Expert Comments on the Environmental Impact Assessment Report for the Sisson Project (Tungsten and Molybdenum Mine), New Brunswick
CEAR #11-03-63169

re: EIA Report Section 8.4 – Water Resources

re: EIA Report Section 8.5 – Aquatic Environment

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Table of Contents (Sections in red are in this shortened version of the CCNB Action report)

1. Introduction

1.1 Background to CCNB Action Inc.'s comments on the Environmental Impact Assessment Report for the Sisson Project

Northcliff Resources Ltd. (the proponent) has proposed to construct and operate a 30,000 tonnes per day tungsten and molybdenum mine approximately 60 kilometres northwest of Fredericton, New Brunswick (the Sisson Project). As described in the project's environmental impact assessment (EIA) report, the project would consist of a 145 hectare open pit mine, a 751 hectare tailings impoundment, numerous water management ponds, an ore crushing and processing plant, a water treatment plant, an ore storage area(s), a transmission line to bring power to the project site, and use of provincial roads. As proposed, the construction and operation of the mine will require the destruction of portions of streams that are headwaters of the Nashwaak River. The Nashwaak River, a tributary of the St. John River, is a main refuge for the endangered St. John River population of Atlantic salmon. The Villages of Napadogan and Stanley are located approximately 10 km and 20 km respectively from the proposed mine.

As the Sisson Project will have environmental impacts on areas of both federal and provincial constitutional jurisdiction, it is subject to two environmental assessment processes, one under the *Canadian Environmental Assessment Act* (*CEAA*), and another under the New Brunswick *Environmental Impact Assessment Regulation - Clean Environment Act* (*NB EIA Reg.*). Because the project commenced under the *CEAA,* the federal environmental assessment of the project will continue under that act rather than the *Canadian Environmental Assessment Act, 2012,* which repealed and replaced the *CEAA.* Due to the amount of ore to be processed, the Sisson Project is subject to a "comprehensive study" type of environmental assessment under the *CEAA* (rather than a "screening"). Provincially, the Minister of Environment has determined the Sisson Project is subject to a "comprehensive review" under the *NB EIA Reg*. A provincial comprehensive review sets out a number of steps in the environmental assessment process, such as the development of terms of reference for the EIA report, the writing and filing of the EIA report, and the holding of a public meeting(s) by the Minister of Environment.

The provincial and federal governments have agreed to conduct a "harmonized" environmental impact assessment process for the Sisson Project. The EIA report describes the harmonized process as being:

> "Under this approach, both levels of government have agreed to cooperate in the carrying out of the EIA to meet the requirements of their respective legislation, beginning with Terms of Reference being issued jointly to define the scope of the EIA federally and how Northcliff will meet the Final Guidelines provincially. They have also agreed that a single EIA Report prepared by the Proponent to meet the requirements of the Terms of Reference would suffice to fulfill the respective provincial and federal EIA requirements. The CEA Agency will then prepare its comprehensive study report (CSR), relying upon the EIA Report and the results of the review process." (at p. 4-4).

On August 30, 2013, the Canadian Environmental Assessment Agency (CEA Agency) released the proponent's EIA report for the Sisson Project to the public for review and comment. The public has 45 days (to October 14, 2013) to submit its comments to the Agency, after which the Agency will consider them before writing its CSR for the project. At present, there is no official period of public review and comment under the provincial process although it is expected that comments made under the federal environmental assessment process will be forwarded to New Brunswick regulators for consideration.

The CEA Agency sometimes provides participant funding to individuals, not-for-profit organizations, and Aboriginal groups, to assist them in participating in a federal environmental assessment process, such as the comprehensive study for the Sisson Project. CCNB Action Inc. applied for and received participant funding. The main purpose of this funding was for CCNB Action to hire experts to review and provide comments on sections of the Sisson Project EIA report and later, the comprehensive study report for the project written by the CEA Agency. Funding is not available under the New Brunswick environmental assessment process to assist groups in their review of EIA Reports. *The purpose of this report is to document the findings of CCNB Action's expert reviewers about the EIA report for the Sisson Project and to detail CCNB Action's position as to whether the construction, operation, and closure of the project should receive federal approval.*

1.2 Expert reports commissioned by CCNB Action Inc.

CCNB Action Inc. had experts review and comment on various sections of the EIA report and on some of the different technical studies completed by the proponent in support of the EIA report. The reviewers were asked to focus their reviews primarily on:

- the methods used by the proponent to gather baseline information,
- the methods used by the proponent to conduct environmental effects analyses for the project alone and cumulatively,
- conclusions reached by the proponent, in particular those dealing with the significance of the environmental effects of the project, and
- various technical aspects of the project such as the design of the tailings dam.

Reviewers were asked *not* to comment on the merits of the project.

In order of their appearance in this final report, the experts' reports are:

1. Impacts of the project on the VEC - Atmospheric Environment, re: air quality.
   - Ms. Inka Milewski and Mr. Lawrence Wuest

2. Impacts of the project on the VEC - Public Health with a focus on the methodology used for the baseline public health assessment.
   - Ms. Inka Milewski

3. Impacts of the project on the VEC – Water Resources, re: ground water and ecological water availability.
   - Dr. André St.-Hilaire

4. Impacts of the project on the VEC – Water Resources,
   The VEC – Aquatic Environment (focus on fish and fish habitat),
   The VEC - Accidents, Malfunctions and Unplanned Events, and
   General comments on Executive Summary, Project Description, Summary of Key Predictive Studies.
   - Dr. Allen Curry

5. Comments on Section 3 Project Description (particularly water management and the design of the tailings storage facility),
   Impacts of the project on the VEC – Aquatic Environment,
   The VEC - Accidents, Malfunctions and Unplanned Events,
   Comments on the proposed Follow-Up and Monitoring Program, and
   Comments on the Conceptual Decommissioning, Closure, and Reclamation Plan.
   - Dr. David Chambers and Mr. Stu Levit, M.S., J.D. (Center for Science in Public Participation (CSP2))
   - Note: The report from CSP2 was commissioned by CCNB Action. CSP2 submitted their review directly to the CEA Agency on October 7, 2013, but it has also been included in this report for convenience.

6. Impacts of the project on the VEC – Terrestrial Environment.
   - CCNB Action (primarily the project's impacts on birds)
   - Ms. Tracy Glynn, M.E.S. (primarily the project's impacts on rare forests and wildlife)
   - Mr. Lawrence Wuest (primarily the project's impacts on protected natural areas)

7. Impacts of the project on the VEC – Vegetated Environment.
   - Ms. Tracy Glynn, M.E.S. (primarily the project's impacts on rare forests)

8. Impacts of the project on the VEC – Wetland Environment.
   - Ms. Stephanie Merrill, M.Sc.F. (primarily the project's impacts on regulated wetlands)

9. Impacts of the project on the VEC – Labour and Economy.
   - Dr. Rob Moir

10. General comments on the proposed water management plans for the project during operation and closure.
    - Mr. Roy Parker, M.E.S.

Finally, this report also includes comments on general EIA report requirements such as a discussion of the need for the project and its role in sustainability. These comments were provided primarily by Mr. Ramsey Hart, M.Sc.

1.3 Summaries of experts' main concerns about the EIA report

1.3.1 Summary of the reviewers' main comments about the EIA report: Atmospheric Environment

- Not enough data/information has been collected to say accurately what is the trace metal content of the ore, pit walls, waste rock, overburden, etc. Without this information, the types and amounts of air contaminants released by the project cannot be determined.
- Using the limited trace metal data that is provided in background studies for the EIA report, the reviewers calculate there is more arsenic in the project's ore than what is reported (EIA report = 41 mg/kg of arsenic; Reviewers = 64.8 mg/kg of arsenic).
- The use of 41 mg/kg of arsenic (vs. 64.8 mg/kg) in modeling for predicted air quality results in the under-estimation of the release of this contaminant. Also, the EIA report only uses arsenic concentrations from the ore in its modeling. This is the lowest concentration of arsenic for any of the potential pathways of air contaminants, other than soil. For example, the EIA report provides the mean arsenic concentration in the overburden as 143.3 mg/kg, which was not used in the report's calculation of trace metal air emissions. Arsenic concentrations are significantly higher in all emission pathways than the value used to estimate arsenic releases from the project.
- The drill core assays used to calculate trace metal content were not taken from random locations or locations that are representative of the entire mine site.
- Wind data provided in the EIA report does not reflect prevailing conditions and it was not collected from the highest point of the mine where tailings beaches will be located.
- Emissions of particulate matter (dust) from the site are under-estimated.
- The EIA report does not provide information on how much hydrogen sulfide and other pollutants the ammonium paratungstate (APT) plant will emit. Based on the reviewers' investigation of the predicted releases from an ATP plant in New York, it is clear the Sisson Project ATP plant will be a significant source of air pollutants.
- The Sisson Project will not contribute to the Canadian Council of Minister of the Environment's nationally-supported goal of "keeping clean areas clean".
- No environmental monitoring for future air quality is proposed for the project despite evidence that mines can release annually 5 to 30 times more dust than predicted in an EIA report.

1.3.2 Summary of the reviewer's main comments about the EIA report: Public Health

- The main concerns raised about the EIA report's section on the Atmospheric Environment are also applicable to the Public Health section. Additional concerns follow below.
- The most serious deficiency is that the EIA report did not evaluate the non-cancer health risk of the most common route of exposure to arsenic - ingestion of soil, water and food and dermal contact with soil. The human health risk assessment (HHRA) has incorrectly assumed that the health risks related to ingesting or inhaling arsenic are cancer-related only and that there are no toxicological reference values for non-cancer health effects via the oral or dermal route for adults or toddlers. As a result, the baseline (and project-related) human health risk assessment via ingestion of soil, water and food and dermal contact with soil has not been assessed for arsenic.
- The HHRA modeling domain is too small and does not cover the entire project Local Assessment Area (LAA). As a result, HHRA receptor locations in the community of Napadogan, and other locations at the edges of the LAA where people from Williamsburg, Currieburg, Boyds Corner, Fredericksburg and Stanley may spend recreation time, are not covered by the HHRA.

- Emissions of particulate matter and metals during the construction phase of the project and the potential seepage of metals from overburden piles during the construction phase have been excluded from the assessment.
- The Project + Baseline assessment of maximum acute and chronic human health risks from inhaling PM_{10} emissions are incomplete and inaccurate.
- Particulate emission estimates during the operational phases of the project are significantly underestimated.
- Arsenic emission estimates during operational phases of the project are significantly underestimated.
- Sulphur dioxide (and other) emission estimates from the Project's ammonium paratungstate (APT) facility are significantly underestimated.
- Characterization of health risks for on-site workers are not reported or discussed.
- A sensitivity analysis of the HHRA results has not been done.
- Public and occupational health follow-up or monitoring will not be done.

1.3.3 Summary of the reviewer's main comments about the EIA report: Water Resources

- In spite of the fact that the analyses could benefit from some potential methodological improvements and specifications mentioned above, the assessments provided appear to be technically and scientifically sound. Some (probably small) risks associated with local, perhaps short term, changes in the hydrological budget and water routing for wetlands and aquatic life are scarcely treated.

1.3.4 Summary of the reviewer's main comments about the EIA report: Water Resources

- The EIA report is incomplete in many critical areas. For example, the EIA report was written before the all-important Metal Leaching/Acid Rock Drainage Potential Report (ML/ARD Report) was completed. The EIA report was submitted to the CEA Agency on July 31, 2013, while the ML/ARD was not completed until August 2013.
- This mine will need a water treatment plant (WTP) and this plant is the core of the mine's water management plan. However, the WTP is poorly described and the plans for it are not in the actual EIA report.
- The WTP was designed to deal with arsenic and antimony only, not the other many chemicals that will be in the tailings pond.
- Details for all water management at the mine site are not provided. For example, water management ponds are to collect and pump back any seepage or other surface water to the tailings pond. How will this be managed (e.g., secure pumping when required, overflow conditions) is not made clear in the EIA report.
- There are no plans to put a liner in the tailings pond to prevent seepage. Tailings pond seepage is a major source of acid rock drainage.
- Models used by the proponent do not model natural variability. The proponent uses averages where it has some information, yet the proponent knows and discusses variability in several places. Confidence limits are best estimated to be +- 100% of the average.
- The EIA report speaks to potential outcomes, but gives no probability values of such as would be expected in an objective report on such an operation. Where risk is presented, it is consolidated into just a few categories. These risks are also the proponent's "judgment"; probabilities (%) need to be presented.

- There is no adequate proposal of environmental funding to deal with the water issues for such massive landscape features of the open pit and TSF post-operations. $50M may clean up the site (no details are provided for how this figure was arrived at), but it will never come close to handling the volumes of water in perpetuity.
- A breach of the tailings dam is not assessed in the EIA report. Although the chances of such may be small, they are not insignificant, and the impacts of such a breach on downstream water quality could be catastrophic. This needs to be assessed.

1.3.5 Summary of the reviewer's main comments about the EIA report: Aquatic Environment

- The main concerns raised about the EIA report's section on Water Resources are also applicable to the Aquatic Environment section. Additional concerns follow below.
- Not enough basic field work was done and where done, not always interpreted properly.
- Atlantic salmon in the St. John River are soon to be an endangered species and the Nashwaak River is officially recognized as the critical river for their survival, yet there is no planning for the risk of loss if any/some/all of the water management plans fail.
- The toxicity of water releases from the tailings pond to Sisson Brook has not been addressed fully.
- The EIA report says that fish habitat loss will be compensated by the removal of the Lower Lake Dam. The proponent has been told repeatedly by locals and scientists that this is not needed and as such it should not be proposed as the most likely habitat compensation scenario.
- A breach of the tailings dam is not assessed in the EIA report. Although the chances of such may be small, they are not insignificant, and the impacts of such a breach on downstream water quality could be catastrophic. This needs to be assessed.

1.3.6 Summary of the Center for Science in Public Participation's (CSP2) main comments and recommendations on the EIA report and proposed mine plans

Note: CSP2 submitted their comments on the project directly to the Agency on October 7, 2013, and are reproduced in Section 2.5 below for convenience.

- Regarding design of the tailings storage facility (TSF), CSP2 recommends "*A more sound approach in terms of controlling seepage would be to remove the native soils for use in reclamation, and to compact the remaining material to a specified density.*"
- CSP2 raises concerns about how the tailings dam response to earthquakes has been modeled. They recommend "*If pseudo-static modeling was used to test for seismic stability, then a numerical model should be used to test the dam under seismic loading.*" Their reason for this recommendation is that "It is especially important that dynamic modeling be performed since the dam design has incorporated a modified centerline-type construction (which has an upstream-type component built on seismically unstable tailings). Today, few US regulatory agencies accept pseudostatic methods for seismic design of new dam projects."
- Regarding the issue of alternatives for the design of the tailings dam, CSP2 states, "The EIA does not explain whether the use of cycloned tailings for dam construction, which would probably require downstream-type construction, would provide better seismic stability than for the modified centerline design chosen as the preferred alternative." It subsequently recommends "*It would be appropriate to have a full explanation of why a modified-centerline rockfill dam is better than a downstream dam constructed of tailings.*"

- Like other reviewers, CSP2 discusses the incompleteness of the acid base accounting for the project: "*The overburden should be sampled for sulfur and carbonate to insure that no acid drainage will emanate from the overburden."*
- The EIA report is not clear about how much surplus water will need to be treated. "The TSF will have approximately 2 million m3/year of surplus water starting at about Year 8." (p.3-123) and; "Approximately 6 million m3/year of TSF pond water will be pumped to the WTP during Operation starting in Year 8 under average conditions." (p. 7-80) This is a discrepancy of 4 million m3/year."
- Like other reviewers, CSP2 discusses the cost of future water treatment. "… the volumes possible at Sisson Brook could require a financial surety in the $100's millions. … By failing to declare, whether through lack of information or analysis, it must be assumed that a financial surety for water treatment in perpetuity needs to be established. However, the financial analysis of this outcome is also not addressed in the EIA. Because of the financial risk it places on the public, this is a major omission in the EIA."
- CSP2 is particularly critical of the EIA report's failure to assess the impacts of a tailings dam breach. "Tailings dam failure is a low probability event, but also an event with high consequences. These consequences have never been ignored in any other EIS/EIA I have reviewed. To in essence assert that 'my engineering' could not possibly fail, in light of existing statistics, is arrogantly assuming that it is always the other guy (or gal) that will make a mistake – but not me. This is exactly the attitude that leads to accidents…"
- Regarding the proponent's plan for quarterly water quality monitoring, CSP2 states "Quarterly monitoring is not adequate to capture surface water variations. Weekly sampling is typical at most mines."
- "The [Conceptual Decommissioning, Reclamation and Closure Plan] should be completed at the mine-proposal stage, and certainly prior to permitting, to a sufficient degree to reasonably determine water treatment costs, reclamation costs, and assess the short and long term social, health, and economic impacts from the mine (including post-closure)."
- The CSP2 review contains other recommendations, such as those dealing with groundwater monitoring, determining the cost of the closure bond, and steps for reclaiming the site.

1.3.7 Summary of the reviewer's main comments about the EIA report: Terrestrial and Vegetated Environments

- Overall, sampling for wildlife other than birds is inadequate.
- From the bird surveys done, there are several Threatened Species in the project area whose protection needs to be addressed before the project proceeds: Common Nighthawk, Olive Sided Flycatcher, and Canada Warbler.
- The EIA report does not discuss the importance of insects to the ecosystem and makes no mention of rare butterfly species such as the early hairstreak, hoary elfin and hoary comma.
- How the project will affect the national recovery strategy for long eared bats (Myotis spp.) is not discussed in the EIA report.
- The impacts of habitat fragmentation are downplayed in the EIA report, especially when one considers the cumulative impacts of human activity in that area, the overall declining health of the Acadian forest type in New Brunswick, and the large vegetated area that the project is impacting.
- The project`s impacts on lynx cannot be rated as "not significant" when no numbers are provided about how many lynx may die because of the project and the number of lynx in NB is not provided.

- The EIA report fails to acknowledge how the cumulative environmental effects of the project will contribute to deforestation and forest degradation at a time when the diversity of the Acadian forest should be restored.
- The EIA report fails to describe the potential effects of ecosystems and changes in the biota of terrestrial and freshwater ecosystems as a result of climate change in the future.
- The EIA report fails to develop a systematic approach to documenting how the project's environmental effects, such as to the atmospheric or aquatic environment, overlap with, and consequently impact on, candidate protected natural areas (PNAs). Many of the project's environmental effects will travel outside of the 1.5 km local assessment area chosen by the proponent to predict the impacts of the project on candidate PNAs.
- The EIA report does not assess the economic benefits of candidate PNAs as economic alternatives to the project, or the impact of PNAs as part of the environment's impact on the project.

1.3.8 Summary of the reviewer's main comments about the EIA report: Wetland Environment

- There is an over reliance on adhering strictly to the current provincial wetlands management policy which (as the proponent clearly states) does not regulate a large proportion of wetlands in the project development area, the local assessment area, and the regional assessment area. This leads to an underestimation of impacts due to a lack of requirements for compensation for this loss and an underestimation of the cumulative impacts, particularly when considered with future forestry activity which has the most impact on the unregulated wetlands (forested wetlands).
- The proponent does not go into detail about their proposed wetland compensation approach for mitigating the loss of wetlands functions of government regulated wetlands.
- The proponent relies heavily on future work to identify compensation measures. With a lack of detail it is impossible to comment on such things as watershed thresholds for wetland function loss and appropriate compensation to reflect the watersheds thresholds. This modeling should be undertaken.

1.3.9 Summary of the reviewer's main comments about the EIA report: Labour and Economy

- The EIA report is only dedicated to describing the economic benefits of mine, not its costs.
- The reviewer questions the use of an economic impact model (EIM) used to calculate the benefits of the project. Under EIMs, all expenditures by the project are a benefit. This includes the money spent to clean-up spills and floods of tailings.
- Even if one accepts the use of an EIM in the EIA report, the economic benefits of the mine have likely been over-estimated.
- A traditional cost-benefit analysis should have been used to improve our knowledge about the economic impacts of the mine.
- No details are provided about how the $50 million in closure costs were estimated. The reviewer believes this amount to be a serious under-estimation.
- Based on the proponent's sensitivity analysis, the reviewer states that mineral price movements, especially in the price of APT, will have a significant effect on the viability of this project. He also notes that current prices for molybdenum are far below the proponent's assumed price of $15/lb.

1.3.10 Summary of the reviewer's main comments about the EIA report: comparing the project to other mines

- From the parts of the EIA report the reviewer read, it is his view that overall the EIA report was very thorough and quite well done. He did raise some concerns about the project's plans for water management and the tailings storage facility (TSF). These follow below.
- A condition for allowing the project to proceed should be the requirement of a detailed plan to deal with emergencies such as a power failure, a pump(s) malfunction, and excessive precipitation.
- The EIA report does not provide a description of the spillway on the TSF or describe the design criteria for that spillway.
- It is not clear from the EIA report whether all of the water management components (WMP, pumps, pipes, and spillways) are designed to deal with these types of extreme rainfall events.
- Annual or at a minimum biannual inspections should be carried out to ensure the integrity of the dams surrounding the TSF versus the five year inspection period proposed by the proponent.
- It is not clear to the reviewer whether $50 million is adequate to properly close the mine.
- The reviewer notes that very few mines commence operation and run uninterrupted for the predicted full operational life of the mine. Metal prices, technical problems and labour disputes can all result in temporary or premature closure of a mine. This issue is not discussed in the EIA. The reviewer asks that should an interruption in production occur, how will that affect the water management plan, the operation of the TSF and the treatment of the waste water?

1.3.11 Comments on the failure of the EIA Report to address Need for and Sustainability of the Project

- The business case for the mine is weak, therefore the proponent has failed to demonstrate a clear need for the project in its basic purpose – supplying tungsten.
- The EIA report does not explain how the project supports sustainable development today and meets the needs of future generations.
- The proponent's, Northcliff Resources, relationship with HDI is unclear, i.e., it seems as though HDI is the proponent. Other environmental assessments have raised serious concerns about the quality of the EIA reports for different HDI projects, such as the Prosperity Mine in BC.

1.4 Five significant shortcomings of the EIA report

CCNB Action's reviewers identified many ways the EIA report needs to be improved. However, after CCNB Action's own review, after reading our experts' reports and discussing the EIA report with them, and hearing from the public, CCNB Action has identified five overarching "themes" about the inadequacy of the EIA report. (Many of these same concerns were raised during the federal review panel's hearing for the EIA report for the New Prosperity Mine in B.C., an HDI (the partner of Northclfiff Resources in the Sisson Project) project (see **Appendix F** of this report)).

1.4.1 The EIA report is fundamentally incomplete

There are many examples of how the Sisson Project EIA report is incomplete and as such needs to be revised before any further consideration of approving the project can take place. Some of the most glaring and vital are discussed below.

1.4.1.1 Acid Base Accounting for many potential sources of metal leaching and acid rock drainage were not complete at the time the EIA report was written

Metal leaching and acid rock drainage are two of the biggest and most obvious environmental effects of a metal mine. The assessment of these effects is fundamental to understanding the impacts of the Sisson Project. As such, they should have been top of mind when it came to completing the EIA report. Clearly they were not as the SRK 2013 ML/ARD Potential Characterization Report was not completed until August 2013, while the EIA report was submitted to the Agency on July 31, 2013. How any work or information from the ML/ARD report could have been included in the EIA report is unclear.

Further to this point, even the acid base accounting work in the ML/ARD report is incomplete. For example:

- **SRK ML/ARD Sec. 3.5:** "Additional overburden sampling is planned as part of geotechnical investigations in early fall 2013 and acid-base accounting analyses will be performed at that time."

- **SRK ML/ARD Sec. 4.5:** "Additional geotechnical investigations are planned for the fall of 2013 and ARD characterization is expected to occur at that time."

  "Additional work will be required to understand the mobility of arsenic from overburden. These studies are planned for the fall of 2013. "

Regarding ML/ARD, the Terms of Reference for the EIA Report required that:

> *The discussion of ML/ARD should demonstrate that Northcliff has the necessary understanding, site capacity, technical capability and intent to identify, avoid, mitigate and/or manage ML/ARD in a manner which protects the environment through the life of the mine and after closure of the mine.*

Given the proponent's cavalier treatment of the issue of ML/ARD in the EIA report, it is clear Northcliff has done none of this.

1.4.1.2 Details and statements regarding seepage from the tailings storage facility are either lacking or unsupportable

At pages 7-79 and 7-80, the EIA report states:

> **7.6.2.2.1.3 TSF Embankment Drainage and Seepage Collection**
>
> Steady-state seepage analyses were completed using the finite element computer program SEEP/W to estimate the amount of seepage through the TSF embankments. It was assumed that a portion the embankment drainage and seepage will be captured by the embankment seepage collection system or intercepted and collected by groundwater pump-back wells downstream of the TSF. A small fraction of the total seepage was assumed to bypass the seepage collection systems and be lost to the environment downstream of the TSF.

Nowhere in the EIA report or supporting studies are the results of these analyses or actual rates of seepage provided. What is a "small fraction" is not quantified. Evidence that this information is not shared with the public or decision-makers can be seen in EIA report Figure 3.4.9 (at page 3-124) "Schematic of Mine Operational Water Balance". The legend figure states the source of the figure is Samuel Engineering 2013. However, closer inspection shows the figure was supplied on March 27 to the proponent by Knight Piesold. While similar, Samuel Engineering did not use this figure. Rather, this figure comes from the reference Knight Piésold 2013b. (Sisson Project – Feasibility Study Monthly Operational Water Balance. Prepared for Northcliff Resources Ltd. dated March 27, 2013.) This Feasibility Study was not placed on the CEAR website for this project.

Dr. Chambers (CSP2) 1-2 highlights the need for this information:

> It is noted in the Knight Piesold Baseline Hydrogeology Report that:
>
> "● Till: Surficial geology mapping has identified basal and ablation tills up to about 10 m in the project area. The till is comprised of varying composition of sand, silt, gravel and clay. The ablation till may be more permeable than the basal till.
> ● Shallow, weathered bedrock: The presence of this zone in the upper 10 m to 20 m of rock is based on regional mapping as well as drilling in the project area."
>
> With up to 10 m of till, potentially on top of fractured bedrock that could be an additional 20 m in depth, the likelihood of seepage under the starter (and fully constructed) tailings dam seems probable in some locations.

1.4.1.3 Hydrometeorology data is missing or seemingly ignored

- **Baseline Hydrometeorology Report Sec. 6.0:** A reasonable amount of hydrological and meteorological data has been collected at the project site. However, periods of limited or missing data exist within the records. The most notable of these is the lack of winter precipitation data at the Sisson climate station, as well as limited May freshet runoff data and winter discharge data. It is therefore suggested that ongoing data collection be continued and that the estimated values in this report be reviewed and updated once additional data become available.

- **Baseline Studies: KP hydrogeology Sec. 4:** The rate of groundwater recharge was estimated as about 8 % of the MAP (1350 mm) based on a watershed model for the project that was calibrated to regional streamflows at Narrows Mountain Brook (KP 2012e). The regional stream flow data currently provides the best approximation of the long-term distribution and volume of flow at the site. As additional precipitation and streamflow measurements (especially low flow measurements) are collected on site, the modelling work may be revised to use site data for calibration. Short warming periods in the winter result in a component of the winter snowmelt and therefore winter low flows may reflect both surface runoff and groundwater discharge.

  This flow condition observed during this packer test indicates that the higher take is likely not indicative of the bulk permeability of the test interval. Given the uncertainty with the high take tests, the following was recommended:
  o Identify the packer tests as high take without assigning an actual hydraulic conductivity value, until there is greater certainty regarding the validity of the testing.
  o If required, carry out additional and more than one type of hydraulic testing (e.g. constant head, falling head, lugeon) to better constrain whether the high take results are indicative of the site conditions or were influenced by the testing tool or method.
  o Recognize the implications of potentially high hydraulic conductivity values within the deposit area on engineering and environmental studies until additional testing is completed to gain a better understanding of the hydraulic conductivity values.

From the above quote, is appears as though the proponent chose to ignore results it didn't like and wait for better data. There is no evidence that further testing was done to determine the mine site's hydraulic conductivity values and as such it is unclear how the proponent reached conclusions regarding the rate of groundwater flow for the project.

1.4.1.3 Understanding the toxicity of water released to Sisson Brook

In the EIA report, the water quality at a node for Sisson Brook is not discussed (at page 7-92) despite it being the receiving waters for the water from the TSF and later, open pit. Instead, the closest water quality node that is discussed is at Napadogan Brook 5 (NAP 5), which is below the confluence of Sisson and Napadogan Brook. At NAP 5, the toxicity of Sisson Brook is diluted by Napadogan Brook, thereby not providing the public and decision-makers of what is the final water quality of Sisson Brook. This information is key if we are to understand the impacts of the project on water quality and fish and fish habitat.

The failure to discuss a water quality node at Sisson Brook provides another example of the poor quality of the background work done for the EIA report. The Predictive Water Quality study treats NAP 5 as an effluent discharge point. For example (at Predictive Water Quality Study page 5):

> Beginning in Year 8, 6,000,000 m^3/yr of excess water from the TSF is pumped to a water treatment plant (WTP) and discharged post-treatment to Napadogan Brook at the confluence with Sisson Brook. The WTP discharge rate is generally proportional to the baseline hydrograph of at the point of discharge. The discharge is further reduced during low flow months in late summer and mid-winter.

Everywhere else in the EIA report it is made clear that water will be discharged to Sisson Brook. Why the Predictive Water Quality Study used a different discharge is unclear. This lack of consistency results in vital information being lost to the EIA report.

Finally, the proponent's assertions that it will do future work to address gaps in data and analyses are not in keeping with the Agency's own guidelines regarding the completion of an EIA report:

> "A commitment to implementing adaptive management measures does not eliminate the need for sufficient information regarding the environmental effects of the project, the significance of those effects and the appropriate mitigation measures required to eliminate, reduce or control those effects. Where additional information collection or studies are needed over the life-cycle of the project, such studies in themselves should not be considered "mitigation measures"." (CEA Agency's 2009 Operational Policy Statement, *Adaptive Management Measures under the Canadian Environmental Assessment Act* at page 4, emphasis added)

The spirit of the 2009 OAP is that EIAs are not complete until all necessary baseline data is collected. Without this, the effects of a project cannot be fully assessed.

Recommendation:

- That the CEA Agency require the proponent to revise the EIA report to address all the concerns identified by CCNB experts and in this report.

1.4.2 No economic cost-benefit analysis

Common sense tells us that large open pit mining operations that dig up acid generating and metal leaching rock, emit contaminated dust, destroy the headwaters of clean and ecologically important rivers, fragment terrestrial landscapes, and have massive tailings ponds and dams, cause harm to the environment. These negative environmental effects also impact communities located near these mines. If these impacts and harm are significant, then these projects should not be approved by the public and environmental assessment decision-makers. However, sometimes they are when it is believed the economic benefits of a mine outweigh or justify the damage it causes to the environment and communities. Implicit in these decisions though is that the economic benefits of a mine are large enough to outweigh its environmental and social costs.

As has been detailed by Dr. Moir (see Section 2.9 below), without a cost-benefit analysis we don't have an accurate picture of the economic benefits, if any, of the Sisson Project. As Dr. Moir notes, the use of an economic impact model, like the one used by the proponent, for a different project showed that the project created a positive economic benefit, while using a true cost-benefit analysis showed this same project generated a negative economic loss to the community. Therefore, without an economic cost-benefit analysis for the Sisson Project, the public and decision-makers cannot make an informed decision about whether the economic benefits of the project justify the damage it will cause to the environment. Making this determination becomes even more difficult when the true closure costs of the Sisson Project are not known.

Recommendations:

- In consultation with Dr. Moir, have the proponent prepare an economic cost-benefit analysis for the Sisson Project for inclusion in a revised EIA report.

- Have the proponent provide a fully costed estimate of the long term closure costs of the Sisson Project for inclusion in a revised EIA report.

1.4.3 No assessment of the failure of the tailings dam

As will be detailed more fully below, and as much as the proponent would like this fact to go away, tailings dams fail! The failure of the Sisson tailings dam could release millions of tonnes of tailings and millions of cubic metres of supernatant water into the ecologically valuable Nashwaak watershed. While understated, the EIA Report does recognize the harm such a failure would cause. "At Sisson, a failure of the TSF embankment and resultant tailings or process water release could significantly affect downstream watercourses and habitats that have substantial ecological and societal value …" (EIAR page 3-25, emphasis added). Despite a tailings dam failure posing the project's biggest acute threat to the environment, the proponent chose not to assess its impacts.

> 8.17.2.1.1 Loss of Containment from Tailings Storage Facility (TSF)
>
> "With the application of these standards and rigorous construction methods to ensure the structural integrity of the TSF embankments and components, the implementation of adaptive management measures as necessary over the life of the mine, and the legislated regulatory oversight, the possibility of a structural failure of a TSF embankment is so unlikely that it cannot reasonably be considered a credible accident or malfunction, and is thus not considered further in this EIA Report." (EIAR page 8-698, emphasis added)

In his review of the EIA report for the Sisson Project (see Section 2.5 below), Dr. Chambers, who has 20 years of experience as an advisor on the environmental effects of mining projects both nationally and internationally, clearly explains why the above thinking is flawed.

> This is the first time I have seen this glaringly overconfident statement made in an EIS/EIA.
>
> In the 10 years since the ICOLD 2001[1] report the failure rate of tailings dams has remained at roughly one failure every 8 months (i.e. three failures every two years).[2] These dam failures are not limited to old technology or to countries with scant regulation. Previous research pointed out that most tailings dam failures occur at operating mines, and that 39% of the tailings dam failures worldwide occur in the United States, significantly more than in any other country.[3]
>
> Tailings dam failure is a low probability event, but also an event with high consequences. These consequences have never been ignored in any other EIS/EIA I have reviewed. To in essence assert that 'my engineering' could not possibly fail, in light of existing statistics, is arrogantly assuming that it is always the other guy (or gal) that will make a mistake – but not me. This is exactly the attitude that leads to accidents – as has been proven many times in the aviation world. (emphasis added)

[1] Tailings Dams, Risk of Dangerous Occurrences, Lessons Learnt from Practical Experiences, Bulletin 121, International Commission on Large Dams, 2001.

[2] Data from http://www.wise-uranium.org/mdaf.html "Chronology of major tailings dam failures" as of March 22, 2011.

[3] Reported tailings dam failures, A review of the European incidents in the worldwide context, M. Rico, G. Benito, A.R. Salgueiro, A. D´ıez-Herrero, H.G. Pereira, Journal of Hazardous Materials 152 (2008) p. 848.

Recommendation:

- Have the proponent complete a detailed environmental effects analysis of the failure of the tailings dam for the Sisson Project for inclusion in a revised EIA report. The assessment would include a modeling of the most likely worst case disaster scenario for such a failure describing, for example, the toxicity of the tailings and supernatant water, how much tailings and supernatant water would escape from the tailings storage facility, how far and to what depth the tailings and supernatant water would travel downstream, and what damage this would cause to communities in the watershed and the environment, including Atlantic salmon habitat, and for how long.

1.4.4 The closure plan is missing significant details

Several CCNB Action reviewers discussed the serious deficiencies of the proponent's closure plan. Mines with acid rock drainage and metal leaching leave long term environmental liabilities that must be managed. Without an understanding of the long term future environmental, social, and economic costs of the Sisson Project, we cannot make a fair determination of whether the project is sustainable, i.e., does it meet the needs of today without damaging the opportunities of future generations. Several of the key deficiencies of the closure plan are discussed below.

1.4.4.1 There is no accurate description of how much contaminated water will have to be managed after closure

The EIA report first states "the TSF will have approximately 2 million m^3/year of surplus water starting at about Year 8" (EIAR page 3-123). It then reports, "Approximately 6 million m^3/year of TSF pond water will be pumped to the WTP during Operation starting in Year 8 under average conditions" (EIAR page 7-80). Finally, the SRK (2013) Metal Leaching and Acid Rock Drainage Potential Characterization then describes in Appendix I (conceptual water treatment plant design) that the TSF, and after closure, the open pit will have an annual discharge of 1,280 m^3/hr (or 11 million m^3/year). This wide variation in water that will have to be treated after closure is never explained.

1.4.4.2 There is no accurate description for how long contaminated water will have to managed after closure

The EIA report provides no details about how long post-closure that water will need to be treated, only that it will be treated for "as long as necessary" (EIAR page 143). Is this 1 year, 10 years, 100 years, or more? This is not an idle question, for as Mr. Parker points out (Section 2.10 below), we already have closed mines in New Brunswick whose waste water requires long-term treatment. The lack of detail in the EIA report obviously does not assist in decision-making about the project.

1.4.4.3 Significant details about the conceptual water treatment plant are missing

The water treatment plant (WTP) is the key component of the closure plan for the mine, yet it is not described in any detail in the actual EIA report. Without the WTP, the environmental effects of the project post-closure on the aquatic environment will not be mitigated, in turn increasing their significance. Given the limitations of the conceptual design for the WTP, at present there is *no water treatment plant* for the Sisson Project. As the SRK 2013 report states:

> In the event that water treatment for sodium or fluoride is required … then the water treatment process proposed here will not be adequate. (SRK 2013 Appendix I, emphasis added)

The EIA report shows (at page 7-98) that post-closure, fluoride levels in water from the mine will be 2 to 3 times the CCME FAL guidelines (for the protection of aquatic life). The proponent can have no expectation that this continual exceedence, amongst others, will be permitted in the future. As a result, there is no actual plan for a WTP in the EIA report and a new conceptual WTP needs to be designed. The consequence of this is that any of the proponent's environmental effects analysis that relied on the existence of the flawed conceptual WTP much be redone, and if not redone, then without the mitigation of a WTP, the adverse environmental effects of the project on the aquatic environment must be considered to be significant.

1.4.4.4 The Terms of Reference regarding closure have not been met

> At a minimum, the discussion of alternative means of carrying out the Project shall include a consideration of the following: …
> • alternative options for reclamation and closure. (TOR at page 22-23)

In response to this requirement, the EIA report (at page 3-77) states, "Northcliff has considered various options to achieve decommissioning, reclamation and closure of the Project site at the end of mine life." No details of these other options are provided. Clearly this is not enough information for the public and decision-makers to weigh these alternatives. It is also not in keeping with Environment Canada's 2011 *Guidelines for the Assessment of Alternatives of Mine Waste Disposal*:[4]

> The alternatives assessment should objectively and rigorously consider all available options for mine waste disposal. It should assess all aspects of each mine waste disposal alternative throughout the project life cycle (i.e., from construction through operation, closure and ultimately long-term monitoring and maintenance). (at page 7)

Recommendations:

- Any plan for the decommissioning and closure of the project should be completed at the mine-proposal stage, and certainly prior to permitting, to a sufficient degree to reasonably determine water treatment costs, i.e., how much water and what is in the water, reclamation costs, and assess the short and long term social, health, and economic impacts from the mine (including post-closure).
- Prior to permitting the proponent should identify what long term and permanent water quality treatment may be necessary at the mine site. This includes but not be limited to discharges from the pit (including from pit walls that will not be submerged and pit discharges to groundwater).
- Permanent treatment should be avoided. The closure plan should more fully evaluate this and identify alternatives to perpetual treatment.

[4] Available at: http://www.ec.gc.ca/Publications/default.asp?lang=En&xml=5ECBCE8B-7E50-49E3-B7AD-8C21A575E873.

1.4.5 Costs of closure are not explained

Regarding this issue, Dr. Chambers writes

> If there is surplus pit water that will require treatment it is reasonable to anticipate that this treatment will be required in perpetuity - forever. That presents clear long-term liabilities and costs to the Crown, Province, and public. These liabilities and costs should be fully evaluated and discussed … (Section 2.5 below).

Similar concerns are raised by Dr. Curry (Section 2.4), Dr. Moir (Section 2.9), Mr. Parker (Section 2.10), and Mr. Hart (Section 3.0 Sustainability).

The proponent provides no details about how it arrived at a figure of $50 million to cover the costs of decommissioning, reclamation, and closure of the project. In addition, all of the above reviewers believe this amount to be very inadequate for a project of this size. The average operational costs of water treatment for mines are estimated to be $1.54 per m^3.[5] Accepting the proponent's figure of the project having 6 million m^3 of surplus water/year, one arrives at roughly $9 million/year being required to treat this water. The proposed $50 million would be depleted in less than 6 years, without including reclamation costs such as for revegeatating the site.

Recommendation:

- Have the proponent provide a fully costed estimate of the long term closure costs of the Sisson Project for inclusion in a revised EIA report.

[5] Zinck, J. and W. Griffith. 2013. Review of Mine Drainage Treatment and Sludge Management Operations. MEND Project: 603054. Report: CANMET-MMSL 10-058(CR).

1.4 CCNB Action's position on the EIA report and adverse environmental effects of the Sisson project

CCNB Action's report below shows that the need for the proposed tungsten and molybdenum mine has not been proven adequately. In addition, CCNB Action's expert reviewers collectively are of the opinion that because of missing vital data or data of poor quality, and inadequate sampling, methodology, and modeling done by the proponent, a large number of the Sisson Project's environmental effects cannot actually be determined. As a result, the EIA report does not fulfill the requirements for the conducting and reporting of the environmental assessment for the project as set out in the project's EIA terms of reference. CCNB Action experts are also of the opinion that based on the data that is available in the EIA report, in many instances the proponent has under-estimated the environmental effects of the project and mischaracterized the significance of these impacts, i.e., CCNB Action experts believe these adverse environmental effects of the project should be rated as significant.

From a reading of our report below, it is evident the presently inadequate and incomplete EIA report for the project must be redone so that fundamental questions about the project can be answered, such as what is the actual trace mineral content of the ore, what is the acid generating potential of the mined rock, and what are the true economic benefits of the project? Based on the fact the EIA report is incomplete, our experts' findings that many of the project's adverse environmental effects are significant, and the application of the precautionary principle, it is CCNB Action's position that the adverse environmental effects of the project must be accepted as being significant. Given all of this, it is clear that at present the obvious risks posed to the environment by the proposed mine, such as the release of air contaminants, the physical destruction of valuable fish habitat, and metal leaching and acid rock drainage, substantially outweigh the unsubstantiated need for or benefits of the project. For this reason, it is the position of CCNB Action the project should not receive the approval of decision-makers until such time as fundamental errors and oversights in the EIA report are adequately addressed. It is only after the EIA report is properly completed that the public and regulators can return to the question of whether the project should receive approval.

Following from the above, we will be requesting that the Minister use her authority under s. 23(2) of the old *CEAA* and/or the CEA Agency use its authority under s. 23(2) of *CEAA 2012* to require the proponent, Northcliff Resources Inc., to redo and revise the EIA report so that the information gaps in it identified by CCNB Action's experts are filled. We will also ask that the current public comment period not be ended and that it be extended for 45 days following the submission of a revised EIA report by the proponent. If these revisions are not made, then CCNB Action will stand by its position that the adverse environmental effects of the Sisson Project must be deemed to be significant and because of the unsubstantiated need for the project, that these effects cannot be justified. As such, we will ask the CEA Agency to conclude in its comprehensive study report (CSR) for the project, "That even with the implementation of mitigation measures, the Sisson Project is likely to cause significant adverse environmental effects and that these effects cannot be justified."

2.3 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Valued Environmental Components: Water Resources
Subject Areas: Ecological Water Availability
EIA Report Sections: 8.4
Date: September 26, 2013

André St.-Hilaire, PhD.
INRS-ETE (Institut national de la recherche scientifique), University of Québec

1. Summary

What did I review?
Baseline Hydrogeology Report, Baseline Hydrometeorolgy Report, EIA report section 8.4 Water Resources, EIA report section 7.6 Predictive Study, re: water quality modeling

What are the highlights of my review?
Hydrometeorology
Overall, the methods used by the proponent to gather data for regarding water resources in the project development area were correct, albeit not the most up to date approaches in the case of regional frequency analysis. Local frequency analysis appeared to be done without respecting the initial verifications on time series and only one statistical distribution was tested. The proponent's work in this area would have been improved by comparing the goodness of fit of more than one distribution. As a result; any extreme value analysis and return period estimated in the report should be treated as an order of magnitude to be partially validated with goodness of fit criteria on the selected distribution.
Hydrogeology
I am less familiar with hydrogeology methods than with surface hydrology. However, I noted that the proponent's consultant claims to want to use the hydrological model results to validate some of the hydrogeology settings to be used subsequently (Baseline Hydrogeology Report page A1 of 43). Later on, the consultant mentions that the model can assist in identifying long term trends from changing climate. I did not find any conclusions related to those two points.

2. Review of methods used by the proponent to study existing conditions (EIA Report section 8.4.2)

Were proper sampling methods used?
- Meteorological data used to perform frequency analysis may be insufficient.
- We do not know what type of water level gauge was used and the precision of the instrument is not mentioned.
- The baseline hydrogeology report recommends (at page 8) that given the uncertainty with the high groundwater take tests, there needs to be recognition of "the implications of potentially high hydraulic conductivity values within the deposit area on engineering and environmental studies until additional testing is completed to gain a better understanding of the hydraulic conductivity values."

It is unclear if this was ever done or accounted for in the EIA report?

Timing of sampling, e.g., appropriate season
Stream gauging in the spring and in the winter is challenging. Given the relatively short period of the study, it should be made clearer in the report if the sampling period covers years that are more or less typical hydrologically for the region.

A large proportion of the synthetic flows (for Station B-2 (Bird Brook at Napadogan Brook) as discussed in Appendix A1, Baseline Hydrogeology report) generated for the period of April and May is in the extrapolation range of the rating curve. Is this a problem?

Is the sampling science/methodology up-to-date (Baseline Hydrometeorology Report)
There are more updated methods for regional frequency analysis (estimation of return periods) for precipitation and flow. It is not clear in the Baseline Hydrometeorology Report if the hypotheses of stationarity, independence and homogeneity were tested before completing the frequency analysis. In Table 2.14 (Baseline Hydrometeorology Report), it is stated: "Return period rainfall amounts computed assuming an Extreme Value Distribution." What specific distribution was used? Does the author mean the Generalized Extreme Value (GEV) distribution? What fitting method was used? I assumed it is L-moments, mentioned earlier in the report. If so, the authors should warn the reader that it is based on order statistics and thus attenuates the relative importance of very high values in the frequency analysis. The approach could be improved by comparing the goodness of fit of more than one distribution.

The Herschfield Equation for PMP (probable maximum precipitation) has been criticized in the past. For instance, Koutsoyiannis (1999) states that there is no published data to support the notion of an upper physical limit to PMP and that a probabilistic framework is more appropriate.

The low flow frequency analysis was done using LFA software (Table 3.10). If I am not mistaken, two distributions can be used in LFA: the Weibull and the LN III. Which one was used? How does this choice affect quantile estimations? Also, regression based generation of synthetic flows without variance inflation may in some cases decrease the variability of synthetic flows compared to natural flows. Is it the case here?

The report states that the consultant has not modified quantitative predictions presented in this report to account for climate change (at page 14). This may be problematic. Minimally, a trend analysis could be performed to see if precipitations and flows are increasing or decreasing in the area. Note that if a trend is present, than no stationary frequency analysis can be performed. Additionally, the consultant could at least look at some of the most pessimistic and optimistic climate change scenarios in regional or even global climate model outputs for the region and provide more information on climate change impact.

At the end of the peak flow estimate section, it is stated: "Return period flood estimates for basins larger than 10 km^2 should be separately assessed on the basis of available regional data" (at page 12). I gathered this has not been done, in spite of the fact that some gauging stations have drainage basin larger than 10 km^2?

Are appropriate references used,
Some of the references are quite old (Hogg and Carr, 1985; Herschfield, 1961).

Are references properly interpreted/reported/used,
For the Baseline Hydrometeorology Report: Yes, from what I can see.

For the Hydrogeology report, Section 3.2.2. It is stated: "These high flow rates indicate the potential for relatively high hydraulic conductivity values but were not conclusively supported by other available drilling information such as drill circulation losses and observations of the core." Are there other references that could have been used to compare these high flow rates with typical values?

Are proper models used
See my comments on Frequency analysis.

Are models used correctly
See my comments on Frequency analysis.

3. Review of results of studies of existing conditions

Based on the methods used, are the results accurate
Hydrometeorology: See my comments on frequency analysis and climate change
Hydrogeology: Results of the hydrological model reflect the difficulty of transferring precipitation information from a regional station and also the (unexplained) potential difficulty in transferring the parameters of the model from a large basin to a smaller one.

Are conclusions/statements made regarding existing conditions (results of studies) accurate
See my comments on Frequency analysis and climate change.

Are the results in keeping with your knowledge or experience from other studies
Regional Frequency analysis on small drainage basins is tricky because there are very few gauged basins of small size. Results for small basins have usually more uncertainty than with larger ones. One way to partially assess the regionalization technique is to proceed with a leave-one-out cross validation on gauged basins.

Are other data sources properly interpreted/reported/used
See my question on synthetic flows.

4. Review of Potential Project-VEC Interactions re: water quantity (EIA Report section 8.4.3)

Are there other interactions that have not been identified?
The interaction between groundwater and wetlands is discussed, but not truly quantified.

5. Review of assessment of project related environmental effects re: water quantity (EIA Report section 8.4.4)

5.1 Review of environmental effects assessment re: Potential Project Environmental Effects Mechanisms (EIA Report section 8.4.4.1)

- **For the environmental effects identified in the EIA Report, are they discussed/described accurately**

The issues included are well described in this section

- **Are there other possible environmental effects that have not been identified**

At this stage of the EIA report, it appears that the only potential impact of the lowering of the water table is related to drinking water. The EIA report stats on page 8-111 that the project "may affect groundwater availability within the PDA and possibly the LAA". Possible impacts on baseflow are mentioned in the context of local water users only. Impacts on stream biota are not discussed (maybe in another report?). The potential impact of water table lowering on wetlands is not mentioned.

5.2 Review of described mitigation measures (EIA Report section 8.4.4.2)

- **Are the suggested mitigation measures feasible?**

In this section, the mitigation measures are described succinctly. The list is quite exhaustive but somewhat lacking in details. For instance, I am not clear on what will be done for sediment mitigation during construction.

- **Are there other measures that should be taken?**

Monitoring of groundwater levels in adjacent wetlands may be useful.

5.3 Review of environmental effects assessment re: Characterization of Residual Project Environmental Effects (EIA Report section 8.4.4.3)

In this section, potential impact of the permanent loss of Sisson Brook is focusing on human water consumption, which is clearly not the main issue. Aquatic life is the main issue. It is discussed briefly in other sections.

Also, on EIAR page 8-123, it is stated: "The Construction activities (Years -2 and -1) will result in retention of Bird Brook water within the PDA which will permanently reduce the stream flows to 16% of MAF. The diversion of a portion of flow of Sisson Brook to McBean Brook, and the installation of a starter dam and WMP, will reduce the flow in Sisson Brook to 42% of MAF, while increasing the flow in McBean Brook to 102% of MAF. The combined effect of stream flow reductions from Bird and Sisson brooks will reduce the flow in Napadogan Brook to 76% of MAF below the confluence with Sisson Brook, and to 91% of MAF at the confluence of Napadogan Brook with the Nashwaak River." Reductions as a percentage of MAF are useful, but can the proponent's consultant provide information about the impact of timing of these reductions within the annual hydrograph?

Post closure stream flows in Sisson Brook will rise to 213% of MAF. What might that increase do to stream geomorphology and riparian flooding?

Sediment loading mitigation will be done by locating structures more than 30 m from watercourses, and use of silt fencing. Maintenance of silt fences should be mentioned. Will there be a need for small settling ponds?

- **Matter of indirect loss of wetlands at p. 8-421.**

In this section, fen hydrology is discussed and it is stated: “These fens all have a high degree of groundwater input as evidenced by the number of springs found during field work…. Because of the location of these wetlands within large wetland complexes and the high input from groundwater, the hydrology tends to be very stable.”

It is unclear to me if the post-closure differences in MAF may have impacts on adjacent fens and bogs and if water table fluctuations may also have an impact.

It is further on p. 8-421: “The relative ratio of groundwater to surface water inputs to the headwaters of McBean Brook cannot be accurately determined.” Water temperature can be a good and cheap tracer for hydrograph separation in groundwater and surface runoff. Conductivity can also be used.

- **Matter of the <u>spatial boundaries</u> used by the proponent in the assessment, in particular the defined “Local Assessment Area” (LAA) (see EIAR 8-61).**

On page 8-61, it is stated that ‘”he LAA is the maximum anticipated area within which Project-related environmental effects are expected to be discernible. For Water Resources, the LAA includes the McBean and Napadogan Brook sub-watersheds (Figure 8.4.1). Spatial boundaries for surface water flows and hydrology will be considered for watercourses draining to and away from Project components and facilities, with a particular emphasis on those watercourses downstream of the Project to determine the potential for flow reductions as a result of the Project.”

What about the aquifer? Drainage basin boundaries do not necessarily coincide with aquifer boundaries.

6. Summary of Water Quality and Water Balance Modelling (EIA Report section 7.6).

Was a proper model used
It is here at last that we find out that the proponent’s consult is using Monte Carlo simulations produced using the Gold Sim software. Form the limited reading I could do of references related to this model, it seems adequate.

The stochastic component of rainfall is modeled using a gamma distribution. It would be nice to see if it is adequate, at least graphically (p.7-78).

On p. 7-80, it is stated that “The TSF pond is predicted to be in a net surplus condition for the entire operating life of the mine, indicating that the system (including the TSF and contributing catchments) is able to supply more than enough water to meet the mill process water requirements, even under dry conditions.” What does dry mean? Are we looking at extreme dry spells? Of which return period?

On p. 7-86, it is stated that 77 parameters were modeled using mass balance. Are they all conservative? I am not a chemist, but it seems to me that e.g., carbon requires a more sophisticated model?

7. Have the project’s residual environmental effects by properly characterized?

Has the analysis for the environmental effect been done correctly and is it environmentally realistic,
There may be room for Improvement, but I think that generally speaking, the methodology is correct.

Based on the models used, are the results accurate

See my previous comments on the results of the model. The claim that the TSF will be in net surplus all the time needs to be quantified in a probalistic framework, in my opinion.

8. Review of Determination of Significance (EIA Report section 8.4.6)

Are proponent's conclusions regarding the environmental effects of the project on water resources being "not significant" accurate?

It is difficult to discuss accuracy of the findings because they are predictions based on models. Georges Box's famous quote comes to mind: "Remember that all models are wrong; the practical question is how wrong do they have to be to not be useful."' I think that, given the information provided, the statement that there is minimal risk to health related to water resources is plausible. The risk of local impacts on aquatic fauna and wetlands is difficult to assess from the sections that I read.

9. Review of Follow-up and Monitoring (EIA Report section 8.4.7)

The proposed monitoring is feasible, but information is missing. Frequency of water quality monitoring should be proposed and some information about the timing of sampling with respect to hydrological events or extremes should be provided. Rating curves for hydrometric stations would benefit from high flow measurements, where feasible.

10. Discussion of uncertainties and inappropriate reliance on adaptive management

Relies on future monitoring to verify or confirm predictions

Potential changes in water quality and quantity will be verified with ongoing monitoring. This is feasible.

Relies on future adaptive management or an ambiguous environmental protection plan to address possible environmental impacts of the project

I did not find ambiguities.

11. Conclusion and recommendations

In my opinion, in spite of the fact that the analyses could benefit from some potential methodological improvements and specifications mentioned above, the assessments provided appear to be technically and scientifically sound. Some (probably small) risks associated with local, perhaps short term, changes in the hydrological budget and water routing for wetlands and aquatic life are scarcely treated.

12. References cited by Reviewer

Koutsoyiannis, D. 1999. A probabilistic view of Hershfield's method for estimating probable maximum precipitation. Water Resources Research 35(4):1313-1322.

13. Biography of Reviewer

Dr. St.-Hilaire's biography can be found at: http://www.inrs.ca/english/andre-st-hilaire.

2.4 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Valued Environmental Components:
1) General comments on Executive Summary, Project Description, Summary of Key Predictive Studies
2) VEC – Water Resources
3) VEC – Aquatic Environment
4) VEC – Accidents, Malfunctions and Unplanned Events
Subject Areas: Water Quality, Fish and Fish Habitat
EIA Report Sections: Exec. Summary, 3.0, 7.0, 8.4, 8.5, 8.17
Date: October 1, 2013

Allen Curry, PhD.
Canadian Rivers Institute
University of New Brunswick

NOTE: Dr. Curry's review begins on the next page. Dr. Curry's biography can be found at: http://www.unb.ca/research/institutes/cri/people/sciencedirectors/curry/index.html.

Canadian Rivers Institute
10 Bailey Drive Fredericton, NB E3B 5A3

1 October 2013

Mr. Scott Kidd
c/o Conservation Council of NB

RE: Sisson Brook Mine EIA Report Review

Dear Scott:

Please find enclosed my report on the issues that arise in this EIA Report. I will present the major concerns that are more project-wide in nature. The final component will be a detailed description of issues that were inadequately addressed in this EIA report beginning with the Water Treatment Plant (WTP), and including my original letter to HDI/Northcliff in 2012 describing the short-comings.

Some highlights of the topics most serious:

1. WTP – Poorly described and what is described is inadequate. It is designed to deal with arsenic and antimony only, not other of the many chemicals in the TSF. This is the core of the water management plan, yet it wasn't presented to the proponent until after the EIA release date (6 August 2013). Ad hoc at best.
2. TSF Liner – Why isn't it lined? We are talking about a massive water body with no guaranteed containment of seepage. To suggest the settling of tailings will create a liner is at best a shot in the dark; how can you present this operation without a risk assessment for full containment of seepage?
3. TSF Plan – Repeatedly, plans for the TSF are described differently including their maps/figures with some in-site features not described except in the technical documents (i.e., ferric sulphate sludge holding).
4. Modeling Natural Variability – Such is not incorporated into their models. The proponent uses averages where it has some information, yet the proponent knows and discusses variability in several places. The biological data has so few data that confidence limits are best estimated to be +- 100% of the average.
5. Atlantic salmon – Soon to be an Endangered Species and the Nashwaak River is officially recognized as the critical river for their survival, yet there is no planning for the risk of loss if any/some/all of their plans fail.
6. Water Releases to Sisson Brook – It is nearly non-existent for the first years then it becomes what the proponent estimates to be all WTP water forever thereafter (discharge to meet pre-construction levels). Massive assumptions, inadequate analyses, and no clear risk assessment for the aquatic environment of this planned management of all water leaving the site.
7. Water Pumping – WMP will collect and pump back to TSF any seepage or other surface water. How will this be managed (e.g., secure pumping when required, overflow conditions) and paid for as long as TSF water is below water quality standards (in perpetuity)?
8. Residual Water Features (post-operations) – TSF, pit lake, and channel between the two. These are massive bodies of potentially seriously, toxic water, yet there is no assessment of this risk into the future.

…/2

9. Financing – There is no adequate proposal of environmental funding to deal with the water issues for such a massive landscape feature post-operations. $50M may clean up the site (it also appears to be a "best guess"), but will never come close to handling the volumes of water in perpetuity. These sites will never be restored by humans, yet the legacy has to be addressed to protect the rest of the environment of the Nashwaak River. And, this money needs to be put up-front, into an independent trust fund untouchable to government or industry.

Some general notes:
The EIA report is written as if the process was concluded and a decision was final to proceed with the project. I have read and critiqued a few EIA reports from across Canada and consistent among the reports is a "tone" of writing as well as selection of terms that detracts from an objective assessment of the potential impacts, their risks, and the options for mitigating risks. Perhaps that is what the law demands – I certainly hope not – we need objectivity to assess accurately. For example, there are repeated references to assessing the accuracy of their many models once the project is underway and using this testing against their predictions as useful in the current assessment. Stating that one goal of the future work is "to confirm results of models" presumes the models were correct. The issue is what to do about the problem if the models were incorrect (risk assessment). Dealing with incorrect models was totally lacking in this report, i.e., there is no risk assessment for assumptions and models. Testing post-hoc is not assessment of risk; it is hand waving, academic hypothesis and prediction testing.

One global issue is the complexity of the presentation. I appreciate it is a complex project, but a reviewer shouldn't have to have multiple documents open and continuously search word by word through documents to find the details of referenced components of the proposed work, especially given the short review time given to the public and government regulators. There are >5000 pages in the document set that need to be reviewed. Poor structure hinders the review process. I hope that proponents don't do this on purpose to keep reviewers (regulators and others) from understanding the actual project and therefore confusing mass of reporting (pages) for quality of an EIA report. I did the math on my time on this review, so this is specific to the complexity, missing pieces and/or mixed location of pieces. I could do about 16 pages per 8 hour day. That is 362 days to actually do it right. The cost would be about $120,000 based on consulting rates.

The EIA report speaks to potential outcomes, but gives no probability values of such as would be expected in an objective report on such an operation. Where risk is presented, e.g., Table 8.17.5, the risk is consolidated into just a few categories (three in this table). These are again the proponent's "judgment"; as a reviewer of the risk, it is imperative that probabilities (%) are presented. Even risk matrices would have been useful.

The objectivity of the EIA report is undermined by their repeated use of their own "expert knowledge and opinion" (e.g., page 8-130). Their job was to collect the data and do appropriate analyses. The public and government regulators require by law (that is my interpretation of the Canadian Environmental Assessment Act), reality not opinion. For example, their description of environmental issues if the

…/3

WTP fails: *"Interaction may occur. However, **based on past experience and professional judgment**, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices."* Given that the proponent has not presented an adequately engineered WTP which is consistent with their engineers' opinion presented in this specific component of the report (see below), any opinion about the WTP and in my view, any opinion in this EIA report, is compromised.

One good example of the poor structure is the description of the Water Treatment Plant (WTP). In reading "Metal Leaching and Acid Rock Drainage Potential Characterization. Sisson Project. FINAL." dated 6 August 2013 (referred to as SRK 2013, e.g., EIAR page 7-88), I discovered buried in an Appendix what appears to be the only description of a Water Treatment Plant, although it is titled "Conceptual Design". This is the WTP from which all water exiting the site must pass, i.e., it is the critical piece in all their water management planning. Point 1: Why is this buried in an Appendix? Point 2: How can you submit an appropriate EIA if you are only seeing a finalized report at the time of the EIA's release to the government and public? (This might explain the many missing pieces, vague, and non-science assumptions the proponent uses in the aquatic resources sections related to water quality.)

Because of the significance of the WTP to the entire aquatic environment, I reviewed it in detail. My notes on the WTP (SRK 2013) are presented below.

Having critically reviewed a multitude of environmental science from around the world, I find it disturbingly unprofessional that environmental scientists would fill a serious assessment with assumptions and non-objective opinions that could have been easily overcome with more investment of time which presumably implies funding. I know the people who prepared this document and conducted many of the baseline studies for the proponent. I know they have the training and experience to understand and accept as legitimate all of the criticisms I and others will present. I can only conclude that had these people been given enough time and resources, they would not have rushed through the assessment process and presented what is without any doubt, a premature EIA report. If this report were a Master of Science thesis I was reviewing, I wouldn't fail the candidate at this time, but I would send her back to the field and laboratory to complete the work required to prepare a full report of value.

Sincerely,

R. Allen Curry
Science Director, CRI
Professor of Biology, Forestry and Environmental Management
University of New Brunswick

cc: Dr. Rick Butts, CRI Director

…/4

The Water Treatment Plant (SRK 2013 - Appendix I: Water Treatment Plant Conceptual Design)

a) *"SRK was directed to investigate water treatment processes for **removal of arsenic and antimony only**. No other elements were considered in the process described herein, although the treatment may result in other metals removal for a net water quality benefit."*

- The proponent assumes that these elements are the only issue, yet we know and the proponent reports a long list of other chemicals in this TSF water. If the proponent can't get the WTP right at the planning stage, how will it do it *ad-hoc* in the field? Here is a list of the actual chemicals the proponent will add to the TSF and not including the elements and compounds arising from the natural geologic by-products:

• sodium hydroxide
• sodium carbonate
• sodium silicate
• sodium hydrosulphide
• quebracho (tannins?)
• fatty acids
• sulphuric acid
• ferric sulphate
• anhydrous ammonia
• lime
• Fuel oil (probable kerosene-type reagents)
• pine oil
• organic exchange media
• potassium alkyl xanthate (PAX)
• methyl-isobutyl-carbinol (MIBC)
• copper sulphate
• sodium cyanide (possibly)
• sodium oleate
• Magnesium Chloride
• Amine
• Frothers (xanthates, dithiophosphates and thionocarbamates)

b) *During operations, the TSF average flowrate will be approximately 700 m^3/hr with peaks up to 2,200 m^3/hr. The mill reclaim (lime and CO_2) water treatment facility is sized to meet the peak mill water demand of 2,200 m^3/hr. However, to meet discharge demands, **we have sized the ferric co-precipitation facility to meet the average flowrate only**, as the TSF may be used for water storage and flow equalization.*

- So what are the efficiencies at flow rates greater than average? Greater than average over long periods? This is the critical process, yet it is not modeled beyond one and only the average scenario.

…/5

c) *Post-closure, the TSF/open pit will discharge an average of 1,280 m3/hr, with seasonal peaks of up to 4,200 m3/hr. This memo assumes that the TSF and open pit may be used for water storage and flow equalization, and that a combination of* ***in-pit ferric iron addition*** *(for arsenic and antimony co-precipitation) and the* ***existing retrofitted mill reclaim water treatment facility*** *will be sufficient for the average post-closure flow rates. However, if the 4,200 m3/hr peak flows must be treated, then* ***a duplicate lime treatment facility*** *must be implemented at closure.*

- Here the proponent introduces several concepts I can't find elsewhere and which should be fully explained, i.e., modeled and planned for appropriately: in-pit ferric iron addition; retrofitted WTF; second lime treatment facility.

d) *The water treatment process described herein is based on an evaluation of general capabilities of water treatment technologies. Performance of water treatment technologies is dependent on site specific factors.* ***Bench and pilot scale tests are required in order to verify the efficacy*** *of the proposed water treatment process.*

- The proponent is guessing based on past experience, but it doesn't know for sure how it will work. So where is the plan (models, financing, etc.) for failure of their assumptions?

e) *The balance of ferric sludge will be* ***pumped for disposal to a holding cell within the TSF****.*

- This is the toxic ferric sulphate and sulphuric acid mix. Where is this holding cell – it is not on any diagrams, it is not discussed, and thus it is not planned for. This sludge must remain stable otherwise it creates a different set of water quality problems, also unplanned for. Where are the EIA statements about this issue?

f) *The treated effluent will report to Sisson Brook and from there to Napadogan Brook.* ***Water treatment will be limited to the open water season****.*

- What are the plans for the released water in winter? No water will be released in winter? If a release becomes necessary, e.g., an emergency, flooding, then will Sisson Brook be only untreated, TSF water? If so, where is the planning and risk assessment of that event?

g) *In-pit water treatment for arsenic and antimony will be implemented after the spring melt each year. Pit water will be pumped to a mixing tank on shore where ferric sulphate will be added from a reagent stock tank. After reacting with ferric sulphate, the process water* ***will flow to a section the pit lake that is enclosed with an open-bottom floating baffle curtain made of impermeable liner material.*** *The enclosed section of the pit lake will allow ferric solids to settle to the bottom of the pit for permanent disposal. Arsenic and antimony will tend to adsorb and precipitate with the ferric solids, which will leave the clarified water depleted in arsenic.*

- Where is this facility/structure in the EIA report? Where is the plan? What will happen in winter? This is serious toxic materials not discussed.

h) ***In the event that water treatment for sodium or fluoride is required or if effluent metal concentrations must be lower than those achievable by ferric and lime treatment then the water treatment process proposed here will not be adequate.***

- As the proponent admits, it is presenting a WTP that is inadequate beyond its restrictive assumptions. Is the entire water management plan based on this inadequate model? It appears so.

…/6

i) *The post-closure metal hydroxide sludge will also be disposed of in a* ***dedicated holding cell within the TSF.*** *This cell can be constructed by placing berms around an appropriately sized area within the TSF. The top of the berms should be above the ultimate water level of the TSF and constructed with a spill-way that connects the holding cell to the rest of the TSF. It is envisioned that sludge will be pumped to – and allowed to settle within – the area behind the berm. Excess water will flow through the spillway to the TMF. Thus, the area behind the berm will act as a settling pond or lagoon for sludge from the water treatment plant.*

- This feature/component is not on any diagrams or discussed elsewhere. Where is the plan for this? Where are the implications for the TSF? What if the berm fails?

The EIA Report - Summary Points:

Page	Issue
EIA Report Executive Summary	
E-2	*$50M to reclaim the site.* a) That may be the case for the construction on site, but the proponent gives no figures to describe these costs. Where are the engineering details for site reclamation? b) Where are the costs described to fix an "unplanned event"? The proponent lists many of these, but gives no cost or the financial plan to address these events. c) Where is the cost to pump water from the WCPs to the TSF, and the other pumping the proponent discusses? It is mentioned no place. Spencer *et al.* estimated the pumping costs could be $200M alone.
EIA Report Sec. 3.2 Description of Major Project Components and Facilities	
3-17, 18	*3.2.3.1 Concentrator Process Facilities* a) The process is described: (W)aste is first and then the same stream flows to Tu. This means that PAG materials are ***not*** fully removed from BSF stream and are in the NPAG stream, i.e., they become part of the presumed NPAG. So, how much is PAG in this stream? And over the life time? b) The PAG stream is still first, so how much of first process (W) "waste" (not sequestered) is going on to second (Mo) is PAG?
3-21, 25, 26, 27	*3.2.4.3 Tailings Storage Facility (TSF)* The facility is inadequately described. Here are the examples I have found: i) Liner – None - Really – for a massive water body that is toxic? ii) PAG will be "*encapsulated by NPAG*". This is appears to be a best guess that it will work – how could you possible engineer and control this to insure it will work over this broad an area? Where is the risk assessment that you will be successful? iii) Another attempt at a pseudo-liner: What determines when native overburden will be compacted? Is this an onsite decision by operators? Rules? Why not do all of it to insure safety of the seepage water? iv) *3.2.4.3.2.5* – "*Waste rock will be placed in the TSF by mine trucks*". Where is there any description of this process? The composition of this rock? The PAG assessment?
3-21, 25, 26, 27 (con't)	v) *Storm Events* - Capacity yes, but what about stress on embankment at this load? What about seepage at load? There are no analyses of such situations. Given recent weather history, why didn't the proponent do these analyses? vi) *Stability Analysis* - What about under load of high tailing pond volumes?
3-25	**Recognition of the TSF as a significant risk** to the aquatic environment downstream. The one and only time this is mentioned. See also Page 8-686
3-37	*Process Water* – Where is the analysis to prove this is enough water? We need to know that rainfall, groundwater, plus impoundment seepage (lack thereof) will be adequate, first, and then we need to know what is the plan for capturing this

	required water for processing if their plan doesn't work, e.g., pumped from Nashwaak River?
3-37	*Fresh Water* – Required is 21 m^3/hour. Average household well is 1 m^3/hour. Their own estimates for area are <1L/s (Page 6-27). Does that mean there will be >20 some wells on site? Where are these to be located? Impact?
EIA Report Sec. 3.3 Alternative Means of Carrying out the Project	
3-79	*Removal of Lower Lake Dam* – The local experts have already told the proponent this is not an option for fish habitat compensation, so why the EIA report recommends it is unclear.
EIA Report Sec. 3.4 Description of Project Phases and Activities	
3-118	*"lined containment pond"* in the TSF – The only time this component is mentioned (3-119, 3-121, 3-136). It is not on the map (Fig. 3.4.5.) So, where and how does this work? Why just this process water?
3-123	*"acceptable pond levels"* – And what happens if you can't meet this target level, i.e., it floods after a rain event? Where are the plans for your WTF to sustain this increased capacity before discharging downstream? If it can't meet that volume of water treatment before discharge – what is the plan? What happens during winter, temperature impacts, ice cover?
3-125	*"an intermediary WMP"* – Where is this located, i.e., it is not shown in Fig. 3.4.9 Schematic of Mine Operational Water Balance? What is its capacity? What are its risks of escaped water?
3-142	***TSF Water Quality*** – Two statements that demonstrate the proponent knows the TSF water quality will not meet any provincial or federal standards.
3-143	*Pit Lake* – a) *"A groundwater sink"*. Pumping water in or out to achieve this requires a perpetual activity, unless the proponent gets "lucky". Where are the numbers that show the probability the proponent won't have to pump in perpetuity? Where are the numbers to show during of pumping and costs? b) *Water quality of pit*: Similarly, where are the numbers to show how much needs to be treated each year for how many years and then what are the costs? c) What if blasting creates fractures and all pit water flows via groundwater to Napadogan? Where is this described and assessed for risk?
EIA Report Sec. 7.4 Key Predictive Study – Fish Habitat Loss and Compensation	
7-35, 7-41	The proponent describes direct loss (site construction) and indirect loss as loss due to flow. Where are the analyses of loss due to process water in the Sisson and Napadogan rivers, i.e., water quality? Where are the blasting effects on fish and/or their eggs and larva?
7-36, 7-39	*Beaver ponds* - Excluded based on statement that these are "ephemeral water features". Beaver ponds ***are*** fish habitat as the proponent's biologists know and the scientific literature well demonstrates. The proponent then says fish were observed in these ponds on page 7-39.
7-45	*Assumed no discharge to Sisson Brook for the models.* Yes it is conservative to

	do this, but it also neglects that there will in fact be discharge water from the TSF/WTP to Sisson Brook. Why weren't those analyses done?
7-52	Why isn't the Fish Passage Issue addressed at this point?
7-58, 7-61, 8-136	*Lower Lake Dam Removal* – Repeatedly, local experts as well as NB DNR have told the proponent that this is not a barrier to fish movement. If the proponent wants to present this as a "barrier" then the proponent should provide some empirical proof that it is a barrier. The proponent had opportunities to do that; it chose not to do that study. To suggest it is a "*viable potential opportunity*" suggests the biologists and scientists truly don't understand this system and specifically the fish in this system. To present it as such is a direct challenge of their professionalism, i.e., it is (again) the easiest and cheapest way forward for the proponent.
EIA Report Sec. 7.5 Key Predictive Study – Geochemical Characterization of Waste Materials	
7-65, 69	*Quarry Rock (Borrow)* – Only two (2) samples tested? This is the rock that will make up the bulk of the dam material, i.e., it is the source chemistry for water seeping through and downstream. Inadequate sampling to confirm NAPG or PAG.
EIA Report Sec. 7.6 Key Predictive Study – Water Quality and Water Balance Modelling	
7-73	*Site Water Management* – Collected in channels and routed to WMPs. So where are these channels on the diagrams and which WMPs are the collector sites? Where is the plan for their failure, i.e., How will these ponds perform in extreme events, winter, site accidents that put metal/chemical TSF/Process water into them?
7-75	*Pit Water (post-operations)* – There is a channel that is mentioned. This is a major water feature that transfers untreated TSF water to the Pit. Where is the plan?
7-75	*Pit Water Levels* – A major operation moving water and treating water. Where is the plan? How much water at what discharge rate? How much money?
7-78	*TSF Embankment Drainage and Seepage Collection*- Seepage through the embankment will occur. Some will be captured. Where is the plan – how much is captured, are the WSP large enough? What is the water chemistry of seepage water? How much will by-pass treatment? Impacts on downstream?
7-79	*Why are the units of measure repeatedly changed? m^3/a, L/s, m^3/hour*
7-79	*6M m^3/a* – This translates to 6B L of water processed in the plant each year and this is released downstream into Sisson Brook. It works out to be 190 L/s, which matches the current discharge pre-operations (200 L/s). Just an FYI.
7-79	*Groundwater inflows to pit are assumed to max-out at 40L/s* – This is equivalent to about 144 household wells (not under Artesian pressure). It seems to be a significant under-calculation. I'm not expert enough in this field to assess the numbers, but it these are wrong, then their fresh water budgets are wrong.
7-83	*Water Management Ponds (downstream of TSF dam walls)* – a) I can't find the calculations to show these are of adequate size/volume? b) Water will not be stored in these WMP, yet the proponent will continuously

	pump, i.e., there is ponded water to pump. There are many questions unanswered about these WMP. Are they of adequate size to take seepage and precipitation/overland flow? If they fail and/or water breaches top of berm, what happens to the untreated water, etc? How do they work in winter?
7-85	*A brief reference to the WTP operations* – It incorrectly describes the "*ferric sulphate batch treatment"* sic. (in fact there is no reference to 'batch treatment' – I'm not sure what the proponent is referring to, it is not in SKR 2013). This begins at the time of operation and discharge of TSF water to Sisson Brook, i.e., Year 7-8.
7-88	*Description of Water Treatment Plant* – This statement doesn't reference SRK 2013 and I would assess from the statement that the writer has not read SRK 2013, or they read it hastily in some draft form (it wasn't released until 6 August 2013).
7-90	*TSF seepage rates are lower in Closure and Post-Closure than during Operation* – Hydrogeologically (near) impossible. The TSF water levels are highest during closure and post-closure and therefore the hydraulic head is maximized and with no changes in hydraulic conductivity, groundwater flow will occur. Categorically wrong.
7-92	*Baseline Water Quality Calibration Model* – a) In every case, elements are elevated once operations begin and well after closed - these are base estimates not including high precipitation or associated events. b) Where is the discussion of the Sisson Brook water quality node? It is the source of all treated water - it is nothing but treated water, i.e., it is all coming from the WTP. It will be the most potentially toxic system, so where is it?
EIA Report Sec. 7.7 Key Predictive Study – Human Health and Ecological Risk Assessment	
7-113	Again, the models are based on everything working perfectly – where is the reality, i.e., a true risk assessment?
7-122	*7.7.2.1.4 COPC Screening Based on Water Quality Guidelines* – Why is anything screened out if this is a full EIA?
EIA Report Sec. 8.4 WATER RESOURCES	
8-57	*"…the environmental effects of the Project on Water Resources will not be significant because…"* – What about the legacy of water features on the landscape. These are not assessed in any manner so how can this be complete and therefore "not significant"?
8-105	*"water quality…is predicted to be of sufficient quality to meet the GCDWQ at some point during the Post-Closure period"* – At some point in time? Correct in about 1000+ years it should be fine. This is not professional assessment quality.
EIA Report Sec. 8.4.4 WATER RESOURCES – Assessment of Project-Related Environmental Effects	
8-106	*"not significant" "not considered further"* – How do you dismiss 2 and possible 3 water features (the channel between the TSF and pit to be constructed) one of

	which will be the largest tailings pond in NB and requiring water treatment for an impossible to estimate number of years.
8-107	*Monitoring* – Great. But, where are the statements of potential problems/risk (follow-up) and the plans to fix including the cost estimates and who pays?
8-110	*Magnitude of Effect* - Here you recognize need to understand natural variability, yet you don't establish baseline of "normal". It needs to be defined upfront for legal purposes.
8-117	*TSF description,* a) Figure 8.4.10 - This diagram is inaccurate. TSF is incorrect in size. It doesn't match Figure 3.4.6. Also, the pit doesn't match Figure 3.4.6. So which one is correct?? b) Starter dams – There are only 2 tests that prove it is NAP. (Pages 7-65, 7-69) c) Groundwater not predicted to be affected – A water body of this size does by the laws of physics these engineers know well, affect groundwater flow and chemistry downstream of the TSF. Unacceptable from a qualified engineer.
8-121	*Fresh Water Supply* – Wells - Where? How Many? It is nice to say you are going to do it right, but this is an EIA and we are assess the water needs.
8-121	*Effects on Stream Flow* - These figures show a 10 to 20% reduction in MAF - that does not jive with HECRAS models? There needs to be an explanation.
8-126	*Water Quality Modeling* – Only under normal conditions. Assumes the system is functioning at 100% efficiency 100% of the time. Where are the extremes? What happens when WTP is not functioning, how many times will that happen, what is the power supply emergency plan, etc.
8-131	*"Water quality monitoring will continue post-closure until such time that the water quality* ***is acceptable****"* – And how is "acceptable" defined? It is not defined in this document – what level, how many occurrences, etc. This is an assessment so how can we know from such statements what we can apply in the future?
EIA Report Sec. 8.4.6 WATER RESOURCES – Determination of Significance	
8-132	*Changes in Water Resources – "…not significant…moderate level of confidence"* – Given that there are no empirical evaluations of risk, this is just an "opinion". It would be better to have a table showing the impacts as probabilities: 90% chance of 25% impact, 50% chance of 20% impacts, etc. This is a risk assessment. A risk assessment is not the proponent making the conclusions - that is not their decision (it is their opinion) and we can't decide if we don't know all the probabilities.
EIA Report Sec. 8.4.7 WATER RESOURCES – Follow-up or Monitoring	
8-133	*Follow-up* – What are the follow-up mitigation activities?
EIA Report Sec. 8.5 AQUATIC ENVIRONMENT	
8-136	*An adaptive management strategy and mitigation plan will be applied in the event that follow-up and monitoring identifies that seepage or treated surplus water releases lead to concentrations of metals in surface waters that pose a risk to ecological or fish health.* – Not good enough – we have stated this repeatedly – identify and describe the risks empirically and then allow us to assess them.

	Simply using current terminology doesn't make reality go away.
8-137	Again, no recognition of what is normal. The proponent only modeled for average. How will the proponent detect the state and therefore define "undesirable change".
8-138	*Water Temperature/Dissolved Oxygen* – Change from baseline is actually not relevant. It is absolute change that would invoke exceedence of temperature and/or oxygen limits. Not acceptable level of interpretation for professional biologists.
8-138	*pH* – Again, assumes the modeling is correct and everything is normal. That is never and will never be the case, so where is the modeling to explain these risks?
8-138	*Benthic Community* – The proponent identified metals in sediment as an issue and then don't address it here?
8-138	*Fish Passage* - Napadogan predicted reduction by 10-20% of MAF. How does this translate to 1 cm drop? This issue needs to be addressed and explained.
EIA Report Sec. 8.5.1 AQUATIC ENVIRONMENT – Scope of Assessment	
8-139	*Approval to Operate and the federal MMER* – The MMER don't meet the same standards set by NB for Water Quality (see Table 8.5.2)
8-140	*"…the potential environmental effects of a failure of water management facilities, including the TSF, on fish and fish habitat* – Here perhaps the most important issue of concern is raised only to be dismissed later.
8-141	*Benthic Macroinvertebrate Community Structure* – What is the metric? There are many options.
8-151	*Water Classification – "Neither the Nashwaak River nor any of its tributaries have been formally classified by the Minister to date, and thus the Regulation has no relevance to the Project at this time and is thus not discussed further in relation to this VEC."* – Northcliff/HDI and Geodex were asked repeatedly by community members and organizations to respect the work they did to have the Nashwaak watershed classified. This dismissal is exactly what I mean when I have said the propenent is doing just what it has to, rather than truly engaging and listening to the community.
8-152	*"…effects…upon which **model predictions** are based are difficult to simulate numerically. Thus, **interpretation and use of the results generally rely substantially upon the professional judgment** of the study team. As with any model, there is also some **inherent uncertainty in the results as models** are simplified or idealized representations of what are complex physical phenomena. The source term estimates and modelling results are nonetheless conservative."* – This is exactly why you do the empirical work *a priori* – so you can define the parameters as best as possible. That you didn't invest in the field work or the time of the analysts to overcome these exact issues doesn't make your models therefore correct. Again, this is unacceptable science, and actually something I expect to hear from first year undergraduates handing in a report they did the night before.

EIA Report Sec. 8.5.2 AQUATIC ENVIRONMENT – Existing Conditions	
8-154	*8.5.2.2 Methods for the Characterization of Baseline Conditions* – See my original letter of December 7, 2012 to HDI/Northcliff about the inadequacy of their sampling, both spatially and temporally (see **Appendix 1** below at the end of Dr. Curry's report). There is no way to know when a location along Sisson, Napadogon, or the Nashwaak is affected in the future. The confidence limits on their data, if they could actually produce such, are best estimated to be ±100%. That plays well to the proponent winning a legal battle in the future trying to determine when something is affected or not, because there is no way to know with the current data. Furthermore, the proponent could have overcome this issue by stating what it defines as outside normal for the record and had that written into any operational agreement. The proponent didn't because it knows it can't define it and therefore in the future the proponent is legally protected.
8-164	*HSI = habitat suitability index* – In this exercise, different sites had different parameters applied, different seasons (i.e., Napadogan Brook), and then the proponent compared all the sites. Not a scientifically defendable method. Late spring was the Napadogan sampling period – this is not a stress period so these results are irrelevant for this analysis.
8-189	*Although the field surveys were carried out as discrete "onetime" sampling events, a **technical limitation of the baseline information**, the species that were not observed are **generally sedentary in nature and would likely have been found if present** at the time of the surveys.* – Simply unacceptable as a science work. That you didn't sample enough doesn't make your results immune for the harshest of criticisms especially given that you were told, repeatedly, you weren't sampling enough. Again, minimal investment of time and money.
EIA Report Sec. 8.5.4 AQUATIC ENVIRONMENT – Assessment of Project Related Env. Effects	
8-194	*Table 8.5.8 Summary of Residual Project-Related Environmental Effects* - Even this 'qualitative" assessment of risk has *prediction confidence* of 'Moderate', not minimum or zero.
8-200	*Primary Environmental Effects Operations* – Where is unplanned point-source events? To simply not include it suggests there will never be a failure, which even this report recognizes and assessed as a potential, i.e., the 12h event for the WTP to stop working (see EIAR page 8-719).
8-202	*Cold Water Plume at W. Napadogan* – A recognized issue, but where is the analysis of this? Is it critical habitat for coldwater species? How will it change?
8-207	*Mine Waste and Water Management – "Prior to Construction, **further** geotechnical and hydrogeological investigations will be undertaken in the TSF area to support basic engineering and detailed design studies for the TSF embankments and associated seepage and water management systems."* – And what if it proves too unsuitable for any of a thousand reasons – then what? That is why we are planning now. Again, the proponent is not ready to do this.
8-209	*Residual Project Environmental Effects - "…the results indicate that standalone*

	and seasonal brook trout habitat is abundant in the West Branch Napadogan Brook watershed, in a few tributaries of East Branch Napadogan Brook, and in Manzer Brook, ensuring that brook trout populations will be maintained in the Napadogan Brook watershed overall". Not all assumed habitat is actual habitat. Which of these assumed habitats are "critical", e.g., what if brook trout can only spawn in Sisson Brook? Again, more sampling is required to understand the impact. This analysis was done as a desktop exercise and biology (as these authors stated before) is near impossible to model. The community asked for a better effort.
8-210	*"not significant effect…and particularly in consideration of the compensation measures as mitigation for the direct loss of fish habitat"* – As this "compensation" has already been deemed irrelevant (the removal of the Lower Lake Dam), hanging your hat on this as your major evidence of non-effect is quite a stretch of imagination.
8-212	*Environmental Effects to Water Quality* – The proponent modeled perfect conditions; this is not acceptable.
8-221	*Water Quality (Temperature)* – The paper cited doesn't address the issue of small, spatially disjoint habitats as is in the Napadogan system (as the proponent's biologists writing the EIA report know well). These biologists know that salmonids move long distance to find thermal habitats. This could have been investigated if the proponent made the investment.
8-222	*Thermal Habitats for Brook Trout* – New data and analyses we have not seen before. Is there a scientific reference for this analysis? If there are brook trout there then it must be habitat and conditions will be warmer longer, then it suggests a loss of habitat. Just because there are fewer brook trout doesn't mean the modeled habitat loss won't be "not significant" for these fish. This presentation of findings would be rejected if peer reviewed (by me at least).
EIA Report Sec. 8.17 ACCIDENTS, MALFUNCTIONS and UNPLANNED EVENTS	
8-698 (see 8-702)	*A loss of containment from a TSF is defined as a significant failure of a TSF embankment leading to the release of large quantities of mine contact water and/or tailings into the receiving environment. As considered by Knight Piésold as experts in mine design, geotechnical engineering, and mine waste and water management, this scenario was not considered to be credible in consideration of the design basis* – I respect that the engineers can design a well-built dam that has a low probability of failure under normal operating conditions. However, the statistics on TSFs are indisputable – the proponent will fail to contain their water. As Larry Wuest points out, "…assuming a mine life of 27 years and the current empirical rate of 1 [failure sic.] in 2000 per dam year, the TSF dam at Sisson would have a 98.65% chance of surviving 27 years without a failure, or a 1 in 74 risk of at least one failure over 27 years…". NB has 5 larger TSFs discussed by Roy Parker (see Section 2.10 below): 1. Heath Steel Mine – 2.3 km long by 2.6 km wide = 598 hectares 2. Brunswick 12 – 2.2 km long by 2.0 km wide = 440 hectares

	3. Nigadoo Mine – 0.76 km long by 0.55 km wide = 42 hectares 4. Mt. Pleasant Tungsten/Tin mine – 1.9 km long by 0.61 km wide = 112 hectares 5. Caribou mine – 1.57 km long by 0.8 km wide = 126 hectares The Mt. Pleasant TSF failed in 1998 ("Tin mine tailing pond breached by flood." Tue Mar 17 1998, Byline: LISA HRABLUK, The Telegraph Journal). That could be interpreted as 1 in 5 large, TSFs in NB have failed to date, i.e., a 20% failure rate in NB. The less dramatic interpretation is also the obvious – TSF failure includes unplanned events that may or may not result in a physical failure of the Embankment structure. As Rico *et al*. point out, we will have failures and in their study area (Europe), "…The major percentage of incidents is related to meteorological causes (26% to unusual rainfall and 3% to snow)…". Given that the Mt. Pleasant TSF failure was due to a precipitation event and which are becoming more common in our region, that such understanding of failures was not incorporated into this analyses and planned for is totally unacceptable. Rico, M., G. Benito, A.R. Salgueiro, A. Díez-Herrero, H.G. Pereira. 2008. Reported tailings dam failures. A review of the European incidents in the worldwide context. Journal of Hazardous Materials 152:846–852.
8-702	*"A release of off-specification effluent could adversely affect downstream surface waters (i.e., Napadogan Brook and eventually the Nashwaak River) and associated fish and fish habitat. This could result in the short-term ingestion/uptake of contaminants by fish, wildlife, the public or First Nations. Downstream groundwater, soil, or wetlands could also be adversely affected.* – The proponent recognizes the implications of a TSF failure or release, but then where is the discussion of the risk? This statement is in conflict with its opinion expressed in 8-698.
8-719	*"Release of Off-Specification Effluent from Water Treatment Plant"* – This entire section is to be rejected. 1. The proponent modeled one (1) fixed amount for one (1) fixed period. It is possible that scenario could be real, but so could an infinite number of other scenarios. Their attempt to negate this risk, *"…any release of off-specification effluent would be detected within a 12-hour period, and corrective action would be initiated such that the release of off specification effluent for a longer period of time is not believed to be a credible scenario."*, demonstrates exactly why their "scenario" is not "credible" = probability of happening is 1 of ∞ (~zero). It is very blatant circular reasoning.
8-720	*"…in the unlikely event of a release of off-specification effluent…This release is not expected to interact with downstream groundwater, but could interact with downstream wetlands and vegetation."* – First, the proponent just argued that release of effluent was NOT a credible scenario. Then to compound its excruciatingly, painful logic and failure of basic physics and hydrogeology, the proponent states that surface water in the brook won't interact with groundwater but it will make it to wetlands (perhaps via the proverbial 'ducks feet'?). The only time no groundwater recharge could occur is in an engineered flowing water

	environment, e.g., an impenetrable culvert or perhaps a massive, flash flood. If the proponent can't get this simple work right, then how can we trust the rest of the documented claims?
8-721	*"Potential Interactions between VECs and Release of Off-Specification Effluent from Water Treatment Plant – Note 1- Interaction may occur. However,* ***based on past experience and professional judgment****, the interaction would not result in a significant environmental effect, even without mitigation, or the interaction would clearly not be significant due to application of codified practices."* – Had the proponent done the appropriate empirical studies, then it wouldn't need to "guess".
8-721	*"Table 8.17.5. Under* ***normal*** *watercourse flow conditions, an off-specification release is not likely to impinge on…"* – Define normal? How often does it occur? We get that the proponent can plan for normal – we want to know what happens the rest of time?
8-721	*"Under normal watercourse flow conditions, an off-specification release is* ***not*** *likely to impinge on riparian wetlands* ***as contaminants will likely flush downstream*** *and be quickly diluted such that contaminant uptake in wetlands will be limited in extent and duration."* If there is nothing but untreated water in Sisson Brook, then what would be the "likely" mechanism of dilution and especially if it were a large volume of water released? We already know from the proponent's plans that the 'new' Sisson Brook will be almost entirely discharge from the WTP (Page 7-79). What about the accumulation of these metals and other chemicals even if diluted along the system – where is that modeled?
8-721	*"…off-specification discharge would move rapidly downstream…"* – Perhaps this may/might be true in its 12hr model, but that was already proven to be 1 of an infinite scenarios.
8-722	*"Based on the mitigation and response mechanisms and procedures, the potential environmental effects of a Release of Off-Specification Effluent from the Water Treatment Plant on the VECs … rated not significant, with a high level of confidence."* – I'm not sure if this is a lack of engineering training, naïve inexperience, or some combination of both. It is a 'true' statement for the failed model the proponent presented; in reality, it is >99% certain not to occur as the proponent described it.
And the rest…	It goes on from here, but I've lost the energy to detail any more challenges in this EIA report.

Appendix 1 to the Comments of Dr. Curry

December 7, 2012

RE: Meeting of December 6, 2012 at Northcliffe Offices, Fredericton, NB

Hello John and the Northcliffe Team:

We went long and late last night, so I wanted to make sure you understood the message we were delivering. I'm following up today to provide you with our concerns from my perspective in writing.

From the very beginning of the project, I and many others have indicated that we are interested in engaging in a dialogue about the potential benefits of the Sisson Brook Mine (SBM). We have made only one fundamental requirement: create and build the best operation the world has ever seen and in doing so, we will be comfortable in supporting you. In response, you and your team over the years have said you were going to do exactly that, build the best.

For those of us engaged on the environment component, we laid out for you our definition of the minimum standards that had to be met to qualify to be the best.

1. We asked you to define what is the current state of the environment for the watershed.
2. We explained that this measure of state includes its inherent variability because this is the fundamental nature of hydrology and biology.
3. When you showed us your 2011 results, we explained that you had not sampled enough of the environment to establish its condition. A) You had not sampled enough of the fish and benthos within the affected area and across the watershed to establish the standard conditions. We explained why – you hadn't sampled all the various habitats for these organisms. B) You had not sampled enough years to establish the variability over time for these species. We explained why – biological systems are regulated by the dynamic components of the physical environment, i.e., seasonal; and annual water levels and temperature.
4. We had asked you match the provincial standards for sampling techniques, i.e., so that your results could be used by the province and the local watershed associations to better understand this river and all our provincial waters. You did follow their standards for fish habitat assessment and electrofishing. You didn't for benthos.
5. We had asked you to use your biological surveys and habitat modelling to tell us the significance of the affected area for the fish and benthos in the Nashwaak River watershed, e.g., what is the production of juvenile salmon and other species in the area, what proportion of spawning for salmon and other species occurs in the affected area, what rare or special species occur in the affected area and is this a significant portion of their populations.

We asked these questions so that you would understand what we consider to be the minimum standard of information we need to enter into a discussion and possible agreement to support the SBM.
We explained why these questions are so critical.

1. We need to know what is the current state, so that in our partnership with you can establish what we will define as "not normal", i.e., when has the system changed its state. We explained that the inherent variability of hydrology and biology across space and time demands an appropriate

sampling regime and we described this in detail. We indicated this is our minimum standard of acceptance.

2. We need to know the significance of the affected areas for the species so we can assess the risk to the ecosystem and discuss and decide if they are acceptable to us. For example, can we (the community) accept the loss of X % of salmon spawning habitat in the Nashwaak River watershed, in terms of the entire Saint John River population, and what are the modeled scenarios for various catastrophic losses of stream habitats (e.g., uncontrolled leaching of toxics, dam breaching).

Your assessment to date hasn't provided the information we asked for as our minimum standard for the best operations. Instead, you appear to be content with achieving the minimum standard for the regulators which we have explained repeatedly is not good enough for our community.

Our goal has always been to establish a partnership with the company that makes us comfortable. We have to live with this undertaking of a major disruption of our natural environment and then we have to live with the legacy long after you and your shareholders are gone. Your industry doesn't have a track record that makes us comfortable and therefore we can't accept any verbal assurance from you and your team (don't take it personally). We can't depend on the regulators because they are governed by politics not the people; therefore our community needs a very well defined partnership agreement in writing.

1. We need to agree on what is the current state of the environment. That has to include a good understanding of the natural variability in this system.
   → You expressed concerns that this will take too much money to cover the necessary area and too many years to sample. As partners, we could have and can come to an agreement on what is mutually acceptable for the sampling regime, i.e., where to sample and for how many years.
2. We need to agree on what will be considered "not normal", i.e., what are the indicators that tell us the system has changed.
   → We don't want to be in a future situation where we may have to argue, including in a court of law, that the system is changed. We want "change" to be articulated in an agreement before you start impacting the environment. This is why understanding the variability is absolutely required. For example, we need to agree in writing upfront to statements such as, "The Lower Napadogan is deemed to have changed its state for brook trout when the average density is less than 2 standard deviations below the pre-activity average, at X number of sites, for Y number of years."
3. We need to agree on the actions to be taken by Northcliffe if your monitoring shows the system has changed.

These are our minimum standards we asked you to meet. You are proceeding to the final EIA report in February 2013 without having started to approach our standards. I think you can understand why we are very unhappy with your performance so far.

Respectfully,

Allen Curry

2.5 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Valued Environmental Components:
1) Comments on Project Description (particularly water management and the design of the tailings storage facility
2) Summary of Key Predictive Study – Geochemical Characterization of Waste Materials
3) VEC – Aquatic Environment
4) VEC – Accidents, Malfunctions and Unplanned Events
5) Follow-Up and Monitoring Program, and
6) Conceptual Decommissioning, Closure, and Reclamation Plan
Subject Areas: Mine design and planning, Water Quality
EIA Report Sections: Exec. Summary, 3.0, 7.5, 8.5, 8.17, 9.0, Other documents: Conceptual Decommissioning, Closure, and Reclamation Plan
Date: October 1, 2013

Dr. David Chambers and Mr. Stu Levit, M.S., J.D.
Center for Science in Public Participation (CSP2)

NOTE: Dr. Chambers and Mr. Levit's review begins on the next page. There biographies can be found at: http://www.csp2.org/expertise.

CENTER for SCIENCE in PUBLIC PARTICIPATION

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"Technical Support for Grassroots Public Interest Groups"

October 7, 2013

Sisson Project
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200-1801 Hollis Street
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Re: Comments on Sisson Brook Environmental Impact Assessment

The Center for Science in Public Participation provides technical advice to public interest groups, non-governmental organizations, regulatory agencies, mining companies, and indigenous communities on the environmental impacts of mining. CSP2 specializes in hard rock mining, especially with those issues related to water quality impacts and reclamation bonding.

SPECIFIC SECTION COMMENTS

3.0 PROJECT DESCRIPTION

3.2.4.3 Tailings Storage Facility (TSF)

3.2.4.3.1 Overview

It is noted that:

> "The TSF will be located in the area formerly covered by Bird Brook and its various tributaries, and will cover an area of approximately 751 ha at its ultimate extent at the end of mine life."
>
> "The base of the TSF embankments will be native overburden, compacted as required to minimize seepage." (p. 3-21)

Seepage under Ring-Dike impoundments is common. Leaving native overburden usually enhances seepage under the tailings dam. The EIA does not expand on when, or how, it will be determined if the 'native overburden' needs compaction, even though this could be critical in controlling seepage.

Recommendation: *A more sound approach in terms of controlling seepage would be to remove the native soils for use in reclamation, and to compact the remaining material to a specified density.*

3.2.4.3.2.1 Embankments

Starter Embankments (Stage 1):

> "The liner will be anchored into a trench keyed into the lower permeability bedrock on the upstream side of the embankment." (p. 3-24)

It seems there might be a possibility that portions of the 8.8 km starter dam cannot be keyed into competent bedrock.

It is noted in the Knight Piesold Baseline Hydrogeology Report that:

"● Till: Surficial geology mapping has identified basal and ablation tills up to about 10 m in the project area. The till is comprised of varying composition of sand, silt, gravel and clay. The ablation till may be more permeable than the basal till.

● Shallow, weathered bedrock: The presence of this zone in the upper 10 m to 20 m of rock is based on regional mapping as well as drilling in the project area."[1]

With up to 10 m of till, potentially on top of fractured bedrock that could be an additional 20 m in depth, the likelihood of seepage under the starter (and fully constructed) tailings dam seems probable in some locations.

The tailings, and co-disposed waste rock, are apparently to be placed on native overburden, like the main raised portion of the tailings dams. One potential approach to minimizing the amount of seepage that will escape under the tailings dams would be to place a drain system underneath the tailings on top of the Zone S fill material that will key the dam into base rock. This would provide several benefits, including: relieving pressure on seepage that would go under the starter dam; dewatering the tailings above the starter dam, which would provide more stability in the event of an earthquake; and, lowering the phreatic surface on the dam face itself.

A tailings drainage system could consist of a series of trenches filled with rock (and perhaps a perforated drainage pipe) placed under the tailings to be deposited at the base of the dam. This seepage could drain to a common sump to be pumped as necessary. This would not be prohibitively expensive, and could more than pay for itself in decreased seepage collection costs, especially post-closure.

3.2.4.3.3.2 Earthquakes

Design Earthquake

It is noted:

> "Consistent with the current design philosophy for geotechnical structures such as dams, two levels of design earthquake have been considered: the Operating Basis Earthquake (OBE) for normal operations, and the Maximum Design Earthquake (MDE) for extreme conditions (ICOLD 1995)." (p. 3-26)

However, it should also be noted that ICOLD has subsequently recommend: "According to the current ICOLD guidelines, large dams have to be able to withstand the effects of the so-called Maximum Credible Earthquake (MCE). This is the strongest ground motion that could occur at a dam site. In practice, the MCE is considered to have a return period of several thousand years (typically 10,000 years in countries of moderate to low seismicity)."[2]

In order to conform with the most recent recommendations from the International Commission on Large Dams (ICOLD), and in recognition that tailings dam must be designed to last in perpetuity, the Maximum Design Earthquake should be equivalent to the Maximum Credible Earthquake.

In this section it is also stated:

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[1] Northcliff Resources Ltd. Sisson Project, Baseline Hydrogeology Report VA101-447/2-8, Knight Piesold, January 2, 2012, p. 11.

[2] Earthquake Safety of Existing Dams for Irrigation and Water Supply in Rural Areas, ICOLD, Martin Wieland, December, 2001

"... the MDE selected for the TSF is the 1-in-5,000-year earthquake which has an estimated mean average maximum acceleration of 0.37g." (p. 3-27)

The MDE should be the 1-in-10,000 year event – the MCE earthquake as recommended by ICOLD.

However, it was also reported in the EIA that the MCE is a magnitude 7.0 event (6.3.1.3.1 Seismicity). If a magnitude 7.0 event is the MCE, as described in Section 6.3.1.3.1 Seismicity, then apparently the MCE was used as the MDE. It should be clarified that the MDE is also the MCE.

Stability Analysis

"The seismic analyses indicate that any embankment deformations during earthquake loading from the OBE or MDE will be minor and will not have a significant impact on embankment freeboard or result in any loss of embankment integrity." (p. 3-27)

It is not clear from the description above if dynamic (numerical) modeling was completed using the MDE/MCE event, or if pseudo-static modeling was used. It is especially important that dynamic modeling be performed since the dam design has incorporated a modified centerline-type construction (which has an upstream-type component built on seismically unstable tailings). Today, few US regulatory agencies accept pseudostatic methods for seismic design of new dam projects. Seismic loading need not be considered for most new dams if the maximum credible earthquake produces a peak ground acceleration of less than 0.1 g at the site.[3]

More detail on the type of modeling used, and the results of that modeling, are warranted.

Recommendation: *If pseudo-static modeling was used to test for seismic stability, then a numerical model should be used to test the dam under seismic loading.*

3.3.4.2 Thickened (Paste) Tailings Disposal

"...the advantage of employing thickened tailings is improved conservation of water..." (p. 3-61)

The primary advantages of paste tailings are: (1) it allows tailings disposal on hillside areas instead of in high value stream valleys; and, (2) it does not require the same impoundment design (starter dams instead of full tailings dams). Conservation of water is an advantage, but is a major factor largely in arid areas.

3.3.4.3 Filtered Dry Stack Tailings Disposal

"… the advantages of filtered tailings are that they allow improved water conservation, and they are denser and thus require slightly less land area for storage …" (p. 3-62)

The primary advantages of dry stack tailings are: (1) it allows tailings disposal on uplands instead of in high value stream valleys; and, (2) it does not require the same impoundment design (starter dams instead of full tailings dams).

It would be more appropriate if the EIA better represented the advantages of paste and dry stack tailings technology.

3.3.5 Alternative TSF Embankment Designs

"Knight Piésold further undertook a trade-off study in 2012 to compare the use of cycloned NPAG tailings sand vs. quarried rock fill as construction material alternatives for the TSF embankments. Both methods are technically feasible, though cycloned sand construction is rather more challenging..." (p. 3-63)

[3] From http://www.meadhunt.com/documents/newsletters/persp_water3.pdf, downloaded on 14Jan10

The EIA does not explain whether the use of cycloned tailings for dam construction, which would probably require downstream-type construction, would provide better seismic stability than for the modified centerline design chosen as the preferred alternative.

Recommendation: *It would be appropriate to have a full explanation of why a modified-centerline rockfill dam is better than a downstream dam constructed of tailings.*

3.4.2.5.4 Mining Waste Disposal

> "Six separate storage cells will be constructed over the mine life to manage the APT residues within the TSF footprint. Each cell will be lined, and equipped with a leak detection and recovery system, to prevent comingling of the APT residues and the TSF water and thus avoid additional treatment of the TSF water for reuse in the process. Fences or other suitable means will be used to limit access to the ponds and deter wildlife entry. The cells will be progressively closed and encapsulated with tailings and barren rock as the TSF fills." (p. 3-137)

The basic construction design of the cells is sound, but the location is problematic. Cell liners can be subject to differential or seismic-induced settling if built on the tailings pond.

Recommendation: *It would be safer to construct the storage cells outside the impoundment (perhaps in the quarry if there is room).*

3.4.1.1.5 Removal and Stockpiling of Topsoil and Overburden

There is very little discussion of the overburden in the EIA. However, in the ML-ARD Potential Characterization Study it was noted:

> "At the time of reporting, acid-base accounting data was not available."[4]

There are a number of examples of overburden containing sulfide material, sometimes related to biologic activity. Failing to sample the overburden for sulfur is a significant technical deficiency.

Recommendation: *The overburden should be sampled for sulfur and carbonate to insure that no acid drainage will emanate from the overburden.*

3.4.2.2.5 Reagents

Each reagent should be evaluated for its stand-alone toxicity and for its ability to react with or alter (or be altered) by other contaminants in the TSF waste stream. The EIA should evaluate the potential for action and interaction individually and between chemical compounds, especially reagents. Monitoring will be critical before, during, and after mining to characterize the waste flows and TSF water quality.

Copper has already been identified as a waste water problem and is known to be toxic to fish and aquatic life, so removing copper sulfate would be a useful goal. Where appropriate, regulators should require removal or treatment of flows into the TSF to reduce interaction between compounds, reduce copper, and thereby overall TSF hazards.

Recommendation: *Reagents and other chemicals added or produced at the mine site should be characterized to determine their potential impacts alone and in combination with the dozens of other compounds at the mine site that will flow into the TSF. This analysis should make a threshold determination of potential impacts to human health or the environment and then those compounds that could cause harm (alone or in combination) should be analyzed for treatment and removal.*

[4] Metal Leaching and Acid Rock Drainage Potential Characterization, Sisson Project, SRK Consulting, August 2013, p. 40

Recommendation: *Monitoring and characterization of both the waste stream into the TSF and in the TSF itself should be sufficient in time, location, and breadth to ensure that the waste stream(s) at the mine are appropriately understood and regulated and where appropriate - specially treated.*

3.4.2.3.4 Water Management in the TSF

There is a discrepancy between a figure quoted in this section, and the prediction for the same figure later in the EIA:

"● The TSF will have approximately 2 million m^3/year of surplus water starting at about Year 8." (p. 3-123)

and;

"Approximately 6 million m^3/year of TSF pond water will be pumped to the WTP during Operation starting in Year 8 under average conditions." (p. 7-80)

This is a discrepancy of 4 million m^3/year.

3.4.3 Decommissioning, Reclamation and Closure

"Once the pit is completely full (at approximately Year 40), Post-Closure begins and water (treated, if necessary, until it meets regulatory requirements) will discharge to the former Sisson Brook channel." (p. 3-139)

The EIA is noncommittal on whether water treatment will be required after mine closure at Year 40. Water treatment has more impact on the amount of financial assurance required and any other facet of the mine. Water treatment, especially for the volumes possible at Sisson Brook could require a financial surety in the $100's millions.

Because the public is ultimately the guarantor of water treatment (not the regulatory agency) or alternatively would bear the effects of the untreated contamination, the public should be involved in the analysis and setting of the amount for the financial surety.

By failing to declare, whether through lack of information or analysis, it must be assumed that a financial surety for water treatment in perpetuity needs to be established. However, the financial analysis of this outcome is also not addressed in the EIA.

Because of the financial risk it places on the public, this is a major omission in the EIA.

Recommendation: *An analysis of a financial surety that includes water treatment in perpetuity should be included in the EIA.*

7.0 SUMMARY OF KEY PREDICTIVE STUDIES

7.5.2.3 Mid-Grade Ore Characterization

"Placement of the mid-grade ore within the TSF area for eventual sub-aqueous storage, if it is unused, should effectively inhibit potential generation of acid and metal leaching." (p. 7-68, 69)

However, it is also noted in the ML-ARD Potential Characterization Study:

"Processing of mid-grade ore is currently uncertain in the project plan and it is possible that it may sit exposed for longer than two years. In the event that ARD is produced, the project plan includes placement of this material on the edge of the TSF so that any contact water flows into the TSF and is

> contained, and as a result, collection of contact water and treatment (if required) would be easily facilitated."[5]

Typically there is only limited room around the edge of a dyke-type impoundment to place rock. There is no discussion of how much room would be required to store 17 Mt of mid-grade ore, and whether all of this material could be placed in a manner to assure it would drain into the tailing pond.

Recommendation: *More discussion of the temporary storage of the mid-grade ore in the EIA is warranted.*

7.5.3 Drainage Chemistry Predictions

> "For tailings, the scaling factor was 0.2 as test material and full-scale material was assumed to have the same particle size." (p. 7-70)

There are several scaling factors applied to convert the laboratory-calculated weathering rates to field conditions weathering rates. These scaling factors include a Temperature Scaling Factor, Particle Size Factor, and Contact Factor. These scaling factors are all 1.0 or less, and are multiplied together to calculate a Bulk Factor, which is applied to reduce the laboratory-calculated weathering rates.[6]

The values for most of the scaling factors (temperature, particle size, contact factor) are based of best professional judgment. Combining that with the fact they are multiplied together means there could be significant uncertainty in the weathering rates assumed for field conditions used in the water quality modeling.

> "After the pit is filled, only a small hanging wall (e.g., average height estimated at 22 m) will remain exposed." (p. 7-70)

It is also noted in the ML-ARD Potential Characterization Study:

> "Monitoring of pit sump water chemistry and pit wall oxidation during operations will help refine this prediction and better inform closure options as required."[7]
>
> and;
>
> "The pit high wall had an average NPR of 0.71 and ranged from 0.7 to 1.7 (5^{th} to 95^{th} percentile, respectively)."[8]

This is clearly Potentially Acid Generating material. For the purposes of establishing a financial surety, it should be assumed that a cover will be placed on exposed PAG pit walls. This is only prudent, and it doesn't mean that the money needs to be spent until the data referenced in the ML-ARD Potential Characterization Study has been collected – but the financial surety needs to be in place when the pit is opened.

Recommendation: *The reclamation plan should assume that a cover will be placed in exposed PAG pit walls until data collection can prove otherwise.*

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[5] IBID, p. 44
[6] IBID, p. 54
[7] IBID, p. 46
[8] IBID. p. 34

8.5 AQUATIC ENVIRONMENT

8.5.6.1 Residual Project Environmental Effects

"… the Project will necessarily need to comply with the discharge limits of MMER and those of the provincial Approval to Operate. Specifically with respect to total dissolved copper levels, the water quality model has predicted that copper concentrations in downstream watercourses will exceed both CCME and USEPA guidelines throughout most of the Operation and Decommissioning, Reclamation and Closure phases." (p. 8-243)

and;

"The parameters that are predicted to exceed at least one guideline at any of the downstream Napadogan Brook model nodes are sodium (Na), manganese (Mn), fluoride (F), aluminum (Al), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), selenium (Se), and lead (Pb). All of the key parameter concentration changes are affected by seepage." (Metal Leaching and Acid Rock Drainage Potential Characterization, Sisson Project, SRK Consulting, August 2013, p. II)

Recommendation: *These statements strongly suggest that water treatment will be required throughout the project, and for as far in time as the water quality predictive modeling was performed. This is further confirmation that long term water treatment should be part of the financial surety for the mine – until it can be demonstrated that treatment will not be necessary.*

8.17 ACCIDENTS, MALFUNCTIONS AND UNPLANNED EVENTS

8.17.2.1.1 Loss of Containment from Tailings Storage Facility (TSF)

"With the application of these standards and rigorous construction methods to ensure the structural integrity of the TSF embankments and components, the implementation of adaptive management measures as necessary over the life of the mine, and the legislated regulatory oversight, the possibility of a structural failure of a TSF embankment is so unlikely that it cannot reasonably be considered a credible accident or malfunction, and is thus not considered further in this EIA Report." (p. 8-698, emphasis added)

This is the first time I have seen this glaringly overconfident statement made in an EIS/EIA.

In the 10 years since the ICOLD 2001[9] report the failure rate of tailings dams has remained at roughly one failure every 8 months (i.e. three failures every two years).[10] These dam failures are not limited to old technology or to countries with scant regulation. Previous research pointed out that most tailings dam failures occur at operating mines, and that 39% of the tailings dam failures worldwide occur in the United States, significantly more than in any other country.[11]

Tailings dam failure is a low probability event, but also an event with high consequences. These consequences have never been ignored in any other EIS/EIA I have reviewed. To in essence assert that 'my engineering' could not possibly fail, in light of existing statistics, is arrogantly assuming that it is always the other guy (or gal) that will make a mistake – but not me. This is exactly the attitude that leads to accidents – as has been proven many times in the aviation world.

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[9] Tailings Dams, Risk of Dangerous Occurrences, Lessons Learnt from Practical Experiences, Bulletin 121, International Commission on Large Dams, 2001

[10] Data from http://www.wise-uranium.org/mdaf.html "Chronology of major tailings dam failures" as of March 22, 2011

[11] Reported tailings dam failures, A review of the European incidents in the worldwide context, M. Rico, G. Benito, A.R. Salgueiro, A. D´ıez-Herrero, H.G. Pereira, Journal of Hazardous Materials 152 (2008) p. 848

9.0 FOLLOW-UP AND MONITORING PROGRAM

9.3.4 Adaptive Management

> "As part of the ESMS and adaptive management plan Northcliff will have in place for this Project, the Follow-up and Monitoring Program will be periodically evaluated for effectiveness and appropriateness of the elements of the Program and the parameters being measured and reported. This evaluation will be done in consultation with the appropriate regulatory agencies and as the results of the Program are analyzed." (p. 9-7)

A consultation limited to the regulatory agencies leaves the public, and any of their concerns, out of the adaptive management process.

As noted in: 9.3.3 Community/Stakeholder/Aboriginal Involvement

> "Communication of the results of follow-up or monitoring initiatives to the general public, stakeholders, and First Nations is an essential component of the Follow-up and Monitoring Program to be implemented by Northcliff. Not only does this maintain communication with all parties and keeps them informed of the Project activities and their associated environmental effects, but it also offers the opportunity to incorporate public, stakeholder and First Nation input into the design of these programs and any consequential adaptive management, as applicable." (p. 9-7)

Recommendation: *The public should be explicitly included in the adaptive management process.*

9.4.3.2.1 Surface Water

> "The concentrations of aluminum, ammonia, arsenic, boron, cadmium, copper, iron, lead, mercury (contingent on MMER, Schedule 5, Section 4(3)); molybdenum, nickel, nitrate, radium-226 (contingent on MMER Section 13(2)); and selenium, thallium, total suspended solids and zinc will be determined." (p. 9-15)

It is not clear if these are the only constituents being monitored as a part of the regular monitoring plan. If this is the case, then in addition to the metals and anions mentioned as substances to be monitored in this section, several others should be added.

Recommendation: *Sulfate is an excellent early indicator of ARD/ML problems. Silver, uranium, and antimony ("... molybdenum, lead, silver, arsenic, uranium, thorium, cadmium, antimony, bismuth, phosphorus, and tungsten have ML potential." Metal Leaching and Acid Rock Drainage Potential Characterization, Sisson Project, SRK Consulting, August 2013, p. 40) should be at least monitored until it is demonstrated that they are not potential contaminants.*

Table 9.4.1 Proposed Water Quality Stations for Long-Term Monitoring

Quarterly monitoring is proposed for several surface water reference locations and other sites. Quarterly monitoring is not adequate to capture surface water variations. Weekly sampling is typical at most mines.

Recommendation: *Monthly sampling is a minimum interval for surface water, especially at potentially mineralized sites where diurnal variations and other natural and anthropomorphic-related causal factors could be involved.*

Recommendation: *If there is a discharge of treated effluent, then monitoring for the discharge site and downstream monitoring locations should be done at least weekly.*

9.4.3.2.2 Groundwater

No groundwater sampling interval is specified/discussed.

Recommendation: *Groundwater monitoring wells should be sampled at least quarterly during mine operation, and at least semi-annually after closure to insure high flow (usually spring) and low flow (usually fall or winter) recharge events are captured.*

9.4.5 Follow-up or Monitoring during Decommissioning, Reclamation and Closure

"The water quality will be sampled twice a year at all sampling stations and the analysis will include the same parameters monitored during Operation." (p. 9-27)

Recommendation: *As previously noted, monthly sampling is a minimum interval for surface water to establish proper background, and similarly semi-annual groundwater sampling.*

CONCEPTUAL DECOMMISSIONING, RECLAMATION AND CLOSURE PLAN

The Conceptual Decommissioning, Reclamation and Closure Plan (the Plan) is an important part of the EIA for two primary reasons: (1) it demonstrates that the mine can be safely closed and restored to a usable land use using existing reclamation techniques in a cost effective manner; and, (2) that a financial surety necessary to accomplish the reclamation and closure tasks can be established to protect the public from financial liability in the event of an unplanned closure/bankruptcy of the mine.

The Plan should ensure that there is sufficient detail and data for regulators and the public to reasonably ascertain the likely water quality and long term treatment needs at the site. The idea of a "living document" is appropriate but it must begin its life with detailed information sufficient to assess long-term impacts, costs, and liabilities.

The Plan should sufficiently describe certain important environmental and other aspects that should be reasonably determined prior to mine permitting. It states that:

> "The Plan described in this document has been prepared to meet one of the requirements for the Environmental Impact Assessment of the Project, and to support the eventual preparation of a Mining and Reclamation Plan required by the *Mining Act* of the Province of New Brunswick." (Plan, page ii – *see also* Section 4.0).

Although the reclamation plan should be a "living document" it should also be sufficiently detailed at the mine-proposal stage to estimate the reclamation and long-term water treatment costs, since these represent major financial and environmental liabilities to the public. A reasonably detailed and accurate mining and reclamation plan is further essential for the public and government to understand and evaluate the true long-term ramifications of the mine. This is particularly important because the facility is proposed for Crown Land (see Section 2.1) meaning that the public and government will be permanently left with the mine's post-closure consequences. Once started, many if not most mining impacts cannot be simply "turned-off" - they tend to last forever.

Recommendation: *The Plan should be completed at the mine-proposal stage, and certainly prior to permitting, to a sufficient degree to reasonably determine water treatment costs, reclamation costs, and assess the short and long term social, health, and economic impacts from the mine (including post-closure).*

Long Term Water Treatment

Post-mine planning documents should explicitly identify what post-mine treatment will be necessary at the site. This includes temporary treatment and treatment into perpetuity. The Plan states that:

> "Within about 10 years following this initial work, the open pit will be flooded. This begins the Post-Closure period and most active reclamation will be complete. Some Project facilities will be nearing their target end land uses. **Work will focus on treating discharge water from the open pit as necessary** to protect the integrity of downstream watercourses, monitoring the stability of the Site, encouraging the development of diverse and sustainable plant communities that are similar to those that were present prior to Project development, and Site maintenance. Some Site infrastructure will remain to support this work" [Emphasis added]. (Plan, Page i.)

It is important to reasonably predict and disclose what long term and permanent water treatment is reasonably probable. The information should be predicted based on water quality, geologic, and other data that is already available. The cost to the government and public of the company's failure to adequately predict long-term water quality is too great to not demand the information before permits are issued.

The Plan appears to acknowledge that the mine site will require treatment into perpetuity. It states:

> "When the open pit has been filled, about 10 years later, the water treatment facilities will be re-furbished as required to treat surplus pit water before it is discharged to Sisson Brook." (Plan, page 38.)

If there is surplus pit water that will require treatment it is reasonable to anticipate that this treatment will be required in perpetuity - forever. That presents clear long-term liabilities and costs to the Crown, Province, and public. These liabilities and costs should be fully evaluated and discussed - and alternatives developed to reduce impacts or the need for permanent treatment.

Recommendation. *Prior to permitting the company should identify what long term and permanent water quality treatment may be necessary at the mine site. This includes but not be limited to discharges from the pit (including from pit walls that will not be submerged and pit discharges to groundwater).*

Recommendation: *Permanent treatment should be avoided. The Plan should more fully evaluate this and identify alternatives to perpetual treatment.*

Water Quality Protection

The Plan strives to protect water quality to meet required permitted water quality requirements (*see e.g.* Plan section 3.6.4) but should strive for even greater water quality protection. While the Plan asserts that the mine will seek to protect water quality, it often does not include specific or clear criteria that it will meet (aside from obvious permit and/or regulatory requirements). Meeting water quality standards and/or permit requirements should be a starting point - not final goal - to water quality protection.

The Plan should seek to not degrade existing quality - even if the current quality is above water quality standards and there is "room" to degrade water quality and also not violate the standards.

Monitoring

The Plan generally describes broad monitoring goals that will be developed in the final plan. (*See* section 4.5.3.1 (surface water) and Plan section 4.5.3.2 (ground water). The plan fails to commit to ensuring that monitoring is representative, accurate, and complete and geographically encompass all disturbed lands (and not just the TSF).

Commitment to Reporting

It is important that the public be able to participate in all phases of mine permitting, operations, closure, and post-closure activities. To support this need, monitoring and discharge reports, including reporting on contamination of surface and ground water, should be made publicly available in a timely manner.

The mine should immediately notify the public of leaks, contamination, etc., and develop a system for such timely notification in a way that is broadly accessible to all affected parties. This is essential for trust and to develop a working relationship with the public, especially affected communities. Adequate monitoring is the only way to determine spills and their impacts. Unknown leaks, or leaks that employees fail to report or attempt to hide will remain undiscovered and their contamination will continue or disperse unless monitoring is in place to detect them. Adequate monitoring before, during, and following mining also protects the company, because it allows all involved to determine what is caused by the mine versus other sources/causes.

Recommendation. *Contaminant release and incident reporting structures should require that the company provide environmental data and reports to the public. There should be full transparency and the company should commit to informing the public and government about any unplanned or unpermitted releases as soon as it becomes known - not just during the regular document/reporting cycle. Annual or even quarterly reports do not adequately address the public's right to know about problems at the mine. This promotes good operating procedures and public trust.*

Tailings Storage Facility

There is little protection to groundwater if the tailings storage facility (TSF) is not lined. Without a liner the TSF could transmit leaks to soils and/or groundwater (and arguably surface water).

Either a compacted liner or a full synthetic liner would be appropriate for the TSF, given that it will contain materials that are expected to produce and leach acid (or chemicals, such as residual milling and processing materials).

Lining the tailings impoundment would increase the cost, but would significantly protect water resources. Moreover, if seepage does occur on a larger scale than predicted, the overall cost will be significantly less than had the pond been lined in the first place.

Finally, monitoring should include leak detection. A leak detection system not only could identify how much and where a liner is leaking, but the leak detection system provides a significant barrier to groundwater infiltration even absent a competent liner.

Open Pit

The Plan states:

> "...the open pit will not be reclaimed other than to allow it to fill with water and to monitor and treat water quality, as required." (Plan, page 29.)

This is proposed because of possible safety or difficulty issues with reclaiming the pit's steep slopes. The Plan states that:

> "Reclaiming these areas [the upper pit slopes] will be difficult not only due to the challenging terrain, but also because of safety concerns." (Plan, page 29.)

This summary disposition of upper-pit reclamation alternatives appears to ignore possible lessening of pit slopes or variable treatments. This may include reducing all or some upper walls and slopes to establish benches or larger areas that could be capped and revegetated.

Recommendation: *The Plan should evaluate actual reclamation alternatives for the upper pit showing a range of alternatives for the above-flood zone and the variable flood-dry interface.*

Because the Plan does not consider in detail the ramifications of chemical and acid leaching from the pit's walls that are above the water level of the flooded pit. The pit's exposed walls could be a considerable source of acid formation and thus acid mine drainage that could alter the predicted chemistry of the flooded pit.

Recommendation: *The Plan should predict the acid mine drainage or other chemical leaching that could occur at the pit slopes/walls and develop a proposal to deal with the predicted outcome.*

The Plan estimates that it could take decades for the pit to fill to its predicted flooded elevation. There is some probability that the pit lake could become acidic by solubilizing/leaching metals from submerged waste rock and/or exposed pit wall rock.

Recommendation: *There should be modeling to predict pit water quality during the pit flooding phase and after the pit is flooded. That will allow the Plan and mine to commit to specific treatment goals and considerations.*

Recommendation: *The Plan should anticipate how to prevent wildlife and bird use of pit waters. This may include the use of nets, hazing, and other demonstrated wildlife mitigation measures.*

Long Term Maintenance

Prior to permitting the mine should develop a detailed long-term monitoring program to provide appropriate remote surveillance and retrieval of field monitoring data and replacement of the remote monitoring equipment.

Recommendation: *The Plan should evaluate the reasonable costs for long term routine maintenance.*

Reclamation Costs

Neither the Plan nor the reference (Samuel Engineering 2013) contains any detail on how the $50 million was estimated. The Samuel Engineering reference, which is an NI 43-101 technical report, contains only two short paragraphs that discuss reclamation.

There is also no discussion of whether the closure cost estimate includes water treatment. $50 million might be a reasonable "ball park" estimate of dirt-moving closure costs for a mine of this size, but if the closure estimate included both dirt-moving and water treatment, the cost estimate is likely too low.

Not having enough money to assume closure obligations, including water treatment in perpetuity, is a major potential financial and environmental impact on the public. This information should be carefully calculated and disclosed as a part of the EIA process. The currently available information is perilously lacking.

Recommendation: *The Plan and environmental impact analysis process should identify implementable reclamation practices and costs in a detailed reclamation plan. This is essential prior to permitting to ensure that regulatory agencies and the public are aware of the potential results that can be achieved, and costs posed in reclaiming the site.*

If a company becomes financially insolvent at any point and there is not sufficient bond available, the public would be responsible for the difference between available funds and the money required to complete site reclamation and other tasks (maintenance, monitoring, etc.). As described in the Plan, the Provincial policy for reclamation costing it is intended to provide 'reasonable assurance' that government funds will not be used for mine reclamation. Therefore it is important in calculating costs to ensure that the calculations represent the actual costs, including indirect costs, for the government to complete reclamation.

Recommendation: *The reclamation financial surety should reflect the third party costs for the remaining reclamation, including indirect costs, and should be adjusted downward as the company completes those tasks.*

At all times during mine activities, the company should be required to maintain a financial surety sufficient to reclaim and restore lands from all mine disturbances that occur over the life of the mine and after closure. Mines incur much/most of their reclamation liability in the first years after opening the mine (pit, tailings pond and dam, and waste rock piles - but before they may produce substantial or any income). If the mine closes or goes bankrupt before mining and reclamation is complete then there probably won't be enough money to close/reclaim the mine. Similarly, if the mine temporarily suspends activities there would need to be funds to maintain operations and activities that protect human health and the environment, such as pumpback operations, water treatment, monitoring, etc.

The cost to an agency to perform reclamation at a mine site is usually 30-50 percent higher than the cost to the original operator. This is because of costs for mobilization, overhead (regulators issuing contracts), contractor profit, etc. The most commonly underestimated portion of these estimates is that of calculating the indirect cost, i.e. the costs to third parties (government and contractors) in performing the reclamation work should the mining operator not be able to do so because of financial insolvency.

The Center for Science in Public Participation (CSP2) has done a number of studies on reclamation costing and the calculation of financial sureties. CSP2 has developed the following recommendation for computing indirect costs, and in the table below the CSP2 recommendations are compared to indirect cost recommendations of the US Forest Service.

Recommendation: *Indirect cost estimates used for reclamation bond calculations should be disclosed to the public and carefully reviewed*

INDIRECT COST GUIDELINES

CSP2* Recommended Percentage of contract costs		USFS** Recommended Percentage of contract costs			
			Minimum	Maximum	
Contingency	10%	Contingencies:	6%	20%	- Scope Contingency
			10%	20%	- Bid Contingency
Mobilization / Demobilization	10%	Mobilization and Demobilization	0%	10%	
Engineering Redesign	3%	Engineering Redesign	2%	10%	
Engineering, Procurement & Construction Management	5%	--			
Contractor Overhead	15%	Contractor's Costs:	3%	3%	- Performance & Payment Bonds:
			0%	5%	- Estimated Sales Tax:
Contractor Profit	10%		15%	30%	- Profit & Overhead:
Agency Administration	10%	Agency Project Management	2%	7%	
Inflation	3%	Inflation	0%	3%	
TOTAL	66%		38%	108%	

References:

* Hardrock Reclamation Bonding Practices in the Western United States, James R. Kuipers, PE, Center for Science in Public Participation, February 2000.

** Training Guide for Reclamation Bond Estimation and Administration, For Mineral Plans of Operation Authorized and Administered Under 36 CFR 228A, USDA Forest Service, Minerals and Geology Management, April 2004.

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Soils Salvage Strategy

The Plan describes "soils" materials and breaks them into Categories for salvage purposes (*See e.g.* Plan section 2.5.1*)*. These descriptions are reasonable but should be applied in a more nuanced manner to maximize available growth media for revegetation and reclamation. The use of 'standardized' depths to plan salvage is inconsistent with the categorical depths/variations described and potentially ignores important materials and maintaining their value for reclamation.

The greater the depth/quantity of topsoil (soil growth media), the greater the chance of revegetation success. Long-term vegetation success will depend on greater soil depths compared to short-term vegetation success. Greater soil depth may not benefit revegetation success in the 5-year period of revegetation monitoring but greater soil depths will benefit longer-term revegetation success. It would be a waste, and potentially impair long-term revegetation success, to not use all topsoil resources. For the public increasing revegetation success is highly valuable, and it is the public that will ultimately be responsible for the site. Therefore, it is important to ensure that all soils materials are actually properly distributed at the site.

Recommendation: *All soil material should be accounted for and distributed to maximize revegetation potential.*

The Plan describes the use of quarried rock for capping and then covering that material with soil for revegetation. The lack of detail makes it difficult to assess from the Plan exactly what the size/fractionation is of these materials, but it is presumed to vary widely. Quarried or 'clean' overburden/waste rock can be very course compared to the other materials. If fine materials, such as topsoil are placed over course materials such that the material sizes are very different, the smaller materials placed on top of the larger materials can form a layer that appears stable but over time (ranging from weeks or months to many years) may form pipes (piping) or simply infiltrate (fall) into the larger material. For this reason, the Plan should ensure that operators and inspectors are aware of the problems associated with disparate size fractions when materials are being placed. This is particularly important for topsoil, which can be particularly susceptible to infiltrating/falling into spaces below it during storm events, snowmelt, and freeze/thaw cycles.

Recommendation: *The Plan should establish general criteria and guidance to ensure that materials placement where topsoil is replaced does not allow small size materials to be placed on materials that have much larger size particles. Where this could happen, an interlayer of mid-size materials should be placed between them.*

Recommendation: *The Plan and permit should require salvaging all topsoil and subsoil from areas disturbed by mining activities - regardless of location or volume. Post-mine plant growth and establishment benefit substantially from maximizing plant growth media (soils), particularly where agriculture is a proposed post-mine land use. The more soil, the better the post-mine revegetation success, particularly in the first five years.*

The best reclamation practice would be to salvage Category 1 soil materials in two lifts - the first being A and B horizons, then the lower horizons. These lower horizons should then be placed as the first step of replacing cover material, upon which the topsoil (A and B horizons) would be placed. The effect is more cover material that will better support plants and more quickly further develop soils than just the A and B horizons placed on top of sand, waste rock, liners, etc. Given the EIA's reclamation goals, ensuring the good growth environment provided by maximum salvage and replacement is essential.

The topsoil salvage piles will stand unused for years. As a result the soils quality will degrade during mine operations and the soil value will be reduced from when it was salvaged compared to when it is replaced.

Recommendation: *To preserve soil integrity (including organic materials, microbes such as mycorrhizae, promote aeration, reduce weed introduction, and reduce erosion, the EIA should identify specific steps that it commits to employ to establishing nurse crops on the topsoil salvage piles. These plants should be consistent with, and not compete, with the planned postmine revegetation, especially agricultural seeding/planting.*

The Plan should commit to characterizing stored topsoil resources (one or two years prior to starting reclamation) to identify basic physical and chemical characteristic. These results can then be used to modify the reclamation plan and determine what, if any, amendments are necessary and appropriate to enhance and ensure revegetation success. Criteria should include material size fractions, nutrients, pH, microbial condition, and organic content. Sampling should be done at the surface and deep in the piles. This will ensure that the replaced soil and subsoil materials/horizons are best able to support post-mine agricultural goals. By sampling and evaluating the materials before they are disturbed, the mine can mix-in organics and other amendments that may be necessary to ensure they are fully integrated into the replaced soils (as compared to simply added as top-dressing).

Recommendation: *The Plan should develop detailed topsoil salvage and storage plans to ensure that the maximum amount of materials is salvaged for reclamation. These materials should be stored to maximize soil health and reclamation efforts. Characterization of materials should be based on field observation and not on a 'standardized' depth measurement.*

Revegetation Plan

The General Plan for Re-Vegetation (Plan section 4.2.5) is obviously general but it fails to establish criteria to measure revegetation success. The Reclamation Monitoring (Plan section 4.5.2) establishes some goals but they remain deficient for this phase of mine planning and based on the need for information to promote public and agency review and consideration.

The Plan should establish specific goals for essential revegetation features and not just generalized, conceptual goals. There should be clear noxious weed criteria, based on basal and aerial cover, which should be used to trigger treatment and retreatment.

Vegetation cover goals should be established - and are suggested to be at least 50%. Further, the percentage cover should be required to persist for at least 5 consecutive years prior to bond release. Plant growth (germination and early growth) is not as important as long-term establishment. Section 4.5.2 discusses a 5-year goal but its details should be expanded.

Because post-mine land uses will not be homogenous, it will be important to establish criteria for both alpha and beta diversity. Such criteria should make clear both aerial and basal cover-percent and further identify criteria for success and failure for both alpha and beta diversity. Without these standards revegetation could achieve some goal or required percent coverage but not establish, or even provide a reasonable ecological basis for future establishment of the diverse vegetative cover that will be needed for post-mine land uses.

The post-mine land use standards should roughly mimic the pre-mine alpha and beta diversity numbers for the mine, broken down into appropriate sub-regions. The goal should be to ensure that both species numbers and richness are established - which is necessary to achieve post-mine land use goals.

The 5-year period described should re-start whenever revegetation activities are taken to enhance revegetation. The goal of the minimum period should be demonstrating that plants have established and are self-sustaining. If supplemental activities are taken (such as adding amendments, fixing erosion or subsidence, recontouring, reseeding, planting, weed control, etc.) then the clock should re-start to ensure

that vegetation is actually surviving on its own. The 5-year period should demonstrate the site's ability to sustain itself - not demonstrate that with various treatments the company can keep the site growing.

Recommendation: *Establish clear noxious weed criteria, including the lowest amount of weeds that will trigger treatment and the highest allowable percentage of noxious weeds that will be allowed for bond release.*

Recommendation: *Establish minimum percentage vegetative cover goals of at least 50% after three years and 80% for five years before determining "success" or allowing relevant bond release.*

Recommendation: *Establish clear alpha and beta diversity requirements for vegetative cover.*

Recommendation: *Revegetation success should be measured no sooner than five years after revegetation goals have been met - without additional treatments or activities. If additional treatments or activities are undertaken, the 5-year clock should restart to ensure that revegetation and long-term plant establishment has actually occurred.*

Weed Management

The Plan does not establish a detailed weed control plan, but weeds could significantly threaten the post-mine land uses. Weed problems can begin during the first stages of mining, particularly during topsoil salvage operations and establishing nurse crops, when weeds can begin to take hold.

Recommendation. *A weed-prevention program should be developed and implemented.*

At a minimum, this plan should include, but not necessarily be limited to:

(1) Certification of weed-free seed;

(2) Processes to prevent weed introduction (such as washing vehicles if there is a specified potential to distribute weeds, such as off-site equipment that will be brought on-site to hydroseed or otherwise cover a lot of ground on the site and could thereby distribute weed seeds across a large area);

(3) Weed-response plan identifying how weeds will be controlled if they do come to the site.

Thank you for the opportunity to comment on this EIA.

Sincerely:

David M. Chambers, Ph.D., P. Geop. Stuart M. Levit, M.S., J.D.

2.10 Review of EIA Report for the Sisson Project (Tungsten and Molybdenum Mine) - New Brunswick, CEAR #11-03-63169

Subject Area: Comparing water management plans for Sisson mine to those of other mines in NB
Date: September 29, 2013

Roy Parker, MSc.

General Comments/Overview

Given my past experience with mines in New Brunswick, I was asked to review the EIA report for the purpose of determining whether it had an "air of reality", particularly with regard to how the report addressed several potential accidents and the possible impacts of the project on water quality. From the parts that I read, it is my view that overall, the EIA report was very thorough and quite well done. The writers examined the major components of this large mining project and their assessment looked at most of the important issues and the potential for impacts in the ecosystem. Their assessment methods followed standard protocols and looked at the valued ecosystem components identified for the area of the mine development. However, I did identify a few issues that were not thoroughly addressed or that the proponent determined would not have a significant impact.

Tailings Pond

This proposed mine will have a huge Tailings Storage Facility (TSF) by the time the project is completed and the project moves to the Reclamation Phase after 27 years of operation. The footprint of the completed TSF will be 786 hectares (about 4.3 km. long and 3.3 km. wide). This will make the TSF at the Sisson Project the largest tailings pond in the province by the end of the operational phase. By comparison, the tailings storage facilities at the Brunswick 12 Mine and at the Heath Steele Mine each cover about 500 hectares. As well, the highest dam wall will be approximately 90 metres high (Table 3.4.2). This is roughly 50 metres higher than the Mactaquac Hydroelectric Dam on the St. John River. While not a failing of the project, the TSF's large size requires it be diligently planned, constructed, operated, and maintained.

Seepage

Almost all dams constructed of earth and rock leak; water seeps through the pores and usually exits at the toe of the outside wall. Seepage rates depend on the type of material used for construction and the diligence of the construction workers in placing and compacting the material. The Sisson project proposes a series of seepage collection ponds (Water Management Ponds, WMP) along the outside perimeter of the dam walls. These ponds will also collect surface runoff water from the outside faces of the dams. If the water collected in these ponds is of acceptable quality, it will be discharged to the environment. If the water is contaminated, it will be pumped back into the TSF. That is the correct approach but the mine operators must have contingency plans in place for the operation of these ponds to deal with:

1. Pumps failures.
2. Disruption in electrical service.
3. Heavy rainfall or large snow melt events that could exceed the capacity of the pumps and result in the WMP overflowing.

The Clover Hill Potash Mine near Sussex was equipped with collection ponds and pumps to intercept seepage water and any overflow water from the tailings pond. During a heavy rainfall event in late 1980's, the tailings pond overflowed but the pumps failed to operate and brine contaminated water escaped from

the site causing the death of hundreds of juvenile salmon and trout in the nearby stream, a tributary of the Hammond River.

As large precipitation events, i.e., storms, and power failures often go hand in hand, the above is a very possible accident for the Sisson Project. Given this, it is surprising that the EIA report or the Environmental and Social Management System (EIAR Appendix D) do not provide more details about how this scenario will be addressed other than a brief mention of "replacement pumps" and "emergency generators" (EIAR pages 8-724 and 8-725). A condition for allowing the project to proceed should be the requirement of a *detailed* plan to deal with such an emergency.

Dam Failure

The Sisson Project will construct the TSF following the Canadian Dam Association Guidelines. These guidelines are based on many years of dam building experience in Canada. However, dams can and do fail. In March, 1998, heavy rainfall in southern New Brunswick resulted in the failure of the tailings dam at the Mt. Pleasant Tungsten Mine. The overflow spillway from the dam was washed away and the water level in the tailings pond dropped several metres. A new, concrete spillway was designed and constructed to withstand excess inflows of precipitation and surface run-off into the tailings pond. As well, an emergency spillway was constructed in the wall of the dam in case the main spillway could not handle the excess flow of water into the pond. The EIA report does not provide a description of the spillway on the TSF or describe the design criteria for that spillway.

Water Management

The EIA report describes the water management plan for all phases of the project from construction to post-closure. In Section 3.2.4.2, it states that "the pumps and pipelines will be sized to remove the inflow volume resulting from the 1 in 10-year design flood event within 10 days." In New Brunswick, the frequency of extreme rainfall events is expected to increase. For example, in 2008, Fredericton had 4 rainfall events that exceeded 50mm (New Brunswick Government Website). It is not clear from the EIA report whether all of the water management components (WMP, pumps, pipes, and spillways) are designed to deal with these types of extreme rainfall events.

Dam Inspections

The EIA states that – "A dam safety review will be conducted every five years by a qualified geotechnical engineer." This does not seem adequate for a structure as large as the TSF. Annual or at a minimum biannual inspections should be carried out to ensure the integrity of the dams surrounding the TSF.

Closure Scenario

The conceptual closure plan for the project appears to be sound and based on best available practices. The EIA states that "It will not be possible to reclaim the open pit other than as an open-water landscape feature..." (EIAR page 3-141). It should be noted that mined-out open pits do get filled in. It is technically possible and has been completed in New Brunswick at two sites, the Murray Brook Mine (2002) and the Stratabound CNE Open Pit Mine (1992). Both of these mines were much smaller than the proposed Sisson Project. It may not be practical or economically feasible to fill in an open pit the size of the one proposed for the Sisson Project, but it can be done.

The EIA predicts that eventually, the water in the flooded open pit will achieve acceptable water quality, and if all of the EIA predictions hold true and everything works out as planned, acceptable water quality

could result. Given my knowledge of the legacy of the continuing contamination of mine waste water in New Brunswick many years after these mines have closed, I have reservations about the proponent's contingency plan if this acceptable water quality is not achieved? While the proponent commits to treating overflow water from the flooded open pit "for as long as is necessary" (EIAR page 3-143), it is my experience that what is necessary is required for a much longer period of time than typically anticipated. Also, will the $50 million proposed to be set aside be sufficient funding to pay for "as long as is necessary"? For example, the Caribou Mine in northern New Brunswick has operated on and off since the 1960's. In the early years of lead-zinc production, acid generating tailings were deposited in a tailings pond adjacent to the mine site. This pond was filled nearly to the top of the dams and was built on sloping ground and contaminated water leaked through the walls of the tailings dam as well as through the bottom of the pond. This water percolated through the aquifer and the contaminated groundwater entered Forty-Mile Brook which flowed through the mine site. The pH of the brook was lowered for several kilometres downstream of the mine and concentrations of lead, zinc and copper were all elevated. Forty-Mile Brook is a tributary of the Nepisiguit River, an important trout and salmon stream in NB. Water samples collected 5 kilometres downstream on the mile were routinely acutely lethal to rainbow trout in standard laboratory tests. When the mine resumed production in the 1980's, a new tailings facility with an effluent treatment system was constructed and was operated in effective manner. Attempts were made to seal the original tailings pond and to intercept the contaminated groundwater seeping from it, but for the most part, these measures were ineffective and Forty-Mile Brook remained contaminated.

The EIA states that, "TSF embankments and beaches will be undergoing re-vegetation with suitable species to provide forested, wetland, and open water habitats suitable for wildlife" (EIAR page 3-139). Vegetation does not grow well on tailings, even tailings that are not acid generating and do not contain elevated concentrations of minerals. Tailings are nutrient deprived, low in organic content and do not hold moisture well. There are many abandoned tailings ponds in the Maritime Provinces that have been sitting unattended for decades and there is no natural vegetation established on them (e.g., Nigadoo Mine in northern NB and the Stirling Mine in Cape Breton). In order to get the vegetation to establish, tailings are normally covered with a layer of soil and supplied with quantities of nutrient in the form of fertilizer or manure. The Sisson Project proposes to stockpile topsoil material as it clears the site for construction but it will take a large amount of soil to cover the exposed tailings beaches in the TSF. It is not clear from reviewing the EIA report that the proponent has calculated the soil requirements for re-vegetation and they will have enough material available when the reclamation begins.

Water Treatment

Although the EIA refers to waste water treatment, no specifics are ever provided about the predicted contaminants or how they will be removed from the effluent before discharge. Will they be required to treat for elevated suspended solids, elevated concentrations of metals, depressed pH or all of the above? Some detail should be provided about the type and efficacy of the proposed waste water treatment processes that will be employed. In Section 7.6.3.3.2, there is a reference to batch treatment of the water in the open pit with ferric sulphate. What is the purpose of this procedure? Most water treatment plants create precipitate containing the contaminants, generally referred as sludge. What plans are there for sludge disposal?

Follow Up Monitoring

In Section 7.6.3.6.3.3, the EIA predicts that fluoride will exceed the CCME FAL guidelines (for the protection of aquatic life) at all model nodes throughout the life of the project. In Section 8.5.4.3.2.2, it states that, "The follow-up and monitoring program for water quality in all metals, including fluoride, is provided in Section 9, and includes metal concentrations in groundwater, surface water, and fish tissue." However in

Section 9.4.3.1.5 Fish Tissue Analysis, fluoride is not listed among the parameters to be measured. As fluoride is known to accumulate in bones, the fish tissue analysis for fluoride should include fish bones. Similarly, in Section 9.4.3.2.1 Surface Water, fluoride is not listed.

Acid Rock Drainage

The proponent has conducted humidity cell testing, acid-base accounting tests, and field kinetic tests to predict the potential for waste material from the mining operation to generate acid rock drainage. These tests represent the best available methods for predicting the acid generating potential of geological material. However, these tests are only predictive and what actually happens during the operation and closure phase of the mine could be quite different. At the East Kemptville Tin Mine in Nova Scotia, the EIA did not predict that the waste rock and tailings would be acid generating. As it turned out, after the mine began operation in 1985, acid rock drainage became an issue and a water treatment plant and a total reconfiguration of the tailings pond system was required to deal with the problem. The mine closed in 1992 and the surface run-off from the site is still being treated, some 21 years after operations ceased.

Operational Interruptions

Very few mines commence operation and run uninterrupted for the predicted full operational life of the mine. Metal prices, technical problems and labour disputes can all result in temporary or premature closure of a mine. This issue is not discussed in the EIA. Should an interruption in production occur, how will that affect the water management plan, the operation of the TSF and the treatment of the waste water?

Biography of Reviewer

I earned a B.Sc. (Biology) and a Masters of Environmental Studies from Dalhousie University. I worked for 34 years as an aquatic biologist with Environment Canada in Dartmouth and Fredericton. I worked in, and then managed an aquatic testing laboratory for Environment Canada for 15 years. In 1985, I became responsible for pollution abatement, pollution prevention and environmental assessment for all mines in the four Atlantic Provinces. Starting in 1992, I became a member of the Environmental Effects Monitoring (EEM) National Team with Environment Canada and worked on the development of EEM regulations for the pulp and paper and the mining industries. I was the Atlantic Regional Coordinator for the implementation of the EEM programs under the revised federal effluent regulations. In 1999, I was assigned to Environment Canada's Fredericton office and focused primarily on assessing the environmental impacts of open-pen salmon farming in the Bay of Fundy and working with other government departments (provincial and federal) and the aquaculture industry to reduce and eliminate adverse effects of salmon farming on the aquatic ecosystem adjacent to the farms.

Appendix F – Article from Vancouver Sun, September 6, 2013

Government experts raised red flags on proposal to build mine: summary of concerns

(Available at: http://www.vancouversun.com/business/2035/Government+experts+raised+flags+proposal+build+mine+summary+concerns/8880799/story.html.)

The following is a summary of the concerns raised by federal and provincial government experts during the Canadian Environmental Assessment Agency review of Taseko Mines' New Prosperity Mine proposal.

1. Deteriorating Fish Lake Water Quality & Unproven "Aquarium" Lake Recirculation

Environment Canada

"The Proponent's modelling suggests water quality in Fish Lake may be marginal for the protection of aquatic life." (EC Panel Submission, July 25, 2013, CEAR #738, p. 10).

"There are few, if any, examples of lake recirculation at the scale proposed by the Proponent" (EC Panel Submission, July 25, 2013, CEAR #738, p. 11).

"Environment Canada is concerned that the recirculation mitigation measure proposed to manage water quality and the biological productivity of Fish Lake is unproven at this scale … the high level of uncertainty regarding the Proponent's recirculation scheme is a particular concern given the stated goal of preserving Fish Lake." (EC Panel Submission, July 25, 2013, CEAR #738, p. 12).

Natural Resources Canada

"The Proponent has estimated from the base of the TSF [Tailings Storage Facility] during the post-closure period at 760 m3/day. NRCan considers this value to be unrealistically low for a 12 km3 impoundment … NRCan estimated seepage through the base of the TSF to be approximately 8250 m3/day or 11 times the value estimated by the proponent". (NRCan Panel Submission, July 4, 2013, CEAR #587, p. 27, confirmed in NRCan's closing remarks, CEAR #1123, August 21, 2013).

Department of Fisheries and Oceans

"The Proponent's mitigation and adaptive management plan to preserve the functioning of Fish Lake using a recirculated closed system uses unprecedented and untested technology … DFO is

not aware of any examples of wilderness lakes or watersheds that have been subject to a recirculation program." (DFO Panel Submission, July 23, 2013, p. 14, CEAR #691).

"The New Prosperity Mine configuration was modified by from the original plan to prevent the immediate destruction of Fish Lake to create a tailings pond. In the New Prosperity Mine configuration, the Fish Lake watershed could be extensively altered, requiring intensive engineering efforts to maintain flows and lake levels. While Fish Lake itself would not be directly destroyed, as noted by the Proponent in the 2012 EIS, the lake is predicted to experience eutrophication and contamination with development of the mine." (Supplemental DFO Panel Submission, August 4, 2013, CEAR #886, p. 15).

Ministry of Energy and Mines

"MEM believes that in the context of preserving Fish Lake and its tributaries there remain uncertainties around the ability to limit and collect the expected volumes of seepage from the TSF, and the ability to effectively treat water to maintain water quality in Fish Lake and its tributaries. This leads MEM to conclude that, as detailed in the EIS and supporting documents, the ability to prevent adverse effects to Fish Lake and its tributaries from a water quality perspective is uncertain." (MEM Panel Submission, August 6, 2013, CEAR #873, p. 3).

"Taseko has proposed relying on adaptive management including water treatment to mitigate adverse effects to Fish Lake water quality and to conclude no significant adverse effects to Fish Lake. Since the effectiveness of the proposed treatment processes to decrease metal concentrations to the design specifications has not been fully provided, MEM believes that Taseko's conclusion of their ability to prevent adverse effects to Fish Lake is also uncertain." (MEM Panel Submission, August 6, 2013, CEAR #873, p. 2).

"Recirculation of Fish Lake flows in an effort to preserve the ecological values of Fish Lake and its tributaries is a very significant commitment. Fresh water diversion and flow augmentation through pumping and piping are sometimes applied at BC minesites, however not typically at this scale or for this length of time." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 16).

"The predicted average model results indicate BC fresh water aquatic life water quality guidelines will be exceeded in Fish Lake, Upper Fish Creek, and Tributary 1 for aluminum, cadmium, iron, lithium, selenium, silver and thallium. Predicted average pit lake concentrations also exceed guidelines for antimony, arsenic, cobalt, mercury and zinc." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 20).

"MEM notes that the proposed membrane water treatment, sulphide reduction, and ion exchange water treatment technologies are not widely used in mining applications, and none are currently in use at British Columbia minesites. The information provided on water treatment in the supplemental response provides very high level concepts but does not provide design level information that demonstrates that target objectives can be met. Water treatment is a primary mitigation strategy for this project and it should be demonstrated to be feasible at the EA phase, especially since it is key to conclusions on project related effects." (MEM Comment on

Adequacy of June 5, 2013 Supplemental Information, Submitted June 14, 2013, CEAR #541, p. 2).

"Seepage from the TSF is a very significant management issue for the Prosperity project, given the directive to protect the integrity of Fish Lake. There is large uncertainty regarding the spatial extent and hydraulic conductivity of the TSF till foundation materials and the current assumptions of its effectiveness to limit seepage have not been justified are considered potentially not conservative. Sensitivity analyses show that significantly higher seepage rates than used in the water quality loading models could occur." (MEM Panel Submission, July 19, 2013, CEAR #655, pp 14-15).

Ministry of Environment (Forests, Lands and Natural Resource Operations)

"Concerns have been raised … over the possibility of deteriorating water quality in the Fish Lake system. This could result in the loss or reduction of the productive capacity of the lake and unsuitable water quality for other uses including wildlife habitat use. These concerns stem from the high degree of uncertainty surrounding the capability and feasibility of the water quality mitigation measures (i.e. mixed levels of success for treatment and the lack of previous experience combining treatments on a lake) to treat water so as to avert irreversible impacts to water quality and aquatic life. Should such a scenario play out, there is a substantially greater risk of irreversibly damage to the Fish Lake ecosystem and the wildlife use of the system either directly by exposure to algal bloom toxins or indirectly by avoidance of the area due to poor water quality." (BC Environmental Assessment Office Panel Submission, July 19, 2013, p. 16/56 of PDF, CEAR 654).

2. Long-term Liabilities to Taxpayers & Questionable Economics of the Project

Ministry of Energy and Mines

"While detailed costing is reviewed at the Mines Act permitting stage when setting the financial security requirements, the full costs of treatment should be fully evaluated by the Proponent at the EA stage as it has the potential to affect the economics of a project. MEM expects that the amount of financial security that could be required to fund this scale of long-term liability would be very high and are likely unprecedented in the province." (MEM Panel Submission, July 30, 2013, CEAR #787, p. 5).

"In addition to the requirements for Fish Lake water treatment, the open pit lake may require water treatment before spilling at Year 48. The potential additional treatment requirements and costs associated with it have not been scoped in the EA or in these review comments." (MEM Panel Submission, July 30, 2013, CEAR #787, p. 5).

"An assessment of the potential effects to predicted water quality in Fish Lake, Fish Lake Tributaries, and the pit lake are documented in the Impact Assessment starting on pages 761, 764, and 769, respectively. The summary water quality effects assessment for Fish Lake, Fish Lake tributaries, adjacent streams and rivers and adjacent lakes all conclude that water quality

conditions could become significantly adverse (pages 793-796) if left unmitigated." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 21).

"MEM concludes it is reasonable to assume that TSF water will need to be relayed to the open pit in the long term and Fish Lake may require re-circulation for at least 100 years, and perhaps in-perpetuity." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 21).

"Based on preliminary cost information submitted for project configuration T2 (IR#4a), it appears that the costs for water treatment and for some aspects of water management, may not have been fully factored into the project. Water treatment is a significant undertaking, and the current proposed water treatment systems are known to be very expensive. The proponent should consider the full costs of these environmental protection requirements, as they have the potential to significantly affect the economics of the project." (MEM Panel Submission, July 19, 2013, CEAR #655, p. 27).

3. Risks to Taseko River & Other Nearby Lakes

Environment Canada

"Environment Canada is concerned that the Proponent may have underestimated the potential impacts of the Project on water quality in Wasp Lake, Little Onion Lake and Big Onion Lake. Given that these lakes drain to the Taseko River, Environment Canada is also concerned that the Proponent may have underestimated impacts on water quality in the Taseko River." (EC Panel Submission, July 25, 2013, p. 19, CEAR #738).

Department of Fisheries and Oceans

"Natural Resources Canada recently expressed concern that Taseko's seepage rate estimates for the TSF [Tailings Storage Facility] may be 11 times higher than those modelled in the EIS [Environmental Impact Statement] … as a result, groundwater seepage estimates that were modelled in the EIS may be underestimated. If actual baseline groundwater seepage contributions into Taseko River are significantly higher than those modelled, then development of the Project could result in impacts to Taseko River that have not been considered by the Proponent." (DFO Panel Submission, July 23, 2013, p. 13, CEAR #691).

B.C. Ministry of Environment

"There are concerns regarding the modelling of groundwater movement and the lack of on-site monitoring wells. Furthermore the mitigation method of recycling the water back from intercepting wells downslope may not be effective because the pathways for groundwater movement are not completely understood. There exists the potential for the movement of contaminated groundwater from the mine site into other surrounding watersheds downslope including the Taseko River" (BC Environmental Assessment Office Panel Submission, page 7/56 of PDF, CEAR 654).

“Water from the seepage ponds are to be discharged to Big Onion Lake and Wasp Lake. These lakes are expected to see deteriorating water quality. Creeks leading from these lakes go to Beece Creek and Taseko River, highly valuable fish streams. Pit Water is expected to be discharged to Fish Creek long after the mining is completed. This water will receive little dilution in Fish Creek before it enters Taseko River” (BC Environmental Assessment Office Panel Submission, page 35/56 of PDF, CEAR 654).

*NOTE: This document does not try to provide a comprehensive list of comments on impacts to Tsilhqot’in culture, rights and use.

Read more:
http://www.vancouversun.com/business/2035/Government+experts+raised+flags+proposal+build+mine+summary+concerns/8880799/story.html#ixzz2hjpkxf1q