



August 26, 2006

Dave White, Executive Director
Snap Lake Environmental Monitoring Agency
Main Floor, Lahm Ridge Tower, POB 95
Yellowknife, NT X1A 2L1

Dear Dave:

Thank you for the opportunity to review the 2005 Aquatic Effects Monitoring Plan (DDMI 2005) that was prepared by DeBeers Canada Mining Inc. (DCMI) to support the aquatic effects monitoring program (AEMP) for the Snap Lake diamond project. Rather than conducting an exhaustive review of the plan, my review focused on evaluating the extent to which the revised AEMP plan addresses the issues and concerns that were expressed to DCMI previously (i.e., the March 2005 review of the AEMP that was prepared for the SLEMA Core Group by MESL). Nevertheless, a number of general comments are offered to ensure that key issues and concerns related to the AEMP are identified. In addition, a summary of the deficiencies of the 2004 AEMP plan is presented along with the results of an evaluation conducted to determine the extent to which DCMI has addressed the issues and concerns identified previously by SLEMA. Finally, the results of the current review are briefly summarized.

1.0 General Comments

The following general comments are offered to improve the usefulness and/or accessibility of information related to the AEMP:

- The purpose of the AEMP should be explicitly described in the AEMP plan and in AEMP reports. Currently, the AEMP plan refers to the Water Licence and related corporate commitments for the purpose of the AEMP;

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- A problem formulation chapter should be developed to provide a linkage between the 2005 AEMP plan and the effects that were predicted in the Environmental Assessment Report (EAR);
- Data quality objectives (DQOs) should be developed and included in the AEMP plan. Such DQOs should be developed in accordance with guidance documents that are readily available on this topic (i.e., from U.S. Environmental Protection Agency);
- The AEMP plan should describe how the results of the various studies and monitoring program elements will be integrated to evaluate the cumulative effects of the project as a whole; and,
- The AEMP plan should describe how the data and information generated under the AEMP will be used to support adaptive management of the project as a whole. While some information is provided on how water quality would be used in adaptive project management, the concepts are not sufficiently fleshed out to fully understand how other types of AEMP data would be used in adaptive management or what types of adaptive management could be taken if various types of project-related effects are observed.

2.0 Groundwater Monitoring Program

The groundwater monitoring program described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the groundwater monitoring program did not provide provisions for assessing the quality and quantity of connate groundwater and recharge water from Snap Lake independently. As a result, SLEMA was concerned that the resultant data would not support an evaluation of the accuracy of impact predictions or the identification of emerging groundwater quality or quantity issues.

Observations: The 2005 AEMP plan did not include changes to the groundwater monitoring plan that would address the concerns identified by the SLEMA. As was the case in the 2004 AEMP plan, it appears that only mine water from the final collection sump will be assessed for quality and quantity. Therefore, it will not be possible to evaluate the relative volumes of connate groundwater and lake recharge groundwater. In addition, it will not be possible to evaluate differences in the quality of these two groundwater sources.

3.0 Fish Health Baseline Study and Monitoring

The fish health baseline study described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the fish health baseline special study did not provide a basis for determining the concentrations of bioaccumulative chemicals of potential concern (COPCs) in fish whole body. In addition, a number of bioaccumulative COPCs were not targeted for analysis. As a result, SLEMA was concerned that it may not be possible to assess the risks to aquatic-dependent wildlife associated with consumption of fish from Snap Lake or to evaluate cumulative environmental effects.

Observations: The fish health baseline study was completed in 2004. The study provided baseline fish health data for Snap Lake, the Northeast Lake, and the 1999 reference lake. These results and comments from DFO were used to design the fish health components described in the 2005 AEMP plan, which included adult fish health monitoring using Environmental Effects Monitoring (EEM) protocols and a juvenile fish special study using non-lethal sampling methods. The results of the present review indicate that the 2005 AEMP did not include an analysis of fish deformities, the health of a benthic species, analysis of COPC concentrations in whole fish, measurement of moisture or lipid content of fish tissues, measurements of COPCs in fish tissues except metals and major ions, or evaluation of within lake or between year random variability in fish health metrics. Therefore, it appears that none of the issues or concerns identified by SLEMA were addressed in the 2005 AEMP plan.

The juvenile fish special study appears to be well-considered and well-designed. The results of this study are likely to provide the information needed to determine if juvenile lake trout and round whitefish can be captured non-lethally from Snap Lake and Northeast Lake and if the resultant data can be used for determining differences between the two lakes in fish health, recruitment, year class strength, and community composition.

4.0 Benthic Invertebrate Community Baseline Special Study and Monitoring

The benthic invertebrate community baseline study described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the design of the benthic invertebrate community baseline special study was not sufficiently robust to provide information that could be used to evaluate spatial or temporal variability in the associated benthic metrics. In addition, the study did not appear to be designed to facilitate the collection of matching sediment chemistry and benthic invertebrate community structure

data. As a result, SLEMA was concerned that it would be difficult to detect changes in benthic invertebrate community structure over time and space. In addition, SLEMA was concerned that it would be difficult to identify the causes of any effects that are observed.

Observations: The benthic invertebrate community baseline program was completed in 2004 and was used to design the benthic component of the 2005 AEMP plan. The main changes in the design of this component of the AEMP include:

- The number of stations in Snap Lake was increased from 12 to 15;
- Annual sampling was selected for the first three years of operation and every two years thereafter (if the resultant data support the decrease);
- Five samples will be collected at each station, with three samples analyzed initially. Additional samples may be analyzed if the variability in total abundance and species richness is greater than expected (i.e., standard deviation is > 20% of the mean, as per EEM guidance);
- Target levels of taxonomic identification were reduced in some cases and increased in others; and,
- Measurements of COPC concentrations in invertebrate tissues was eliminated from the program.

Based on the results of this review, it is not clear that DDMI has incorporated many of SLEMA's recommendations into the 2005 AEMP plan. More specifically:

- No provisions have been added to facilitate collection of supplemental information for interpreting the results of the benthic monitoring program (e.g., pore-water hydrogen sulfide, pore-water ammonia, total organic carbon, metals and other COPCs);
- Importantly, it is not clear if the whole-sediment chemistry and benthic invertebrate community structure data will be synoptically collected;
- No provisions have been made for collecting sediment samples for toxicity testing or bioaccumulation testing.
- Although the text of the 2005 AEMP plan indicates that the sampling design for the reference lake will be similar to the design for Snap Lake, details of the reference lake sampling design are not provided (i.e., number of stations, location of stations, metrics, etc.); and,
- While rationale was provided for the selected sampling timing, no data have been collected to evaluate the seasonal variability in benthic invertebrate community structure metrics. Therefore, it is not possible to confirm that the selected sampling timing is appropriate.

Considering the limitations on invertebrate biomass experienced in the 2004 sampling program, it is important to include 28-day bioaccumulation tests as part of the overall benthic program. Such tests involve collection of sediment from the site, sending the material to a laboratory, and exposing benthic invertebrates (typically, worms; Limbriculus variegatus) to the sediment for four weeks. Then, the worms are collected from the sediment samples and used to evaluate COPC concentrations in invertebrate tissues. Such data will satisfy the intent of the conditions of the Water Licence that require collection of invertebrate tissues for analysis of metal concentrations. In addition, inclusion of 28-day toxicity tests with amphipods in the benthic monitoring program would provide additional and better data for evaluating the effects of project-related activities on the benthic invertebrate community.

5.0 Zooplankton and Phytoplankton Special Study and Monitoring

The zooplankton and phytoplankton special study described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the 2004 AEMP plan did not provide sufficient detail on the zooplankton and phytoplankton special study to permit comprehensive evaluation of the proposed methods. In addition, the study design did not include a reference lake or sufficient within station replication. As a result, SLEMA was concerned that it would be difficult to assess spatial variability in conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions.

Observations: The results of the 1999 and 2004 plankton sampling programs were used in the development of the phytoplankton and zooplankton components of the 2005 AEMP plan. The revised plan includes a number of changes from the approach that was used in the zooplankton and phytoplankton special study, including:

- A reference lake is being sought to include in the monitoring program;*
- Chlorophyll and microcystin will be used as surrogate parameters for the phytoplankton community in the reference lake;*
- More rationale on the selection of sampling stations is provided;*
- More information is provided on sample collection methods; and,*
- The recommendation for conducting 10% re-analysis of samples by a second taxonomist has been adopted.*

Some of the outstanding issues that have yet to be addressed include:

- *No rationale has been provided on why Northeast Lake has not be used as an interim reference lake for phytoplankton and zooplankton monitoring;*
- *The rationale for requiring a reference lake with similar levels of productivity as Snap Lake is not provided;*
- *No baseline data have been collected on a reference lake, making it impossible to determine if temporal variability in Snap Lake is similar to that in a reference lake with similar or lower productivity than Snap Lake;*
- *Using surrogate parameters for phytoplankton in the reference lake will severely limit our ability to evaluate changes in the community over time in the reference lake, which in turn will preclude data analyses designed to determine if observed changes in the community of Snap Lake are due to project-related activities or to regional changes in conditions; and,*
- *The number of samples collected is still insufficient to evaluate differences between years by sampling station or between sampling stations by year.*

6.0 Periphyton Special Study and Monitoring

The periphyton special study described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the periphyton special study did not include a reference lake or sufficient within station replication. In addition, the methods that were selected may not provide reliable data. As a result, SLEMA was concerned that it would be difficult to estimate biomass at each station, to assess spatial variability in conditions within Snap Lake, and to discriminate between project-related effects and regional changes in conditions.

*Observations: DCMI conducted the periphyton special study in 2004. Based on the results of this study, DCMI has recommended that periphyton not be included in the AEMP in the future. DCMI cited substantial variability in periphyton taxonomy and chlorophyll *a* concentrations, both within a site and between sites, as the primary reason for discontinuing periphyton monitoring. This recommendation should be reconsidered for several reasons, including:*

- *No information on periphyton biomass or community composition was collected at a reference lake. Such information would have been important for assessing natural variability under current conditions and for assessing project-related effects in the future;*

- *As pointed out in our earlier comments, the methods that were selected to evaluate periphyton biomass and community composition are not the most reliable. Rather than scraping rocks in situ, artificial substrates (i.e., of known area) could have been deployed to reduce the variability in the resultant data;*
- *Sampling intensity was not sufficient for evaluating within station variability, for evaluating variability between stations, or for evaluating variability within reaches of the lake; and,*
- *Data on the variables that could influence periphyton abundance were not evaluated simultaneously to determine if variability could be reduced by normalizing the data to, for example, phosphorus concentrations.*

The information provided does not provide sufficient rationale for discontinuing the application of periphyton monitoring as part of the AEMP. Therefore, it is recommended that additional investigations be conducted to provide a proper evaluation of the use of periphyton monitoring for assessing the effects of project-related activities at the site.

7.0 Water Quality Monitoring Program

The water quality monitoring program described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the water quality monitoring program did not provide sufficient rationale to permit comprehensive evaluation of the proposed approach and methods. In addition, the study design did not include a reference lake, sufficient sampling effort in the first year, or sufficient within station replication. As a result, SLEMA was concerned that it would be difficult to assess spatial and temporal variability in water quality conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions.

Observations: The 2005 AEMP plan provides a description of the water quality sampling program conducted under the AEMP. This description identified five types of water quality stations sampled under the program, including diffuser stations, standard water quality stations, TDS stations, water intake station, and watercourse stations. This classification of the sampling stations provides the reader with better rationale for the selection of locations for sampling. Apart from this classification of the water quality stations, obvious differences between the 2004 AEMP plan and the 2005 AEMP plan are not readily apparent. However, some of SLEMA's concerns have been addressed (i.e., addition of organics analyses near the diffuser). Some of the outstanding concerns regarding the water quality monitoring program design include:

- *Provisions for including a reference lake to assess water quality conditions were not described;*
- *Natural variability in water quality conditions has not been sufficiently characterized;*
- *I was unable to locate the results of power analyses that identified the minimum number of samples required to discriminate between natural variability and project-related effects on water quality;*
- *The number of samples collected at each station is unlikely to be sufficient to evaluate temporal trends in water quality by station. This limitation will restrict the use of such data in an early warning system;*
- *Visual inspections of the lake surface are still not included in the design; and,*
- *The sensitivity of the monitoring program in terms of its ability to detect effects of specific sizes is still not readily apparent.*

8.0 Sediment Quality Monitoring Program

The sediment quality monitoring program described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the sediment quality monitoring program did not provide sufficient rationale to permit comprehensive evaluation of the proposed approach and methods. In addition, the study design did not include a reference lake, sufficient sampling effort in the first year, sufficient within station replication, or a full list of COPCs. As a result, SLEMA was concerned that it would be difficult to assess spatial and temporal variability in sediment quality conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions.

Observations: The 2005 AEMP plan provides a description of the sediment quality sampling program that is being conducted under the AEMP. Obvious differences between the 2004 AEMP plan and the 2005 AEMP plan are not readily apparent. Some of the outstanding concerns regarding the sediment quality monitoring program design include:

- *Provisions for including a reference lake to assess sediment quality conditions were not described;*
- *Rationale for the selection of the number and locations of sampling stations is still not readily apparent;*

- *I was unable to locate the results of power analyses that identified the minimum number of samples required to discriminate between natural variability and project-related effects on sediment quality;*
- *The number of samples collected at each station is unlikely to be sufficient to evaluate temporal trends in sediment quality by station. This limitation will restrict the use of such data in an early warning system;*
- *The list of target analytes is still limited to conventional variables, nutrients, and metals. Importantly, PAHs and/or other measures of hydrocarbon contamination are not included in the list of analytes. In addition, standard approaches for assessing the effects of metals enrichment are not included (i.e., simultaneously extracted metals and acid volatile sulfides); and,*
- *The sensitivity of the monitoring program in terms of its ability to detect effects of specific sizes is still not readily apparent.*

9.0 Fish Habitat Monitoring

The fish habitat monitoring program described in the 2004 AEMP plan had several deficiencies that needed to be addressed to ensure that the resultant data could be used for evaluating project-related effects. More specifically, the fish habitat monitoring program may not have sufficient sampling frequency to assess project-related effects. In addition, no information was provided on how the monitoring results would be used in an adaptive management framework. As a result, SLEMA was concerned that the resultant data may not provide the information needed to assess or mitigate project-related effects.

Observations: *No further comments are offered on this element of the AEMP.*

10.0 Summary and Conclusions

An evaluation was conducted to determine if the recommendations offered by SLEMA on the 2004 AEMP Plan were incorporated into the 2005 AEMP Plan that was developed by DCMI. The results of this review indicated that the AEMP is likely to provide a great deal of valuable information. More specifically, the data and information generated in the various components of the monitoring program are likely to meet the needs of regulatory instruments and contribute to verification of the accuracy of impact predictions, to evaluate the effectiveness of mitigation measures, to establish the thresholds or early warning signs, and to implement adaptive management strategies at the site. However, the proposed monitoring programs still have a number of deficiencies that will need to be addressed to ensure that they provide the information needed under the terms of the Environmental Agreement and DCMI's Class A water licence, including:

- The groundwater monitoring program still does not provide provisions for assessing the quality and quantity of connate groundwater and recharge water from Snap Lake independently. Therefore, it may not be possible to evaluate the accuracy of impact predictions or to identify emerging groundwater quality or quantity issues;
- The fish health baseline special study still does not provide a basis for determining the concentrations of bioaccumulative chemicals of potential concern (COPCs) in fish whole body. In addition, a number of bioaccumulative COPCs were still not targeted for analysis. Therefore, it may not be possible to assess the risks to aquatic-dependent wildlife associated with consumption of fish from Snap Lake or to evaluate cumulative environmental effects of the project and other anthropogenic activities;
- The benthic invertebrate community monitoring program is still not sufficiently robust to provide information that can be used to evaluate spatial or temporal variability in sediment quality conditions. In addition, the study does not appear to be designed to facilitate the collection of matching sediment chemistry and benthic invertebrate community structure data. Furthermore, bioaccumulation and toxicity testing should be added to the program to provide the data required under the Water Licence and to evaluate project-related effects. Implementation of the current program will make it difficult to detect changes in benthic invertebrate community structure over time and space. Additionally, it will be difficult to identify the causes of any effects that are observed;
- The zooplankton and phytoplankton monitoring program still does not include sufficient within station replication to evaluate natural variability. In addition, the use of surrogate parameters for the phytoplankton community in the reference lake is likely to limit the applicability of the resultant data for assessing project-related effects. Therefore, it will be difficult to assess spatial variability in conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions;
- The periphyton monitoring program is slated for discontinuation due to the high variability observed in the 2004 special study. However, the special study was not appropriately designed and the methods that were selected may not have provided reliable data. Therefore, more work is required before a decision can be made on the applicability of periphyton monitoring in the AEMP;
- The water quality monitoring program does not include a reference lake, sufficient sampling effort, or sufficient within station replication. Therefore, it will be difficult to assess spatial and temporal variability in water quality conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions;

- The sediment quality monitoring program does not provide sufficient rationale to permit comprehensive evaluation of the proposed approach and methods. In addition, the study design did not include a reference lake, sufficient sampling effort, sufficient within station replication, or a full list of COPCs. Therefore, it will be difficult to assess spatial and temporal variability in sediment quality conditions within Snap Lake and to discriminate between project-related effects and regional changes in conditions;

The nature and severity of the deficiencies in the various monitoring programs have the potential to jeopardize DCMI's ability to generate environmental monitoring data and information needed to satisfy the stated objectives of these initiatives. Therefore, it is recommended that the various monitoring plans be further refined to address the above stated concerns. Here's hoping that these comments are useful to you.

Sincerely,

A handwritten signature in cursive script, appearing to read "Don MacDonald", with a large, sweeping flourish extending to the left.

Don MacDonald,
Principal, RPBio., CFP