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Our File # NWT-142

Chuck Hubert  
Environmental Assessment Officer  
Mackenzie Valley Environmental Impact Review Board  
Suite 200, 5102 50th Avenue,  
Yellowknife, NT X1A 2N7

*Sent via email: [chubert@reviewboard.ca](mailto:chubert@reviewboard.ca)*

**Re: EA0809-002 – Final Submission from Natural Resources Canada**

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This letter is in response to the Mackenzie Valley Environmental Impact Review Board (the Board) letter of July 15, 2011 requesting final written submissions from parties prior to the closure of the public record for the environmental assessment of the Prairie Creek Mine.

As the Board is aware, Natural Resources Canada (NRCan) has been involved in the review of the proposed Prairie Creek Mine both in the context of our role as a federal department with a regulatory role through the *Explosives Act* in relation to the manufacture and storage of explosives, and as a leader in science and technology in the fields of minerals and metals and the earth sciences. Specific areas of NRCan expertise that have been engaged in the proposed Prairie Creek Mine Environmental Assessment Review are:

- (Deposit) Geology;
- Earthquake Hazards;
- Geotechnical Science, Permafrost, Terrain Sensitivity;
- Carbonate Stratigraphy, Karst;
- Surficial Geology, Geohazards and Stratigraphy; and
- Mine Waste Management.

Through these roles, NRCan has participated in the review of the Developer's Assessment Report (DAR) Draft Terms of Reference, the review of the DAR, the Board's Information Request process and technical meetings, the submission of a Technical Report, participation in the Public Hearings at Fort Simpson (NWT), and participation of departmental officials in the various interdepartmental meetings, and meetings with the proponent, as and when necessary.

NRCan is using the opportunity of this final submission to summarize for the Board's consideration of our recommendations leading to the Public Hearings, and to provide the Board with updated considerations as a result of new information filed by the proponent following those hearings.

**NRCan's Technical Report**

The 12 recommendations made by NRCan in our Technical Report (June 3, 2011), and discussed at the Public Hearing, are summarized in Attachment 1. These recommendations provide further guidance on factors that should be considered in final design, or subsequent monitoring and follow-up plans, to ensure that certain possible environmental impacts are minimized.

**Review Board Undertaking**

At the Public Hearings, NRCan was directed to provide a summary of discussions between NRCan's geochemistry reviewer and the proponent's geochemistry consultant. In our July 8, 2011 submission, we reiterated the view that predictions made in the DAR regarding leachate



water quality from the paste backfill can be confirmed, by the proponent, through further testing and analyses. NRCan would be supportive of a commitment by the proponent to conduct this testing as early as practical, before irreversible actions are taken.

### **Proposed Water Storage Options**

The technical report, Golder Associates (2011) *Consideration of Additional Water Storage Options, Prairie Creek Mine, NWT*, submitted by the proponent in August 2011, was reviewed in the context of recommendations found in NRCan's Technical Submission. NRCan's technical review is included as Attachment 2.

In summary, NRCan's reviewer recognizes the benefit of a second Water Storage Pond (WSP), which would almost double the planned capacity. NRCan recommends the same testing and design approach for the second WSP as that proposed by the proponent for the first WSP. Thus, the analysis and recommendations provided in NRCan's Technical Submission under the heading "*Stability of the Water Storage Pond (WSP)*" remain valid (see recommendations 4 through 7 in Attachment 1). The reviewer further recognizes, however, that a preliminary stability analysis is not available for the second WSP, and that there is less information available on a clay layer, which affects slope stability. Therefore, the updated recommendations in Attachment 2 suggest a phased approach, with further analysis to demonstrate "proof of concept" prior to final design.

### **Tailings Management and Backfill**

Following the June 24, 2011 Prairie Creek Mine public hearings, NRCan participated in the review of additional information brought forward by the proponent in response to Aboriginal Affairs and Northern Development Canada (AANDC) views at the time that, from the calculations of AANDC's consultant, the proposed use of paste backfill would result in a small surplus of tailings each year which cannot be placed underground. In preparation for a meeting on August 18, 2011 with AANDC officials and Canadian Zinc Corp.'s representatives and consultants, NRCan's mining expert reviewed Byard MacLean, SNC-Lavalin Memo, July 7, 2011 (*Undertaking No. 1 – Response to Brodie Consulting's Review*), and subsequently reviewed the proponent's August 22, 2011 memorandum to AANDC, included as an attachment in *Environmental Assessment EA0809-002, Prairie Creek Mine, Paste Backfill Review (September 2, 2011)*.

In summary, NRCan's reviewer found that, based on the volume calculations and dry density of tailings, all flotation tailings produced should be capable of being placed underground. NRCan is supportive of commitments by the developer that; 1) all development waste be brought to the surface; 2) use of Dense Medium Separation be kept to a minimum; and, 3) that all flotation tailings be stored underground. NRCan's reviewer's conclusions have been considered by AANDC in their final submission on this topic.

NRCan's reviewer also considers upsets of the backfill plant and parts of the distribution system (trucks breaking down, pipes blocked, etc.) to be a likely occurrence, especially during the commissioning of the plant and distribution system. The currently proposed temporary storage area provides capacity that is sufficient for planned maintenance, but potentially not sufficient for breakdowns that last over long periods. The limited capacity of the temporary storage area for flotation tailings means that regulators and the proponent will need to be cognizant of the potential exists that mill operations may need to be suspended, should storage area capacity be reached.

### **Conclusion**

NRCan acknowledges that project design is an iterative process, and expects that detailed engineering design and preproduction testing can address the recommendations that the department's officials have raised throughout the review process.



NRCan trusts that the Board will carefully consider all the information on the public record, and clearly recommend programs for follow-up environmental monitoring, analysis and management as may be necessary to support sustainable development and safeguard the well-being of the environment and people of the Mackenzie Valley. Should the Board require any clarification on NRCan comments, I can be contacted at (613) 943-0773.

Sincerely,

*Original signed by*

John Clarke  
A/Director  
Environmental Assessment, SPI

Attachment: (2)

cc: R. Johnstone, MMS  
C. Hogan, MMS  
F. Schellekens, ESS



## Attachment 1

### Summary of NRCan Recommendations from “Natural Resources Canada Technical Submission - Environmental Assessment of Canadian Zinc Corporation’s Proposed Prairie Creek Mine” (June 3, 2011)

1. NRCan recommends that the Developer follow up on the recommendation made by Golder to conduct geotechnical investigation along the access road to better define the terrain conditions in particular in areas of potential instability such as ice-rich permafrost and at slopes and water crossings. The information obtained from these investigations should be incorporated into final design plans and environmental management plans for the access road.
2. NRCan recommends that the Developer ensure that excessive blading and levelling of the ground surface is avoided to preserve the organic layer and minimize the potential for thawing of ice-rich ground and also to reduce the potential for erosion. NRCan suggests the proponent use, in addition to a contractor to construct the winter road, a qualified and experienced QA/QC winter road engineer to advise the proponent and contractor on technical issues pertaining to the winter road (e.g. geohazards, bearing capacity, surface preparation, environmental management and other issues).
3. NRCan suggests that environmental management plans for the access road include a decision tree or toolbox that includes the available mitigation options and the criteria to be utilized to select from these options.
4. NRCan recommends that the Developer conduct, prior to final design of the WSP the additional geotechnical investigations suggested by Golder to better characterize the properties of the materials underlying the North Slope, including the extent of the clay layer. This information should be incorporated into the stability analysis and final design.
5. NRCan recommends that the Developer conduct sensitivity analyses to include the effects of extreme events (high rainfall, snowmelt events) into the slope stability analysis and design of components of the WSP (slope, diversion ditches etc.)
6. NRCan recommends that the Developer considers conducting sensitivity analysis to include effects of variable water levels into stability analysis and final design of the WSP to deal with uncertainties related to storage capacity and the water balance.
7. NRCan recommends the following be considered as part of the environmental and management plan for the WSP and surrounding slopes:
  - a. The Developer installs additional instrumentation (as recommended by Golder) such as slope inclinometers and piezometers, as part of their environmental monitoring and management plan for the WSP and the surrounding slopes.
  - b. The environmental monitoring and management plan include the definition of critical values that will be utilized to determine when action is required (due to issues related to instability), the mitigation options and the criteria for selecting the mitigation technique (i.e. decision tree or mitigation toolbox). Also included should be the response required if monitoring data deviate from predicted values but still remain below critical values.
8. NRCan recommends that the Developer continue to monitor performance of flood protection structures to determine if maintenance and repairs are required.
9. NRCan recommends that environmental monitoring and management plans associated with flood protection structures include definition of critical values to be utilized to determine when



action is required, the options for action should critical values be exceeded and the criteria used to determine the action required.

10. NRCan recommends that the Proponent conduct a more detailed / larger scale (1:50,000 or better) mapping, inventory or risk assessment of landslides in the highly landslide susceptible terrain such as the western part of Prairie Creek Mine and eastern reaches of the access road to properly evaluate past, present and future geohazards for mine facilities and access road, before final detailed design and construction of the project.

11. In keeping with the developer's commitment (May 6, 2011) to determine a final composition for the WRP cover based on monitoring during operation, and to re-construct, upgrade or decommission ditches and other water control facilities as required, NRCan recommends that the Developer's design consideration should include the need to minimize or avoid contaminant loadings to Prairie Creek.

12. Prior to operation, as part of planning for hydrogeology and geochemistry data collection and the further studies of attenuation mechanisms, the developer should document its resolution the following questions:

- a. What would be the coupled redox drivers in the mine water for Se reduction and precipitation of Hg as tiemannite. Dissolved Se is also known to be precipitated as elemental Se under alkaline pH and reducing conditions, thus, competing directly with the above HgSe precipitation process. Under what conditions would the former reaction be favoured?
- b. Are the surface complexation and adsorption processes for metal attenuation in the two aquifers capacity limiting in the long-term such that a breakthrough would eventually occur?
- c. Would the above scenario impact long-term, post closure Prairie Creek water quality?
- d. Would the precipitation of ferrihydrite through groundwater discharge in the oxic environment of Prairie Creek impair its aesthetic as well as chemical water quality?
- e. Would these processes gradually impact the sediment quality and its toxicity level in Prairie Creek?
- f. Would there be any surface or shallow sub-surface discharge from the backfilled mine workings directly to Prairie Creek?



## Attachment 2

### Comments on Proposed Water Storage Options Geological Survey of Canada, NRCan

The following document submitted by CZN was reviewed:

*Golder Associates, 2011. Consideration of Additional Water Storage Options, Prairie Creek Mine, NWT. Submitted to Canadian Zinc Corporation, Aug. 2011.*

The document was reviewed with consideration of material previously submitted by CZN including the Development Assessment Report, other supplemental information and responses to information requests.

#### Introduction

The maximum storage volume provided by the original water storage pond (WSP) has been found to be inadequate for the project. The Developer has proposed two main solutions to increase the storage capacity: (i) modification of the existing WSP design to increase storage capacity; (ii) construct a second WSP (similar in size to the existing WSP) to be operated in combination with the existing WSP. If a second WSP were constructed, one pond would be utilized for process water and the other for mine water. This would negate the need for a separation dyke in the existing WSP.

#### Options for existing Water Storage Pond (WSP1)

A number of options were proposed to increase water storage. The first option requires further excavation of soil to reduce the load on the underlying clay layer. Less material would then be required for buttressing and the storage capacity would be increased. The second option would include construction of a cut off wall or shear key in the backslope through the clay layer leading to a reduction in material required for the buttress and apron and increased storage capacity. Raising the embankments is the third option. This could be done by upstream or downstream methods with greater storage capacity being provided by downstream methods. Golder (2011) has indicated that additional site investigations would be required to assess the various alternatives. NRCan also suggests that further stability analysis will need to be conducted for each proposed design.

#### Second Water Storage Pond WSP2

The Developer proposes that a second WSP be constructed downstream of the main project site in an area previously identified as a suitable pond location. The overburden excavated from the existing WSP backslope could be used for construction. Berms would be constructed to a maximum height of 10 m above the existing ground level. Rip rap would protect the toe of the berm proximal to Prairie Creek and the berm would be constructed to the 1:200 year flood level. The pond would be keyed into the existing slope on the north east side of WSP2. Disturbance of steeper slopes (up to 30%) is to be minimized or avoided and excavation is to be minimized. WSP2 is to be designed to have a maximum water level of 9 m and a freeboard of 1 m.

A visual assessment of the site was conducted by Golder in June 2011 and previous investigations conducted in 1980 (Golder 1980) provide information for four boreholes, two within the pond footprint and two between the pond and Prairie Creek. The borehole information indicates that 8.5 to 10 m of very stiff clay underlies 3-5 m of compact to dense sand and gravel. Ground temperature measurements for one of the boreholes (BH7) indicate that frozen ground is not likely present in the pond footprint. Insufficient information is provided to determine if the clay layer extends into the slope. Slope movements in the backslope of the existing WSP1 were observed to correspond to the depth of the clay layer (DAR Appendix 12). For the proposed WSP2, slope instability, in particular associated with the steeper slopes to the northeast, could also be an issue if the clay layer is extensive. Slope instability at the existing WSP1 was in part due to thawing permafrost. Permafrost is unlikely to be present in the slopes adjacent to WSP2



based on the limited information available on ground thermal conditions for the pond footprint. However, further site investigations of the adjacent slopes would be required to adequately determine the thermal conditions. Foundation and stability analysis utilizing site specific geotechnical information would also be required.

There is potential for foundation and slope instability at the proposed WSP2 site. NRCan agrees with Golder (2011) that for further design (preliminary and detailed) further site investigations are necessary to characterize subsurface conditions and assess soil parameters, determine excavation volumes and to assess ground and slope stability. NRCan also agrees with Golder's suggestions regarding monitoring. However, in addition to installation of piezometers, NRCan suggests that slope inclinometers be installed, particularly in the area to the northeast of WSP2.

### **Conclusion and Recommendations**

A number of solutions have been proposed to increase the water storage capacity for the Project. The options for the existing WSP1 are reasonable but NRCan agrees with Golder (2011) that further site investigations and analyses are required to determine the feasibility of these alternatives and whether they can provide the required storage volume. A second water storage pond, WSP2, is likely the more preferable option to increase storage capacity. However, given the nature of the foundation materials and the potential for instability, further site investigations and additional analyses will be required to ensure that the proposed design is adequate to ensure that the structure maintains its integrity over its intended lifetime.

With respect to modifications in the design of the existing WSP1 and assessment of the proposed alternatives, NRCan recommends:

- Further site investigations be conducted to better characterize subsurface materials.
- Stability analysis be conducted, utilizing the additional site specific information, for each alternative to determine the preferred option.

With respect to design of a second facility WSP2, NRCan recommends:

- Additional site investigations (as recommended by Golder) to characterize subsurface materials within and adjacent to the pond footprint. This should include investigations on the adjacent slopes particularly to the NE of the pond to determine the extent and geotechnical properties of the clay layer. If frozen conditions are observed in any of the additional boreholes, installation of temperature cables is also recommended.
- The Developer conduct foundation and slope stability analyses (in particular for the slopes above the pond to the NE) utilizing the revised soil parameters obtained through the additional site investigations.
- Installation of piezometers and slope inclinometers as part of a monitoring program to monitor stability of slopes. This is in addition to piezometer installation for the berms proposed by Golder.

### **Reference**

Golder Associated, 1980. Report to Ker Priestman & Associates Ltd. RE: Tailings storage and mine plant facilities. Cadillac Explorations Ltd., Northwest Territories. Sept. 1980.