



Independent Environmental Monitoring Agency

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August 10, 2017

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

Dear Mrs. Camsell-Blondin,

Re: Dominion Diamond Ekati Corporation's (DDEC) 2016 Waste Rock and Waste Rock Storage Area Seepage Survey Report

The Independent Environmental Monitoring Agency (Agency) has reviewed the 2016 Waste Rock and Waste Rock Storage Area Seepage Survey Report (2016 Seepage Report). 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 Three Ekati Minesite Reports Related to Water Contamination* (Dr. Morin's Report) has been provided to the Agency's Society members and is available on the Agency web site at www.monitoringagency.net.

In addition to the 2016 Seepage Report, the Agency asked Dr. Morin to review the Fox Geotechnical and Geochemical Reports associated with the Fox Geotechnical Investigation conducted in 2015. These reports were included in the review as they are relevant and provide context to the 2016 Seepage Report. For the purposes of this review our comments are focusing specifically on the 2016 Seepage Report and not the Fox Geotechnical Investigation.

The following sections outline the Agency's concerns regarding the 2016 Seepage Report. While some context is provided below greater detail can be found in Dr. Morin's Report.

Water Balance

The Agency is concerned that DDEC has yet to provide a water balance for the Pigeon WRSA Expansion and other Waste Rock Storage Areas (WRSA) at the Ekati mine. The Agency's February 14, 2017 letter regarding the Closure Ecological Risk Assessment (Closure ERA) identified this as a concern. Since Dominion Diamond Ekati Corporation (DDEC) has yet to respond to our comments we raise the issue again. The Agency believes the information necessary to provide a reasonable water balance is readily available in various reports previously submitted by DDEC and their consultants. There is no clear reason why a water balance for each of the WRSA's has not yet been completed.

In order to help frame the discussion, Dr. Morin used the site specific information (annual precipitation, infiltration as a % of rain and snow fall, and total areas for WRSA's) provided by DDEC and its consultants to provide the Agency with a preliminary water balance for the Ekati site (table below). To be clear, the Agency is not proposing that Dr. Morin's balance be used for the Ekati mine. The Agency believes that it is DDEC's responsibility to provide a detailed water balance. Table 4-1 is provided as a reasonable starting point for discussion.

MDAG Table 4-1. Minimum and Maximum Flows through Ekati WRSAs based on Ekati Data		
WRSA	Minimum Flow (m ³ /yr)	Maximum Flow (m ³ /yr)
Panda/Koala/Beartooth	179,000	566,000
Coarse Kimberlite Reject Storage Area	42,000	132,000
Fox	135,000	425,000
Misery	47,000	149,000
Pigeon (Original Plan)	23,000	72,000
Pigeon (Expanded Plan)	28,000	90,000
TOTAL¹	605,000	1,911,000

Note: the original table in Dr. Morin's Report used L/year and this table uses m³/year but the volumes are the same.

¹ Total does not include Pigeon (Expanded Plan).

It is important to note that Ekati seepage reports often mention low or no flows coming from the WRSA's. Since very little water is being captured by the current surface seepage monitoring program, there is an urgent need to improve the understanding of what is happening to the water entering, and presumably leaving, the WRSA. This can be accomplished by increasing the frequency of monitoring WRSA seeps and establishing subsurface monitoring stations to determine the quality and quantity of subsurface flow. Once the locations and volume of water exiting the WRSAs is better understood, then we will be in a better position to understand the water balance of the piles and DDEC can address or mitigate any potential concerns.

Recommendation: DDEC conduct an initial study of the WRSA's to determine the ideal locations to install and monitor subsurface flows.

Recommendation: Increase the annual seepage sampling requirements to better capture seasonal flows and more accurately quantify the quality and quantity of seepage runoff. These surveys should include both surface and subsurface flow.

Recommendation: Based on the above findings DDEC should submit a detailed water balance for each of the WRSA's at the Ekati mine.

Validity of Reference Seep (Ref 005)

All seepage data are compared to a reference station to determine if concentrations are rising relative to non-impacted areas. The only remaining seepage reference site is Ref 005. In its report DDEC concludes that “Concentrations of parameters in the reference station to the east of Bearclaw Lake remained low with historical seasonal differences between the freshet and fall surveys related to dilution by snow melt.”.

An expansion of data presented in Figure 3 of the 2016 Seepage Report indicates that several mine related parameters (sulphate, dissolved aluminum, magnesium, nickel and strontium) are increasing at Ref 005 (MDAG Tables 4-1 to 4-4). This may be an indication that Ref 005 is in some way being impacted by mine operations and no longer accurately represents pre-development baseline levels. Therefore additional reference stations need to be identified that better reflect un-impacted tundra conditions.

Recommendation: Identify and install additional seepage reference stations that have not been impacted by the mine.

Contaminants Increasing in Some Seeps

A comparison of the current water licence effluent quality criteria and measured seepage water quality indicate that current water quality of many WRSA seeps exceed the water licence limits for some maximum grab and maximum average concentrations. The results are summarized in the following table (reproduced from MDAG Table 4-2).

WRSA	Percentage of Water-Quality Samples that Exceeded Ekati Water Licence Effluent Quality Criteria for Maximum Grab^{1,2}	Elements that Exceed Ekati Water Licence Effluent Quality Criteria for Maximum Average^{1,2}
Panda NE	TSS (11%), SO4 (5%), NO3 (18%), NO2 (9%), Al (51%), K (0.4%), Se (7%)	Nitrate, Nitrite, Al, Se
Koala SW (CKRSA)	TSS (10%), SO4 (4%), NO3 (2%), NO2 (36%), Al (19%), As (1%), K (14%), Se (48%), Sr (1%)	Nitrite, Al, Se
Fox	TSS (15%), SO4 (5%), NO3 (6%), NO2 (3%), Al (29%), As (3%)	TSS and Al
Misery	TSS (12%), NH3 (23%), NO3 (14%), PO4 (43%), As (1%), Cu (23%)	Ammonia, Nitrate, Phosphate, Cu
Pigeon	NO2 (100%)	None

¹ Measured water quality from SRK.

² Ekati Water Licence Effluent Quality Criteria (EQC) are for total elements. Where dissolved concentrations exceeded total concentrations, dissolved concentrations were used.

Considering the potential volume of water moving through the WRSAs this may pose a considerable risk to the surrounding aquatic and terrestrial receiving environments. Not only are many seeps exceeding the current licence limits, some are showing increasing trends over time. Of particular concern are the increases in Sulphate levels. Sulphate levels are an indicator of increasing rates of sulphide oxidation, acid generation, and internal heat generation.

Current and Long Term Predictions for WRSA Water Quality

The recently reviewed Closure ERA outlined predictions for maximum predicted water quality in WRSA seeps during Operations and through Closure. A comparison of the predicted values in the Closure ERA documents to measured seepage water quality indicates that several parameters have already exceeded the maximum predicted values. These elements include nitrate, aluminum, chromium, cobalt, copper, iron, lead, nickel, silver, uranium, vanadium and zinc around the Panda/Koala/Beartooth, Fox and Misery WRSAs and the Coarse Kimberlite Rejects Storage area. The Agency is concerned that the predictions made in the Closure ERA underestimate the potential water quality.

Recommendation: DDEC update future Closure ERA predictions based on existing seepage water quality data.

Clarification of Common Terminology

In many reports, including the 2016 Seepage Report, terms such as un-reactive, non-acid generating (NAG), and non-Potentially Acid Generating (non-PAG) are used to describe rock types. These terms can be misleading as they are often used to categorize certain rock types as being of little concern because they are 'unreactive', will not oxidize and therefore not produce acid or heat. As described in Dr. Morin's report (page 44):

“Non-acid generating” rock literally generates no internal acidity at all, and thus its NP [Neutralizing Potential] is not important. Such rock has not been documented at Ekati. In reality, all Ekati rock can generate some acidity upon oxidation. This makes the identification of accurate, field-effective NP in Ekati rock very important. However, as explained in the next subsection, effective NP at Ekati has not been correctly defined, and thus ARD potential has been under-estimated at Ekati.

Basically, all rock at Ekati has the potential to generate some acidity and heat depending largely on its sulphide content. This becomes important when trying to determine the acid rock drainage potential and thermal conditions of the WRSA's.

Recommendation: Future thermal modeling of WRSAs and calculations of ARD potential should consider acid generation and heat generation from all rock sources.

Amount of Neutralizing Potential (NP) used to calculate ARD Predictions

The current predictions for ARD potential at the Ekati mine use 100% NP. This means that all of the NP is assumed to be available to neutralize any acid generated. It is very unlikely that 100% of the NP is available under field conditions. The 2017 Waste Rock and Ore Management Plan 7.0 recognized this by stating: '*Sobek NP typically over estimates effective field NP due to the strong acid used in the test.*'. Therefore, a more appropriate percentage of NP should be used.

As detailed in Dr. Morin's report (page 44) '*A typical correction to measured NP is subtracting 10 kg/t from measured NP. This would have a tremendous effect on some ARD predictions in the 2016 Seepage Report.*'. For example, Figures 6.1 and 7.1 from the 2016 Seepage Report indicate that most samples of Misery and Pigeon schist are classified as non-PAG and uncertain, assuming 100% NP. However, if the suggested correction (subtracting 10 kg/t) is used the majority of samples would be classified as net acid generating. This could be a concern since rock classified as non-PAG is often used as 'clean' aggregate during operations for road construction and as WRSA cover material.

Recommendation: All future ARD predictions should use the suggested correction of subtracting 10 kg/t from measured NP.

Net Acid Generating and Net Acid Neutralizing Criteria

The criteria used to differentiate net acid generating and net neutralizing rock is described in the 2016 Seepage Report (page 4) as:

Classification of acid rock drainage (ARD) potential for waste rock and CKR was performed using acid-base accounting, including measurements of sulphur species, neutralization potential (NP), pH, and calculations of maximum potential acidity (MPA; calculated from total sulphur) and neutralization potential ratio (NP/MPA). In the Northwest Territories (DIAND 1993), NP/MPA ratios of less than 1 are considered to be potentially acid generating (PAG). Samples with NP/MPA ratios greater than 3 are considered to be acid-consuming (non-PAG). NP/MPA ratios between 1 and 3 are considered to have uncertain potential for acid rock drainage.

Dr. Morin's report states that the DIAND NP/MPA (NPR) are screening criteria to be used in the absence of specific kinetic testing. However, kinetic testing of kimberlite and host rock types at Ekati have been done and therefore should be used instead of the current screening criteria. The original 1995 documents for NPR calculation have been included as a reference.

The NPR ratio represents the different rates at which the NP and acid generation are being consumed. Therefore, if a humidity cell test shows that NP is being consumed twice as fast as the acid is being generated the NPR criterion would be two. Therefore, there would need to be twice as much NP as acid generation. Based on the initial humidity cell tests at Ekati for kimberlite, the NP is getting consumed up to four times faster. Therefore, the NPR criteria should be four unless additional kinetic tests can prove otherwise. Once kinetic tests confirm a site specific NPR for each rock type there is no need for an 'uncertain' designation, the rock either will or will not release ARD.

Recommendation: DDEC recalculate NPR based on all site specific kinetic test data by rock unit thereby eliminating the need to use the 'uncertain' criteria.

Thank you for the opportunity to provide our input on the 2016 Seepage Report. 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 – Shin Shiga
Kitikmeot Inuit Association – Jared Ottenhof
Government of the Northwest Territories – Laurie McGregor
Indigenous and Northern Affairs Canada – Jennifer O'Neil