Northwest Territories Lands

July 7, 2014

Simon Toogood
Environmental Assessment Officer
Mackenzie Valley Environmental Impact Review Board
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Dear Mr. Toogood,

Re: EA 1314-02
De Beers Canada Inc. Snap Lake Mine
Public Hearing Closing Arguments

The Mackenzie Valley Environmental Impact Review Board (Review Board) requested written closing arguments from parties prior to the closure of the public record for EA1314-02. The Government of the Northwest Territories (GNWT) provides this submission in response to the Review Board's request.

The GNWT has participated in the Review Board's process to date including:

- Providing initial comments on the application comments;
- Attending the April 2014 technical session;
- Submitting Information Requests;
- Submitting a written Technical Report, including ten recommendations; and
- Participating in the public hearing.

The GNWT stands by the evidence and associated recommendations in the Technical Report and now provides these final closing comments on the De Beers application.

Key Messages

GNWT and most of the other parties to this EA have stated that there is a potential for significant adverse impacts relative to a different standard than aquatic effects via toxicity, and that standard is traditional use. GNWT has recommended and continues to recommend that the Review Board determine significance, and recommend measures, according to a traditional use standard.

The GNWT reiterates that there continues to be an incomplete "proposed development" in front of the Review Board as well as parties to the process. The GNWT emphasizes that the developer has not made clear in its evidence to the Review Board how it will achieve any level short of the unmitigated scenario, and that the developer has not committed to any specific mitigation. The GNWT has therefore recommended and continues to recommend that the Review Board consider the unmitigated, worst case scenario for the Snap Lake Mine as a significant deviation from what was assessed in the 2003 Report of Environmental Assessment and subsequently approved by the Responsible Ministers. In the GNWT's view, the Review Board must include in its deliberations an assessment of what the developer *cannot* achieve.

Guidance for Water Quality Guidelines and Site-Specific Water Quality Objectives

On Day 2 of the public hearing, the GNWT was questioned by Dr. Kathy Racher, technical advisor to the Review Board, regarding the standards which should be applied to a site-specific water quality objective (SSWQO). She also requested clarification on some perceived inconsistencies regarding the relationship between various guidance documents published by the Canadian Council of Ministers of the Environment (CCME).

For clarity, the GNWT recommends that the guidance published in 2003 on the derivation of SSWQOs and the protocol published in 2007 for the derivation of water quality objectives be followed by De Beers in the derivation of SSWQOs. This is a reasonable recommendation as adherence to these protocols should result in levels of contaminants of potential concern (COPCs), such as Total Dissolved Solids (TDS) and chloride that are protective of aquatic life and are consistent with the guiding principles of the CCME. To be clear, recent guidelines were specifically developed to ensure that all forms of aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term are protected (CCME 2007).

Over the years since the promulgation of the first CCME guidance document, various task groups have requested to improve the guidelines and address previous gaps. Part of this work includes the development of minimum information standards to be used to derive water quality guidelines and SSWQOs. Much of this is based on aquatic science, ecology and statistics in order to ensure that the recommended SSWQOs derivation process would be both robust and protective. It is important to note that in the 2007 guidance there were no changes to the number of fish, invertebrate, and plant species tested to meet the minimum data requirements. Rather, the 2007 update adds further specificity to these minimum data requirements. Given this information, it is the opinion of the GNWT, that guidance developed by CCME is clear on both the development of water quality guidelines and SSWQOs. Thus, the application of the CCME guidance (2003 & 2007) will result in concentrations of the chemicals of potential concern that will be protective of all forms

of aquatic life and all aspects of the aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term.

The GNWT believes that some of the confusion relates to the reference dates, and the situation where a 2003 document apparently referenced a 2007 document. The 2003 Guidance document references a 1991 Protocol document. The 1991 Protocol document was updated in 2007, and the new Protocol applies in the context of the derivation process for SSWQO described in CCME 2003.

References:

CCME (Canadian Council of Ministers of the Environment). 1991. Appendix IX — A protocol for the derivation of water quality guidelines for the protection of aquatic life (April 1991). In: Canadian water quality guidelines, Canadian Council of Resource and Environment Ministers, 1987. Prepared by the Task Force on Water Quality Guidelines.

CCME (Canadian Council of Ministers of the Environment). 2003. Canadian water quality guidelines for the protection of aquatic life: Guidance on the Site-Specific Application of Water Quality Guidelines in Canada: Procedures for Deriving Numerical Water Quality Objectives. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

CCME (Canadian Council of Ministers of the Environment). 2007. A protocol for the derivation of water quality guidelines for the protection of aquatic life. In: Canadian environmental quality guidelines, 1999, Canadian Council of Ministers of the Environment, Winnipeg.

Narrative Statements for Water Quality Objectives

Development of numerical water quality objectives for TDS has been a central issue in this proceeding. A key element of the SSWQO development process is the identification of water uses that need to be protected and the level of protection that is afforded for the receiving water body. While the GNWT agrees with De Beers that water in Snap Lake needs to be safe to drink and the fish safe to eat, additional protection is also necessary. As stated by Dr. Peter Chapman at the June 2014 public hearings:

> *"we need to protect not just the fish, but we need to protect the food they depend on"* (June 6, 2014 Snap Lake Public Hearing, Page 152).

In addition to the objectives outlined by De Beers, water quality must be maintained in the condition that respects and protects the traditional uses of Snap Lake and downstream waters. Furthermore, numerical SSWQOs should be established at levels that protect all forms of aquatic life and all aspects of the aquatic life cycles,

including the most sensitive life stage of the most sensitive species over the long-term exposure to COPCs. This is consistent with the guiding principles of the CCME for deriving water quality guidelines as outlined previously and aligns with principles of the NWT Water Stewardship Strategy (AANDC and GNWT, 2010), as described in the GNWT's Technical Report.

Hardness reduction and metal cycling from sediment

As stated in the GNWT's Technical Report, there is a concern that while De Beers has anticipated potential effects on the proposed ameliorating capacity of hardness on a variety of parameters, it is unclear if hardness will reduce at a similar rate as other parameters. This has the potential to result in a toxic condition post-closure should higher levels of parameters exist in a reduced hardness environment.

During Day 1 of the public hearings, De Beers' representatives were asked if they had considered the potential for some parameters to not act conservatively as modeled and if they were aware of any long-term studies that demonstrate that this should not be considered. De Beers representative, Alison Snow, replied that they were not aware of any studies to this effect (June 5, 2014 Snap Lake Public Hearing Page 92).

There were also several lines of questioning from Review Board staff to parties related to this subject. Of note, during Day 2, Review Board staff inquired if the GNWT had evidence to this regard, specifically regarding statements related to cycling and accumulation of metals in sediments.

As noted on page 53 of the Day 2 Transcripts, the GNWT committed to providing the Board evidence from the NWT Diamonds Project on sedimentation (EKATI Diamond Mine). This is in response to Dr. Racher's questioning with respect to conservative parameters that may be present in sediment after the closure of the mine.

The GNWT is pleased to include for the Board's consideration Volume II, Environmental Settings Parts 1 and 2 from the NWT Diamonds Project Environmental Assessment as prepared by EKATI Diamond Mine for the Canadian Environmental Assessment Agency under the *Environmental Assessment and Review Process Guidelines Order* (attached). The specific sections as they relate to sediments can be found in Section 2.5 (p. 189 of the document).

The GNWT has also summarized the specific points and included references from De Beers 2013 Aquatic Effects Monitoring Report to highlight the applicability of the reference:

The NWT Diamonds Project (EKATI Diamond Mine) looked at sediment accumulation in northern lakes as part of the environmental impact statements (EIS) (NWT Diamonds 1995). The lakes they had investigated were from the Northwest Territories and included Koala, Ursula, Paul, South and Misery watersheds. The

research for the EIS was completed to understand the natural cycling processes of trace metals and other water constituent's effect on sediment composition. From this assessment, significant research was conducted pertaining to sedimentation specifically in the area of diagenesis. Diagenesis is the process describing any chemical, physical, or biological change undergone by sediment after its initial deposition and during and after its lithification (NWT Diamonds 1995).

As part of the NWT Diamonds Project it was noted that the deposition of contaminants is well documented as resulting from influx elements due to water quality. It was demonstrated that once oxygen is no longer available to react with organic matter, secondary oxidants are utilized as follows; nitrate, manganese-oxide, iron-oxide, sulphate and carbon dioxide (Froelich et al. 1979). As oxygen is used the consumption of manganese-oxides and iron-oxides release dissolved manganese and iron (Stumm and Morgan 1981). Where dissolved oxygen exists iron and manganese oxides exist as solids whose surfaces strongly absorb trace metals. (Froelich et al 1979). Their continuous formation in near surface sediments results in surface enrichment of the oxides themselves as well as a host of other metals such as arsenic, copper, cobalt and zinc (Tessier et al. 1985, Fuller et.al 1993).

> *"An additional consideration in many lakes is for fine-grained material to re-suspend, settle and focus in more tranquil water. Since metal oxides and organic matter are fine-grained they are susceptible to re-suspension and re-deposition in the deeper areas of the lake. Fine grained fractions will remain in suspension until it enters calm waters such as those found in deep basins (James and Barko 1993, Bengtsson et al 1990)."* (NWT Diamonds 1995)

Additionally as described by the NWT Diamonds Project, iron and manganese are sensitive to redox conditions, they form solid oxides in oxic regimes and dissolved species under reducing conditions. Iron and manganese have a tendency to accumulate and become enriched in the oxide surface sediments. Due to the affinity of many trace metals toward oxide surface sediments there is often a corresponding enrichment in several other trace metals such as arsenic, cobalt, copper and zinc. Trending between lakes is relatively consistent and predictable resulting from the combined effect of all post-depositional chemical and physical processes. The research by James and Barko (1993) has shown that this is a long-term process in northern lakes and sedimentation rates will be slow and dependent on water quality.

The GNWT would like to highlight that this phenomenon may also be occurring in Snap Lake, based upon the results related to sediment being found as provided in Section 4.0 of the 2013 De Beers Snap Lake Aquatic Effects Monitoring Plan (AEMP) report:

> *"Chromium, copper, and zinc concentrations were above their ISQGs at the Snap Lake diffuser station in 2013; concentrations of these metals have been above their ISQGs at this station and elsewhere in Snap Lake in previous years. Arsenic, cadmium, lead, and mercury concentrations have consistently*

been below their respective ISQGs at the Snap Lake diffuser station since 2005 (except for an anomalous lead measurement in 2005), although concentrations have been above their ISQGs elsewhere in Snap Lake in previous years." (De Beers 2014)

"Twelve parameters had statistically significant increasing trends: available potassium; available sulphate; aluminum; boron; calcium; iron; mercury; molybdenum; selenium; silver; sodium; and, strontium. Four parameters had statistically significant decreasing trends at the Snap Lake diffuser station: barium; cesium; thallium; and, titanium." (De Beers 2014)

"The results of these comparisons indicated that concentrations of available sulphate, calcium, mercury, sodium, and strontium at the diffuser stations are potentially being influenced by Snap Lake Mine (Mine) operations." (De Beers 2014)

As stated in the GNWT's Technical Report and discussed during the Public Hearing, it may be possible during the post closure period for elements to be released from sediment, potentially causing a condition in Snap Lake that has adverse effects on the aquatic environment.

In summary, while some information exists in this regard, it is the GNWT's position that a significant amount of uncertainty exists regarding the ameliorating effects of hardness and the behavior of hardness and other parameters post-closure. This further supports GNWT's argument that the guidance outlined previously in these comments be adhered to and that precautionary principles be applied.

Reference:

Bengtsson L. Hellstrom T. and Rakoczi L. 1990. Redistribution of sediment in three Swedish lakes. *Hydrobiolgia* 192: 167-181

BHP Diamonds and Diamet Minerals. 1995. NWT Diamonds Project Environmental Impact Statement. Volume II. Environmental Setting.

De Beers. 2014. 2013 Aquatic Effects Monitoring Report.

Froelich, P.N, G.P. Klinkhammer, M.L. Bender, N.A. Luedtke, G.R. Heath, D.Cullen, P. Dauphin, D. Hammond, B. Hartman and V. Maynard. 1979. Early oxidation of organic matter in pelagic sediments of equatorial Atlantic: suboxic diagenesis. *Gechimica et Cosmochimica Acta* 43: 1075-1090

Fuller C.C., J.A. Davis, G.A. Waychunas. 1993. Surface chemistry of ferrihydrite EXAFS studies of the geometry of coprecipitated and adsorbed arsenate. Geochim. Chosmochi Acta 57, 2251-2296

Fuller C.C. J.A. Davis, G.A. Waychunas. 1993. Surface chemistry of ferrihydrite Kinetics of arsenate adsorption and coprecipitation. Geochim. Chosmochi Acta 57,2271-2282.

James W.F., J.W. Barko, 1993. Sediment Resuspension, Redeposition, and Focusing in a Small Dimictic Reservoir. *Canadian Journal of Fisheries and Aquatic Sciences.*

Stumm, W. and J.J. Morgan. 1981. Aquatic Chemistry Chemical Equilibria and rates in Natural Waters. *Science* New York: John Wiley and Sons.

Tessier A., R. Carignan, B. Dubreuil, F. Rapin, 1989. Partitioning of zinc between the water column and the oxic sediments in lakes. *Geochimica et Cosmochimica Acta* Volume 53, 7, July 1989, 1511–1522.

Safety Factors

There have been ongoing discussions throughout this review regarding the necessity to apply safety factors to SSWQOs developed by De Beers. While discussions have provided additional insight into this topic, it remains the GNWT's position that a safety factor of 1.0 does not provide additive protection.

As stated by Dr. Don Hart of Ecometrix:

> *"a safety factor of one point zero (1.0) obviously doesn't do anything...I think what use of a factor like that is really saying is that....we don't have have any uncertainty that we feel needs to be compensated by use of a ...safety factor."* (June 5, 2014 Snap Lake Public Hearing p. 213)

The question then becomes not whether 1.0 is valid as a safety factor but whether there is a requirement for a safety factor at all. As Dr. Hart stated, the lack of a safety factor would indicate that no uncertainty exists that would require additional protection measures. As stated in the GNWT's Technical Report, our position in this regard remains that the purpose of a safety factor is to account for a variety of derivation uncertainties as outlined by CCME (2007). Additionally, the GNWT believes that additional uncertainties have been identified throughout the EA process, some of which are again reiterated throughout these closing comments. As such, additional precautions such as safety factors should be considered when setting numerical Effluent Quality Criteria (EQCs). This will be addressed by the GNWT in more detail during the regulatory process.

Spatial Extent and Baseline

Section 3.2.4 of the GNWT's Technical Report detailed information on the predicted spatial extent of impact from an unmitigated scenario. To re-iterate, GNWT's position based on information taken from Information Responses provided by De Beers, remains as:

> *"Under the unmitigated worst case scenario (1700 mg/L TDS) as described in Section 3.2.1, predicted TDS concentrations will double the local background concentrations at Monitoring Site 23, located 65 km downstream of Snap*

> *Lake. Predicted concentrations at this location are 20 mg/L compared to local background concentrations of 10 mg/L. Predicted TDS concentrations become closer to local background at Monitoring Site 3 where the predicted concentration is 25 mg/L compared to a local background concentration of 20 mg/L. The GNWT notes that Monitoring Site 3 is 155 km downstream from Snap Lake (Table MVRB/MVLWB_IR#11-4)." GNWT Technical Report, May 21st, 2014.*

During the public hearings, Dr. Peter Chapman suggested that natural and laboratory analytical variability may be responsible for small differences in TDS concentrations of 1-2 mg/L and this does not provide good evidence that a change has occurred. Dr. Chapman added:

> *"This is why GNWT's suggestion that spatial changes will be measureable more than 65 kilometres downstream and up to 155 kilometres downstream is an overestimation."* (June 5, 2014 Snap Lake Public Hearing, Page 69)

De Beers believes that effluent from Snap Lake will only be measureable over a much smaller spatial extent. As stated in De Beers' presentation at the public hearing:

> *"De Beers has predicted that the effluent from Snap Lake at the proposed…EQC will be measureable in waters up to 44 km downstream of the outlet of Snap Lake"* (June 5, 2014 Snap Lake Public Hearing, Page 57)

When the GNWT calculated whether detectable change was anticipated at downstream lakes, baseline values were compared to Upper Bound Scenario A values for an unmitigated scenario. As seen from the table below provided in Information Requests from De Beers, the point at which De Beers believes there will be detectable change is 44 km away at which a 270% increase can be observed (baseline 20 mg/L compared to 74 mg/L predicted). However, the table below also indicates an increase of 41% (baseline 17 mg/L compared to 24 mg/L predicted) at 109 km and at 155 km a predicted increase of 25% is shown (baseline 20 mg/L compared to 25 mg/L). The GNWT notes that at the 155 km distance the difference in TDS concentrations is 5 mg/L which is much greater than the 1-2 mg/L variation described by Mr. Chapman at the public hearing. Therefore, it is the GNWT opinion that a difference in the range of 3-5 mg/L (5 mg/L representing an increase of 25% from background) would be measureable 155 km away from the Snap Lake Mine (see scenarios in the Table below).

Of note, an additional discrepancy between De Beers and the GNWT in these calculations may be the utilization of regional baseline values by De Beers. As noted below, it is De Beers position that baseline TDS in the Lockhart River system is 10-53 mg/L and therefore anything that falls within this range is within natural variability. The GNWT is concerned that regional values are highly influenced by a single value of 53 mg/L at Downstream Site 43 that may not be appropriate for comparison to all

other stations on a "regional" level. This concern was noted by the GNWT at the public hearings in relation to Slide 39 of De Beers' presentation which contained a figure displaying EAR predictions against baseline range.

De Beers further stated that they would be conducting further work with the Land and Water Board and other parties who are monitoring that area to further develop the range of natural variability in the river system (June 5, 2014 Snap Lake Public Hearing, page 110). This was reiterated in De Beers' June 10, 2014 Response to Undertakings. The GNWT will continue to work with De Beers in this area as required to ensure baseline values are both adequate and appropriate for the detection of change and impacts from the Snap Lake development.

Table MVRB/MVLWB_IR#11-4: Maximum Predicted Concentrations in Lakes Downstream of Lac Capot Blanc During Operations, Unmitigated Case (emphasis added)

Downstream Site	Distance Downstream from Snap Lake (km)	Baseline TDS (mg/L) (range = 10 to 53)	Maximum TDS Concentrations (mg/L)				
			EAR Predictions	2013 Model Predictions			
				Lower Bound Scenario A	Lower Bound Scenario B	Upper Bound Scenario A	Upper Bound Scenario B
37 (upstream of King Lake)	24	17	119	126	89	176	119
22 (Mackay Lake)	44	20	41	57	45	74	55
11 (Mackay Lake)	54	12	16	21	18	24	20
23 (Mackay Lake)	65	10	13	17	14	20	16
24 (Mackay Lake)	81	14	16	19	18	22	19
26 (Mackay Lake)	109	17	19	22	20	24	22
3 (Inlet of Aylmer Lake)	155	20	22	24	22	25	23
4 (Aylmer Lake)	172	24	22	27	26	28	27
53 (Clinton Colden Lake)	227	35	36	37	36	38	37
52 (Ptarmigan Lake)	310	24	25	26	26	27	26
43 (Lockhart River)	419	53	54	55	54	55	55
19 (Lockhart River outlet)	434	14	14	15	15	16	15

Conclusion

Throughout this process, the GNWT has endeavoured to provide sound technical advice to the Review Board for consideration in its decision-making process. The GNWT stands by the evidence and associated recommendations provided to the Board in the GNWT's Technical Report and this submission.

The GNWT appreciates the opportunity to provide closing arguments for this assessment process. If you have any questions or require any additional information regarding this submission, feel free to contact Lorraine Seale, Manager, Project Assessment Branch, at 867-765-6786 or Lorraine_Seale@gov.nt.ca.

Sincerely,

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