



Caivan Brazeau Development Corporation
2934 Baseline Road, Suite 302
Ottawa, ON K2H 1B2

January 21, 2020

Attention: Andrew Finnson, Director, Land Development

**Re: Professional Opinion about Aggregate Reserves
Marcel Brazeau Todd/Cedarview Pit, Part of Lot 8, Concession III RF, City of Ottawa (Nepean)
Caivan Brazeau Development Corporation**

Dear Mr. Finnson;

GRI was retained by Caivan Brazeau Development Corporation to provide a professional opinion on the aggregate resource both above and below the water table that remain in a licensed sand and gravel operation. The site operates under Lic. # 4219 under the Aggregate Resources Act. The license is held by Marcel Brazeau and is located on Part of Lot 8, Concession III RF, in the former City of Nepean, City of Ottawa. The pit is shown on Figure 1.

The site, identified on the ARA site plans as the Todd Pit, but has also been called the Cedarview Pit and possibly the Brazeau Pit¹, is located on a large granular deposit in the area that has been extracted for sand and gravel uses since, at least the early 1950s. Sado and Vos (1976), and Gorrell (1991), Gorrell Resource Investigations (1993) and MHBC (1995) described the collection of glaciofluvial and glaciolacustrine deposits in the area as the Twin Elm Assemblage.

To prepare the opinion, the following sources of information were reviewed:

- soil descriptions from historic testing completed on the site,
- the drill hole logs completed by Gorrell (1991) that delineated the buried sand and gravel deposits in Eastern Ontario,
- aggregate resource reports characterizing and classifying the material in the area and within the Twin Elm Assemblage,
- reports completed for the City of Ottawa for the Trail Road Waste Management Facility and Nepean Landfill detailing the lateral extent of the sand and gravel and hydrogeological characteristics of the area,

¹ The use of "Brazeau Pit" may result in confusion with another pit, ARA Lic. #4199, also licensed and operated by Marcel Brazeau that fronts on Moodie Drive.



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- sand and gravel testing completed on adjacent properties,
- current beneficiation practices used in other operations on sand and gravel excavated within the Twin Elm Assemblage to identify how the aggregate quality is for use as construction aggregate, and
- Common Boundary Agreements between the site and adjacent properties.

1 PREVIOUS STUDIES ON ASSEMBLAGE

Studies completed in the area over the last 60 or more years provide extensive background data for the site and assemblage. The potential aggregate reserves volume below the water table were estimated using a generally accepted and current geologic conceptual model that has evolved and been refined since the early 1980s. The model used the available data and knowledge of the morphological process to interpret the sediment that will be found. It has been calibrated on other sites with subsurface test pit and test hole logs and by examining most of the pit faces in the area operations. Most of this information can be found in the following sources:

- Fletcher, T.W. and M.A. Klugman. 1979. Aggregate Assessment of the Regional Municipality of Ottawa-Carleton, Ontario Canada. Regional Municipality of Ottawa/Carleton and Ontario Ministry of Natural Resources. 44 pp. 4 maps 1:100,000. Golder Associates. 2000. Hydrogeological Assessment of Alternative Aggregate Extraction Scenarios at the Trail Road Landfill. 27 pages, 4 tables, 30 figures.
- Gorrell, G. A. 1993. Mineral Resource Study for the Regional Municipality of Ottawa-Carleton. 27 maps. 1:50000.
- Gorrell, G.A. 1991. Buried Sand and Gravel and Blending Sands in Eastern Ontario. Ministry of Northern Development and Mines. Ontario Geological Survey. Open File Report 5815; 120 pp.
- Gorrell Resource Investigations. 1995 Material Evaluations. Cedarview Road Pit. 5 pages, 4 appendices, 1 figure.

The data in the Gorrell (1991) and GRI (1995) reports are the basis of all sand and gravel studies used to delineate the mineral aggregate reserves with the City of Ottawa.

- MacNaughton Hermsen Britton Clarkson Planning Ltd (MHBC), Gorrell Resource Investigations, A.J. Robinson and Associates and Smith Consultants. 1995. Mineral Resource Study. Volume 1 and II. Regional Municipality of Ottawa-Carleton.
- Ontario Geological Survey. 2013. Aggregate Resource Inventory of the City of Ottawa, Southern Ontario, Aggregate Resources Inventory, 191. 28 pp, 11 tables, 8 figures, 2 maps, 5 appendices.
- Richard, S.H., 1982. Surficial geology, Kemptville (31G/4), Ontario. Geological Survey of Canada Map 1492A. scale 1:50,000.
- Sado, E and Vos. 1976. Resources or Construction Aggregate in the Regional Municipality of Ottawa-Carleton. 74 pp. 4 maps.

- Reports on the Trail Road Waste Management Facility located approximately 100 m west of the pit, and the Nepean Landfill found approximately 1.5 km west, provide detailed subsurface geology that can be used with the other data to refine the deposit configuration and the type and continuity of the deposit below the water table.
- Information on 13 test pits excavated in the pit were provided by Brazeau.

2 TWIN ELM ASSEMBLAGE GEOLOGY

The pit is situated on a sediment of variable consistency that was deposited in glaciofluvial and glaciomarine depositional environments during, and just after, the last ice age in the Quaternary period approximately 10,000 years ago (Cummings *et al.* 2011). The deposition model has evolved since the early 1960s, but is now generally accepted to have been deposited as an assemblage of esker, esker-spray, fans and cavity fills altered by shoreline processes (Gorrell, 1991, 1993, 1998, GRI, 1995, 2009; Gorrell and Shaw, 1991; and Cummings *et al.*, 2011). Every author and agency that has studied the composition of the assemblage stressed that while the assemblage is a source of laterally extensive coarse aggregate there is significant variability of material types.

The grain size or texture of the sediment within the assemblage has been found to range from silt and clay, to fine sand and gravel, to boulders. In more recent studies Cummings *et al.* (2011) indicated that much of the sand and gravel was deposited near the glacier margin in a series of coalescing fans, eskers and debris flows. Sediment was deposited from beneath the ice as well as in front of and beyond the ice margin during the last ice age from what were dynamic and sometimes chaotic processes and was subsequently modified by shoreline processes.

The assemblage also has one of the largest shoreline deposits in Eastern Ontario (Gorrell, 1991) and developed on two distinct glaciofluvial portions of the assemblage. The first extends from the eastern edge of Tomlinson's Harvey Pit, through the Lafarge Canada Inc. (Lafarge) Clark Pit, the Brazeau Pit, along the eastern side of Tomlinson's Standard Pit, the western side of the City's Cambrian Road Pit, through the Trail Road Waste Management Facility, the Lafarge Johnston Pit, and along the eastern side of Tomlinson's Howe-Ross Pit. The second extends from north of the Drummond Costello Pit and can be traced through the deposit southward through the Village of Kars and across the Rideau River (Gorrell, 1991). As the ice retreated, and the Champlain Sea water level dropped, the deposited sand and gravel was subsequently altered extensively by shoreline (limnological) processes. Farther away from the ridge, where the wave energy was less silt and clay were deposited. Therefore, the position of the site on the assemblage is a large factor in the quality, and aggregate operations in close proximity can have a very different quality and texture of deposit.

Previous studies on the Trail Road Waste Management Facility and Nepean Landfill (shown in Dillon, 2011a, b) reported a bedrock elevation of 72.8 to 74.5 m above sea level (ASL) west of the pit.

2.1 Gorrell 1991, GRI 1995 and Lee (MNR) 2013

These three studies discuss the quality and/or gradation of the sand and gravel. Gorrell (1991) used 35 samples taken over the assemblage to identify and characterize the depositional environments and sedimentary facies that are present and to classify their construction aggregate potential. The Fineness

Modulus (FM) for the samples detailed in that report (Appendix A) range from 0.25 to 4.53. Higher FM's (coarse sand) were obtained from samples derived from the depositional environments found west and north of the site.

The sediment that has been excavated from the pits in the area have been used for a variety of purposes including construction aggregate. Construction aggregate, as used in this letter, comprises a broad range of coarse-grained materials used for:

- Granular fill for construction of roads and buildings.
- Composite materials for concrete and asphalt.
- Granular fill for residential and commercial buildings, in tile beds, and other applications where cohesionless free draining backfill is required.

The portion of the assemblage that can be used to provide aggregate for infrastructure and is therefore the most desirable part of the deposit is the glaciofluvial facies that extends from the Marcel Brazeau Pit (ARA Lic. #4199) on Moodie Drive, through the Tomlinson Harvey and Standard Pits, through the Trail Road Waste Site. Gorrell (1991) showed that the glaciofluvial deposits extends southward to the Village of Kars.

Lee (2013) designated the deposit as a secondary significance resource area because of the variability of the quality and texture of the material in the assemblage. GRI (1995) and Lee (2013) indicated that beneficiation is required for the coarser grained sand to meet to the requirements for high quality aggregate, such as concrete or asphalt sand. In parts of the assemblage, the material would be too fine grained to be used as a source of high-quality aggregate. The reports concluded that, while the sand and gravel laterally and horizontally extensive within the Twin Elm Assemblage, there are large lateral variations in the sediment, a reflection of the complex and dynamic depositional processes. Most of the highest quality material has been depleted.

2.2 Remaining Reserves within the Assemblage

Lee (2013) stressed that protective measures should be considered for any remaining coarse grained expanses in the Twin Elm Assemblage. One of the reasons given for this recommendation was in portions of the that the Twin Elm Assemblage there still are sources of concrete and asphalt sand (MHBC, 1995; OMMA, 1995). The area of the assemblage where the remaining concentration of high quality aggregate (sand) is found is on the western glaciofluvial ridge that extends from the Harvey Pit, through the Brazeau Moodie Drive Pit, Tomlinson Standard Pit, City of Ottawa Cambridge Pit and through the Trail Road Waste Disposal Site (Figure 1). The material will still have to be beneficiated by crushing and classifying, but interbeds of till and diamicton will not have to be removed as the case is more likely to be found on the eastern glaciofluvial portion in the remaining sand deposited in cavity fills.

3 PIT GEOLOGY

From pit face mapping and borehole data, it was found that the geology at the site consists of a drumlinized till ridge, shore-line deposits and proximal ice contact cavity fill deposits. Cumming *et al.*

(2011) suggested that the deposit may have developed either because of a grounding line of glacial ice², or because the assemblage was deposited in a series of cavities.

The site can be subdivided into deposits of 1) limnological, 2) glaciofluvial cavity fills, and 3) diamicton and till zones (Figure 1). While there may be pockets of high-quality aggregate, most of the site will consist of fine sand, granular fill and clay. Even the higher quality zones will likely contain interbeds of till and diamicton, and the limnological zone is underlain by saturated leda clay. The site has been excavated to within a metre of the water table, and part of the north-west corner was excavated below water.

3.1 Remaining Sand and Gravel Deposit on Site

As noted above, Lee (2013) recommends protection of remaining coarse-grained deposits of reasonable extent. However, the Brazeau Todd property should not be considered such a source (Gorrell, 1991, MHBC, 1995) due the variability of material and depositional environments.

Sand and gravel remain in the eastern third of the site, but it is not the material that was being recommended for protection. This material is a mixture of sand, gravel and till or diamicton that has a potential use as granular fill, which is not rare within the City. It would be more difficult to beneficiate as the deposit in the western portion is, because of the presence of diamicton, till and clay, and there would be a high proportion of waste- potentially more than product.

If this material was excavated, material of essentially identical quality would have to be used to replace it before it's future use could be developed.

If you have any questions, or we can be of further help, please do not hesitate to contact me.

Sincerely;



George A. Gorrell M.Sc. P.Geo. F.G.A.C.
Senior Geoscientist

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² i.e. the glacier got “stuck” on bedrock



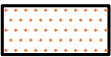
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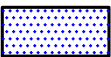
SITE



2017 TEST PITS



GLACIOFLUVIAL - SAND AND GRAVEL
-With beneficiation may be used as source of high quality construction aggregate



LIMNOLOGICAL - SAND, SOME GRAVEL
OVER CLAY AND TILL
-With beneficiation may be used as source of high quality aggregate - fines downward to silt and clay with possible till at base



GLACIOFLUVIAL - CAVITY FILL
SAND, GRAVEL WITH TILL AND DIAMICTON
INTERBEDS
-granular fill source with pockets of high quality aggregate, mostly excavated to water table



DIAMICTON AND TILL - UNSORTED TO
SORTED INTERBEDS
-mainly source of granular fill, although may be pockets of high quality aggregate

FIGURE 1

SITE CHARACTERISTICS

PROJECT NO.: 20-020

CLIENT: CAIVAN BRAZEAU DEVELOPMENT CORP

DATE: JANUARY 2020



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