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Memorandum

To:	Michel Groleau – Nunavut Permitting Lead, Agnico Eagle Mines Ltd.
From:	Gillian Allen, Geoenvironmental Engineer
Cc:	Jenyfer Mosquera – Agnico Eagle Mines Ltd.
Our ref:	948-011-M-006 Rev3
Date:	May 10, 2019
Re:	**Agnico Eagle Mines Ltd. - Landform Water Balance Modelling of Whale Tail and IVR WRSF**

O'Kane Consultants Inc. (Okane), is currently undertaking thermal modelling of the waste rock storage facilities (WRSFs) at Agnico Eagle Mines Ltd.'s (AEM's) Amaruq project. Thermal modelling will assist in developing the expected seasonal active layer thickness under climate change conditions, as well as determine if permafrost conditions within the WRSFs are sustainable under climate change conditions. The ultimate objective of the project is to demonstrate the physical and chemical stability of the Whale Tail and IVR WRSFs while optimizing risk and cost for AEM.

As part of this objective, a landform water balance was completed, including estimates of runoff, interflow, and basal seepage rates for different slopes and aspects of the WRSF (if applicable). The following memorandum summarizes the results of the landform water balance. A separate detailed modelling report summarizes specific modelling background and methodology (Okane, 2019[1]).

Conceptual Hydrologic Model of Amaruq WRSFs

The following summarizes the conceptual model of the hydrologic regime at the Whale Tail and IVR WRSFs:

- The existing proposed thermal cover system (4.7 m of NAG/NML material) is not expected to promote runoff / interflow from the cover system due to sufficient infiltration capacity of the waste rock and cover system materials as a result of the expected coarse texture of materials.
- High infiltration rates will result in gradually (over several years) increasing interflow and/or basal flow reporting to WRSF collection ponds as the WRSF is constructed and reaches its final extent.
- Slopes are expected to be more susceptible to infiltration entering waste rock prior to freeze back compared to the plateau.

[1] O'Kane Consultants Inc. 2019. Agnico Eagle - Detailed Thermal Modelling Report for the Whale Tail and IVR WRSFs – DRAFT.

- Cover system material (NAG/NML) is expected to experience less weathering compared to Portage (increase in fines) due to lithology (greywacke vs. ultramafic) resulting in higher long-term infiltration rates and higher propensity for convective cooling compared to Portage.
- Decreased reactivity in NAG waste rock is expected to result in decreased arsenic load generation (but not zero load generation).
- Any interflow / runoff from the thermal cover system is not expected to report to collection ponds as 'plug flow' due to the variance in transit times across the landform. Put simply, incident precipitation at the toe of the WRSF will report to water collection systems much sooner than precipitation which lands on the plateau of the landform. Any contaminants of potential concern present within the thermal cover system material (eg. Arsenic), will therefore also be released gradually.
- Gradual decrease in arsenic loading over time is expected due to the hydrology of WRSFs.
- The thermal and hydrologic regimes are expected to be different based on North and South aspect.

Methodology

GeoStudio Version 10[2] was used to conduct the modelling for this project. This version of GeoStudio is a substantial upgrade to previous versions software as it is able to account for advective air flow as well as gas consumption due to mineral oxidation within the WRSF and associated heat generation via an add-in module developed for the software. Four components of the GeoStudio suite of programs were used in combination for this project: SEEP/W; TEMP/W; AIR/W, and CTRAN/W (with the gas consumption and exothermic reactions add-in incorporated into the CTRAN analysis).

Models representative of selected locations of thermistor strings at Meadowbank's Portage WRSF were simulated for the same period of time as the thermistor strings have been operational. The model results were then compared to the field data to determine that the model reasonably estimated field thermal conditions. Material inputs for the model were calibrated to provide a reasonable comparison to the field data. A detailed description of all material inputs can be found in the detailed thermal modelling report (Okane, 2019).

Following the one-dimensional calibration described above, a two-dimensional (2-D) cross section was developed (Figure 1) to determine the main factors promoting and inhibiting freeze-back of and seepage (amount and timing) from the WRSFs. The existing 4.7 m cover system design was modelled as the base case. Models consider coupled gas, heat, water, and air transfer processes. Additionally, the models account for the exothermic oxidation of sulphide materials. Therefore, TEMP/W, SEEP/W, and AIR/W components of the GeoStudio software suite were used in combination with the Gas Consumption and Exothermic Reactions add-in module GEOSLOPE developed with Okane to simulate sulphide oxidation.

[2] GEOSLOPE, 2018. GeoStudio 2019. Online. https://www.geoslope.com

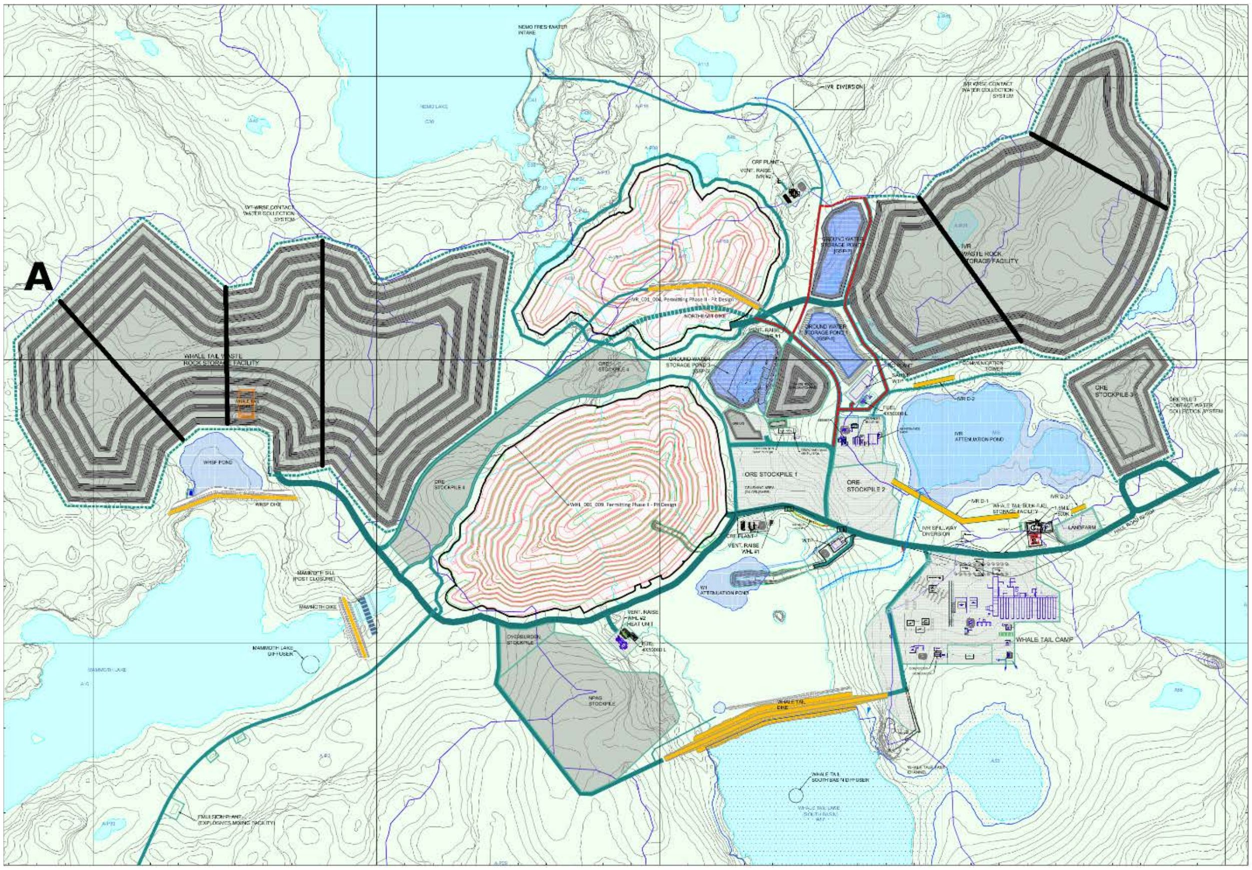

Figure 1: Location of the cross section ‘A” used in modelling.

In order to capture the effects of construction on the landform water balance, the cross section modelled was ‘built-up’ in three-month intervals, according to the construction schedule provided (AEM, 2018[3]).

<u>Results</u>

Surface Water Balance

A summary of the surface water balance for the Amaruq WRSFs is provided in Table 1. This summarized the volume of annual runoff expected from the landforms as a percentage of incident precipitation (both snow and rainfall). Results of the surface water balance support the conceptual model that the hydrologic regimes are expected to be different based on North and South aspect. Generally, higher net radiation results in greater evaporation and soil heating. With more evaporation, less water is available to runoff and/or infiltrate. Higher net radiation will also result in more sublimation, as more energy is available to convert snow into water vapour.

[3] Agnico Eagle. 2018. Agnico Eagle – Meadowbank Division Amaruq Mine Project 005 – Site Preparation 210 General Arrangement Amaruq Mine Site Arrangement Permitting Dwg, 2019Q4 v7, 2020Q4 v7, 2021Q4 v7, 2022Q4 v7, 2023Q4 v7, 2025Q4 v7, & AFTER MINE v7. October 18, 2018.

Table 1: Summary of average surface water balance for different aspects of the WRSF.

Water Balance Parameters	Plateau	SE Aspect	NW Aspect
Total Precipitation (mm)	296 mm	296 mm	296 mm
Rainfall (% of Total Precipitation)	55-60%	55-60%	55-60%
Snow (% of Total Precipitation)	40-45%	40-45%	40-45%
Actual Evaporation (% of Total Precipitation)	25-30%	30-35%	25-30%
Runoff (% of Total Precipitation)	<5%	<5%	10-15%
Net Percolation (% of Total Precipitation)	30-35%	25-30%	20-25%
Sublimation (% of Total Precipitation)	35-40%	40-45%	40-45%

In order to simplify runoff outputs from the surface water balance, the runoff values for each aspect were weighted based on the relative area represented by each aspect. This results in an overall runoff rates from the Whale Tail and IVR WRSFs of approximately 5% of incident precipitation. Runoff was assumed to interact with surficial materials to a depth of 30 cm.

The surficial materials interacting with landform runoff will change over time as progressive reclamation is completed. Table 2 and Table 3 summarize the relative percentage of runoff expected to interact directly with the cover system material and waste rock material over time.

Table 2: Relative amount of runoff from bare waste rock vs cover system materials at the Whale Tail WRSF.

Year	Percentage of Runoff from Bare Waste Rock	Percentage of Runoff from Cover System
2019	100%	0%
2020	82%	18%
2021	82%	18%
2022	71%	29%
2023	71%	29%
2024	61%	39%
2025	0%	100%

Table 3: Relative amount of runoff from bare waste rock vs cover system materials at the IVR WRSF.

Year	Percentage of Runoff from Bare Waste Rock	Percentage of Runoff from Cover System
2021	50%	50%
2022	50%	50%
2023	75%	25%
2024	75%	25%
2025	0%	100%

The majority of runoff from the WRSFs is expected to occur as a result of spring melt, however some runoff is expected throughout the unfrozen period. The distribution of runoff by month is provided in Table 4.

Table 4: Runoff distribution by month for the Whale Tail and IVR WRSF.

Month	Percent of Total Annual Runoff by Month (%)
January	0%
February	0%
March	0%
April	0%
May	0%
June	85-90%
July	5-10%
August	5-10%
September	<5%
October	0%
November	0%
December	0%

Basal Seepage

The high infiltration capacity of the cover system materials and waste rock materials result in a propensity for incident precipitation to result in infiltration, rather than runoff (Table 1). As water infiltrates into the surficial materials, net percolation flows vertically through the WRSF, eventually freezing back at depth. The base layer of the WRSF is consistently frozen from the time of placement. As a result, basal seepage from the landform is negligible.

Interflow

There is some lateral flow of water within the cover system on the angle of repose slopes (known as interflow), however, lateral flow infiltrates vertically in zones of enhanced infiltration along the toe of each bench of the WRSF. This is shown conceptually in Figure 2.

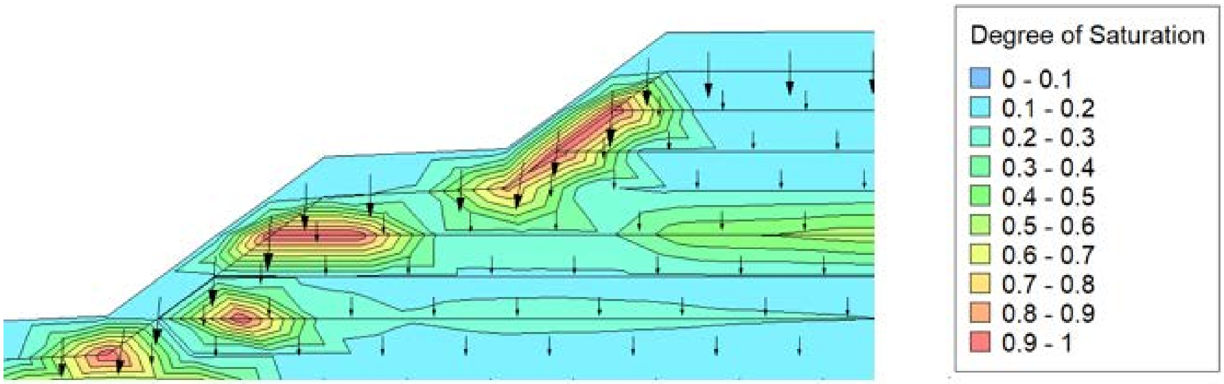

Figure 2: Sketch of hydrologic regime of the Whale Tail WRSF near surface with water flow vectors (black) shown.

A small portion (less than 1%) of incident precipitation over the entire landform(s) is expected to exit the landform as interflow. This occurs when infiltration occurs along the slope of the lowest bench of the WRSF. This flow path interacts with the entire 4.7 m depth of the cover system, along a maximum flow path of approximately 10 m. Interflow does not interact with the potentially acid generating and metal leaching waste rock.

We trust information provided in this memorandum is satisfactory for your requirements. Please do not hesitate to contact me at 306-713-1568 or gallen@okc-sk.com should you have any questions or comments.