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Subject: West Cochrane Pit 254757 - UAP - SIR#2
Groundwater Clarification Report

Dear Travis Coates:

1 INTRODUCTION

Matrix Solutions Inc., a Montrose Environmental company (Matrix), has prepared a Groundwater Clarification Letter Report (Clarification Report) to address the Supplemental Information Request (SIR) #2 provided by the Ministry of Environment and Protected Areas (EPA) on May 2, 2023, for the West Cochrane Gravel Pit expansion. The Hydrogeology Framework and Impact Assessment for the proposed expansion was prepared by Matrix in July 2022.

This Clarification Report addresses SIR #2 Items 9 and 10.

1.1 Item 9: Dewatering/Recharge Ponds

What is the expected groundwater inflow to the pit and ponds? It was discussed that both the east and west ponds may be operational at the same time, and therefore may be considered temporary “pit lakes”. What portion may be exposed groundwater in the ponds, and what is the annual and cumulative evaporative loss? (Please use the calculator provided in the [Guide to groundwater authorization \[2023\]](#))

Matrix Response:

The groundwater inflow to the pit due to depression of the water table has been estimated and presented in Table 10 on page 51 of the April 2023 Code of Practice (COP) amendment report (and Table 26 on page 33 of the December 2021 Conceptual Stormwater and Drainage Management Plan) shown here:

TABLE 26 Annual Groundwater Diversion Rates

Pond	Maximum Annual Groundwater Diversion Volume (m ³)		
	During Initial Dewatering Phase	During Ongoing Mining (Assuming 6 months of dewatering)	Total
West Recharge Pond	244,486	123,100	367,586
East Recharge Pond	423,507	233,900	657,407

The evaporative loss from the dewatering excavation areas (west and east) was estimated based on an assumed maximum dewatering excavation area of 250 m × 250 m. It is expected that standing water would not be continuously present as water would be pumped off into the recharge ponds or percolate into the gravels. Based on a conservative assumption that the dewatering excavation area would have standing water for 20% of the time in a typical (mean) year, the amount of net evaporation is estimated below in Table 1-9. The methodology outlined the “*Guide to Water Act Authorizations Required for Excavations (Dugouts, Borrow Pits and other types of Pits/Excavations)*” (AEP 2020) was adapted to assess evaporation of standing water due to intercepted groundwater.

TABLE 1-9 Estimate of Mean Annual Evaporation from Dewatering Excavation Areas

	West Dewatering Excavation Area	East Dewatering Excavation Area
Estimated Area of Pondered Water (m ²) (20% × 250m × 250m)	12,500	12,500
Mean Annual Morton’s Shallow Lake Evaporation (30-year Average for the project site)* (mm)	760.7	760.7
Mean Annual Local Precipitation (30-year Average for the project site)** (mm)	417.9	417.9
Mean Annual Net Evaporative Loss (Evap. – Precip.) (mm)	342.8	342.8
Mean Annual Net Evaporative Loss (m ³)	857	857

* Gross evaporative losses are based on 30 year Morton’s mean annual shallow lake gross evaporation map (1980-2009 avg) <https://agriculture.alberta.ca/acis/docs/mortons/mortons-evaporation-estimates.pdf>

** Mean annual precipitation was obtained from ACIS – Alberta Climate and Atlas Map (<http://agriculture.alberta.ca/acis/>)

During mine operation, pit dewatering and surface water flows would be directed to the recharge ponds and would be considered more as stormwater infiltration ponds than temporary “pit lakes”.

The proposed east and west recharge ponds are in locations where the water table was noted below the pond bottom elevation, under normal static conditions, and therefore no passive groundwater inflows to the ponds would occur. The recharge ponds are sized to contain maximum expected rates of pumped groundwater from inflow into any mining phase plus runoff from a 1:10 year, 24-hour design storm event from the two largest adjoining mining phases on either side of Grand Valley Creek. An additional 10% buffer has been added to the runoff area to account for uncertainty in the mining boundaries.

Evaporation losses could occur when water ponds in the recharge pond and have not yet dissipated into the subsurface. Based on the modelling conducted for the design of the recharge ponds as part of the December 2021 Conceptual Stormwater and Drainage Management Plan, the west and east recharge

ponds would have water present/ponding for 44% and 60% of the time, respectively, for the 30-year average period (1980 -2009).

The evaporative loss was estimated for the recharge ponds as shown below in Table 2-9.

TABLE 2-9 Estimate of Mean Annual Evaporation from Recharge Ponds

	West Recharge Pond	East Recharge Pond
Area of Recharge Pond at Bottom (m ²)	8,100	9,025
Area of Recharge Pond at 1.0 m Depth (m ²)	8,844	9,809
Maximum Depth of Ponding based on Long-term Continuous Simulation Results (m)	0.25	0.19
Percentage of Time Pond is Dry based on Long-term Continuous Simulation Results (%)	56	40
Mean Annual Depth of Ponding based on Long-term Continuous Simulation Results (m)	0.03	0.04
Pond Area at Mean Annual Depth of Ponding (m ²)	8,144	9,087
Mean Annual Morton's Shallow Lake Evaporation (30-year Average for the project site)* (mm)	760.7	760.7
Mean Annual Local Precipitation (30-year Average for the project site)** (mm)	417.9	417.9
Mean Annual Net Evaporative Loss (Evap. – Precip.) (mm)	342.8	342.8
Mean Annual Net Evaporative Loss (m ³)	2,791.8	3,115.0

* Gross evaporative losses are based on 30 year Morton's mean annual shallow lake gross evaporation map (1980-2009 avg) <https://agriculture.alberta.ca/acis/docs/mortons/mortons-evaporation-estimates.pdf>

** Mean annual precipitation was obtained from ACIS – Alberta Climate and Atlas Map (<http://agriculture.alberta.ca/acis/>)

1.2 Item 10: Mitigative Measures

One of the mitigative measures proposed for the situation quote below does not seem to have a corresponding implementation plan. Please supply a diagram showing the areas where this will be employed and an implementation plan.

“Should operations occur directly on fractured bedrock especially in close proximity of water bodies, consideration should be given to minimizing infiltration of turbid water or contaminants by placing either a layer of low permeability material or a bed of suitable sand and gravel to act as a filter. A layer of the natural sand and gravel should be left in place in areas where stormwater and infiltration ponds are being proposed.” (pg 453 of April 2023 COP amendment)

Matrix Response:

The mitigative measures proposed on page 453 of BURNCO's Code of Practice (COP) Amendment Report (April 2023, version 3) have been addressed and will be implemented by BURNCO as follows:

Stormwater and Infiltration Ponds: A review of the recharge pond design (stormwater and infiltration pond) and borehole log information nearby the recharge pond locations, as detailed in Figure 19 (page 59) of the April 2023 COP Amendment Report indicates that east and west ponds will both be located in areas where a minimum of 3 m of overburden material (predominately sand and gravel) overlies the native

bedrock. The stormwater and infiltration ponds were designed with a depth of 1 m to 1.5 m below grade. As per borehole log information, there should be at least a 2 m thick layer of sand and gravel remaining below the pond bottom. This exceeds the recommendation of leaving a 1 m filtration layer to assist with reductions to the turbidity of infiltrated water entering the underlying groundwater.

Mining Pit: Proposed sand and gravel mining operations will not result in the excavation of all existing sand and gravels above the top of bedrock. BURNCO's current practise is to leave approximately a 1 foot (or 0.3 m) thick layer of native soil above the top of bedrock, identified as a "hydraulic conductivity layer" to mitigate the infiltration of turbid water into the bedrock. The hydraulic conductivity layer extends throughout the mining area, as shown in the cross-section drawings contained in Appendix 1 (Figures A - A' through K - K') of BURNCO's COP Amendment Report (April 2023).

Summary: BURNCO is not proposing to conduct any mining operations directly on bedrock (fractured or unfractured). The practice of leaving an undisturbed 0.3 m soil horizon above the bedrock will ensure that groundwater will be adequately protected from the infiltration of fines due to mining operations above the bedrock layer. On-site groundwater and springs monitoring programs will further assist in confirming this assessment.

2 CLOSURE

We trust that this letter report suits your present requirements. If you have any questions or comments, please call either of the undersigned at 403.237.0606.

Yours truly,

MATRIX SOLUTIONS INC.
A Montrose Environmental Company

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DISCLAIMER

Matrix Solutions Inc. certifies that this report is accurate and complete and accords with the information available during the project. Information obtained during the project or provided by third parties is believed to be accurate but is not guaranteed. Matrix Solutions Inc. has exercised reasonable skill, care, and diligence in assessing the information obtained during the preparation of this report.

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VERSION CONTROL

Version	Date	Issue Type	Filename	Description
V0.1	26-May-2023	Draft	26388-512-GW_SIR2-ClarificationLR_V0.1.docx	Issued to client for review
V1.0	13-Oct-2023	Final	26388-512-GW_SIR2_Clarification LR 2023-10-13 final_V1.0.docx	Issued to client

REFERENCES

Alberta Environment and Parks (AEP). 2020. *Guide to Water Act Authorizations Required for Excavations (Dugouts, Borrow Pits and other types of Pits/Excavations)*. ISBN 978-1-4601-4853-2. November 2020. <https://open.alberta.ca/dataset/bf6f994d-60f9-4b1d-b4a5-ca631934f262/resource/1b37232c-9dd1-42b6-b6fd-ed90651a44ad/download/aep-guide-to-water-act-authorizations-required-for-excavations-2020-11.pdf>

BURNCO Rock Products Ltd. (BURNCO). 2023. *Code of Practice Activities Plan Amendment, West Cochrane Gravel Pit NE 15-26-05 W5M (Title # 141P219), N/2 14-26-05 W5M (Title # 151 199 374), W/2 13-26-05 W5M (Title # 151 199 374 +1), NE 13-26-05 W5M, SE 24-26-05 W5M (Title # 141 167 388), SE 13-26-05 W5M (Title # 141 167 387), SW 18-26-04 W5M (Title 141 167 389), NW 18-26-04 W5M, SW 19-26-04 W5M (Title # 141 167 390), SE 18-26-04 W5M, NE18-26-04 W5M (Title # 141 167 053)*. April 2023, V3 (originally submitted July 2020). April 2023.

Matrix Solutions Inc. (Matrix). 2021. *Conceptual Stormwater and Drainage Management Plan, BURNCO West Cochrane Gravel Pit, NE ¼ 15-026-05 W5M to SE ¼ 18-026-04 W5M*. Version 4.0. Prepared for BURNCO Rock Products Ltd. Calgary, Alberta. December 2021.