



## Independent Environmental Monitoring Agency

P.O. Box 1192, Yellowknife NT X1A 2R2 ▪ Phone (867) 669 9141 ▪ Fax (867) 669 9145

Website: [www.monitoringagency.net](http://www.monitoringagency.net) ▪ Email: [monitor1@monitoringagency.net](mailto:monitor1@monitoringagency.net)

August 8, 2017

Violet Camsell-Blondin  
Chair, Wek'eezhii Land and Water Board  
#1-4905 48th St, Yellowknife, NT  
X1A 3S3

### **Re: Dominion Dimond Ekati Corporation (DDEC) Waste Rock and Ore Management Plan (WROMP) Version 7.0**

Dear Mrs. Camsell-Blondin,

The Independent Environmental Monitoring Agency (Agency) has reviewed the WROMP version 7.0 and associated Pigeon Waste Rock Storage Area Design Plan. The Agency has retained the consulting services of Dr. Kevin Morin of the Minesite Drainage Assessment Group (MDAG) to assist in its review. Dr. Morin's report entitled *Review of the Proposed Expansion of the Pigeon WRSA and Its Closure (July 2017)* has been provided to the Agency's Society members and is available on the Agency web site at [www.monitoringagency.net](http://www.monitoringagency.net).

The following sections outline our specific comments and concerns with the documents.

#### **Waste Rock Storage Area Geometry and Layout**

The design and construction of waste rock storage areas (WRSA) is a very important component of final closure and abandonment of the mine site. The WRSAs represent permanent modifications to the natural landscape surrounding the Ekati Mine and, once constructed, any significant modifications would be difficult and costly, and for these reasons should not be anticipated. It is therefore important that all aspects of the design be carefully considered and all reasonable attempts be made to 'get it right the first time'.

Appendix C section 3.1 of the Pigeon WRSA Updated Design Report outlines the basic design criteria for the proposed waste rock pile expansion. The Agency supports many of the criteria including: the pile footprint and distance to Pigeon Pit should be minimized; the pile should be located in a single catchment or sub-catchment; and drainage from the pile should be directed towards the Long Lake Containment Facility. Dominion Diamond Ekati Corporation (DDEC) is encouraged to continue to incorporate these criteria as the design is finalized.

#### **Modeling Methodology and Data Analysis**

On February 14, 2017, the Agency submitted comments on the Waste Rock Storage Area Closure Ecological Assessment. The Agency's concerns focused on two major areas. Firstly, on the ability of a

one-dimensional model to accurately predict the future thermal characteristics of a complex multi-dimensional waste rock pile and secondly, the lack of measured data used as input variables in the thermal and water quality models. We concluded that, given these limitations in the modeling studies, the validity and accuracy of the thermal and seepage predictions were questionable. Although the deadline for DDEC to submit comment responses was June 30, 2017 the deadline was extended to August 30, 2017 at the request of DDEC. As a result, we do not yet know how, or if, DDEC agrees with the comments submitted by the Agency and other reviewers with respect to the modelling methodology. The Agency believes this has direct relevance to the current review of the WROMP version 7.0 and associated Pigeon WRSA Design Plan.

The waste rock from Pigeon Pit is comprised of a combination of mixed metasediment, waste kimberlite and xenoliths. Appendix C, page 1 states that some of the material is potentially acid generating (PAG) but cannot be easily differentiated from non-PAG granite. As a result, all waste rock from the Pigeon Pit will be treated as PAG for the purpose of waste rock management.

The Agency believes that the current WROMP 7.0 does not include any reasonable prediction of the impact the additional 11.5 million m<sup>3</sup> of waste material may have on the Pigeon WRSA. Section 4.1 of the Design Plan states *“The volume of the Pigeon WRSA has been significantly increased from its original design; however, the conclusions from the Tetra Tech EBA 2014 thermal analysis are still valid for the new larger capacity Pigeon WRSA. This is directly attributed to the geometry of pile expansion; the major design assumptions remain unchanged. As such, the thermal behaviour of the WRSA is expected to be similar to the original design.”* It is difficult to reasonably imagine a scenario where nearly doubling the volume of the waste rock pile from 13.4 million m<sup>3</sup> to 25 million m<sup>3</sup> will not have an impact on the ability or rate of the WRSA to freeze.

The Agency believes reasonable predictions related to thermal behavior in the WRSA would only come from non-steady, three-dimensional modeling of the proposed expansion of the Pigeon WRSA that considers conduction, convection and solar radiation. This behavior appears to have been simulated by Tetra Tech EBA (2014) through relatively slow, one-dimensional vertical heat conduction to an overlying horizontal surface. Despite the addition of 11.6 million m<sup>3</sup> of PAG rock and the limitations of the 2014 thermal modeling, the designers of the expanded Pigeon WRSA conclude that the 2014 thermal analysis is still valid.

Other uncertainties identified during the Agency’s review are summarized below. For greater background and detail on these uncertainties, please refer to Dr. Morin’s report entitled *Review of the Proposed Expansion of the Pigeon WRSA and Its Closure* (July 2017) :

- (1) the possible under-estimation of the amount and duration of internal heat generation;
- (2) undefined tonnages of individual waste rock units;
- (3) varying solar radiation on WRSA slopes that represent up to 90% of the pile’s surface area;
- (4) while the WROMP Ver. 7.0 considers the amount of seepage from the Pigeon WRSA to be negligible, the Closure Ecological Risk Assessment for Ekati indicates that, based on the size of the WRSA and infiltration rates, between 20,000 and 70,000 m<sup>3</sup> of water will drain into, and likely out of, the Pigeon WRSA each year;

- (5) using different values for sulphur content in granite in thermal analysis of the Pigeon WRSA (0.05%) and the 2016 Seepage Survey (0.14%); and
- (6) if, and how, capping the lower portions of the side slopes with 5 m granite cover will affect heat transfer within the WRSA.

Recommendation: Given the significant uncertainties in future Pigeon WRSA thermal characteristics and behaviour, the WROMP version 7.0 and associated Pigeon WRSA Design Plan should not be approved. The thermal modeling for the currently approved and proposed Pigeon WRSA expansion is over-simplified and unreliable. In its place, thermal analysis should come from non-steady, three-dimensional modeling using inputs based on on-site measured data where available.

Recommendation: A technical workshop should be sponsored by DDEC where experts, reviewers and Board staff can discuss and seek agreement on WRSA thermal modeling processes and methodologies. Discussions should be focused on: (1) on-going uncertainties and questions associated with one-dimensional vs. three-dimensional modeling; and (2) the need to collect on-site data to reduce the uncertainty of model predictions.

#### **Use of the 100 Year Climate Change Forecast**

The Design Report uses the 100 year climate change model. Table 3 of Design Plan (page 4) *Summary of Predicted Maximum Active Layer Thickness in the Closure Cover*, predicts that the maximum thickness of active layer will exceed the cover design thickness in 50-100 years. Considering that climate change is expected to last longer than 100 years and the WRSAs at Ekati will be permanent landscape features, the Agency is concerned that the model only forecasts out to 100 years.

Recommendation: All future thermal modeling of WRSAs at Ekati be forecast forward well beyond 100 years as climate change is expected to become more pronounced after the current modeled period of 100 years.

#### **Physical Stability of the Closure Cover**

The updated Design Report states “*the existing cover design comprises a layer of 3 m thick till, overlain by 1 m of NAG (non-acid generating) granite waste rock*”. Due to the lack of sufficient till material, approximately 17% of the WRSA surface, primarily the lower portion of the side slopes, will eventually be covered by a 5 m thick layer of NAG granite to complete the WRSA permanent cover.

Figure 6 of the Design Plan shows proposed typical sections for the closure cover design where the fine-grained till will be placed directly over courser waste rock. No graduation layer is shown as being constructed between the compacted till and underlying waste rock. This could result in the eventual collapse of fine-grained glacial till downwards into underlying waste rock voids due to the differences in particle size and ongoing settlement of waste rock. Under these conditions, the cover would eventually become physically unstable (i.e., perforation, sagging and local collapse) negating the value of the thermal cover and enabling the direct infiltration of precipitation.

Tetra Tech EBA recognizes this concern and recommends that “*the waste rock surfaces ... be graded and compacted to form smooth surfaces without open voids. If required, any open voids should first be backfilled with a transitional rockfill to avoid potential loss of the till cover into the waste rock*”

voids.” (Design Plan, page 3). It is unclear from the Design Plan whether this recommendation has been, or will be, incorporated into the final cover design.

Recommendation: DDEC clarify whether Tetra Tech EBA’s recommendation for a transitional rockfill layer has been, or will be, incorporated into the final WRSA cover design.

Should you have any questions concerning these comments, the Agency is pleased to discuss these at your convenience.

Sincerely,

A handwritten signature in blue ink, appearing to read "Jaida Ohokannoak", with a long horizontal flourish extending to the right.

Jaida Ohokannoak  
Chairperson

Cc: Dominion Diamond Ekati Corporation – April Hayward  
Tlcho Government – Jessica Hum  
Yellowknives Dene First Nation – Alex Power  
Lutsel K’e Dene First Nation – Ron Griffith  
North Slave Metis Alliance – Nicole Goodman  
Kitikmeot Inuit Association – Jared Ottenhof  
Government of the Northwest Territories – Laurie McGregor  
Indigenous and Northern Affairs Canada – Jennifer O’Neil