ARL Groundwater Resources Ltd.
13 Douglas Drive
Ayr, ON N0B 1E0

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The Corporation of the Town of Caledon
6311 Old Church Road
Caledon, ON L7C 1J6

Attention: Harsh Padhya, Genevieve Scott

PEER REVIEW OF HYDROGEOLOGICAL REPORTING
PROPOSED CBM CALEDON PIT & QUARRY

ARL Groundwater Resources Ltd. (ARL) was retained by the Corporation of the Town of Caledon (Town) to undertake a peer review of the hydrogeological reporting for the Proposed Official Plan Amendment (POPA 2022-0006) and Zoning By-law Amendment (RZ 2022-0010) associated with the proposed CBM Caledon Pit & Quarry.

SUMMARY DESCRIPTION OF THE PROPOSAL

CBM Aggregates, a Division of St. Mary's Cement Inc. (Canada) has submitted applications to amend the Town of Caledon Official Plan and Zoning By-law to permit development of a new pit and quarry in Part of Lots 15-18, Concession 4 WSCR, and Part of Lot 16, Concession 3 WSCR (former geographic Township of Caledon), Town of Caledon, Region of Peel.

The proposed pit and quarry would operate under a Class A License (allowing extraction above and below the water table) to be issued by the Ministry of Natural Resources and Forestry (MNRF) under the Aggregate Resources Act (ARA). Site plan drawings prepared by the firm MHBC show that extraction would occur in 3 areas, referred to as the Main Area, North Area and South Area. Seven phases of extraction are proposed with the first 5 phases occurring in the Main and North Areas, and the last 2 phases in the South Area. Information on the site plans indicate that extraction would occur to depths of approximately 8 – 30 m below the water table. The total area to be licensed is approximately 261 ha and aggregate extraction would occur over approximately 200 ha. Golder Associates Ltd. (Golder, December 2022, revised July 2023) has estimated that there are approximately 78 million tonnes of high-quality bedrock resource and 4 million tonnes of high-quality sand and gravel resource available within the proposed extraction area. The license application is for an annual resource extraction rate of 2.5 million tonnes. At this rate of extraction, the resource would be exhausted within approximately 33 years. However, the water management strategy discussed in an appendix to the Level 1/2 Water Report prepared by Golder is based on a 38-year operational period.

SCOPE OF PEER REVIEW

ARL was retained to undertake a hydrogeological peer review of the technical reporting prepared in support of the applications as it relates to potential impacts on water resources. The review included the following sources of information made available to ARL by the Town and Golder Associates Ltd.:

1. Full-Size, Scalable ARA Site Plan Drawings prepared by MHBC Planning Limited (MHBC) dated August 2023.

2. Final Rehabilitated Landform and Ecological Enhancement Areas prepared by MHBC Planning Limited (MHBC) dated July 2023.

3. Natural Environment Report prepared by Golder Associates Ltd., dated December 2022, revised July 2023.

4. Water Report Level 1/2, prepared by Golder Associates Ltd., dated December 2022, revised July 2023.

5. Maximum Predicted Water Table Report, prepared by Golder Associates Ltd., dated December 2022, revised July 2023.

6. Water Report Level 1/2 Peer Review Letter, prepared by GHD Engineering Ltd., dated August 2023.

7. Natural Environment Report Peer Review Letter, prepared by GHD Engineering Ltd., dated August 2023.

REVIEW COMMENTS – SCOPE OF WORK AND METHODOLOGY

After reviewing the above list of documents, it is my opinion that the work program and reporting undertaken with respect to hydrogeology and water resources (Water Report Level 1/2 and Maximum Predicted Water Table Report) is consistent with Terms of Reference (TOR) described in correspondence between Golder Associates Ltd. and CBM Aggregates dated August 24, 2022. The work program included the appropriate methodology and activities required to characterize the hydrogeology and surface water resources at the site. Overall, the approach and work program are consistent with the level of effort needed for a pit and quarry of this size and the hydrogeological setting.

REVIEW COMMENTS – PROPOSED PIT/QUARRY DEVELOPMENT

Section 2.0 of the Water Report Level 1/2 provides a brief description of the proposed pit/quarry development, as noted above. Section 2.0 does not comment on the proposed maximum depth of the pit/quarry and the depth below the water table. Later, in Section 4.0 of the Report, the results of an aggregate resource investigation for the site are presented and it is noted that there is approximately 2.75 million m^3 of **sand and gravel resource** with approximately 75% of the material above and 25% of the material below the high water table. Cored boreholes advanced to

evaluate the rock resource reportedly penetrated through the full thickness of the Gasport Formation (bedrock subcrop) and into the underlying "Shaley Dolostone", in some cases extending through the "Shaley Dolostone" and into the Cabot Head Formation shale. The Gasport Formation was encountered in all the boreholes, with thicknesses reportedly ranging from approximately 3 – 28 m. The discussion appears to indicate that the target resource includes the Gasport Fm. and zones of dolostone below the Gasport Fm. but above the Cabot Head Fm. The total **dolostone resource** is estimated at 31.6 million m^3, with approximately 8% above and 92% below the high water table at the site.

REVIEW COMMENTS – HYDROGEOLOGY CONCEPTUAL UNDERSTANDING

Section 3.5.2 of the Level 1/2 report provides information on the bedrock geology. It is noted that the Gasport Formation is the "main upper bedrock unit on the Site and is the primary target formation for aggregate production". Figure 3-3 (based on pre-existing mapping by the Ontario Geological Survey) indicates that the Gasport Fm. forms the bedrock subcrop beneath the Main Area and part of the North Area of the proposed pit/quarry. Bedrock formations lower in the stratigraphic sequence are shown to form the bedrock subcrop in the South Area (Gasport Fm. is not present). This appears to be refuted by the results of the aggregate resource investigation discussed above (see Figure 4-4), which shows that the Gasport Fm. is present across most of the South Area, with thicknesses ranging from about 4 – 18 m.

Section 4.3.3 (Geologic Model) is very brief (one paragraph) and does not discuss the differences between the bedrock geological mapping and the findings from the resource drilling. Two cross-sections are referenced in Section 4.3.3 and provided as figures (Figure 4-5 and 4-6). The cross-sections lack good reference points for orientation (such as road locations) and the vertical exaggeration and scales make it very difficult for a reviewer to check the interpretation. There is almost no discussion about what the cross-sections show in relation to the formations proposed for extraction.

Section 5.0 describes in detail the groundwater investigation undertaken to characterize the hydrogeological conditions and assess the potential impacts of the proposed pit/quarry on groundwater resources, groundwater users and ecological receptors. There are subsections on drilling and monitoring well installation, downhole geophysical logging, groundwater level monitoring, packer testing, single well response tests, pumping tests, groundwater quality testing and assessment, a supplemental investigation in the northwest area (which we understand was motivated in part by review comments from GHD), and an assessment of karst (provided as Appendix K). The subsections include comprehensive descriptions of methodology, large tables of data/results, analyses and interpretations. It is obvious that a very comprehensive investigation has been undertaken to characterize the site.

The final subsection (5.10) presents a "Conceptual Site Model" (CSM) that includes 12 hydrostratigraphic units. There is little to no discussion to support selection of these units and the significance of each one. Information is provided on hydrologic boundaries of the CSM, hydraulic properties of the hydrostratigraphic units, hydraulic heads (groundwater levels) and gradients. The information was processed and interpreted using a three-dimensional computer based geological modelling tool. No manually produced figures such as cross-sections or maps are provided. The geological modelling tool was used in developing an integrated groundwater-surface water

modelling tool (Hydrogeosphere) for use in making predictions about the potential impacts to water resources resulting from development of the pit/quarry.

It is our opinion that insufficient information (such as cross-sections, isopach maps, formation contact structure maps) is provided in the Level 1/2 report for the reader to view and assess the reasonableness of the three-dimensional representation of the CSM in the geological modelling tool. This is important as the geological representation and CSM forms the foundation of the predictions that follow later using the Hydrogeosphere water modelling tool.

REVIEW COMMENTS – EVALUATION OF IMPACTS ON WATER RESOURCES AND PRIVATE WELLS

The surface water investigations (Section 6.0) and surface water balance (Section 7.0) sections of the Level 1/2 water report are comprehensive. The approach and results appear reasonable. In Sub-section 6.8 (Groundwater-Surface Water Interaction), the report identifies the pairings of surface water and groundwater monitoring locations in four focus areas. One of the pairings, located in the Coulterville Wetland Complex area (SW4/MW20-27), is unusual as the monitoring well (MW20-27) appears to be over a kilometre away from the surface water monitor (SW4) based on the maps provided in the report (Figures 5-1 and 6-1).

The construction and use of a settling/holding pond for the pit/quarry discharge water is a reasonable way to manage the water prior to offsite discharge. Additional descriptions and analyses are likely to be provided when the proponent applies for the various approvals from MECP, such as an Environmental Compliance Approval (ECA) and a Permit to Take Water (PTTW). The proposed offsite pit/quarry discharge to the nearby golf course for use as an irrigation water supply, with excess water discharged to the Credit River, is a reasonable water management strategy.

Section 8.0 of the Level 1/2 report describes the use of the integrated groundwater-surface water model (HydroGeoSphere or HGS) based on the CSM. The model is used to make predictions concerning potential impacts on water resources associated with the proposed operational plan and after rehabilitation.

In Section 8.2 of the report, it is noted that initial HGS model simulations indicated that dewatering during the later stages of operation would result in a decline in groundwater levels to the south and southwest of the proposed license area. Based on these findings a strategy was developed to mitigate the impacts and tested using the HGS model. The proposed mitigation measures include the installation/operation of six infiltration trenches along the west side of the main and south quarry areas and the south side of the south quarry area. A portion of the water collected from the pit/quarry dewatering operations will be directed to these infiltration trenches to maintain groundwater levels beyond the pit/quarry boundaries in those directions. The mitigation measures also include a proposed slurry wall in the overburden sediments and grouting of the upper weathered bedrock zone between the infiltration trenches and the extraction limit. The purpose of the slurry wall/grout zone is to minimize flow of water from the trenches back into the pit/quarry excavation. It is intended that the slurry wall will be removed after pit/quarry rehabilitation to reinstate the groundwater/surface water connection with areas to the south and southwest. This plan is ambitious and will require a comprehensive maintenance plan to prevent plugging of the infiltration trenches.

The HGS model is the main tool for predicting changes associated with the phased pit/quarry development. The Level 1/2 report provides a satisfactory description of the approach and model results.

Section 9 of the report provides the results of the impact assessment with the mitigation measures in place during Phases 3 – 7 of pit/quarry operations. The results show that some areas will experience significant changes in catchment areas due to the pit/quarry development (such as SW12 on the north side of the South Area and SW16 to the south of the Main and South Areas). It is challenging to follow the discussion with respect to understanding the potential for adverse impacts to the various surface water features in the study area. However, a summary table listing the various surface water stations indicates a low or no potential for impacts to existing surface water flows in the area. A similar table showing the potential for impacts to surface water levels at the various features including wetlands is not provided. Such a table would be a useful addition to the water impact assessment.

The groundwater impact assessment (Section 9.2) follows a logical progression of simulating (predicting using the HGS model) the water table drawdown at the end of each operational phase. The discussion and figures are understandable and relatively easy to follow. The report notes that the modelling simulations show that groundwater levels beneath the Cataract PSW will not change significantly, which seems unusual given the proximity and location of the PSW relative to the pit/quarry. The assessment appears to rely on the HGS model simulations showing vertical hydraulic gradients in the aquifer underlying the PSW wetland area as neutral or downward, implying that the PSW is mostly supported by precipitation and runoff. This may be correct. However, the monitoring data and modelling predictions should be illustrated with more focussed information, such as local detailed hydrogeological cross-sections, to support these assertions, given the significance of the PSW and its location downgradient of the proposed pit/quarry.

Assessment of potential impacts to existing private wells used for water supply purposes in the area is based on information in the MECP water well record database. There is little or no field confirmation (such as ground truthing and testing) of the existing private wells. Although the Level 1/2 report provides a comprehensive review of the water well record information, and a reasonable approach to identify the level of risk to the various wells, it will be very difficult to determine potential or actual interference caused by quarry dewatering. Inaccuracies or missing information are a common issue in the well record database. Some existing wells may be marginal water supply sources to begin with and small levels of impact may result in adverse effects, such as loss of water supply. The Gasport Fm. appears to be the main aquifer providing potable water to the private wells. Mitigation measures such as lowering the well pump or deepening the well may restore some of the lost capacity but could result in poor water quality if the lower bedrock formations are used to compensate for loss of supply from the Gasport Fm. The Report does provide a comprehensive water well complaint response plan (Section 9.3, Appendix S).

REVIEW COMMENTS – PROPOSED WATER MONITORING PROGRAM
REVIEW COMMENTS – SITE PLANS

The proposed monitoring program includes many stations (monitoring wells, surface water stations, minipiezometers) and appears appropriate for the purposes of the Official Plan and Zoning Bylaw amendments. The monitoring program may and likely will be modified later as part of the application process for a Permit to Take Water (PTTW), with rationale provided or each of the monitoring locations.

We note that the main tributaries (#1, #8) identified in the Level 1/2 report are not clearly shown and labelled on the Existing Features site plan. Wetland names used in the Level 1/2 report (i.e. Coulterville Wetland Complex and Northwest Wetland) are also missing in the Existing Features site plan. It would be helpful if this information was added to the site plan.

CONCLUSIONS AND RECOMMENDATIONS

The hydrogeological reporting as presented in the Level 1/2 Water Report and the Maximum Predicted Water Table Report is comprehensive and generally well done. In our opinion, the work is sufficient to support the OPA and Zoning amendments needed to allow the proposed pit/quarry to proceed.

We recommend that additional work be undertaken to improve the presentation of the conceptual hydrogeological model for the site. This work should include preparing additional hydrostratigraphic cross-sections on both a local and regional scale. The cross-sections should show local landmarks for orientation purposes and clearly illustrate the relationship between the main hydrostratigraphic units, water table/piezometric surface, Cataract PSW and private water supply wells.

The private well survey proposed upon license approval and prior to initiation of aggregate extraction should consider methods that will encourage participation of the private well owners in the vicinity. In our opinion, additional information about the existing private wells will be needed to ensure that adverse interference does not become an ongoing issue during the active pit/quarry operations, particularly once operations occur in the South Area.

Respectfully submitted,
ARL GROUNDWATER RESOURCES LTD.

A.R. (Tony) Lotimer, M.Sc., P. Geo.
Principal Hydrogeologist