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REPORT ON

Cumulative Impacts Assessment for Groundwater Takings in the Carden Plain Area

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REPORT

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Executive Summary

Due to the recent level of aggregate extraction activity in the Carden Plain Area, the Ontario Ministry of the Environment requested a multidisciplinary study and impact assessment to evaluate the potential cumulative impacts of quarry dewatering at multiple sites on groundwater, surface water and ecological receptors. Golder Associates Ltd. was retained by the Ontario Stone, Sand, and Gravel Association to complete the required study. The study area for the project focuses on the Carden Plain.

Along the northern edge of the study area, the Grenville Province of the Canadian Shield (Precambrian basement) is the upper bedrock unit. For the majority of the study area, the upper bedrock unit is a member of the Simcoe Group, which is composed of a depositional bedrock sequence representing a generally deepening oceanic shelf environment. The Simcoe Group starts with an erosional unconformity with the Precambrian basement, and consist of, from oldest to youngest, the Shadow Lake, Gull River (which includes the “green bed” layer), Bobcaygeon, Verulam and Lindsay Formations. The formations exhibit a gentle regional dip towards the southwest throughout the study area. This gentle dip results in rock layers often appearing as flat-lying in outcrops within the study area.

Within the study area, twelve quarries operated by ten companies were identified for inclusion in the cumulative impact assessment. These quarries were identified based on the understanding that the quarry locations currently have, or will require, a Permit to Take Water to allow for operation of the site, and extraction of bedrock below the groundwater table.

The objectives of the study were to screen out areas where cumulative impacts are unlikely, identify areas where cumulative impacts are likely, and to provide a preliminary assessment of the potential magnitude of predicted cumulative impacts. For the purpose of this study, a cumulative impact is defined as the additive effect of multiple quarry dewatering operations on groundwater, surface water and/or natural environment features. For groundwater, a cumulative impact could result from the intersection of various dewatering zones of influence associated with the operation of multiple quarries. The intersection of multiple dewatering zones of influence results in a cumulative impact because more groundwater level drawdown occurs within the intersection area than if each quarry was operated in isolation. For surface water, cumulative impacts to water quantity and water quality in a receiving watercourse(s) may result from the discharges from multiple quarries. Cumulative impacts may also occur as a result of drawdown of the shallow groundwater table beneath a surface water feature as a result of the dewatering of multiple quarries. For natural environment features, cumulative impacts relate to the potential effect of dewatering and discharge from multiple quarries on the surrounding flora and fauna.

The study involved the review of available groundwater, surface water and natural environment information, as well as the completion of discipline-specific field programs to gather additional information to assess potential cumulative impacts within the study area. The field programs included collection of baseline groundwater level data, borehole geophysical logging, instantaneous surface water flow measurements, surface water quality monitoring, continuous lake level monitoring, benthic invertebrate community monitoring, aquatic habitat assessments and a survey of the conditions in the Cranberry Lake Wetland. A numerical groundwater flow model was used to identify areas of potential cumulative impact associated with groundwater level drawdown based on an existing quarry conditions scenario, 20-Year Development scenario (the most reasonable scenario to be considered at this time) and a Full Licensed Depth quarry development scenario (which is not a reasonable scenario and is not likely to ever occur).

Based on the surface water budget analysis, monitoring stations with cumulative impacts (downstream of more than one quarry) were generally shown to have relatively small (between 0% and 6%) increases in annual surplus based on the 20-Year Development scenario water balance. Based on the surface water quality impact assessment, elevated measured concentrations of sulphate and chloride at downstream cumulative discharge locations and the predicted elevated concentrations of iron and boron at all stations are thought to be partially attributed to quarry discharges. The elevated concentrations of boron, iron, sulphate and chloride are related to naturally occurring concentrations of these parameters in the groundwater/bedrock within the study area. Based on the flooding and erosion impact assessment, adverse impacts are not anticipated under the 20-Year Development scenario.

The groundwater modelling identified two potential zones of cumulative impact within the upper weathered zone and two zones within the green bed layer. The zones of cumulative impact within the upper weathered zone were localized around the individual quarries, while the zones within the green bed layer showed the potential for greater lateral extension. The individual drawdown cones modelled in the upper weathered zone are generally similar in size and shape for the 20-Year Development scenario and the Full Licensed Depth scenario. This suggests that the drawdown predicted for the 20-Year Development scenario is at or near the maximum drawdown that will occur in the upper weathered zone. Because of the greater potential lateral extent of the drawdown in the green bed layer compared to the upper weathered zone, depressurization of the green bed layer has greater potential to result in cumulative impacts relating to groundwater within the study area. Based on the results for the 20-Year Development scenario, it is unlikely that within the next 20 years groundwater levels in the water supply wells identified within, or in close proximity to, the predicted zones of cumulative impacts will drawdown to the point where well interference will occur.

Based on the low flow impact assessment, the cumulative drawdown of groundwater levels between the Miller and Tomlinson quarries is not expected to have an additional effect on flows or the ecological condition in the drainage features.

A water balance for the adjoining Cranberry Lake (which included surface runoff, groundwater inputs, quarry dewatering and quarry discharges) suggests only minor net changes to flows in Cranberry Lake as a result of the predicted cumulative drawdown of groundwater levels between the Beamish and Holcim quarries. Due to the small magnitude of change to flows at the Cranberry Lake wetland edge, an area of the wetland which is relatively more resilient to annual water level fluctuation, the ecological form and function of the wetland is not expected to be significantly affected.

In summary, based on the analysis presented for the 20-Year Development scenario, cumulative effects of the quarries considered in this study, on groundwater drawdown, drinking water wells, wetland function, low flows in creeks and rivers, flooding and erosion in creeks and rivers and most water quality parameters are expected to be negligible. Increases in concentrations of boron, iron, sulphate and chloride are expected as a result of dewatering groundwater (which naturally contains these parameters) from quarries.