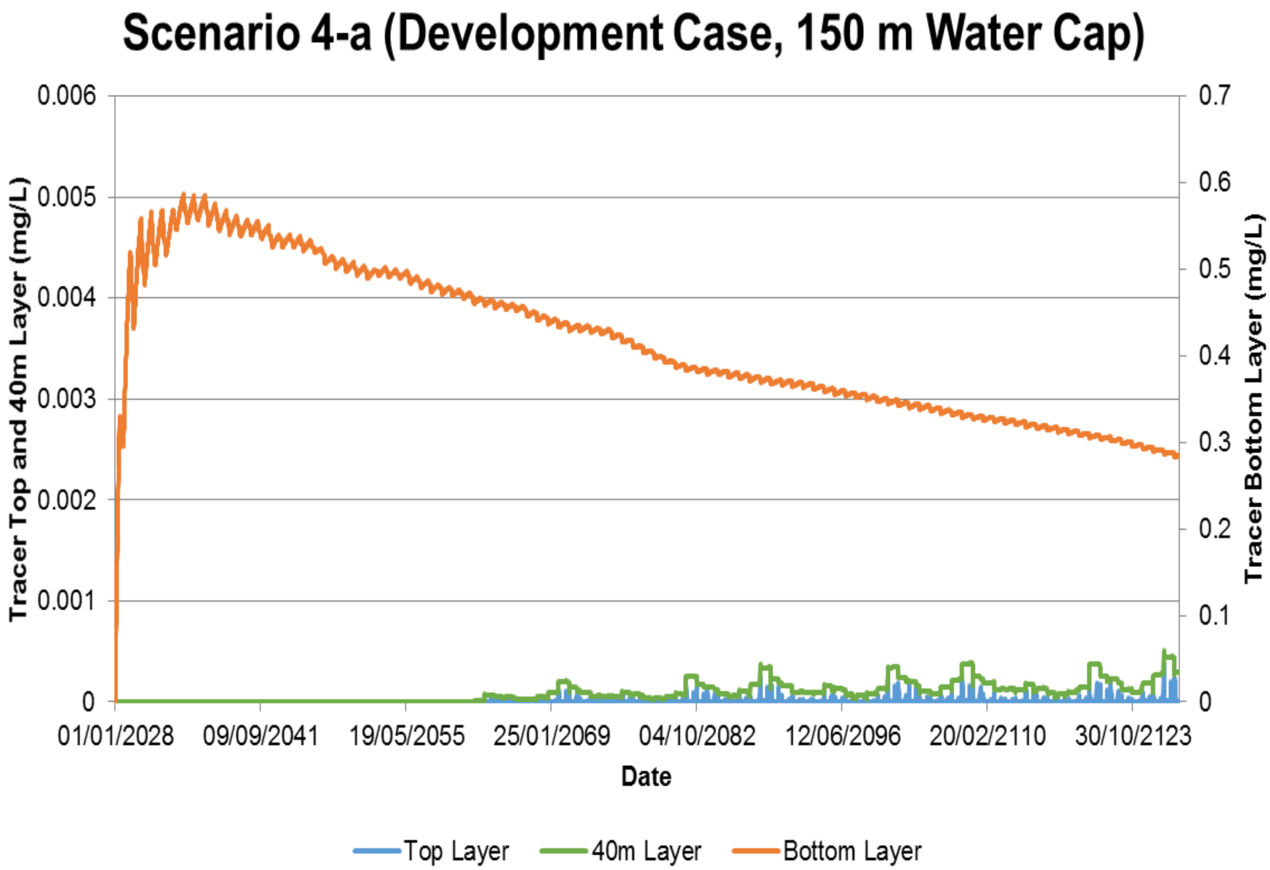
Scenario 4-a (Development Case, 150 m Water Cap)
TDS Top and 40 m Layer (mg/L)
TDS Bottom Layer (mg/L)
50
40
30
20
10
0
500
400
300
200
100
0
01/01/2028
09/09/2041
19/05/2055
25/01/2069
04/10/2082
12/06/2096
20/02/2110
30/10/2123
Date
Top Layer
40 m Layer
Bottom Layer

ATTACHMENT-6

Time series Plots of Tracer Concentrations







Scenario 4-a (Development Case, 150 m Water Cap)
Tracer Top and 40m Layer (mg/L)
Tracer Bottom Layer (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
01/01/2028
09/09/2041
19/05/2055
25/01/2069
04/10/2082
12/06/2096
20/02/2110
30/10/2123
Date
Top Layer
40m Layer
Bottom Layer

ATTACHMENT-7

Results for an unanticipated event causing fully mixed conditions in A418 Pit Lake (Year 100)

Parameters	Unit	Benchmark	Scenario 2-a (Development Case, 150 m Water Cap)	Scenario 3-a (111 m Water Cap)	Scenario 4-a (Development Case, 150 m Water Cap)
Calcium	mg/L	-	3.2	3.6	3.2
Chloride	mg/L	120	7.0	8.7	7.0
Fluoride	mg/L	0.12	0.04	0.041	0.04
Magnesium	mg/L	-	1.5	2.9	1.5
Potassium	mg/L	-	9.1	12	9.1
Sodium	mg/L	52	7.9	10	7.9
Sulfate	mg/L	100	16	26	16
Nitrite as nitrogen	mg/L	0.06	0.035	**0.065**	0.036
Nitrate as nitrogen	mg/L	3	1.0	1.9	1.0
Ammonia_N	mg/L	4.7	0.16	0.27	0.16
Phosphate, Ortho	mg/L	-	0.0033	0.0049	0.0033
Phosphorus	mg/L	-	0.0054	0.0072	0.0054
Aluminum	µg/L	87	6.0	5.8	6.0
Antimony	µg/L	33	1.1	1.2	1.1
Arsenic	µg/L	5	0.61	0.84	0.61
Barium	µg/L	1000	12	14	12
Beryllium	µg/L	-	0.039	0.22	0.039
Boron	µg/L	1500	6.9	8.2	6.9
Cadmium	µg/L	0.1	0.014	0.042	0.014
Cobalt	µg/L	-	0.027	0.034	0.027
Copper	µg/L	2	0.71	0.72	0.71
Iron	µg/L	300	4.0	7.2	4.0
Lead	µg/L	1	0.033	0.046	0.033
Lithium	µg/L	-	2.2	-	2.2
Manganese	µg/L	-	3.1	3.3	3.1
Molybdenum	µg/L	73	15	35	15
Nickel	µg/L	25	0.87	1.4	0.87
Selenium	µg/L	1	0.061	0.085	0.062
Silicon	µg/L	2100	339	407	339
Silver	µg/L	0.25	0.016	0.029	0.017
Strontium	µg/L	30000	50	67	50
Sulfur	µg/L	-	6901	9462	6922
Thallium	µg/L	0.8	0.01	0.016	0.01
Tin	µg/L	73	0.25	0.32	0.25
Titanium	µg/L	-	0.5	0.53	0.5
Uranium	µg/L	15	0.12	0.15	0.12
Vanadium	µg/L	-	0.18	0.24	0.18
Zinc	µg/L	30	0.34	7.8	0.34

Bold: exceeding benchmark

ATTACHMENT-8

Appendix VI Post Closure Monitoring and Reporting

VI-1 Open Pit, Underground and Dike Areas

VI-2 Wasterock and Till Area (See NCRP-WRSA Final Closure Plan V1.1)

VI-3 Processed Kimberlite Containment Area

VI-4 North Inlet Area

VI-5 Mine Infrastructure Areas

Appendix VI-1 Post Closure Monitoring and Reporting - Open Pit, Underground and Dike Areas

Two types of post-closure monitoring programs are planned: performance monitoring specific to the open pit, underground and dike area and environmental effects monitoring which would include combined effects from all post-closure areas. These are described in Section 1.0 with the type and frequency of reporting described in Section 2.0.

1.0 Performance Monitoring

1.1 Geotechnical

During mining operation the dike, open-pit and underground areas undergo regular geotechnical inspections. As fish habitat work within the dike areas are complete geotechnical inspections will review these areas. Once the underground and pit areas have been flooded inspections will focus on dike and shoreline stability. No geotechnical instrumentation is planned once the back-flooding is complete.

An aerial drone survey will be conducted starting the year prior to back-flooding and then for the following 5 years. The survey before back-flooding will document the constructed fish habitat in each dike area and be submitted separately to Fisheries and Oceans Canada.

1.2 Water Quality

Water quality is monitored during operations at several SNP locations that include underground mine water, open-pit mine water and dike seepage water. This monitoring will cease once back-flooding commences. Immediately following completion of the back-flooding of each of the A154, A418 and A21 dike areas, post-closure SNP monitoring of the dike areas will begin at the following SNP locations:

SNP Site #	Description
1645-87 (new)	A154 Back-flooded area
1645-88 (new)	A418 Back-flooded area
1645-89 (new)	A21 Back-flooded area

Water quality will be sampled monthly until water quality is approved to allow breaching of each dike. Samples will be collected from surface, 15m depth and 30m depths. Water samples will be analyzed for the parameters listed below (source W2015L2-0001 – SNP 1645-81). Profiles for temperature, turbidity, conductivity and dissolved oxygen will be recorded over the first 30 m of depth during each sampling event. Twice per year deep water quality samples will be collected from approximately 25 m above the pit bottom, if feasible.

Sampling Parameters:	Total Ammonia, Field Parameters[3], ICP-MS Metal Scan[1](Total), Major Ions[2], pH[4], Total Petroleum Hydrocarbons

After each of the dikes have been breached and rejoined with Lac de Gras the frequency of SNP monitoring will be reduced to twice per year.

1.3 Wildlife

DDMI will employ existing monitoring procedures (as updated from time-to-time) to record wildlife use of the mine and dike areas and observations of behavior when animals are present in these areas. These procedures include:

ENVR-031-0720 – Caribou Road Surveys
ENVR-517-0912 – Caribou Management/Observation
ENVR-531-0812 – Wildlife Monitoring

1.4 Dust

DDMI will use the existing Total Suspended Particulate (TSP) monitoring system and procedures (as updated from time-to-time) combined with visual observations to monitoring dust generated from the dike and mine areas post-closure. This monitoring will begin during at the same time as back-flooding.

1.5 Environmental Effects Monitoring

DDMI implements two environmental effects monitoring programs:

- Aquatic Effects Monitoring Program (AEMP)
- Wildlife Effects Monitoring Program (WEMP)

These are defined programs, updated or revised as warranted, to monitor mine effects on the Lac de Gras aquatic ecosystem and wildlife within a defined study area. These programs are conducted annually with specific scopes varying from year to year. For example the AEMP has an expanded program every three years and a base program annually. Towards the end of commercial operations, DDMI expects to reduce the scope and/or frequency of these programs as the need to implement operational management responses declines. Near-Field AEMP sampling locations will be adjusted to target runoff/seepage and water quality through dike breaches rather than the NIWTP effluent discharge. The attached Figure VI-1 shows the proposed relocated near-field AEMP stations renamed near-field closure (NFC). After the end of commercial production DDMI will continue these monitoring programs to monitor responses to the cessation of mining operations. The frequency would be reduced to every three years.

2.0 Reporting

2.1 Reclamation Completion Reporting

At the end of the calendar year following each of the dike breach excavations DDMI and the Engineer of Record will prepare a Reclamation Completion Report. The report shall include:

- Daily construction reports;
- Photographic documentation of construction works;
- Summary of construction problems and resolutions; and
- Completed construction checklist.

This report will be submitted to the WLWB as per Part K Item 5.

2.2 Performance Assessment Report.

Once sufficient information is available to evaluate the performance of the back-flooded dike area generally and Closure Objectives and Closure Criteria specifically, DDMI will submit a Performance Assessment Report to the WLWB for approval under Part K Item 6. The Report will be developed in accordance with the Mackenzie Valley Land and Water Board's *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites within the Northwest Territories*.

3.0 Monitoring and Reporting Schedule

The anticipated monitoring and reporting schedule for the dike area and site wide effects monitoring is shown below. This schedule is subject to change based on actual construction timeline as well as results from inspections and monitoring programs. The number of years of post-construction monitoring required to adequately assess performance is unknown at this time and will depend upon the results obtained. The monitoring duration will be adaptively managed to be responsive to conditions as they are evaluated. DDMI has assumed 3 year of monitoring after the dikes have been breached to provide sufficient information to support an assessment report.

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Geotechnical inspections																
Water quality monitoring																
Dust Monitoring																
Wildlife Use Monitoring																
Aquatic Effects Monitoring																
Wildlife Effects Monitoring																
Annual CRP Progress Reporting																
Reclamation Completion Report																
Performance Assessment Report																

Appendix VI-3 Post Closure Monitoring and Reporting - Processed Kimberlite Containment Area

Two types of post-closure monitoring programs are planned: performance monitoring specific to the Processed Kimberlite Containment (PKC) area and environmental effects monitoring which would include combined effects from all post-closure areas. These are described in Section 1.0 with the type and frequency of reporting described in Section 2.0.

1.0 Performance Monitoring

1.1 Geotechnical

Presently the PKC is inspected weekly to identify any stability issues and to identify seepage/runoff. This inspection frequency will continue until the end of commercial operations after which it will reduce to monthly (November to May) and weekly June to October.

Observation wells, collection wells, thermistors and slope inclinometers have been installed in the PKC area to monitor operational performance. Much of this instrumentation is expected to remain post-closure, however the final determination of post-closure instrumentation will not be made until the final closure plan is prepared.

Annually, visual inspection will include an aerial drone surveys. These surveys will commence with the end of commercial production.

1.2 Seepage/Runoff Water Quality

Seepage/runoff and PKC pond water quality monitoring is proposed at the following SNP locations:

SNP Site #	**Description**
1645-42	Collection Pond 4
1645-69	Collection Pond 5
1645-44	Collection Pond 7
1645-16	PKC Pond water within the PKC
1645-31	Groundwater GW4 West of PKC
1645-32	Groundwater GW4 South of PKC, between the Ammonia Nitrate Storage and Pond 7
1645-77	PKC Seepage
1645-78	PKC Seepage
1645-79	PKC Seepage
1645-80	PKC Seepage

Seepage or runoff quality will be sampled at a weekly frequency if sufficient volumes are identified during the weekly geotechnical inspections. Water samples will be analyzed for the following (source W2015L2-0001 – SNP 1645-81):

Sampling Parameters:	Total Ammonia, Field Parameters[3], ICP-MS Metal Scan[1](Total), Major Ions[2], pH[4], Total Petroleum Hydrocarbons

SNP 1645-42,69 and 1645-44 are currently located within the collection ponds. Once collection ponds are breached, DDMI proposes to relocate these stations to the outlet channel.

Additionally if the estimated flow volume from 1645-42, 69 or 44 is greater than 10 L/s following breaching of the collection ponds then a sample will also be collected quarterly and assessed for acute lethality to rainbow trout, *Oncorhynchus mykiss* as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13.

SNP 1645-31 and 1645-32 are currently inactive. DDMI will reactivate them post-closure to either confirm absence of groundwater flow or measure the quality of detected flow.

1.3 Wildlife

DDMI will employ existing monitoring procedures (as updated from time-to-time) to record wildlife use of the PKC area and observations of behavior when animals are present in the PKC area. These procedures include:

ENVR-031-0720 – Caribou Road Surveys
ENVR-032-0721 – Caribou PKC & NCRP Use
ENVR-517-0912 – Caribou Management/Observation
ENVR-531-0812 – Wildlife Monitoring

1.4 Dust

DDMI will use the existing Total Suspended Particulate (TSP) monitoring system and procedures (as updated from time-to-time) combined with visual observations to monitoring dust generated from the PKC area. This monitoring will begin during erosion cover placement and continue after the end of commercial production.

1.5 Environmental Effects Monitoring

DDMI implements two environmental effects monitoring programs:

- Aquatic Effects Monitoring Program (AEMP)
- Wildlife Effects Monitoring Program (WEMP)

These are defined programs, updated or revised as warranted, to monitor mine effects on the Lac de Gras aquatic ecosystem and wildlife within a defined study area. These programs are conducted annually with specific scopes varying from year to year. For example the AEMP has an expanded program every three years and a base program annually. Towards the end of commercial operations, DDMI expects to reduce the scope and/or frequency of these programs as the need to implement operational management responses declines. Near-Field AEMP sampling locations will be adjusted to target runoff/seepage and water quality through dike breaches rather than the NIWTP effluent discharge. The attached Figure VI-1 shows the proposed relocated near-field AEMP stations renamed near-field closure (NFC). After the end of commercial production DDMI will continue these monitoring programs to monitor responses to the cessation of mining operations. The frequency would be reduced to every three years.

2.0 Reporting

2.1 Reclamation Completion Reporting

Upon completion of construction activities at the end of each calendar year, DDMI and the Engineer of Record will prepare a Construction Record summary report. The report shall include:

- Daily construction reports;
- All testing records including a summary of all test sample locations and test results;

- Photographic documentation of construction works;
- Summary of construction problems and resolutions; and
- Completed construction checklist.

Upon completion of the PKC closure construction, a single comprehensive PKC Reclamation Completion Report will be prepared by the Construction Management team and Engineer of Record for submission to the WLWB as per Part K Item 5.

2.2 Performance Assessment Report.

Once sufficient information is available to evaluate the performance of the PKC closure design generally and Closure Objectives and Closure Criteria specifically, DDMI will submit a Performance Assessment Report to the WLWB for approval under Part K Item 6. The Report will be developed in accordance with the Mackenzie Valley Land and Water Board's *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites within the Northwest Territories*.

3.0 Monitoring and Reporting Schedule

The anticipated monitoring and reporting schedule for the PKC and site wide effects monitoring is shown below. This schedule is subject to change based on actual construction timeline as well as results from inspections and monitoring programs. The number of years of post-construction monitoring required to adequately assess performance is unknown at this time and will depend upon the results obtained. The monitoring duration will be adaptively managed to be responsive to conditions as they are evaluated. DDMI has assumed 3 year of monitoring from the time the PKC closure is completed until there is sufficient information to prepare an assessment report.

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Geotechnical inspections																
Seepage/Run-off monitoring																
Dust Monitoring																
Wildlife Use Monitoring																
Aquatic Effects Monitoring																
Wildlife Effects Monitoring																
Annual CRP Progress Reporting																
Reclamation Completion Report																
Performance Assessment Report																

Appendix VI-4 Post Closure Monitoring and Reporting - North Inlet Area

Two types of post-closure monitoring programs are planned: performance monitoring specific to the North Inlet (NI) and environmental effects monitoring which would include combined effects from all post-closure areas. These are described in Section 1.0 with the type and frequency of reporting described in Section 2.0.

1.0 Performance Monitoring

1.1 Geotechnical

Presently the NI is inspected weekly to identify any geotechnical issues. This inspection frequency will continue until the end of commercial operations after which it will reduce to monthly (November to May) and weekly June to October.

Thermistors and slope inclinometers installed for operations monitoring will remain post-closure. Once the NI area has been decommissioned the inspections will focus on the east dam and shoreline stability. No geotechnical instrumentation is planned once the east dam has been breached.

Annually, visual inspection will include an aerial drone survey of the area. These inspections will begin prior to decommissioning and continue until 2032.

1.2 Water Quality

SNP monitoring of the NI and NIWTP will continue as per operations when the NIWTP is operating. Once NIWTP operations are no longer required water quality monitoring is proposed at the following SNP locations:

SNP Site #	Description
1645-13	North Inlet – Influent prior to treatment

Water quality will be monitored monthly and analyzed for the following parameters (source W2015L2-0001 – SNP 1645-81):

Sampling Parameters:	Total Ammonia, Field Parameters[3], ICP-MS Metal Scan[1](Total), Major Ions[2], pH[4], Total Petroleum Hydrocarbons

Once water quality in the NI is approved for breaching of the NI east dam, then the monitoring frequency at 1645-13 will reduce to twice per year.

1.3 Sediment Quality

A sediment quality investigation will be conducted at the end of commercial operations to evaluate the sediment conditions in the NI. The investigation will follow the scope and procedures used in 2015 (Golder 2016 *Consolidated Report: North Inlet Sludge Management Report and North Inlet Hydrocarbon Investigation Report*. February 25, 2016).

1.4 Wildlife

DDMI will employ existing monitoring procedures (as updated from time-to-time) to record wildlife use of the NI area and observations of behavior when animals are present on the NCRP. These procedures include:

ENVR-031-0720 – Caribou Road Surveys
ENVR-517-0912 – Caribou Management/Observation
ENVR-531-0812 – Wildlife Monitoring

1.5 Dust

DDMI will use the existing Total Suspended Particulate (TSP) monitoring system and procedures (as updated from time-to-time) combined with visual observations to monitoring dust generated from the NI area. This monitoring will begin during decommissioning of the NI east dam.

1.6 Environmental Effects Monitoring

DDMI implements two environmental effects monitoring programs:

- Aquatic Effects Monitoring Program (AEMP)
- Wildlife Effects Monitoring Program (WEMP)

These are defined programs, updated or revised as warranted, to monitor mine effects on the Lac de Gras aquatic ecosystem and wildlife within a defined study area. These programs are conducted annually with specific scopes varying from year to year. For example the AEMP has an expanded program every three years and a base program annually. Towards the end of commercial operations, DDMI expects to reduce the scope and/or frequency of these programs as the need to implement operational management responses declines. Near-Field AEMP sampling locations will be adjusted to target runoff/seepage and water quality through dike breaches rather than the NIWTP effluent discharge. The attached Figure VI-1 shows the proposed relocated near-field AEMP stations renamed near-field closure (NFC). After the end of commercial production DDMI will continue these monitoring programs to monitor responses to the cessation of mining operations. The frequency would be reduced to every three years.

2.0 Reporting

2.1 Reclamation Completion Reporting

Upon completion of NI closure DDMI and the Engineer of Record will prepare a North Inlet Reclamation Completion Report. The report shall include:

- Daily construction reports;
- All testing records including a summary of all test sample locations and test results;
- Photographic documentation of construction works;
- Summary of construction problems and resolutions; and
- Completed construction checklist.

This report will be submitted to the WLWB as per Part K Item 5.

2.2 Performance Assessment Report.

Once sufficient information is available to evaluate the performance of the NI generally and Closure Objectives and Closure Criteria specifically, DDMI will submit a Performance Assessment Report to the WLWB for approval under Part K Item 6. The Report will be developed in accordance with the Mackenzie Valley Land and Water Board’s *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites within the Northwest Territories*.

3.0 Monitoring and Reporting Schedule

The anticipated monitoring and reporting schedule for the NI and site wide effects monitoring is shown below. This schedule is subject to change based on actual construction timeline as well as results from inspections and monitoring programs. The number of years of post-construction monitoring required to adequately assess performance is unknown at this time and will depend upon the results obtained. The monitoring duration will be adaptively managed to be responsive to conditions as they are evaluated.

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Geotechnical inspections												■	■	■	■	■
NI pond water monitoring												■	■	■	■	■
NI sediment investigation									■							
Dust Monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Wildlife Use Monitoring												■	■	■	■	■
Aquatic Effects Monitoring										■			■			■
Wildlife Effects Monitoring										■			■			■
Annual CRP Progress Reporting	■	■	■	■	■	■	■	■								
Reclamation Completion Report														■		
Performance Assessment Report												■	■	■	■	■

Appendix VI-5 Post Closure Monitoring and Reporting - Mine Infrastructure Areas

Two types of post-closure monitoring programs are planned: performance monitoring specific to the Infrastructure areas and environmental effects monitoring which would include combined effects from all post-closure areas. These are described in Section 1.0 with the type and frequency of reporting described in Section 2.0.

3.0 Performance Monitoring

3.1 Geotechnical

Aspects of the infrastructure area are inspected weekly during operations to identify any stability and or seepage/runoff. This inspection frequency will continue until the end of commercial operations after which it will reduce to monthly.

Annually, visual inspection will include an aerial drone survey of the infrastructure areas each year starting with the end of commercial production.

3.2 Seepage/Runoff Water Quality

Seepage/runoff water quality monitoring is proposed at the following SNP locations:

SNP Site #	Description
1645-45	Collection Pond 10
1645-46	Collection Pond 11
1645-47	Collection Pond 12
1645-33	Groundwater nearest to Bulk Fuel Storage
1645-81	Surface Runoff during freshet

Seepage or runoff quality is sampled at a weekly frequency if sufficient volumes are identified during the weekly geotechnical inspections. Water samples will be analyzed for the following (source W2015L2-0001 – SNP 1645-81):

Sampling Parameters:	Total Ammonia, Field Parameters[3], ICP-MS Metal Scan[1](Total), Major Ions[2], pH[4], Total Petroleum Hydrocarbons

SNP 1645-45,45 and 1645-47 are currently located within the collection ponds. Once collection ponds are breached, DDMI proposes to relocate these stations to the outlet channel.

Additionally if the estimated flow volume is greater than 10 L/s once the collection ponds are breached then a sample will also be collected quarterly and assessed for acute lethality to rainbow trout, *Oncorhynchus mykiss* as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13.

3.3 Wildlife

DDMI will employ existing monitoring procedures (as updated from time-to-time) to record wildlife use of the NCRP and observations of behavior when animals are present on the NCRP. These procedures include:

ENVR-031-0720 – Caribou Road Surveys

ENVR-517-0912 – Caribou Management/Observation
ENVR-531-0812 – Wildlife Monitoring

3.4 Dust

DDMI will use the existing Total Suspended Particulate (TSP) monitoring system and procedures (as updated from time-to-time) combined with visual observations to monitoring dust generated from the Infrastructure areas. This monitoring will begin at the end of commercial production.

3.5 Re-Vegetation

- Areas of re-vegetation would be assessed for overall health, including: cover, density, species identification and diversity, seed production, litter and evidence of wildlife grazing. Soils in re-vegetated areas would be sampled and analyzed for structure and texture, pH and organic matter. The need to obtain and analyze plants and soils for metal uptake levels will be evaluated based on risk.

- Additional re-vegetation monitoring items may include shoreline vegetation surveys around collection pond areas, PKC outlet, A154, A418, A21 and the North Inlet as well as documentation of areas of natural recovery, plant ingress/egress or identified invasive species.
- Re-vegetated areas will be inspected annually for two years following initial planting.

3.6 Environmental Effects Monitoring

DDMI implements two environmental effects monitoring programs:

- Aquatic Effects Monitoring Program (AEMP)
- Wildlife Effects Monitoring Program (WEMP)

These are defined programs, updated or revised as warranted, to monitor mine effects on the Lac de Gras aquatic ecosystem and wildlife within a defined study area. These programs are conducted annually with specific scopes varying from year to year. For example the AEMP has an expanded program every three years and a base program annually. Towards the end of commercial operations, DDMI expects to reduce the scope and/or frequency of these programs as the need to implement operational management responses declines. Near-Field AEMP sampling locations will be adjusted to target runoff/seepage and water quality through dike breaches rather than the NIWTP effluent discharge. The attached Figure VI-1 shows the proposed relocated near-field AEMP stations renamed near-field closure (NFC). After the end of commercial production DDMI will continue these monitoring programs to monitor responses to the cessation of mining operations. The frequency would be reduced to every three years.

4.0 Reporting

4.1 Reclamation Completion Reporting

Upon completion of construction activities at the end of each calendar year, DDMI and the Engineer of Record will prepare a Construction Record summary report. The report shall include:

- Daily construction reports;
- All testing records including a summary of all test sample locations and test results;
- Photographic documentation of construction works and any associated re-vegetation efforts;
- Summary of construction problems and resolutions; and

- Completed construction checklist.

Upon completion of the infrastructure closure, a single comprehensive Infrastructure Reclamation Completion Report will be prepared by the Construction Management team and Engineer of Record for submission to the WLWB as per Part K Item 5.

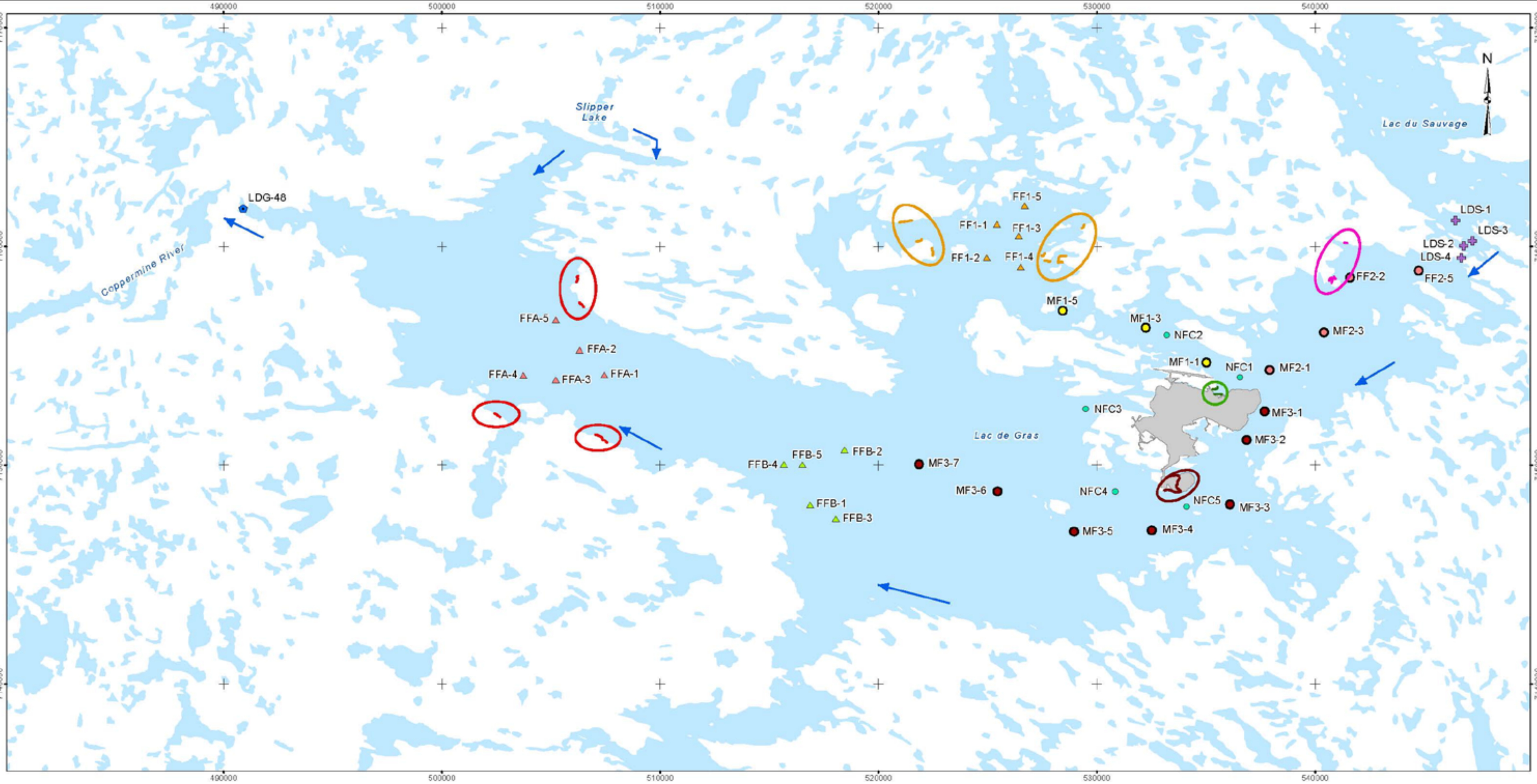
4.2 Performance Assessment Report.

Once sufficient information is available to evaluate the performance of the infrastructure area generally and Closure Objectives and Closure Criteria specifically, DDMI will submit a Performance Assessment Report to the WLWB for approval under Part K Item 6. The Report will be developed in accordance with the Mackenzie Valley Land and Water Board's *Guidelines for the Closure and Reclamation of Advanced Mineral Exploration and Mine Sites within the Northwest Territories*.

3.0 Monitoring and Reporting Schedule

The anticipated monitoring and reporting schedule for the Infrastructure and site wide effects monitoring is shown below. This schedule is subject to change based on actual construction timeline as well as results from inspections and monitoring programs. The number of years of post-construction monitoring required to adequately assess performance is unknown at this time and will depend upon the results obtained. The monitoring duration will be adaptively managed to be responsive to conditions as they are evaluated.

Activity	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Geotechnical inspections																
Seepage/Run-off monitoring																
Dust Monitoring																
Wildlife Use Monitoring																
Re-Vegetation Monitoring																
Aquatic Effects Monitoring																
Wildlife Effects Monitoring																
Annual CRP Progress Reporting																
Reclamation Completion Report																
Performance Assessment Report																



LEGEND

STATION LOCATIONS
- NEAR-FIELD CLOSURE
- MID-FIELD 3
- MID-FIELD 1
- FAR-FIELD 2; MID-FIELD 2
- FAR-FIELD 1
- FAR-FIELD A
- FAR-FIELD B
- LAC DU SAUVAGE
- LDG 48
- FLOW DIRECTION

SAMPLING SITES FOR SLIMY SCULPIN
- FAR-FIELD 1
- FAR-FIELD 2
- FAR-FIELD A
- MID-FIELD 3
- NEAR-FIELD

- DIAVIK FOOTPRINT
- WATERBODY

NOTE

THE LOCATION OF STATION LDS-4 WILL BE DETERMINED DURING THE FIRST SAMPLING EVENT AT THIS STATION. THE LOCATION SHOWN IS APPROXIMATE.

REFERENCE

HYDROGRAPHY DATA OBTAINED FROM CANVEC © DEPARTMENT OF NATURAL RESOURCES CANADA. ALL RIGHTS RESERVED.
PROJECTION: UTM ZONE 12 DATUM: NAD 83

5 0 5
SCALE 1:175,000 KILOMETRES

PROJECT
DIAVIK DIAMOND MINES INC.

TITLE
AEMP CLOSURE SAMPLING STATIONS

Golder Associates

PROJECT		1648005	FILE No.
DESIGN	LJ	17 Apr. 2017	SCALE AS SHOWN REV. 0
GIS	ANK	17 Apr. 2017	
CHECK	LJ	17 Apr. 2017	FIGURE: VI-1
REVIEW	GM	17 Apr. 2017	

I:\CLIENTS\DIAVIK\1648005\Mapping\MXD\CRP_update\Fig VI-1 AEMP Closure Sampling Stations.mxd