Aggregate Resource Assessment Elginburg Quarry, Kingston, Ontario

Lot 12 to 15, Concession 5, City of Kingston, County of Frontenac

Presented to:

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EXECUTIVE SUMMARY

Morrison Hershfield Limited (MH) was retained by Cruickshank Construction Limited (Cruickshank) to assess aggregate resources within proposed expansion of the Cruickshank Elginburg Quarry.

The study included background data review, field investigations and testing, and data analysis including aggregate resource assessment. The background data review included inspection of maps and other geological and topographic information, and review of a preliminary aggregate resource assessment carried out by Golder in 2011. The field investigations and testing included rock quality testing of a half of a split core remaining from the Golder assessment, coring of one borehole and rock quality testing of the core, rock drilling of three boreholes, and geophysical logging of eight open holes. The data analysis included establishment of a layer-cake stratigraphic model based on the core and geophysical logs, assessment of the usefulness of the various parts of the stratigraphy for concrete stone and for granular "A", and estimation of respective volumes considering the planned quarry expansion.

As shown in Figure 3, the following two sources of concrete stone for use in structures, sidewalk, curb and gutter, and concrete base were identified:

1. All rock above 115 masl in the north extraction area so long as the rock column is effectively mixed during the blasting, loading, and crushing operation. There is approximately 10 million tonnes of this resource.

2. All rock above 128 masl in the south extraction area, north of approximately 4907320N (see Figure 3). There is approximately 2 million tonnes of this resource.

The remainder of the rock can be used for Granular A (approximately 40 million tonnes). None of the rock can reliably be considered concrete stone for use in pavement.

A program of rock quality testing is recommended at the start of quarrying of the north expansion area, to ensure that effective mixing of the rock column is achieved.

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1. INTRODUCTION

Cruickshank Construction Limited (Cruickshank) owns the Elginburg Quarry, Lots 13 and 14, Concession 5, City of Kingston, Ontario. The quarry is licensed under the Aggregate Resources Act (# 2901). Cruickshank intends to expand this quarry westward into Lots 12 and 13, Concession 5 (see Figure 1). These expansion lands are south of Unity Road and north of Burbrook Road, to the west of the existing quarry.

Morrison Hershfield Limited (MH) was retained by Cruickshank to assess rock quality and aggregate resources, and to provide input to the design of the quarry expansion.

1.1 Study Area

The study area consists of the expansion lands in Lots 12 and 13, Concession 5, as shown in Figure 1. The expansion lands are irregular in shape with approximately 185 m frontage on Unity Road and extending approximately 2 km south.

1.2 Scope of Work

The scope of work is defined as including background data review, collection and testing of rock samples to determine quality with respect to Ontario Provincial Standards Specifications for Aggregates, Assessment of volumes of aggregate for various uses, and reporting. All work is to be carried out in accordance with industry standards.

1.3 Contents of Report

This section of the report provides information on the context for the study, the scope of work and the layout of the report. Section 2 describes the methods used in the study. Section 3 describes the results including background information, the results of field investigations and rock quality testing, and any direct comparisons between testing results and the OPSS. Section 4 provides conclusions and recommendations. Section 5 provides closure notes and signatures of the report authors, and Section 6 presents the limitations and use of this report. References are provided in Section 7. Figures, tables, and supporting documents are provided in the appendices.

2. METHODS

2.1 Data Review and Program Design

Available correspondence and previous reports pertaining to the site were reviewed, along with geological, topographical and physiological maps to form an up-to-date understanding of the geology of the site and its surrounding area. Based on this review, the need for additional boreholes was determined, and borehole locations were communicated to Cruickshank as UTM coordinates. Boreholes were laid out by Cruickshank.

2.2 Field Investigations and Testing

2.2.1 Diamond Drilling and Core Logging

Diamond drilling was conducted to allow for the recovery of rock core, with diameter determined by the drill bit size. Core was recovered from the core barrel, inspected and placed in core boxes, labeled to indicate depth interval. Each core was visually inspected for colour, texture and composition of the rocks, fractures in the core and evidence of fossils or bioturbation. The surface of the core was also scratch-tested for hardness using a pocket blade. The classification shown in Table 1 was used to determine the hardness of the rock.

Table 1 - Rock Hardness Classification

Classification	Description
Very Soft	Can be peeled with a knife.
Soft	Can be easily gouged or carved with a knife.
Medium soft	Can be readily scratched with a knife blade; scratch leaves heavy trace of dust and is readily visible after powder blown away.
Hard	Can be scratched with a knife with difficulty; scratch produces little powder and is often faintly visible.
Very Hard	Cannot be scratched with a knife or can barely be scratched with a knife.

Acid testing was also carried out on the core samples to distinguish between limestone and dolostone. Acid was prepared by mixing muriatic acid and water in a 1:7 ratio to form a diluted HCl acid. The HCl acid was transferred into a squeeze bottle fitted with a cap to enable precise application of small amounts of acid onto the core samples. When applied to limestone, acid reacts and fizzes vigorously as carbon dioxide is produced. When applied to dolostone, acid reacts to a lesser extent and fizzes very slightly. Dolostone surfaces typically need to be scratched prior to adding acid to facilitate a more visible reaction. It is noted that the reaction may also take place on other rock types if calcite is present (e.g. sandstone with calcite cement).

All observations and field test results were noted during field work and used to produce borehole logs using Gint software.

2.2.2 Core Testing

Core samples were shipped to core testing laboratories, where they were crushed, mixed, and tested to determine usefulness of rock for the various types of aggregate. The requested physical tests are summarized in Table 2.

Table 2 - Concrete Aggregate Test Parameters

Laboratory Test	Lab Test No.
Absorption	LS-604
Magnesium Sulphate Soundness	LS-606
Potential Alkali-Carbonate Reactivity	CSA A23.2-26A
Petrographic Number	LS-609
Micro-Deval Abrasion	LS-618

2.2.3 Rock Drilling

The bit of a rock drill is pushed and hammered into the ground, while the crushed rock chips are brought to the surface using compressed air. Common types of rock drills at quarry sites include water well rigs and top-hammer rigs used in quarrying.

Rock drilling was carried out at the site, and documented by drill interval. Rock chips from each interval were flushed out into piles near the drill. Rock chips samples at each interval were collected using a trowel and placed into zip-lock bags for later analysis. After samples were taken, the piles were cleared out to make room for the next rock chip sample interval so as to not mix two sample intervals.

The rock chips were later arranged into compartmentalized boxes for ease of storage and assessment. The rock chips were visually inspected for colour and tested for limestone and/or dolostone using HCl acid (as described in Section 2.2). All observations and field test results were noted down and used to produce borehole logs using Gint software.

2.2.4 Downhole Geophysical Logging

Downhole geophysics was carried out in all boreholes by Notra Inc. of Ottawa. It was carried out using a BMP06 probe which measures simultaneously the temperature, apparent conductivity, apparent resistivity, single point resistance, magnetic susceptibility and natural gamma at a rate of 2 readings per second recorded on a logging computer. The probe was lined up with the top of the casing and a depth of zero was entered in the logging computer. With the computer logging, the probe was lowered at approximately 5 meters per minute, resulting in one data point for all parameters recorded every 4 cm. The probe was stopped briefly at calibrated 10 meter intervals to confirm accuracy of the logged depth. After reaching the end of the hole, the probe was brought back up at a faster rate, while still logging data. The up data was compared to the down data to ensure proper operation of the unit.

Depth data in each borehole were calibrated using the 10 m calibration intervals and each parameter was extracted to an asc file. The files were then plotted in LogView from which the analysis was conducted. More detailed methodology and analysis can be seen in the report attached in Appendix C.

2.3 Resource Assessment

2.3.1 Assessment of Physical Testing Results

The results of the testing were compared to the following standards, to determine the usefulness of the rock as Granular “A” or “B” and as aggregate in concrete for pavement and for structures, sidewalk, curb and gutter, and concrete base.

- Ontario Provincial Standards Specification (OPSS) 1010 Material Specification for Aggregates – Base, Subbase, Select Subgrade, and Backfill Material, Table 1: Physical Property Requirements; and,

- Ontario Provincial Standard Specification (OPSS) 1002 Material Specification for Aggregates – Concrete, Table 5: Physical Requirement – Course Aggregate for Concrete.

Based on the testing results rock thicknesses for various aggregate types was determined.

2.3.2 Stratigraphic Correlation to Establish Layering

Available core logs, rock chip samples, and geophysical logs were used to precisely identify the rock strata present on site. The correlation between boreholes was accomplished using the rock chip samples and the downhole geophysical results (comparison of natural gamma radiation signature markers). The strike and dip of the strata was determined from the elevations of the geophysical markers, as determined from their depths below ground surface, and the approximate ground surface elevation interpolated from a digital elevation model taken from The Base Mapping drawing of the study area.

2.3.3 Setback Assumptions

The volume of extractable aggregate is dependent on the thickness of the strata, and on the area within which extraction can take place. Setbacks were specified in accordance with the site plan for the expansion, as follows:

- 30 m setback from roads and residential properties on the northern property line;

- 15 m encroachment on the existing quarry property (i.e., a negative setback to account for the extra rock which will be available for extraction assuming the expansion will be contiguous with the existing quarry); and,

- 15 m setback on all other property boundaries.

2.3.4 Volume Calculations

Volume and tonnages were calculated using 3-D volumetric modeling in Surfer 11 software. The top elevation of the model was taken from the (Base Mapping) digital elevation model (DEM), while below-grade elevations were taken from the results of the borehole assessment. Volumes were calculated using on a 25 m by 25 m Surfer grid, taking into account the various offsets. Tonnages were calculated using a density of 2.7 tonnes per cubic metre.

3. RESULTS

3.1 Data Review and Borehole Locations

3.1.1 Topography, Physiography, Geology

The site is mostly forested with some open pasture. The currently active Elginburg Quarry is located to the east of the site. The site is accessed via trails from Unity Road, Burbrook Road and the existing quarry. Vehicular travel within most of the property is limited to track-mounted equipment or small off-road vehicles.

The defining feature of the study area is a north-east south-west trending escarpment which marks the southern edge of a limestone plain and is approximately coincident with the south end of the existing Cruickshank Elginburg quarry. The top of the escarpment is approximately demarked by the 125 masl topographic contour line (see Figure 1 in Appendix A) and the rock is mapped as the upper member of the Gull River Formation (Carson, 1981). Below the escarpment the ground surface is at approximately 90 masl, and the rock is mapped as Precambrian. On the escarpment itself, the rock is mapped as the middle member of the Gull River Formation, which would appear from the mapping to be approximately 20 m thick. The geology from Carson (1981) is approximately shown on Figure 2.

Most of the expansion lands are underlain directly by bedrock, with very little overburden. At the base of the escarpment, there are massive-to-well-laminated, fine-textured glaciolacustrine deposits of silt and clay with minor sand and gravel (Ontario Geological Survey, 2010).

The Ministry of the Environment water well database (Water Well Information System, accessed October, 2012) indicates presence of limestone to at least 43 m depth on the northern side of the property and at least 28 m depth on the western side of the property, and granite to at least 16 m depth on the south eastern side of the property with limestone to at least 10 m depth on the south western side of the property. Well records indicate overburden depths between 0.6 m to 1.8 m throughout the property.

3.1.2 Previous Aggregate Assessment

According to the Ministry of Natural Resources (1987), bedrock aggregate assessment, the upper member of the Gull River Formation is Class 1A aggregate useful for asphalt and concrete, while the middle member of the Gull River Formation is Class 2A aggregate useful for Granular “A” 5/8 crushed.

Golder Associates Ltd. (2011) carried out a preliminary aggregate resource assessment of the expansion lands. The assessment involved the coring of a borehole to 36 m depth (DDH10-01), and rotary drilling of three boreholes (BH11-2, 3, and 4) to 35 m depth. The locations of these boreholes are shown in Figure 1. Detailed logging of the core from DDH1-01 was carried out and the core was split longitudinally so that half of it could be tested for aggregate quality using the following four tests: Petrographic Number (PN), micro-deval abrasion loss (abrasion), potential alkali-carbonate reactivity (reactivity), and magnesium sulphate soundness loss (soundness). The other half of the core was retained by Cruickshank for future use. Geophysical logging of the four boreholes was also conducted.

Five depth intervals were selected for aggregate testing, as shown in Figure 3. The results are shown in Table 3, and exceedances of the maximum allowable values for concrete stone for use in structures, sidewalk, curb and gutter, and concrete base (PN=140, abrasion=17%, reactivity=non-expansive, soundness=12%) are highlighted in bold text.

Table 3 - Results of Preliminary Aggregate Resource Assessment (Golder, 2011)

Sample ID	Depth Interval (mbgs)	Physical Testing Results (PN, Abrasion, Reactivity, Soundness)
A	0.15-6.00	Failed for concrete stone (**159**,14.7,NE, 6.9)
B	6.00-9.65	Concrete stone (137, 11.9, NE, 3.3)
C	9.65-14.85	Failed for concrete stone (**168**, **20.5**, **PE**, **18.1**)
D	14.85-20.60	Concrete stone (139, 15.8, NE, 6.4)
E	20.60-25.88	Failed for concrete (**162**, **19.7**, **PE**, **19.7**)

Note: NE=non-expansive, PE=potentially expansive

The Golder (2011) results identified an approximately 5 m thickness of rock not suitable for concrete stone between approximately 10 and 15 m depth, and again below approximately 20 m depth. The Golder (2011) report is reproduced in Appendix F.

3.1.3 New Borehole Locations

Based on the data review, the need for an additional cored borehole (BH13-01) and three additional drilled boreholes (BH12-01, BH12-02 and BH12-03) was identified. The locations of the boreholes are shown in Figure 1.

3.2 Field Investigations and Testing

3.2.1 Physical Testing of Existing Core (DDH10-01)

Physical testing was carried out on the remaining half of the split core left over from the Golder (2011) assessment. The rock samples were delivered to the Stantec geotechnical lab in Ottawa for testing. Table 4 below shows the tests requested from Stantec for this assessment. In short, Golder samples A, B, and D were combined as CS-1 and submitted for a full suite of tests to confirm usefulness for concrete stone. Golder samples C and E, which had previously failed for use as concrete stone were submitted as CS-2 and CS-3, respectively for a limited number of tests to assess usefulness for Granular A. The lower 10 m of rock core was submitted as CS-4 for a full suite of tests to provide rock quality information for the lower 7 m of extractable aggregate and for 3 m below the licensed quarry floor.

Table 4 - Physical Testing Conducted on DDH10-01

<table>
<tr><th>Sample ID</th><th>Depth Interval (m) and Golder ID</th><th>Absorption</th><th>Magnesium Sulphate Soundness</th><th>Potential Alkali-Carbonate Reactivity</th><th>PN</th><th>Micro-Deval Abrasion</th></tr>
<tr><td>CS 1</td><td>0-9.65 & 14.85-20.6 (A,B, and D)</td><td colspan="5">Yes (to assess again for concrete stone)</td></tr>
<tr><td>CS 2</td><td>9.65-14.85 (C)</td><td colspan="3" rowspan="2">No (already failed for concrete stone)</td><td colspan="2">Yes</td></tr>
<tr><td>CS 3</td><td>20.6-25.88 (E)</td><td>No (known)</td><td>(to assess for granular A)</td></tr>
<tr><td>CS 4</td><td>26.06-28.91 & 31.5-34.24 (not tested)</td><td colspan="5">Yes (to assess lower 7 m of extractable aggregate and 3 m below quarry floor)</td></tr>
</table>

The results of the physical testing are summarized in Table 5, along with an assessment of the suitability of the rock for various uses. A copy of the physical testing report is presented in Appendix D.

The results in Table 5 indicate that the upper limestone above Golder Sample “C”, and the 5 m thick zone below Golder Sample “C” is concrete stone for use in structures, sidewalk, curb and gutter, and concrete base. The 5 m thick zone sandwiched between these sources of concrete stone, Golder Sample “C”, is not by itself concrete stone. Coring and testing of BH13-01 was added to the program to determine if this full stratigraphy (i.e., the sandwich), when crushed and mixed together could meet the specifications for concrete stone. The results indicate that Golder Sample “E” and below is not concrete stone, but is suitable for Granular “A”.

Table 5 - Physical Test Results – DDH10-01

Test	Standards				Results			
	Granular A	Granular B, I & II	Coarse Aggregate for Concrete		CS 1 (Golder A, B, D) (0-9.65m & 14.85-20.6m)	CS 2 (Golder C) (9.65-14.85m)	CS 3 (Golder E) (20.6-25.88m)	CS 4 (26.06-28.91m & 31.5-34.24m)
			Pavement	Structures, Sidewalk, Curb and Gutter, and Concrete Base				
Absorption (% max)	NA	NA	2		0.45	*NT*	*NT*	0.49
Magnesium Sulphate Soundness (% max loss)	NA	NA	12		(6.9, 3.3, 6.4)[2] 9.9	(**18.1**)[3]	(**19.7**)[4]	6.5
Potential Alkali-Carbonate Reactivity	NA	NA	Chemical Composition must plot in the non-expansive field of Fig. 1 of Test Method[1]		(NE, NE, NE)[2] NE	(**PE**)[3]	(**PE**)[4]	**PE**
Petrographic Number (max)	200	250	125	140	(**159**,137,139)[2] 116	(**168**)[3] 115	(**162**)[4]	107
Micro-Deval Abrasion Loss (% max)	25[5] / 30[6]	30[5]/ 35[6]	14	17	(14.7,11.9,15.8)[2] 13.6	(**20.5**)[3] **19.5**	(**19.7**)[4] **18.8**	8.9

Note: 1 Results described as Non-Expansive (NE) or Potentially Expansive (PE)

2 From Golder (2011) Samples “A”, “B”, and “D”

3 From Golder (2011) Sample “C”

4 From Golder (2011) Sample “E”

5 Micro-Deval Abrasion Fine Aggregate Loss Test Standards

6 Micro-Deval Abrasion Coarse Aggregate Loss Test Standards

3.2.2 Rock Drilling and Rock Chip Logging

Drilling and chip logging was carried out at BH12-01 to BH12-03, as described in Section 2.3. The locations of the boreholes are shown in

Figure 1. All three (3) boreholes were terminated at approximately 40.2 m depth. The lithology observed in the core is summarized in Table 6.

Table 6 - Summary of Rock Chip Logging

Borehole	Layer	Depth to Bottom of Layer (m)
BH12-01	Brown to grey limestone	3.66
	Light to dark grey limestone	18.29
	Greenish grey dolostone	25.6
	Grey limestone	40.22
BH12-02	Grey to dark grey limestone	32.92
	Green and grey dolostone	40.22
BH12-03	Dark grey to grey limestone	21.95
	Grey to light grey limestone	40.22

Borehole logs are provided in Appendix B. Based on the borehole logs, limestone and dolostone were observed to be present in all three holes to the bottom of the holes at 40.22 m. The lithology is shown in cross section in Figure 3.

3.2.3 Drilling and Testing of BH13-01

Diamond drilling was completed on December 9th and 10th, 2013 by George Downing Estate Drilling Ltd., under the supervision of Morrison Hershfield staff. A single core hole named BH13-01 was drilled to 35.05 m depth in the northwest corner of the property. The coring bit was HQ sized, leaving a 96 mm diameter borehole, and returning a 63 mm diameter core.

A total of twenty-four (24) core runs of between 0.5 m and 1.5 m were collected into 15 core boxes. Micritic limestone of the Gull River Formation was encountered that was generally medium-grained, moderately bedded, and moderately hard. Above 12.5 m depth, the limestone was occasionally interbedded with lime mudstone. Between 12.5 and 19 m depth the lime mudstone beds increased in frequency and thickness (up to 10 cm). Grey-green argillaceous lime mudstone was noted below 25 m depth.

Horizontal clay/shale filled fractures were noted in every core run, while vertical fractures were noted only twice: near the surface, and at approximately 21 m depth. The lithology is shown in cross section in Figure 3. Borehole logs are provided in Appendix B.

Based on inspection of the core and the geophysical log, the following samples were submitted to AMEC Environment and Infrastructure in Hamilton, Ontario for rock quality testing:

- **RQ1**: 0.76 m to 6.96 m
- **RQ2**: 6.96 m to 13.16 m
- **RQ3**: 13.16 m to 19.36 m
- **RQ4**: 19.36 m to 25.56 m

The relative depths within the stratigraphic sequence are for the RQ series, the Golder A-E series, and the CS series are shown schematically in Figure 3.

To assess the quality of various mixtures within the rock "sandwich", testing was carried out in stages on composite samples made up of crushed samples RQ1 through RQ4, as follows:

- **RQ1-4**: 0.76 m to 25.56 m
- **RQ2-4**: 6.96 m to 25.56 m
- **RQ3-4**: 13.16 m to 25.56 m

The full rock quality testing report is reproduced in Appendix E. The results of the testing are summarized in Table 7.

Table 7 - Physical Test Results – BH13-01

Test	Standards				Results		
	Granular A	Granular B, I & II	Coarse Aggregate for Concrete		RQ1-4 (0.76-25.56)	RQ2-4 (6.96-25.56)	RQ3-4 (13.16-25.56)
			Pavement	Structures, Sidewalk, Curb and Gutter, and Concrete Base			
Absorption (% max)	NA	NA	2		0.48	0.50	0.59
Magnesium Sulphate Soundness (% max loss)	NA	NA	12		7.6	9.1	n/a
Potential Alkali-Carbonate Reactivity	NA	NA	Chemical Composition must plot in the non-expansive field of Fig. 1 of Test Method[1]		NE	NE	**n/a**
Petrographic Number (max)	200	250	125	140	133	**141**	**170**
Micro-Deval Abrasion Loss (% max)	25[2] / 30[3]	30[2]/ 35[3]	14	17	12.9	14.5	n/a

Note: 1 Results described as Non-Expansive (NE) or Potentially Expansive (PE)

2 Micro-Deval Abrasion Fine Aggregate Loss Test Standards

3 Micro-Deval Abrasion Coarse Aggregate Loss Test Standards

These results indicate that the lesser quality rock previously referred to as Golder Sample "C" (see Section 3.1.2 and 3.2.1) can be mixed with the overlying and underlying better quality limestone to produce concrete stone for use in structures, sidewalk, curb and gutter, and concrete base. The results suggest that this "sandwich" must contain a minimum of approximately

6.2 m of the overlying better quality limestone. In Section 3.3.3, to assess the volumes of concrete stone, the minimum required thickness of overlying better quality rock is assessed as 8 m (for a total “sandwich” thickness of 20 m), to allow for imperfect mixing and natural variability.

3.2.4 Downhole Geophysical Logging

Downhole geophysics was carried out by Notra Inc. of Ottawa in DDH10-01, BH11-02, BH11-03, BH11-04, BH12-01, BH12-02, BH12-03, and BH13-01. The geophysical logging on all but BH13-01 and on BH13-01 was carried out on December 18th, 2012 and December 10, 2013, respectively. Natural gamma rays, temperature and resistivity were measured in the 2012 investigation, while only natural gamma rays were measured in the 2013 investigation.

The natural gamma results are shown in cross section in Figure 3. The results of the geophysical testing are provided in Appendix C.

3.3 Resource Assessment

3.3.1 Assessment of Physical Test Results

The results of the field investigations and rock quality testing confirm that the upper part of the sequence (approximately the upper member of the Gull River formation, see Figures 2 and 3) is concrete stone for use in structures, sidewalk, curb and gutter, and concrete base. This upper “light grey limestone”, the “green beds” and the “dark grey beds” (both defined below) are shown in cross section in Figure 3.

The results of the field investigations and rock quality testing indicate that there is a zone of rock which should not be used for concrete stone, regardless of the amount mixed with better quality aggregate. This zone is properly defined as the top of the marked increase in natural gamma response in the geophysical log, which occurred at 20.6 m depth in DDH10-01 and at 25.6 m depth in BH13-01. For ease of reporting and to assist in field identification, the zone is defined by the green colour of the rock approximately one metre below the gamma marker. Thus, the “green beds” are defined to start at the top of Golder Zone “D” in DDH10-01, and the bottom of Zone RQ4 in BH13-01.

The results of the field investigations and rock quality testing indicate that there is a zone of rock which should not be used for concrete stone, unless it is effectively mixed with better quality overlying rock. This top of this zone is defined by the top of the marked increase in natural gamma response in the geophysical log which occurred at 9.7 m in DDH10-01 and at 13.3 m in BH13-01. The bottom of this zone is the top of the green beds, as defined above. For ease of reporting and to assist in field identification, the zone is defined by the dark colour of the lime mudstone prevalent within it. Thus, the “dark grey beds” are defined to start at the top of Golder Zone “C” in DDH10-

01 and the top of Zone RQ3 in BH13-01. It is noted that the dark grey beds zone is approximately 10 m thick, and that the upper 5 m contains more of the dark grey beds of lime mudstone than the lower 5 m.

The results of the field investigations and rock quality testing indicate two possible sources of concrete stone for use in structures, sidewalk, curb and gutter, and concrete base:

1. Rock column greater than 20 m thick above the green beds, when effectively mixed; and,

2. Rock above the dark grey beds.

Volumes of concrete stone in these two sources were calculated based on the results of the stratigraphic correlation.

3.3.2 Stratigraphic Correlation

Correlation of the natural gamma between all eight boreholes was conducted by NOTRA Inc., and the elevation of a marker location was determined in each borehole. For reference, the geophysical marker bed is at the base of CS 3 in DDH10-01. The depth below ground surface of the geophysical marker bed in each borehole based on geophysical correlation is shown in Table 8.

Table 8 - Stratigraphic Plane Information

BH	Easting	Northing	Ground Surface (masl)	Depth to Marker Bed (mbgs)	Elevation of Marker Bed (masl)
DDH10-01	375488	4907856	135.37	25.9	109.47
BH11-02	375321	4908199	138.14	29.5	108.64
BH11-03	375109	4907991	137.72	28.6	109.12
BH11-04	375437	4907054	125.69	12	113.69
BH12-01	375319	4907602	133.2	25.3	107.9
BH12-02	375148	4907222	128.9	19.5	109.4
BH12-03	374786	4906954	131.3	16.4	114.9
BH13-01	375115	4908411	138.15	30.0	108.15

The strike and dip for the stratigraphy was determined using a best fit plane through the geophysical marker bed in each borehole. The best fit plane through the marker locations, determined using a solver dips 3.6 m per kilometre to the north, and 2.2 m per kilometre to the east. In this stratigraphic model, and based on all the available information, the top of the green beds is 5.3 m above the marker bed, and the top of the dark grey beds is 16.2 m above the marker beds. The stratigraphic model is shown in cross section in Figure 3.

3.3.3 Assessed Volumes/Tonnes of Concrete Stone and Granular A

The stratigraphic model was inspected relative to the two extraction areas north and south of the gas pipeline to determine a practical quarrying operation to maximize extraction of concrete stone for use in structures, sidewalk, curb and gutter, and concrete base. As shown in Figure 3, the following two sources of concrete stone for use in structures, sidewalk, curb and gutter, and concrete base were identified:

1. All rock above 115 masl in the north extraction area so long as the rock column is effectively mixed during the blasting, loading, and crushing operation. There is approximately 10 million tonnes of this resource.

2. All rock above 128 masl in the south extraction area, north of approximately 4907320N (see Figure 3). There is approximately 2 million tonnes of this resource.

The remainder of the rock can be used for Granular A (approximately 40 million tonnes).

Due to its petrographic number, none of the rock can reliably be considered concrete stone for use in pavement.

4. CONCLUSIONS AND RECOMMENDATIONS

The results of the current assessment indicate the existence of three distinct zones of rock: an overlying light grey limestone, the “dark grey beds”, and the “green beds”. The overlying light grey limestone is concrete stone for use in structures, sidewalk, curb and gutter, and concrete base. Neither the dark grey beds nor the green beds alone are concrete stone; however the dark grey beds are concrete stone, so long as they are mixed with sufficient quantity of the overlying better quality rock.

As shown in Figure 3, the following two sources of concrete stone for use in structures, sidewalk, curb and gutter, and concrete base were identified:

3. All rock above 115 masl in the north extraction area so long as the rock column is effectively mixed during the blasting, loading, and crushing operation. There is approximately 10 million tonnes of this resource.

4. All rock above 128 masl in the south extraction area, north of approximately 4907320N (see Figure 3). There is approximately 2 million tonnes of this resource.

The remainder of the rock can be used for Granular A (approximately 40 million tonnes). None of the rock can reliably be considered concrete stone for use in pavement.

A program of rock quality testing is recommended at the start of quarrying of the north expansion area, to ensure that effective mixing of the rock column is achieved.

5. CLOSURE

We trust the above meets with your current requirements. Should you have any comments, questions, or require additional information, please do not hesitate to contact this office.

Respectfully Submitted

Morrison Hershfield Limited

Anthony West, Ph.D., P.Eng.
Senior Geo-Environmental Engineer

Adel Chowdhury B.Eng.
Geo-Environmental Consultant

6. LIMITATIONS AND USE

This report has been prepared for the exclusive use of Cruickshank Construction Limited, by Morrison Hershfield Limited (Morrison Hershfield). Morrison Hershfield hereby disclaims any liability or responsibility to any person or party, other than Cruickshank Construction Limited, for any loss, damage, expense, fines, or penalties which may arise from the use of any information or recommendations contained in this report by a third party.

The report, which specifically includes all tables, figures and appendices is based on data and information collected during investigations conducted by Morrison Hershfield and is based solely on the conditions of the site at the time of the investigation, supplemented by historical information and data obtained by Morrison Hershfield as described in this report.

Morrison Hershfield has exercised professional judgment in collecting and analyzing the information and formulating recommendations based on the results of the study. The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to this study. No other warranty or representation, either expressed or implied, as to the accuracy of the information or recommendations included or intended in this report.

7. REFERENCES

Carson, D.M., 1981. Paleozoic Geology of the Tichborne-Sydenham Area, Southern Ontario; Ontario Geological Survey Preliminary Map P. 2413, Geological Series. Scale 1:50,000, Geology, 1980.

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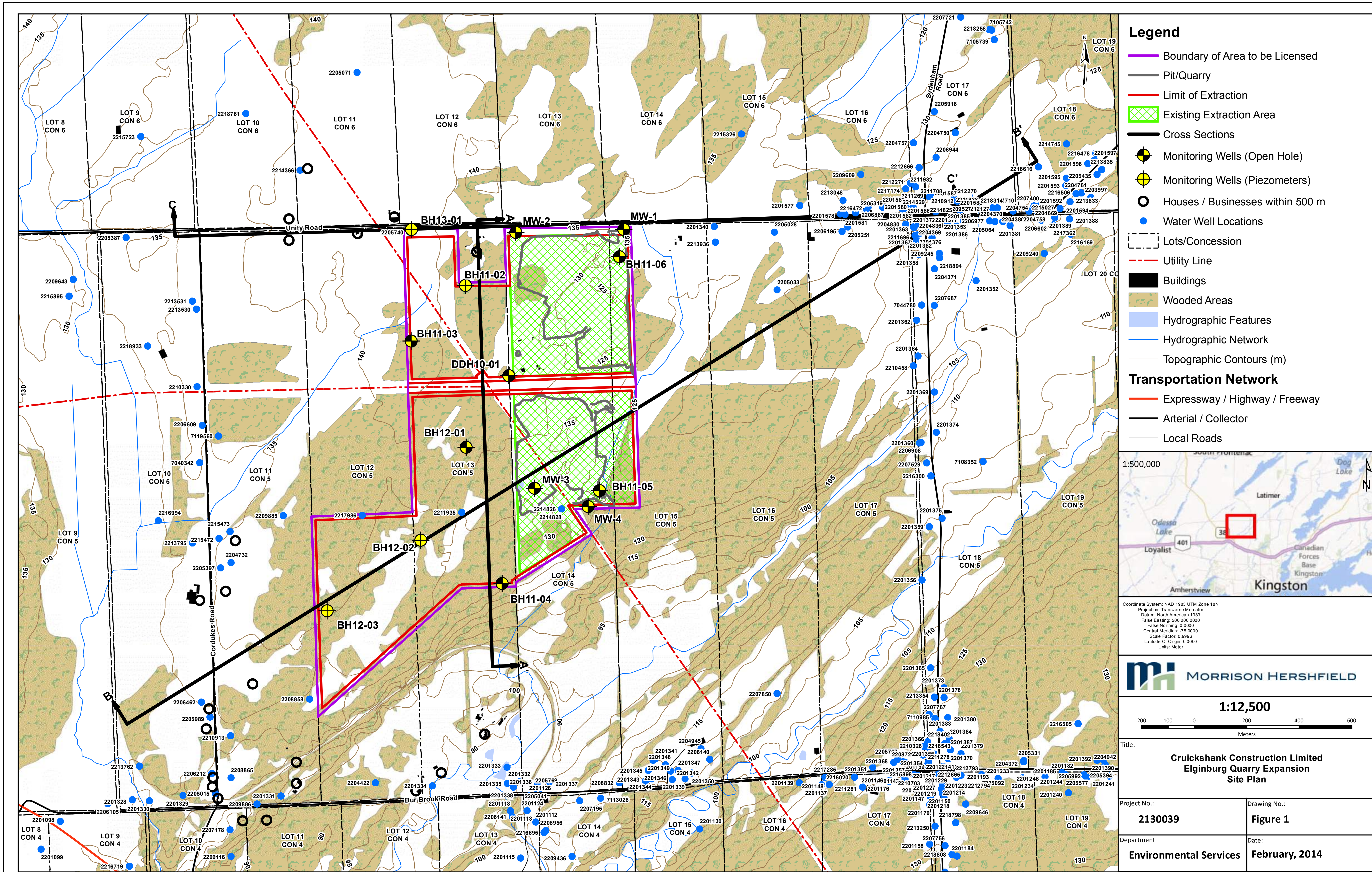
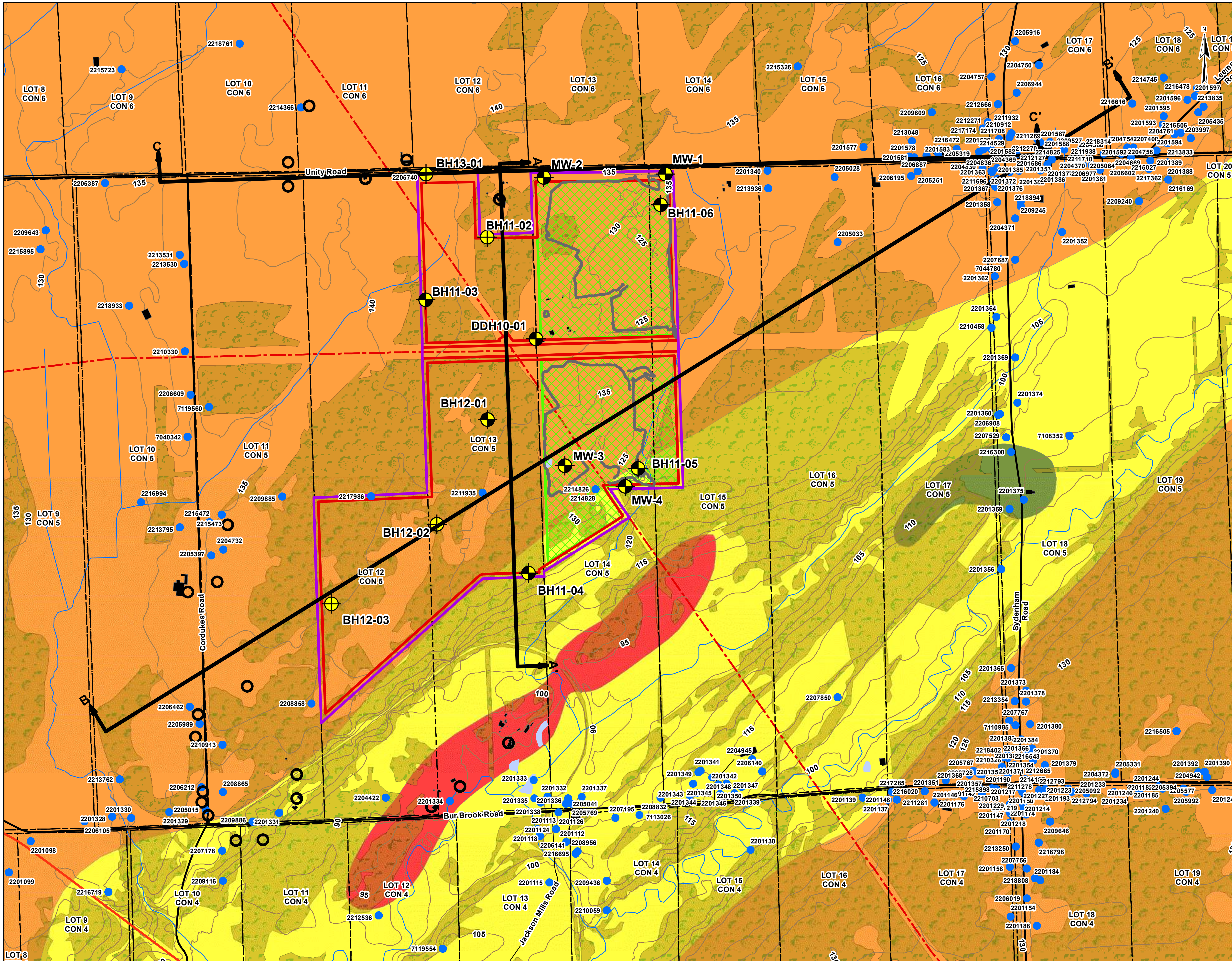
Water Well Information System 2012, Well Records, Ministry of the Environment http://www.ene.gov.on.ca/environment/en/subject/wells/STDPROD_075977.html, October

APPENDIX A: Figures



Legend
Boundary of Area to be Licensed
Pit/Quarry
Limit of Extraction
Existing Extraction Area
Cross Sections
Monitoring Wells (Open Hole)
Monitoring Wells (Piezometers)
Houses / Businesses within 500 m
Water Well Locations
Lots/Concession
Utility Line
Buildings
Wooded Areas
Hydrographic Features
Hydrographic Network
Topographic Contours (m)
Transportation Network
Expressway / Highway / Freeway
Arterial / Collector
Local Roads
1:500,000
Latimer
Odessa Lake
Loyalist
Amherstview
Kingston
Canadian Forces Base Kingston
Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -75.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter
MORRISON HERSHFIELD
1:12,500
200 100 0 200 400 600
Meters
Title:
Cruickshank Construction Limited
Elginburg Quarry Expansion
Site Plan
Project No.:
2130039
Drawing No.:
Figure 1
Department
Environmental Services
Date:
February, 2014
Unity Road
Bur Brook Road
Cordukes Road
Sydenham Road
MW-1
MW-2
MW-3
MW-4
BH13-01
BH11-02
BH11-03
BH11-04
BH11-05
BH11-06
BH12-01
BH12-02
BH12-03
DDH10-01



Legend

- Boundary of Area to be Licensed
- Pit/Quarry
- Limit of Extraction
- Existing Extraction Area
- Cross Sections
- Monitoring Wells (Open Hole)
- Monitoring Wells (Piezometers)
- Water Well Locations
- Houses / Businesses within 500 m

Ontario Geological Survey

FORMATION, MEMBER

- Gull River, upper member
- Gull River, middle member
- Gull River, lower member
- Precambrian,
- Lots/Concession
- Utility Line
- Buildings
- Wooded Areas
- Hydrographic Features
- Hydrographic Network
- Topographic Contours (m)

Transportation Network

- Expressway / Highway / Freeway
- Arterial / Collector
- Local Roads

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983
False Easting: 500,000.0000
False Northing: 0.0000
Central Meridian: -75.0000
Scale Factor: 0.9996
Latitude Of Origin: 0.0000
Units: Meter

MORRISON HERSHFIELD

1:12,500

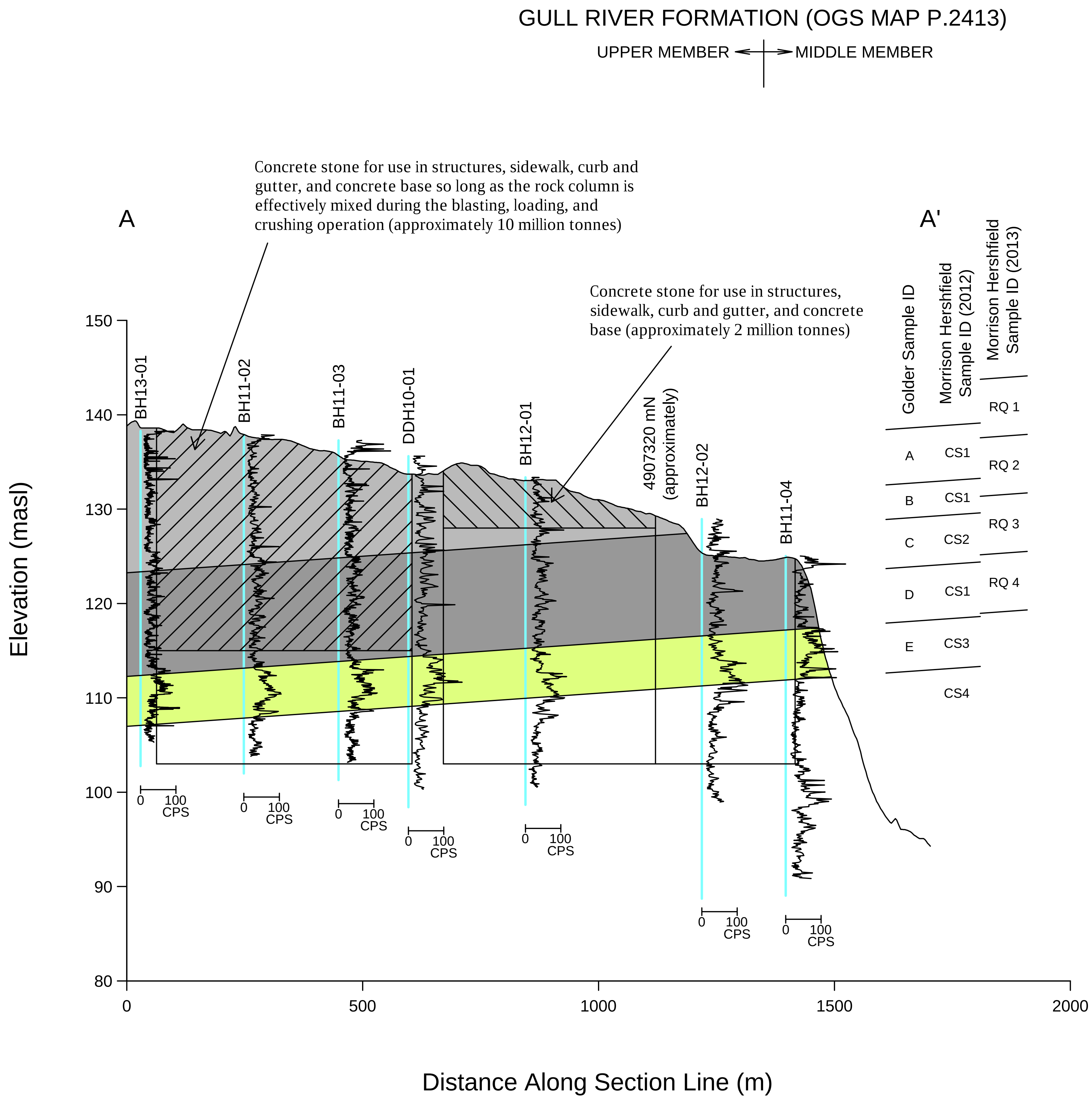
200 100 0 200 400 600
Meters

Title:

Cruickshank Construction Limited
Elginburg Quarry Expansion
Bedrock Geology

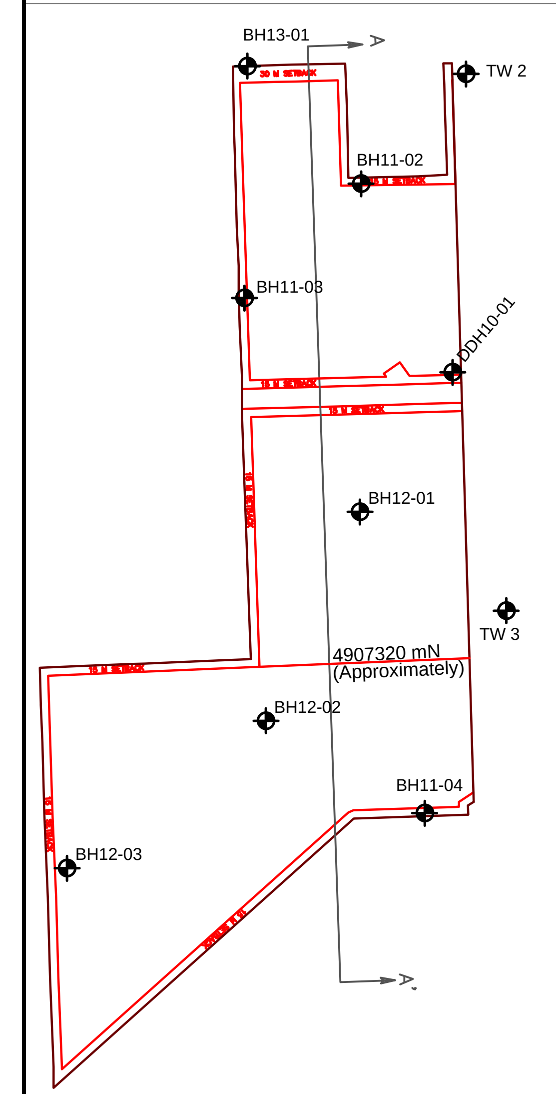
Project No.:	Drawing No.:
2130039	Figure 2
Department	Date:
Environmental Services	February, 2014

K:\Internal\Environmental Services\GIS_Environment_Services\GIS_Project_Work\Ottawa\2124083\Phase2\GIS_2124083\GIS_Maps\Site_Plan_2130039_Expansion_geo.mxd



Legend

- Light Grey Limestone
- Limestone with Dark Grey Beds
- Limestone with Green Beds
- Limestone



MORRISON HERSHFIELD

Scale: N.T.S.

Title: Elginburg Quarry Expansion
Section AA' Through Quarry

Project No.: 2130135	Drawing No.: Figure 3
Department: Environmental Services	Date: March 7, 2014

L:\proj\2130135\Cross Section\Updated Cross Section Mar 6 2014.dwg

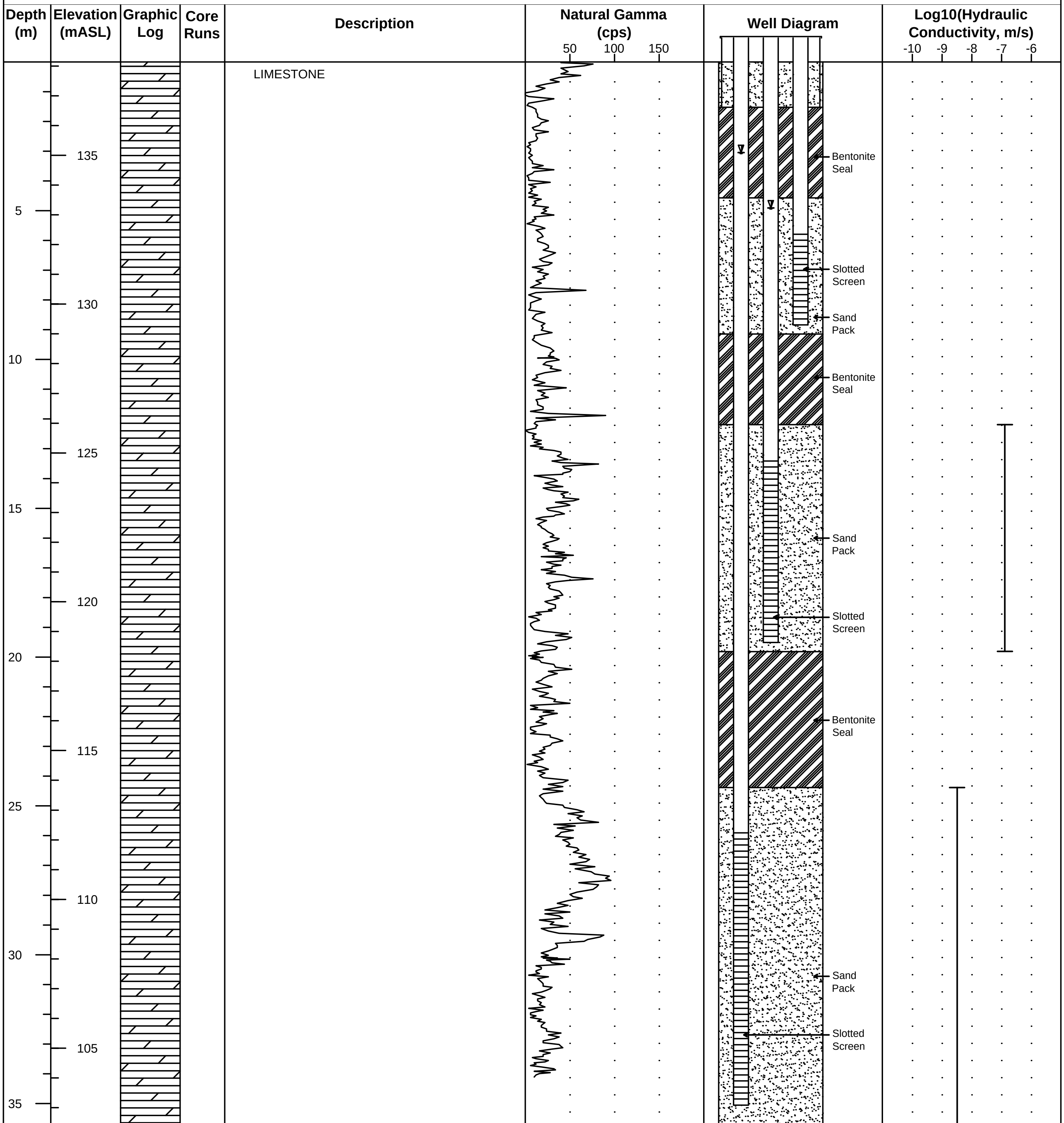
APPENDIX B: Borehole Logs

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH11-02

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375321 mE, 4908199 mN (UTM Zone 18 NAD 83)
Date Completed 12/12/2013
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 138.14 mASL
Casing Top Elevation 138.94 mASL
Static Water Level See Well Diagram



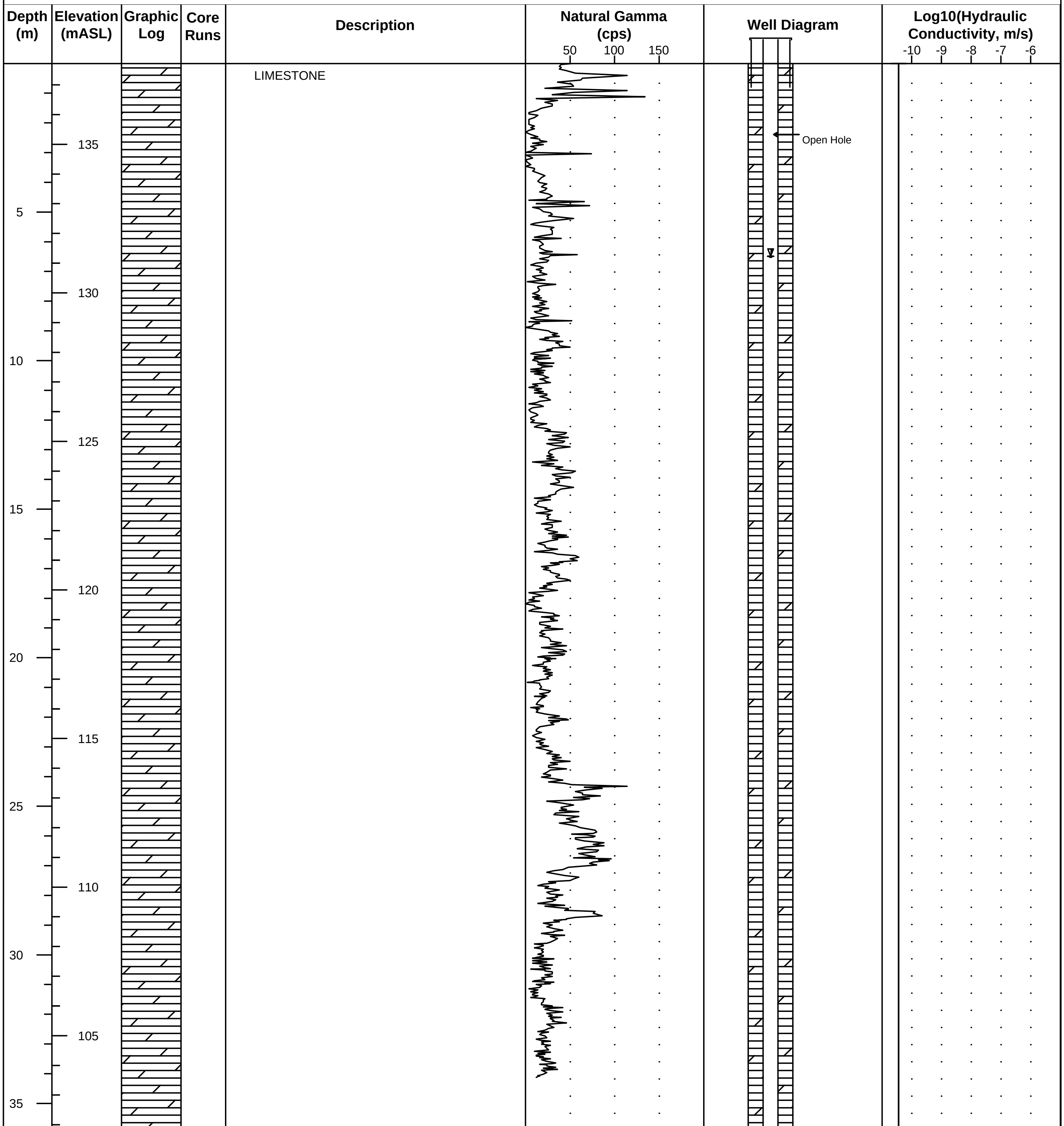
End of Borehole at 102.18 mASL

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH11-03

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375109 mE, 4907991 mN (UTM Zone 18 NAD 83)
Date Completed 2011
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 137.72 mASL
Casing Top Elevation 138.52 mASL
Static Water Level See Well Diagram



End of Borehole at 101.72 mASL

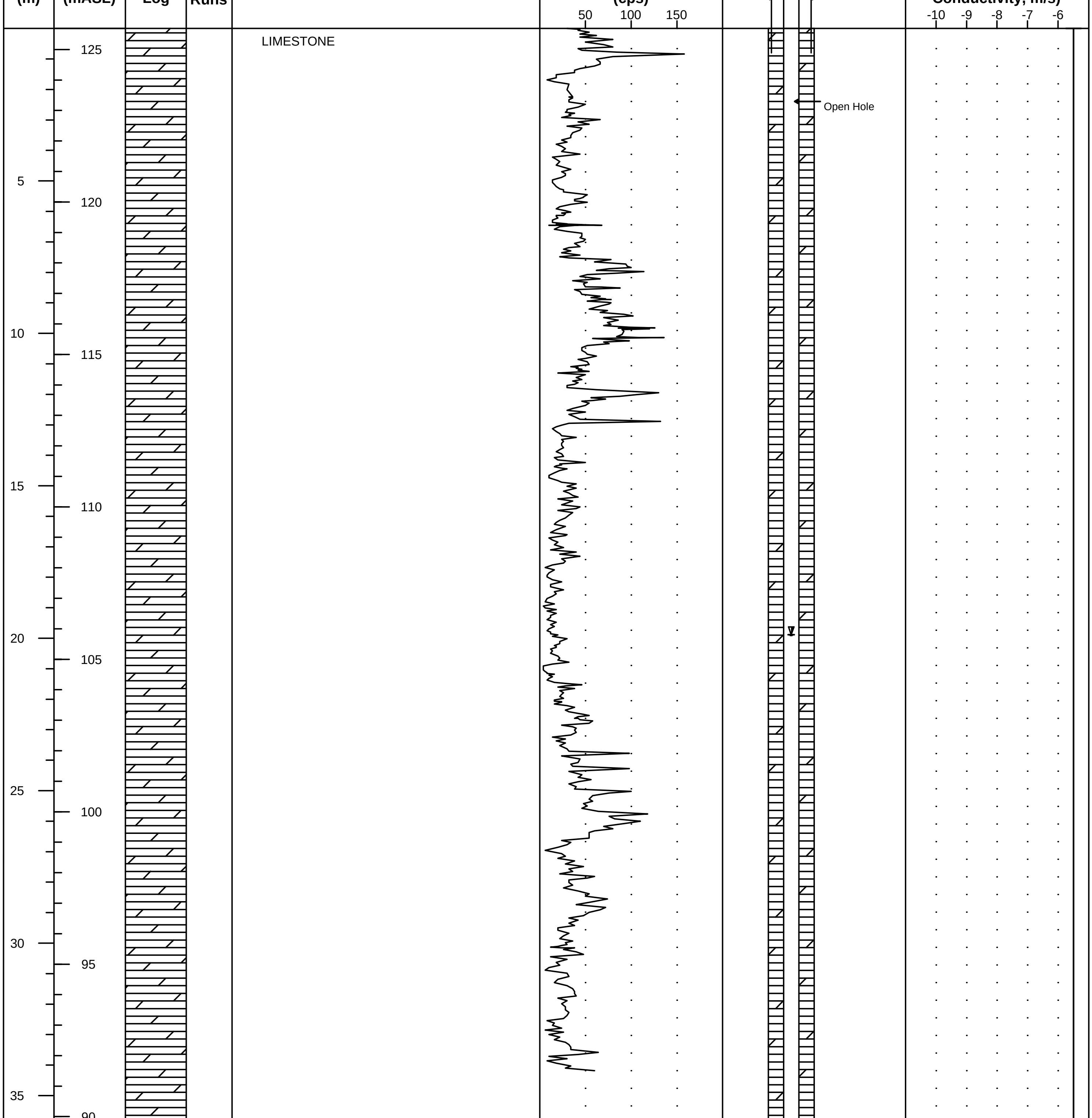
Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH11-04

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375437 mE, 4907054 mN (UTM Zone 18 NAD 83)
Date Completed 2011
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 125.69 mASL
Casing Top Elevation 126.63 mASL
Static Water Level See Well Diagram

Depth (m)	Elevation (mASL)	Graphic Log	Core Runs	Description	Natural Gamma (cps)	Well Diagram	Log10(Hydraulic Conductivity, m/s)



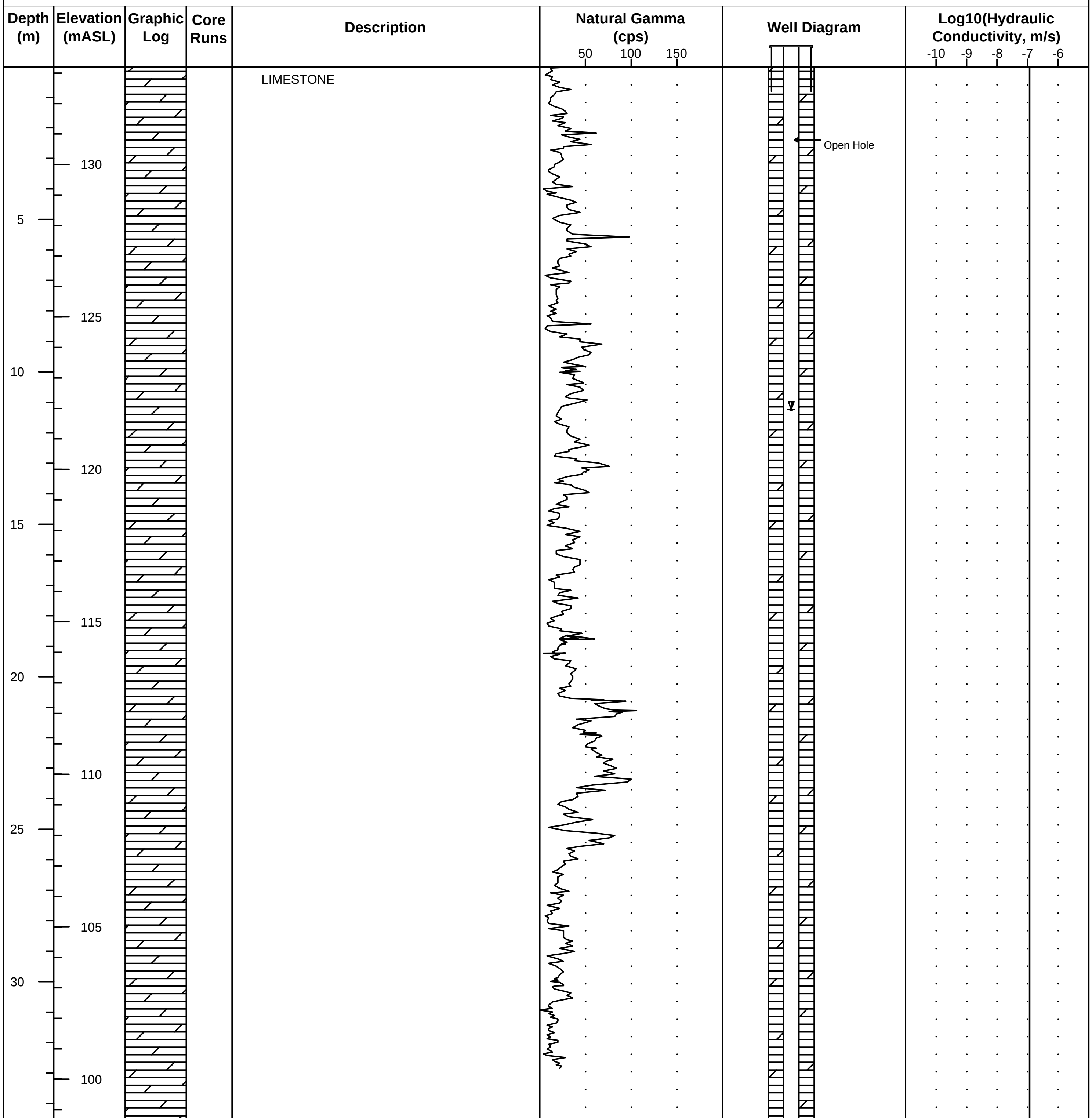
End of Borehole at 89.69 mASL

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH12-01

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375319 mE, 4907602 mN (UTM Zone 18 NAD 83)
Date Completed 12/14/2012
Hole Size 4 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 133.20 mASL
Casing Top Elevation 133.84 mASL
Static Water Level See Well Diagram



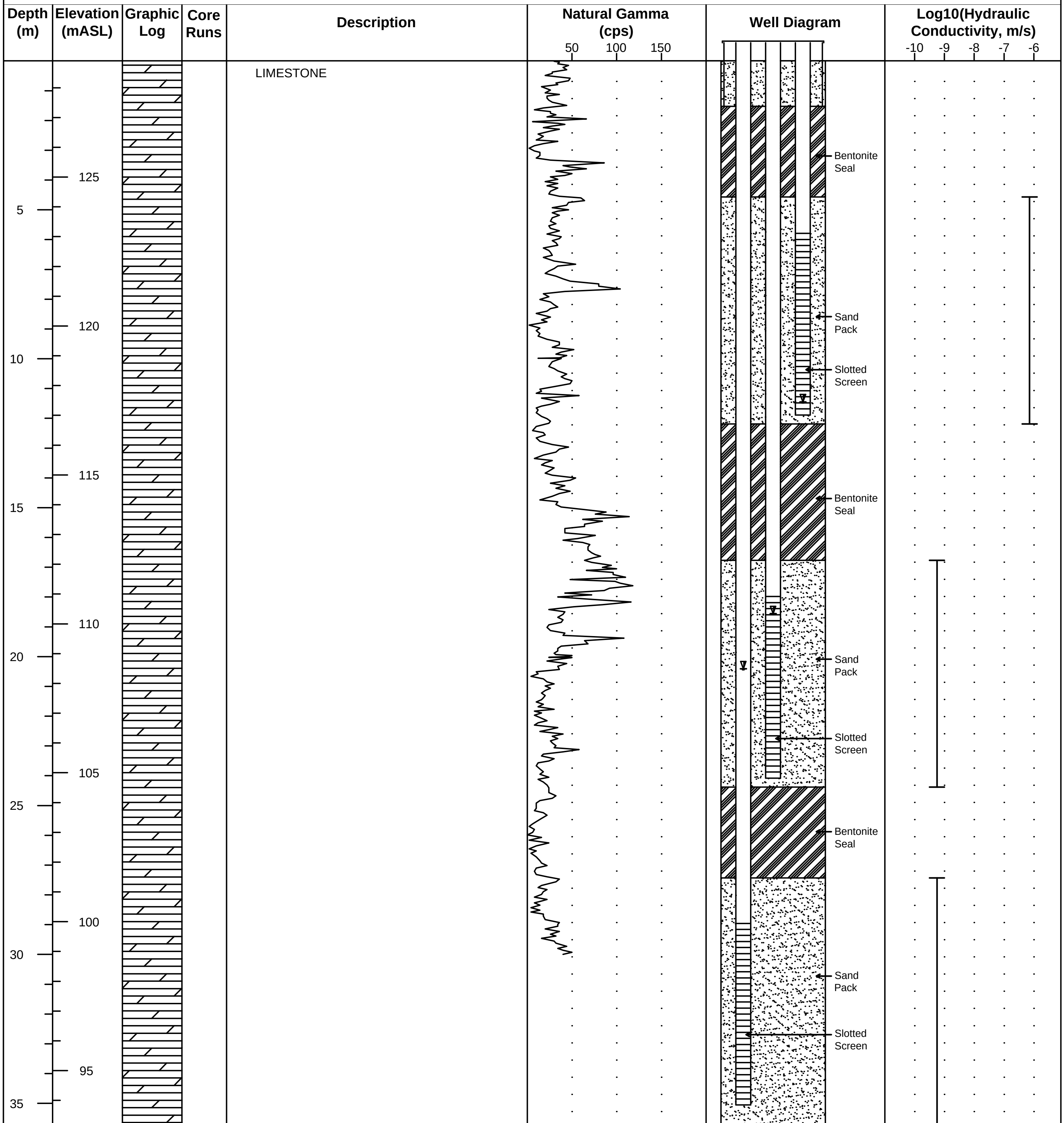
End of Borehole at 98.50 mASL

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH12-02

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375148 mE, 4907222 mN (UTM Zone 18 NAD 83)
Date Completed 12/12/2013
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 128.90 mASL
Casing Top Elevation 129.51 mASL
Static Water Level See Well Diagram



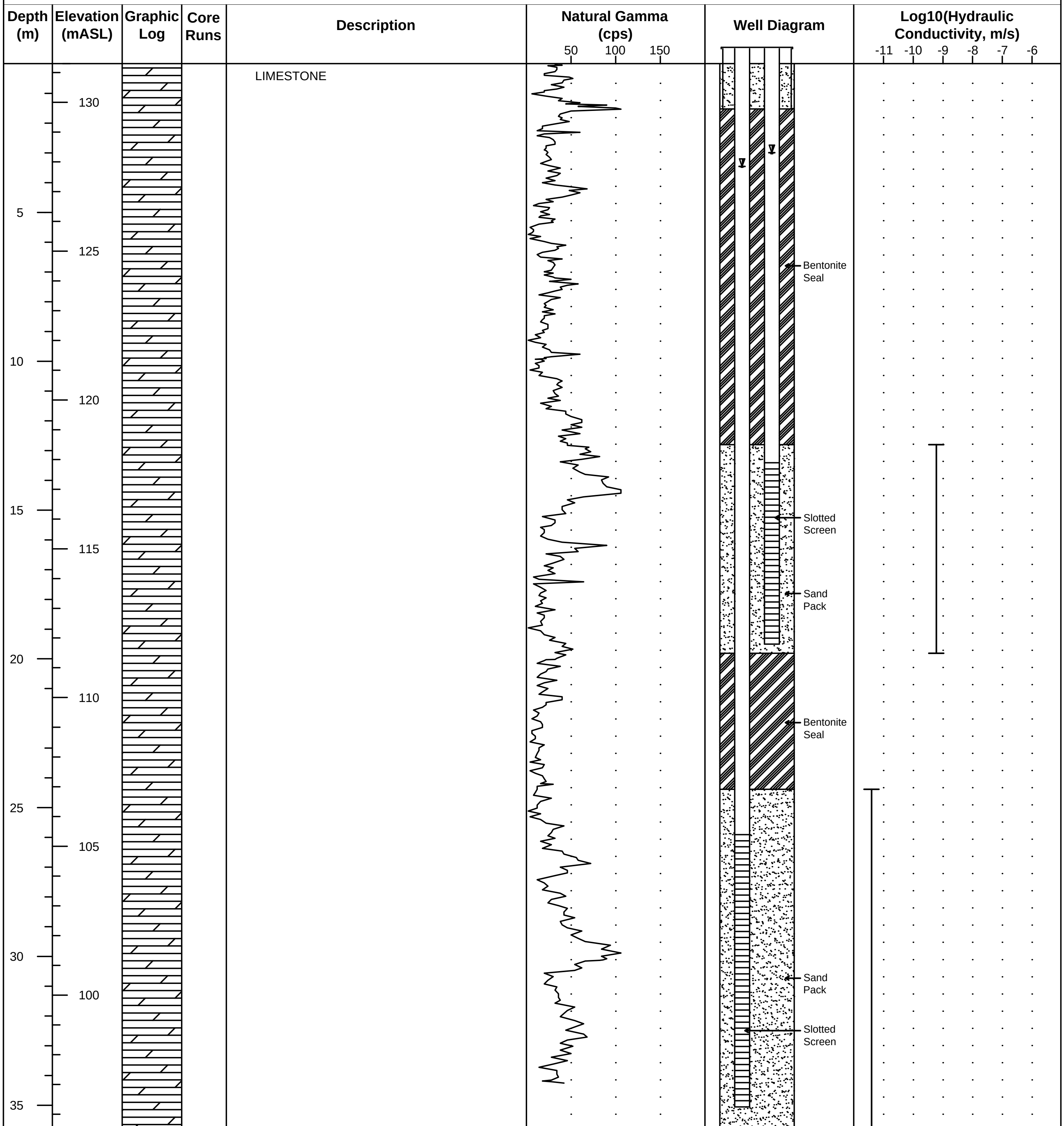
End of Borehole at 92.94 mASL

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH12-03

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 374786 mE, 4906954 mN (UTM Zone 18 NAD 83)
Date Completed 12/12/2013
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 131.30 mASL
Casing Top Elevation 131.80 mASL
Static Water Level See Well Diagram



End of Borehole at 95.34 mASL

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH13-01

CLIENT Cruickshank Construction Limited
PROJECT NAME Elginburg Resource Evaluation
PROJECT NUMBER 2130039
PROJECT LOCATION Elginburg Quarry, Kingston, Ontario
DATE STARTED 12/9/13 **COMPLETED** 12/10/13
GROUND ELEVATION **HOLE SIZE** 4"
DRILLING CONTRACTOR George Downing Estate Drilling Ltd.
GROUND WATER LEVELS:
DRILLING METHOD
AT TIME OF DRILLING ---
LOGGED BY P. Roger **CHECKED BY** A. West
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	Vapor Concentrations: IBL (ppm) 0 0 0 0 / HEX (ppm) 0 0 0 0
0			TOPSOIL/SUBGRADE	
		0.8	Light grey DOLOSTONE with dark grey beds. Solid, medium soft, medium to fine grained. Fratured with smooth to rough, flat, natural and mechanical fractures. Brown/white infilling present (possibly calcite). RQD = 0%	
		1.1	Light grey DOLOMITIC LIMESTONE with dark grey beds (random) with 2" white/grey limestone layer. Solid, medium soft, medium to fine grained. Fractured with smooth to rough, flat, natural and mechanical fractures and smooth, vertical, natural fracture. RQD = 14.2%	
2		2.7	Light grey DOLOMITIC LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Fractured with smooth to rough, flat, mechanical and natural fractures. RQD = 50%	
4		4.3	Light grey DOLOMITIC LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Fractured to blocky with flat, smooth to rough, natural and mechanical fractures. RQD = 56%	
		5.8	Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky to seamy with smooth to rough, flat, natural fractures. RQD = 78%	
6		7.3	Light grey LIMESTONE with minimal dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy/fractured with flat, smooth to rough, natural fractures. RQD = 97%	
8		8.8	Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy/fractured with flat, smooth to rough, natural fractures. RQD = 100%	
10		10.3	Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy/fractured with flat, smooth to rough, natural fractures. RQD = 86%	
12		11.9		

(Continued Next Page)

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH13-01

CLIENT Cruickshank Construction Limited
PROJECT NAME Elginburg Resource Evaluation
PROJECT NUMBER 2130039
PROJECT LOCATION Elginburg Quarry, Kingston, Ontario

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	Vapor Concentrations: IBL (ppm) 0 0 0 0 / HEX (ppm) 0 0 0 0
12			Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy with flat, smooth to rough, natural fractures. RQD = 91% *(continued)*	
			13.4	
14			Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy/fractured with flat, smooth to rough, natural fractures. RQD = 85%	
			14.9	
16			Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Blocky/seamy/fractured with flat, smooth to rough, natural fractures. RQD = 98%	
			16.4	
			Light grey LIMESTONE with dark grey beds. Solid, medium soft, medium to fine grained. Fractured with flat, smooth to rough, natural and mechanical fractures. White, medium soft infilling, possibly calcite. RQD = 99%	
18			18.0	
			Light grey LIMESTONE with dark grey beds. Solid, medium soft to hard, medium to fine grained. Fractured with flat, smooth to rough, natural and mechanical fractures. RQD = 100%	
			19.4	
20			Light grey LIMESTONE with dark grey beds. Speckled patch at approximately 20.73m. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough, natural and mechanical fractures. RQD = 100%.	
			21.0	
22			Light grey LIMESTONE with dark grey beds. Solid, medium soft to hard, medium to fine grained. Blocky/seamy with flat, smooth to rough, natural and mechanical fractures and a moderately dipping (45 deg angle) fracture at approximately 21.18 m. RQD = 99%	
			22.5	
			Light grey LIMESTONE. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough, natural and mechanical fractures. RQD = 100%	
24			24.0	
			Light grey LIMESTONE. Solid, hard, medium to fine grained. Fractured with flat, smooth to rough, natural and mechanical fractures. Dark grey silty clay layer present between 24.69 m and 24.89 m. RQD = 85%	
			25.5	

(Continued Next Page)

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH13-01

CLIENT Cruickshank Construction Limited
PROJECT NAME Elginburg Resource Evaluation
PROJECT NUMBER 2130039
PROJECT LOCATION Elginburg Quarry, Kingston, Ontario

DEPTH (m)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	Vapor Concentrations IBL (ppm) / HEX (ppm)
26			Light grey LIMESTONE. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. RQD = 100% *(continued)*	
			27.0 — Light grey LIMESTONE with greenish beds. Solid, medium soft to hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. RQD = 97%	
28			28.5 — Light grey LIMESTONE with a few greenish beds. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. RQD = 79%	
30			30.0 — Light grey LIMESTONE. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. Light grey, clayey like material infill with fragments of rock at approximately 30.43 m. RQD = 88%	
			31.5 — Light grey LIMESTONE. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. RQD = 100%	
32			33.1 — Light grey LIMESTONE. Solid, hard, medium to fine grained. Blocky/seamy with flat, smooth to rough fractures. RQD = 100%	
34			34.6 — Light grey LIMESTONE. Solid, hard, medium to fine grained. Fractured with flat, smooth to rough fractures. RQD = 100%	
			35.1	

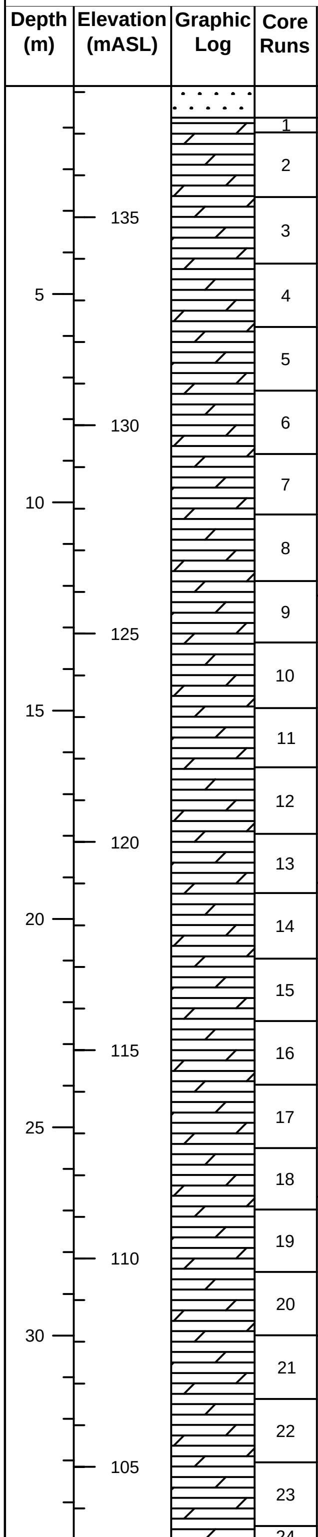
Bottom of borehole at 35.05 meters.

Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

BORING NUMBER BH13-01

Client Cruickshank Construction Limited
Project Number 2130039.00
Well Location 375115 mE, 4908411 mN (UTM Zone 18 NAD 83)
Date Completed 12/12/2013
Hole Size 6 inch

Project Name Elginburg Quarry Expansion ARA Application
Project Location Elginburg Quarry
Ground Surface Elevation 138.15 mASL
Casing Top Elevation 138.61 mASL
Static Water Level See Well Diagram



Description

TOPSOIL

LIMESTONE. Light to dark blue grey. Solid, medium soft to hard, micritic to medium grained. Blocky to fractured with smooth to rough fractures. Occasionally interbedded with lime mudstone.

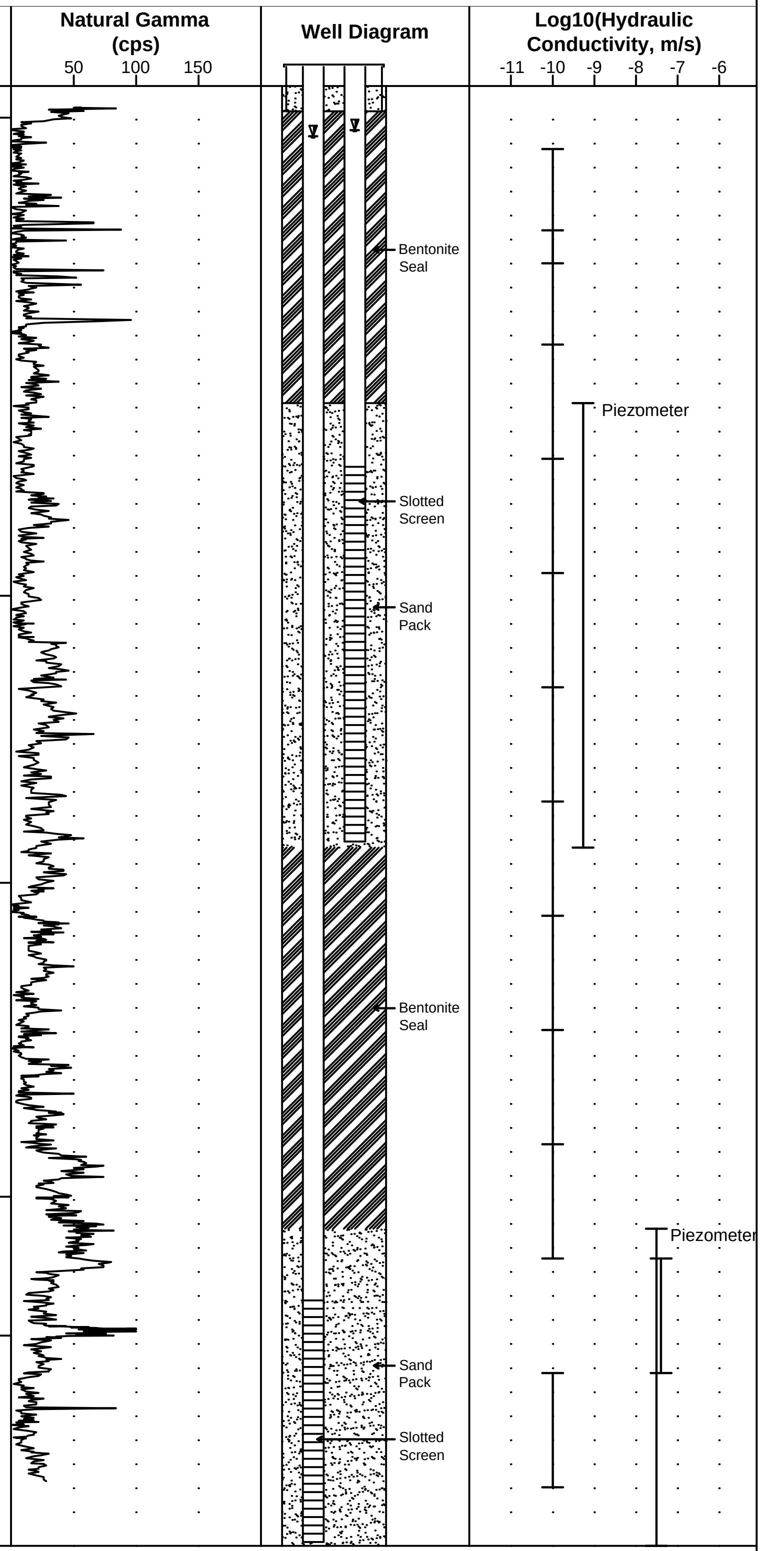
LIMESTONE. Light to dark blue grey. Solid, medium soft to hard, micritic to medium grained. Blocky to fractured with smooth to rough fractures. Extensive lime mudstone bedding (up to 10 cm in thickness).

LIMESTONE. Light to dark blue grey. Solid, medium soft to hard, micritic to medium grained. Blocky to fractured with smooth to rough fractures. Occasional lime mudstone interbedding (up to 3 cm in thickness).

Dark grey silty clay layer present between 24.69 m and 24.89 m.

LIMESTONE. Light to dark blue grey. Solid, medium soft to hard, micritic to medium grained. Blocky to fractured with smooth to rough fractures. Contains grey-green argillaceous lime mudstone interbedding.

LIMESTONE. Light to dark blue grey. Solid, medium soft to hard, micritic to medium grained. Blocky to fractured with smooth to rough fractures.



End of Borehole at 103.10 mASL

Hydraulic Conductivity are from Packer Test unless noted otherwise.
Packer Test: No flow assumed equal to 1 x 10^{-10} m/s

APPENDIX C: Downhole Geophysics Report

NOTRA

SUMMARY OF THE PHYSICAL PROPERTY BOREHOLE GEOPHYSICAL SURVEYS CONDUCTED AT ELGINBURG, ONTARIO

Submitted To:

Morrison Hershfield

Date
29 January 2013

Prepared By:

NOTRA Inc.
Dennis Gamble, P.Geo.

EXECUTIVE SUMMARY

A potential quarry expansion has been identified along the west and south west side of the current operations near Elginburg, ON, north of Kingston, Ontario.

In order to determine if suitable rock materials are sufficient and shallow enough to make a quarry operation feasible, a series of three (3) additional bore holes were commissioned throughout the property (in addition to 3 previously drilled). One hole, DDH10-01 (2010) was cored using a diamond drill borehole rig, allowing for a core log to be determined as well as additional chemical analysis. The geologic sections determined from DDH10-01 served as a reference log of the local geology and other boreholes.

An additional three (3) holes were drilled using reverse circulation techniques in 2012, holes BH1201, BH1202 and BH1203, which result in only rock dust being retrieved from the holes. Three other holes drilled in 2011 were also surveyed (BH1102, BH1103 and BH1104). In order to determine the lithology in these holes, borehole physical property surveys were conducted and the results compared to the reference log of DDH10-01.

Morrison Hershfield contracted NOTRA Inc. to conduct the seven (7) borehole physical property surveys. The Instruments for Geophysics (IFG) BMP06 multi-parameter probe was used along with the IFG 100 meter winch with optical depth encoder. The BMP06 simultaneously measures six (6) parameters at a rate of two (2) readings per second. The site was large; with limited access to the holes that were distributed over an area of approximately 1.2 km x 500m. A Side by Side ATV was used to transport the equipment from hole to hole.

Following analysis of the data it was determined that the natural gamma displayed a very close resemblance between all seven (7) boreholes. Using the DDH10-01 results, marker locations for the other 6 holes were projected using the natural gamma and resistivity data.

At the time of this report the results of the core and chemical analysis were not provided, however, the geophysical markers can be used to interpolate the relative depths any zones of interest from DDH10-01 to the other holes.

The overall trend indicates that the sedimentary rock sequences dip linearly to the south relative to the ground surface (elevation data has not be collected or provided). Over approximately 1100 meters from north to south, the top of DDH10-01 is found to have an additional 13 meters of sedimentary rock above it, implying a dip of approximately 0.6 Degrees.

TABLE OF CONTENTS

1.0 Introduction

On 18 December 2012, NOTRA conducted a physical property borehole survey of seven (7) Boreholes that were approximately 35m in depth. Borehole DDH10-01 was a cored hole from which geophysical markers were identified. The other six (6) holes were drilled using reverse circulation and no core logs were produced.

The purpose of the borehole survey was to provide a manner to compare the geology sequences and depths between the cored hole and the six non-cored holes. An IFG BMP06 multi-parameter borehole tool was used to log data at approximately 5 cm intervals in all seven (7) holes.

The water table was found to be relatively deep, between 8 to 20 meters for the five (5) holes. The Apparent Resistivity and Single Point Resistance can only work within the water column and were deleted in the dry section of each hole. The Magnetic Susceptibility and Apparent Conductivity reacted only to the casing and were not used otherwise. The temperature data is presented, but only provides information of possible porous fractures.

The natural gamma data works within casing, dry sections of holes and within the water column with no variation. It was this parameter that was reproducible from hole to hole and can be used to imply the depths of any sequence relative to the sequences present in DDH10-01.

2.0 Methodology and Approach

BMP06

The BMP06 measures simultaneously the temperature (T), apparent conductivity (AC), apparent resistivity (AR), single point resistance (SPR), magnetic susceptibility (MS) and natural gamma (NG) at a rate of 2 reading per second. The depth is also measured using an optical depth encoder that is part of the pulley mechanism affixed to the casing.

During the survey a 5 mA current is transmitted into the electrode from the control unit (remotely placed 25 meters from the borehole). This is used for the apparent resistivity measurements.

Upon placing the borehole probe in the hole, the depth of Zero is entered in the logging computer after the top of the probe has been lined up with the top of the casing. All depth references are to the top of the casing.

With the computer logging, the probe is lowered at approximately 5 meters per minute, resulting in one data point for all parameters being recorded every 4 cm. The probe is stopped briefly at 10 meter intervals (to confirm the accuracy of the optical depth encoder). Following completion of the hole, data is then collected while bringing the probe up, although at a faster rate. This up data is compared to the down run data to ensure proper operation of the unit. In the event there is a depth dispute when the probe reaches the top of the casing, the hole is resurveyed.

From each file the depth values are also confirmed (using the 10 m calibration points) and each parameter is extracted to an asc file. These files were then plotted in LogView from which analysis can be conducted.

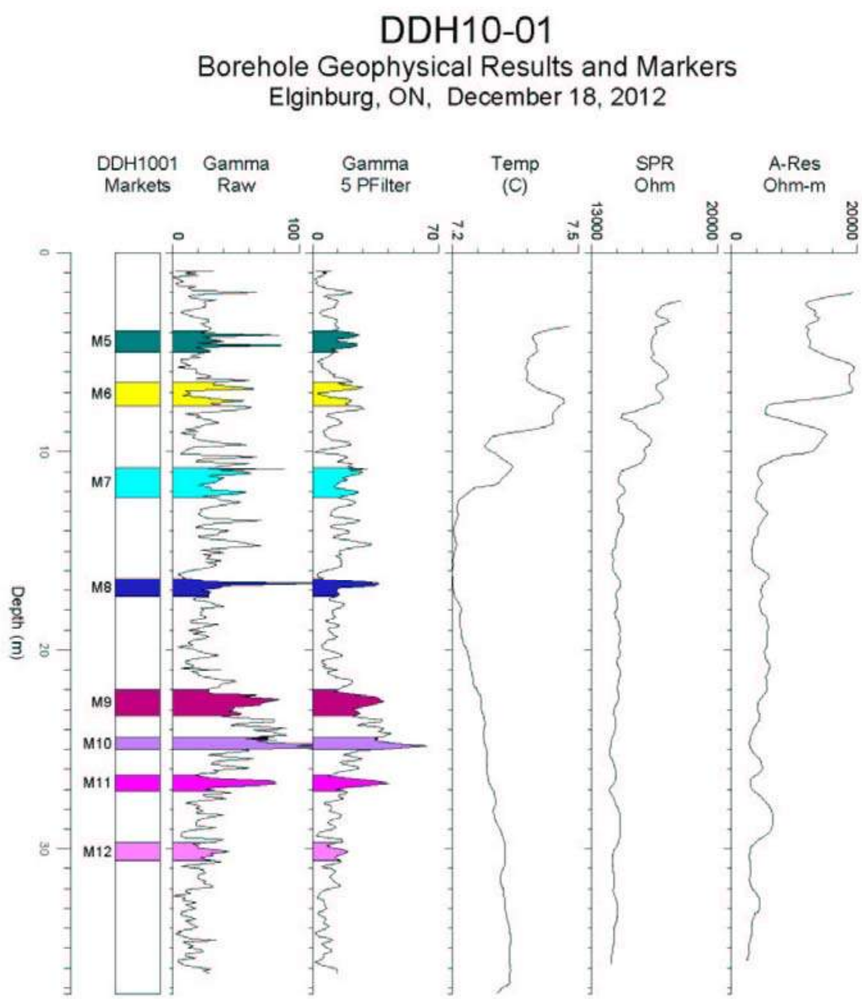
Annex A has a complete description of the BMP06 probe and winch used during this survey.

Annex B has a description of the portable, manual 100m winch.

3.0 Results

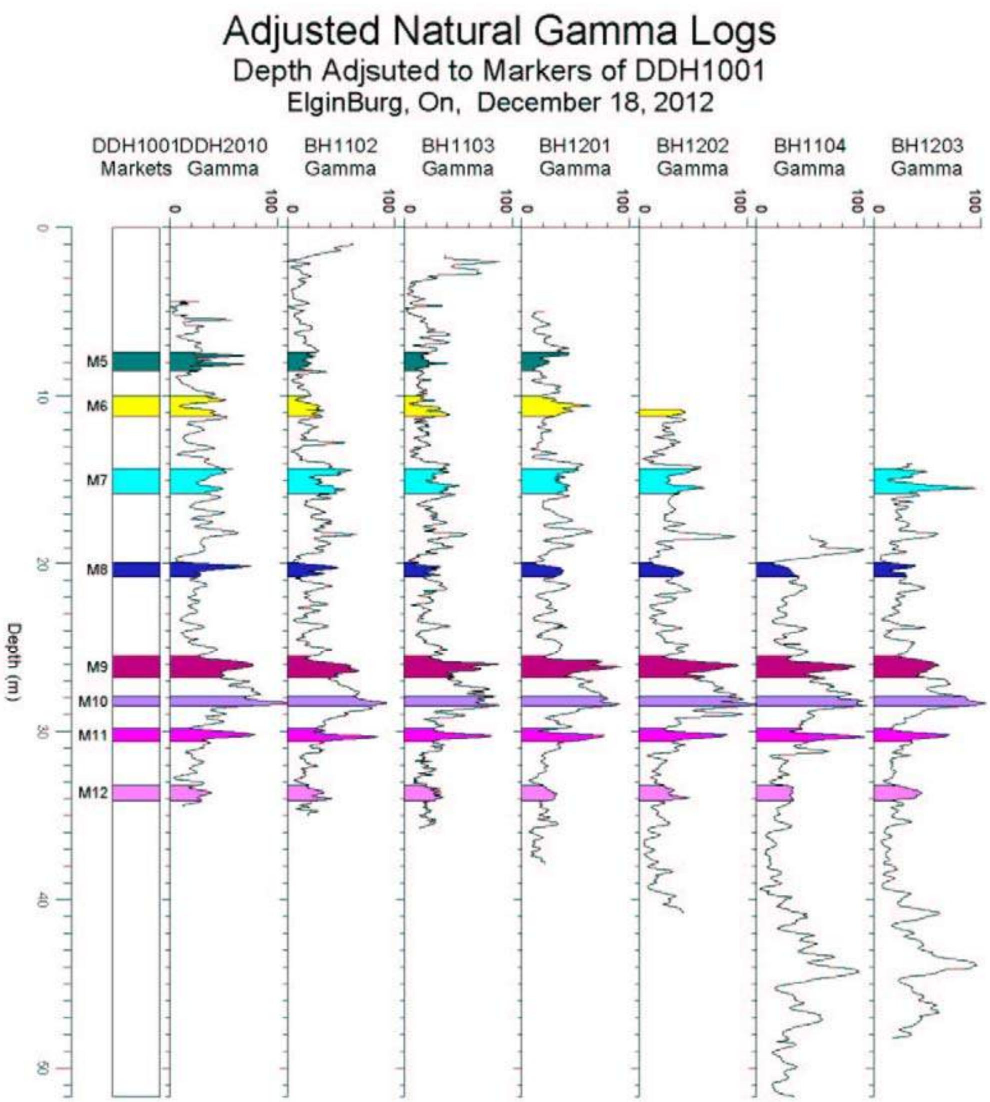
DDH10-01 was surveyed and divided into the eight markers (8) units based on the natural gamma profiles starting at marker 5 (marker 1 to 4 to be attributed to markers higher in the sedimentary sequence than present at the ground level of DDH10-01).

Figure 1 – DDH10-01 with Markers



After determining location of these markers depths for the remaining 6 holes, the relative depth was adjusted until they matched that of the natural gamma markers (M5 toM12), the Natural Gamma data was plotted for all the holes and adjusted to line up (on BH1102 – the highest). - The complete logs for BH1102-BH1104, to BH1201-BH1203 are contained in Annex B.

Figure 2 - Natural Gamma Data – Levelled to Markers



The natural gamma data maps profiles for each hole are very similar when adjusted by a vertical shift and aligned to specific features in the profiles.

The following table summarizes the depth of each hole surveyed, the water table depth and the relative shift to the natural gamma profiles to align the markers to BH1102.

Table 1 - Borehole Summary

		Depth in meters	
Borehole	Water	Hole Length	Shift to Align Markers
DDH1001	3.7	37.2	4.4
BH1102	4.9	35.9	0.9
BH1103	8.8	36.0	1.6
BH1104	19.8	36.0	18.3
BH1201	11.4	34.7	5.0
BH1202	17.6	39.1	10.8
BH1203	2.0	36.1	14.0

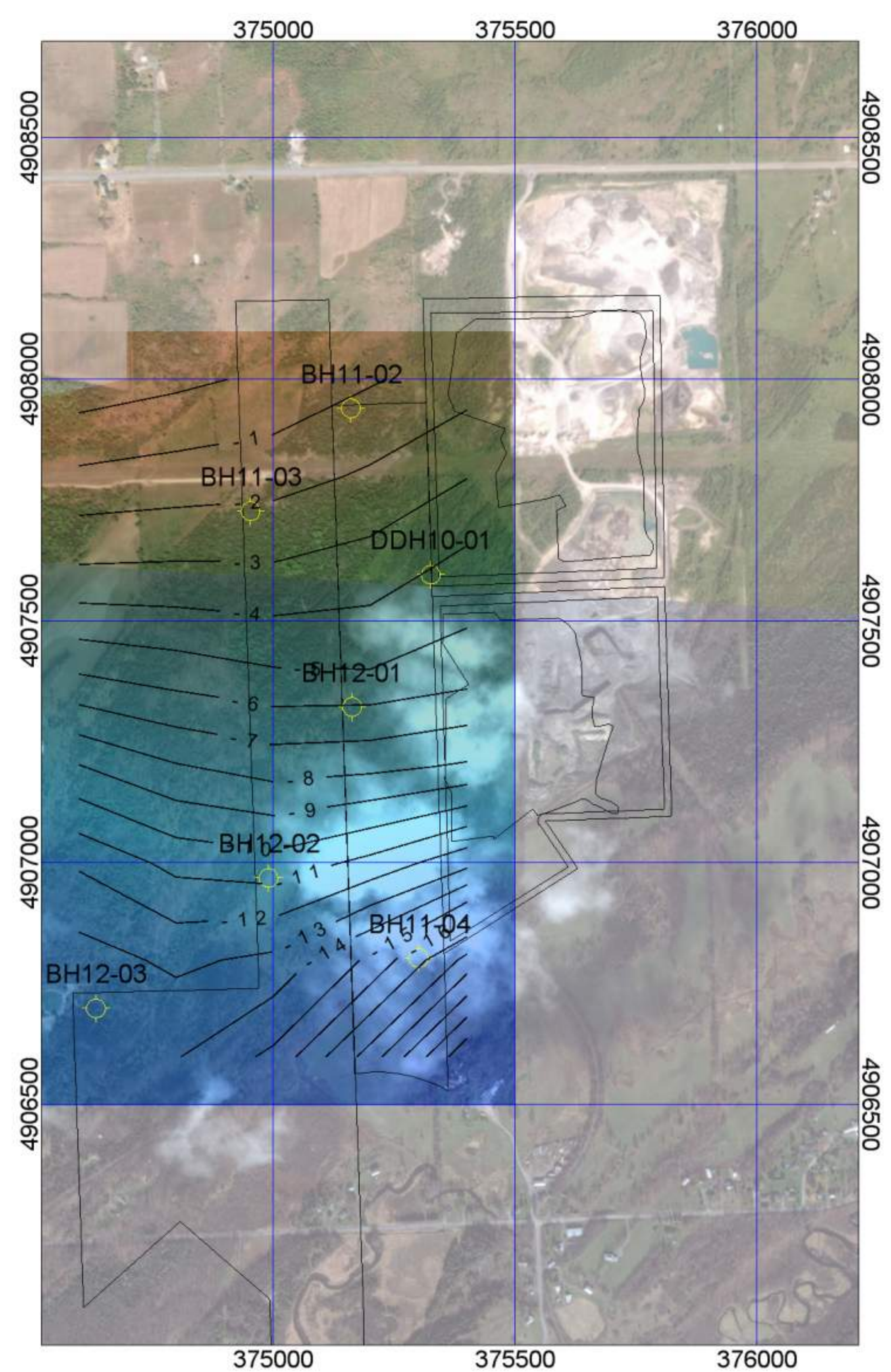
By plotting the location of each hole and the shift required to align the Natural Gamma data, the relative dip and strike of the sedimentary rocks can be plotted relative to the top of the borehole casing (the reference for each profile). Table 2 below has the locations (provided by Morrison Hershfield) and the shift.

Table 2 - Borehole Locations and Shift to Align Markers

Name	X	Y	Shift to Align Gamma
DDH10-01	375326.5	4907596.0	4.4
BH11-02	375161.1	4907940.2	0.9
BH11-03	374953.6	4907727.6	1.6
BH11-04	375301.2	4906803.1	18.3
BH12-01	375163.5	4907322.5	5.0
BH12-02	374990.9	4906968.5	10.8
BH12-03	374634.1	4906698.8	14.0

Figure 3 is a contour map of the borehole locations and the shift applied to match the markers identified in the natural gamma data.

Figure 3 – Contour Map of Shift applied to Alien Natural Gamma Data



4.0 Conclusions

At the Elginburg Site, natural gamma (NG) data can be used to determine the locations of lithology between all seven (7) Boreholes.

Markers relating to Natural Gamma data can be identified and located on all of the holes surveyed. Markers M5 to M12 were located on the reference hole, DDH10-01 and located on the additional six (6) boreholes

By shifting the elevation of each hole, the Natural Gamma and markers were aligned. A plot of this shift value for each hole using the provided borehole location indicates a dip of less than 1 degree to the south relative to ground surface (top of casings for each hole).

This implies a significant additional amount of rock of over 10 meters is above the beginning sedimentary rock units present at the top of DDH10-01 at a distance of 1 km to the south, increasing to 18m at a distance of 1200m.

The locations of fractures can be obtained from the temperature and temperature gradient data; however, at this time this information is not required.

5.0 Statement of Limitations

This Geophysical Survey Report has been prepared exclusively for Morrison Hershfield. The purpose of this report is to provide them with an assessment of the lithology of six (6) Boreholes relative to one (1) Diamond Drill Hole. This report is neither an endorsement nor a condemnation of the subject property.

The borehole geophysical techniques employed typically produce methods to map and differentiate structure in bead rock. However, each technique has limitations, especially in areas in which there is little magnetic changes, conductivity changes or in dry portions of wells.

The results and conclusions documented in this report have been prepared for a specific application to this project and have been developed in a manner with that level of skill normally exercised by qualified professionals currently practicing in this area of geophysical surveying. No other warranty, expressed or implied, is made.

Reports or memoranda resulting from this assignment are not to be used in whole or in part outside Morrison Hershfield without prior written permission.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. NOTRA Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

If new information is developed in future work (which may include the survey in of borehole locations and elevations or changes to the diamond drill logs), NOTRA should be contacted to re-evaluate the conclusions of this report and to provide amendments as required.

Dennis Gamble

Dennis Gamble, P.Geo, P.Geoph.
Senior Geophysicist, NOTRA Inc.
January 29, 2013

ANNEX A
EQUIPMENT DESCRIPTION

- BMP06 Multi-Component Probe
- 100m Winch

Instruments for Geophysics (IFG) - BMP06 Multi-Component Probe

General Description

The BMP-06 is a multi-component probe designed by the IFG Corporation in Brampton, Ontario. It simultaneously measures temperature (T), Relative Conductivity (RC), Magnetic Susceptibility (MS), Natural Gamma (NG), Single Point Resistance (SPR) and Apparent Resistivity (AR).

The probe is a total length of 196 cm (from cable head to tip). The parameters measured are located along the full probe length.

Parameter Description

Temperature

A temperature sensor is located 182 cm below the cable head. The temperature sensor is resilient to drift and measurements are repeatable to within 0.01 of a degree Celsius. For additional calculations such as gradient or differential temperature, the temperature data is interpolated to a fixed depth interval.

As the probe goes down the hole it disturbs the static water column. For this reason the initial down run is used for presentation and interpretation. It is also preferable to conduct the survey when the water within the hole has been allowed to settle following drilling, purging or other actions.

Temperature is effective at detecting water-flowing fractures. When water from the surrounding rock enters of leaves the borehole, it may be evident as a rapid change in temperature that may be enhanced with temperature gradient calculations. To enhance water leaving the column, the borehole column can be heated and the temperature resurveyed.

Relative Conductivity

The RC sensor is located 120 cm below the cable head. The sensor, coincident loop coil, is tuned for relatively conductive environments (sulfide differentiation) and is susceptible to drift due to temperature changes, especially in low conductivity environments (0.1 to 20 mS/m).

The RC may be used to measure large conductivity contrasts in the borehole.

Magnetic Susceptibility

The MS sensor is located 150 cm below the cable head. The coincident loop coil is tuned to measure the in phase response that may be related to magnetic materials in the borehole. This relationship may breakdown in highly conductive environments (sulfides) and the MS response is susceptible to drift due to temperature changes.

Rock units that have contrasting iron content may be mapped with the MS.

Natural Gamma

The natural gamma sensor is located 92 cm below the cable head. The natural gamma measures gamma rays in the spectrum between 0.1 and 3 MeV in counts per second.

In most rock units it is the variations in potassium content that results in variations in the gamma values (ranging from 30 to 500 cps). This technique is the most successful at differentiating changes in lithology, especially in a multi-hole project in which subtle variations may be related from hole to hole.

The introduction of concentrations of uranium (and to some degree thorium) may result in a significant increase in count rate of well over 1000 cps. As the energies of the gamma rays are not measured, it is not possible to attribute a high gamma count rate to a specific element.

The natural gamma sensor is not sensitive to temperature changes and can be used in the presence of borehole casing.

Single Point and Apparent Resistivity

The single point resistance (SPR) is the electrical resistance measured between the cable head and the casing or grounded electrode at surface. The SPR may be used to differentiate rock units that have large resistivity variations.

For the Ares, a constant 5 mA current is applied between the grounded electrode (or casing) and the cable head and the voltage measured between two additional electrodes below the cable head. The scale factor used to calculate the apparent resistivity (AR) is;

AR = pi (V/i)/ 0.406 where V is the measured voltage and i is the constant current

Although the AR closely matches the SPR, it is a more precise measurement of the rock resistivity. For both AR and SPR, the probe must be submerged in water.

Instruments for Geophysics (IFG) - 100 m Winch - General Description

The borehole winch used is the IFG 100 meter manual winch with external controller. The system is ideal for shallow environmental surveys due to its relative portability.

The basic system includes a winch with a geared hand crank and 100 m of 4-conductor cable. A pulley placed on the borehole casing or affixed to the winch has a laser counter built in to measure cable motion (depth).

A controller box is used to power the various probes that may be attached to the winch, to digitize the analog signal from the probes and to digitize the counter signal. A stream of digital data is transmitted from the controller to a laptop computer at a rate of 1 complete data set/second. The controller requires 200 Watts of power and can be powered by portable 12 volt battery with and a small inverter (12v DC to 110 v AC).

The IFG DAS software is used to control data acquisition and monitor data quality.

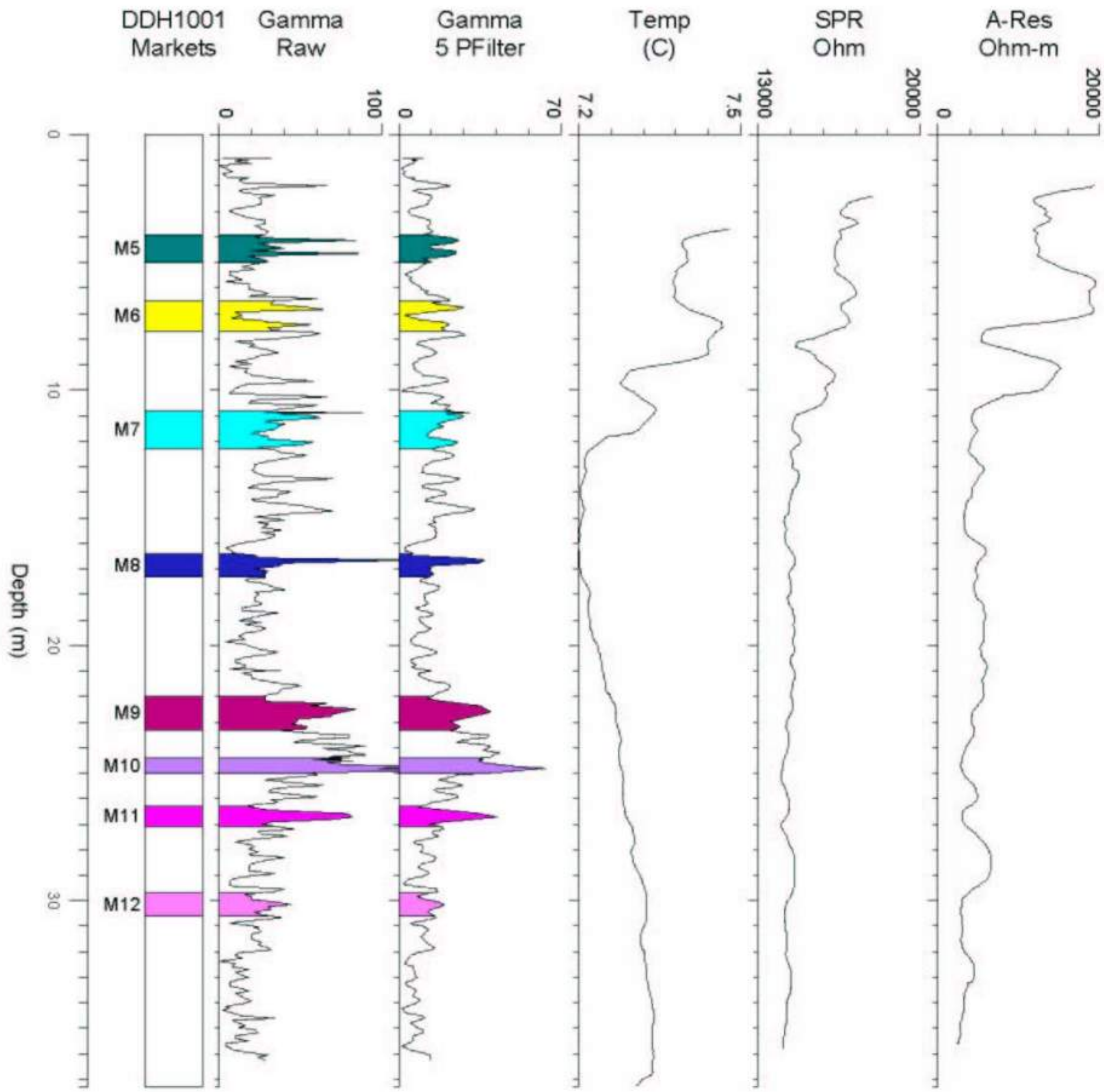
Field Procedures

During each survey the zero depth is established as the location of the cable head (to the probe) relative to the top of the casing. As the probe is lowered at a rate of 4cm/sec data is stored to a *down run file*. As there is the possibility of pulley slippage or dirt and ice interference, the borehole cable has markings at 10 meter intervals. At each 10 meter marking the digitized depth is noted. Any deviation between measured depth and actual depth is corrected during post processing.

When the end of hole is encountered the down run file is closed and an up run file is opened. The up run is collected as a check against probe operation. Provided there is no deviation between runs for a particular parameter, only one run is presented in profiles.

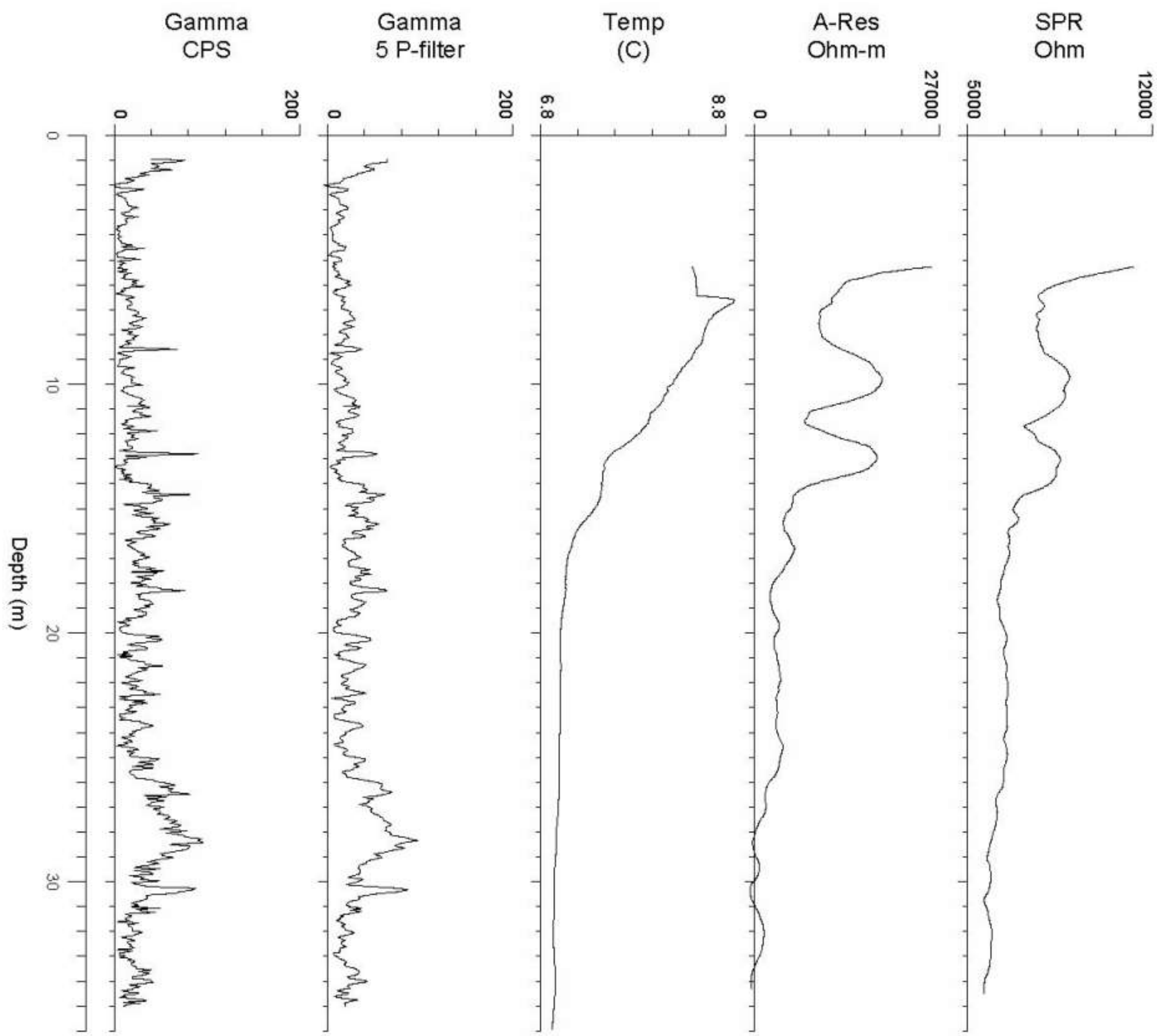
ANNEX B
COMPLETED LOGS

DDH10-01
Borehole Geophysical Results and Markers
Elginburg, ON, December 18, 2012

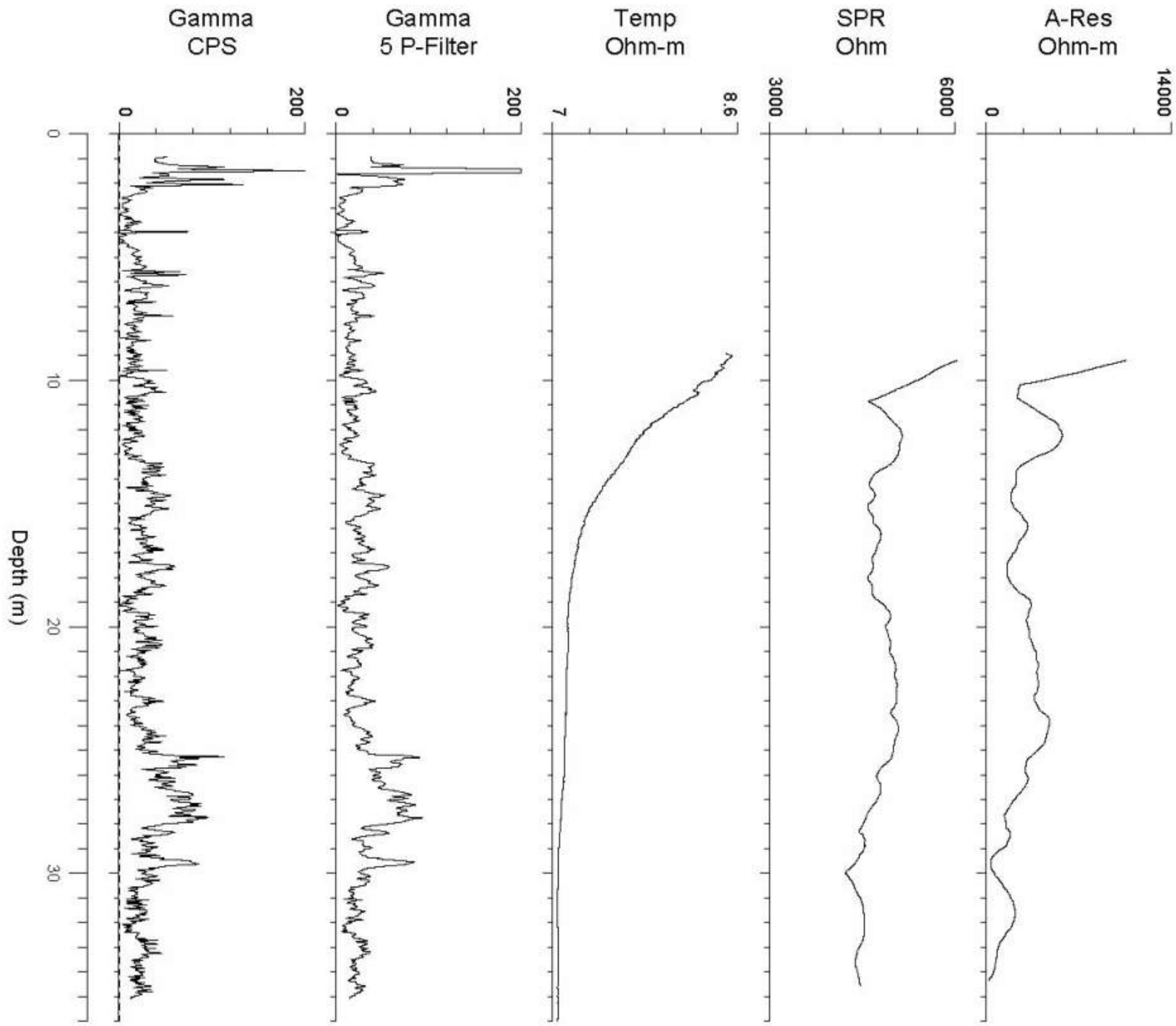


NOTRA

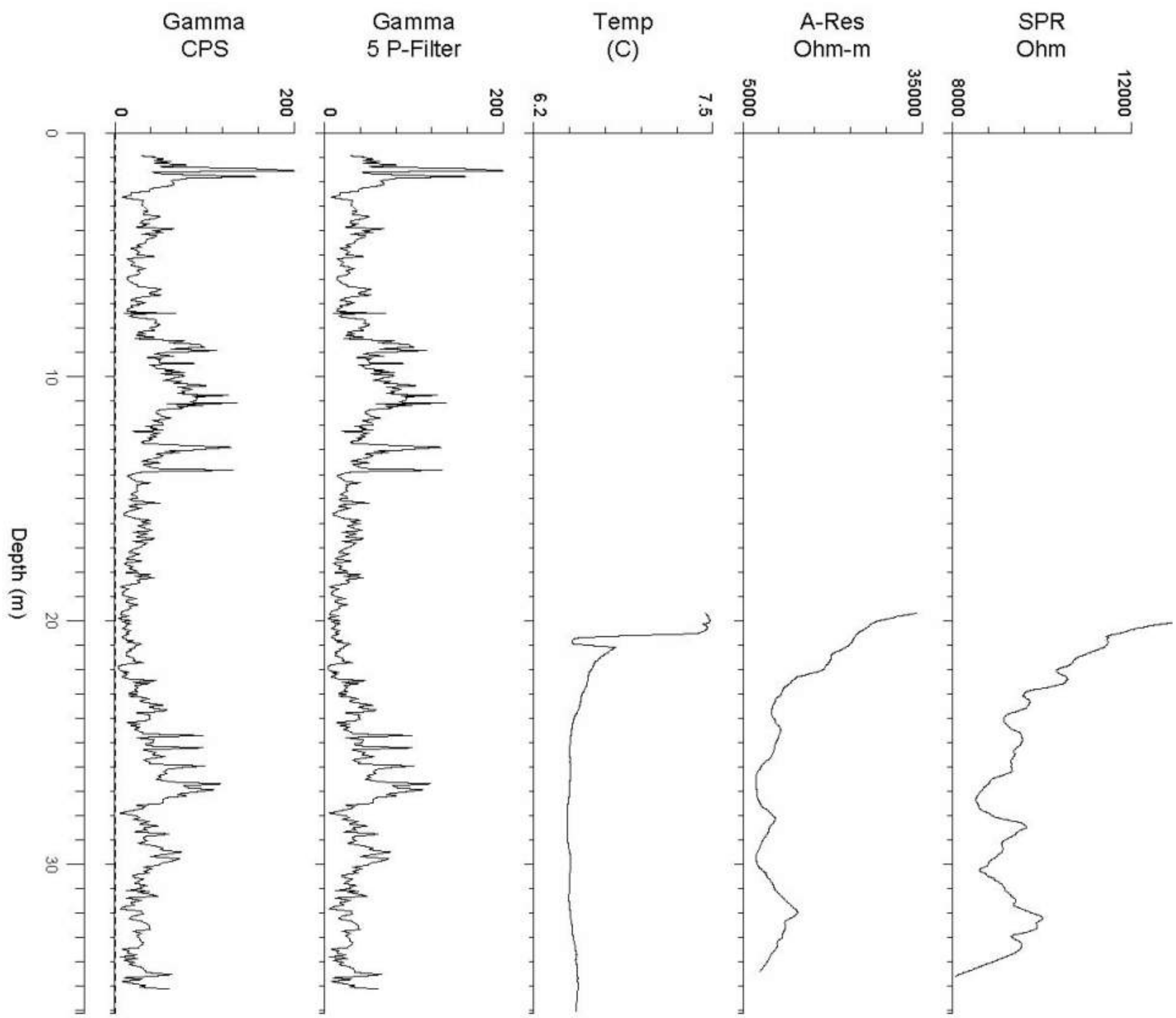
BH1102
Borehole Geophysical Results
Elginburg, ON, December 18, 2012



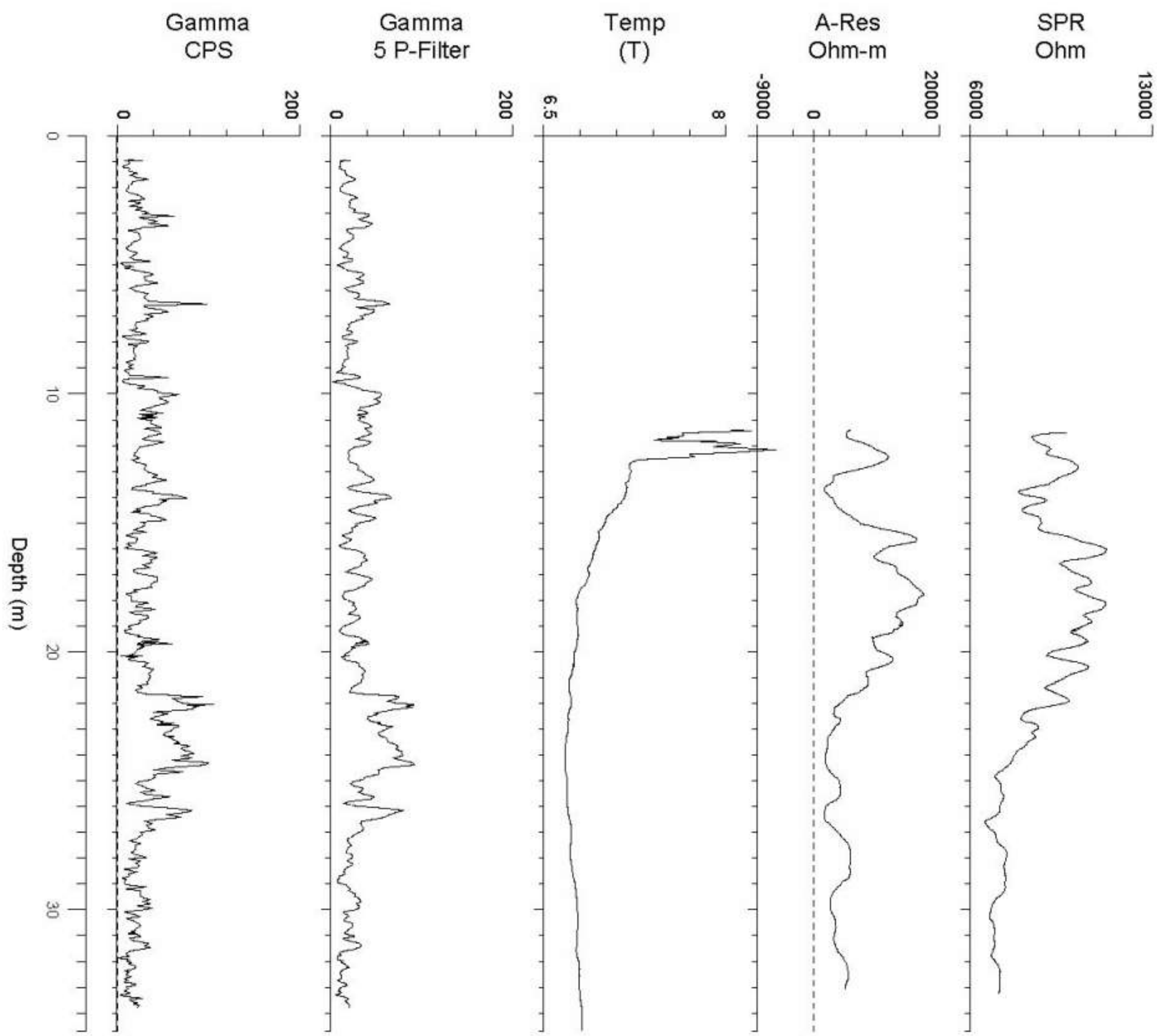
BH1103
Borehole Geophysical Results
Elginburg, ON, December 18, 2012



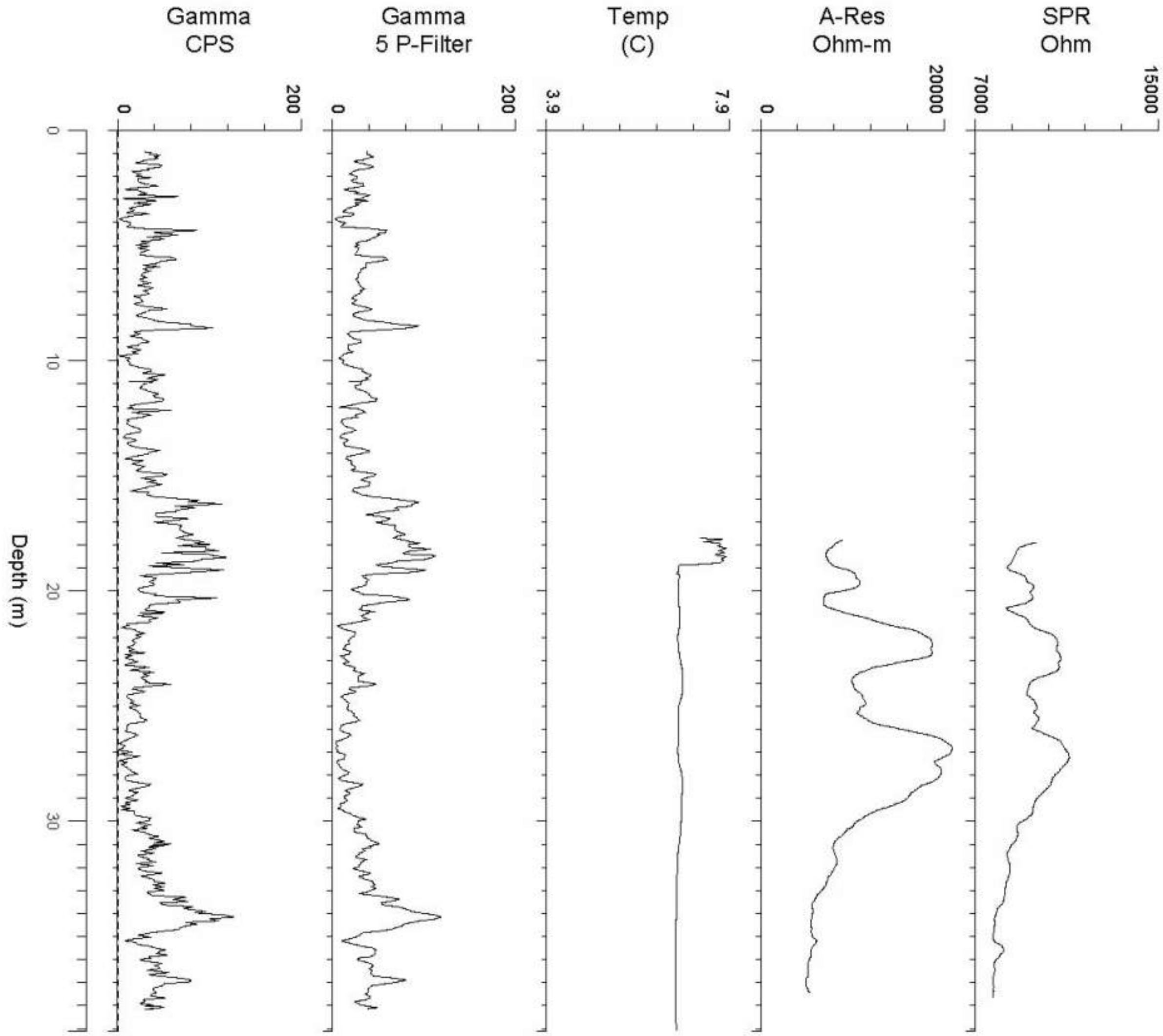
BH1104
Borehole Physical Property Log
Elginburg, ON, December 18, 2012



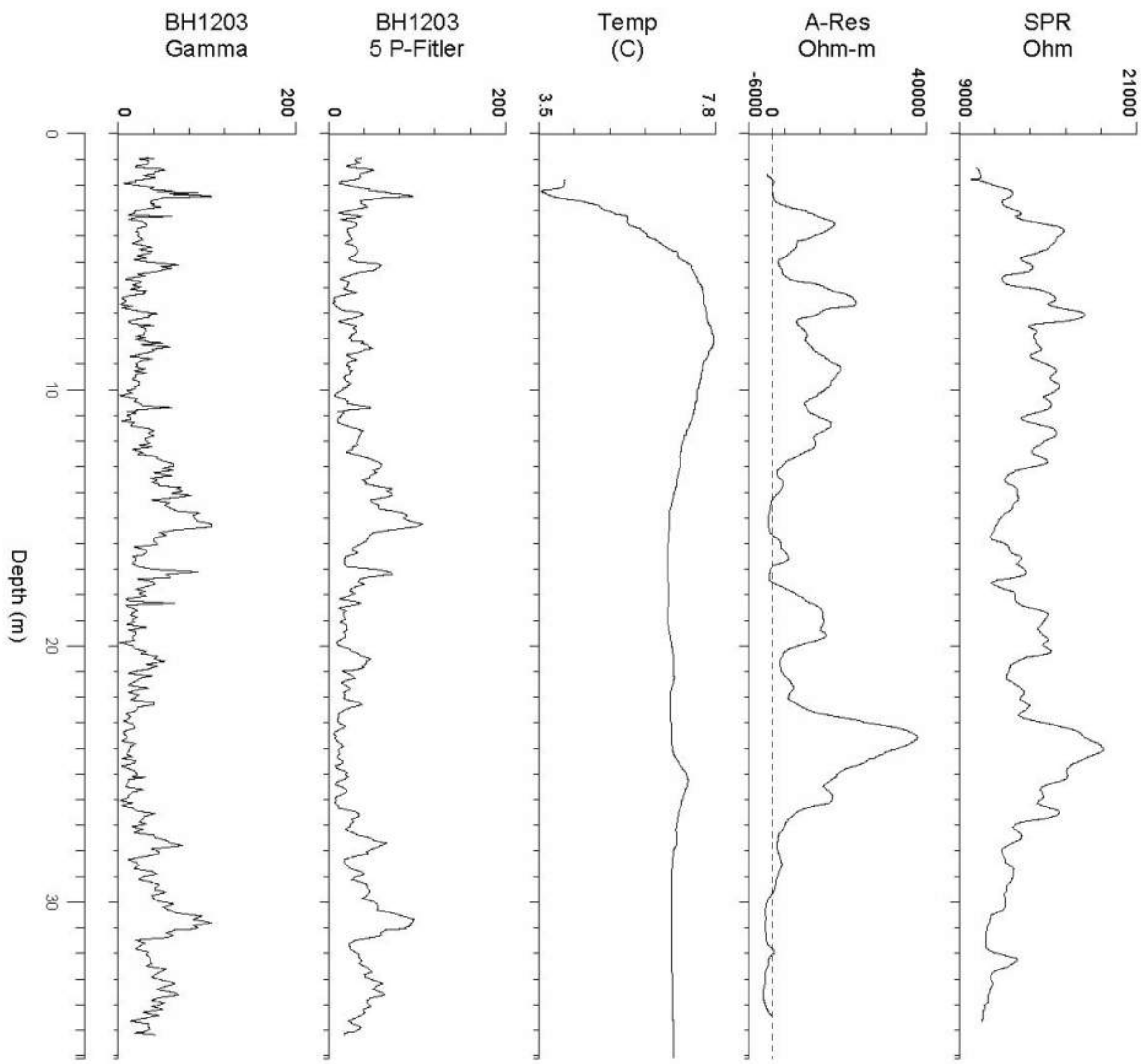
BH1201
Borehole Geophysical Results
Elginburg, ON, December 18, 2012



BH1202
Borehole Geophysical Results
Elginburg, ON, December 18, 2012



BH1203
Borehole Geophysical Results
Elginburg, ON, December 18, 2012



ANNEX C
PICTURES

System Logging –DDH10-01

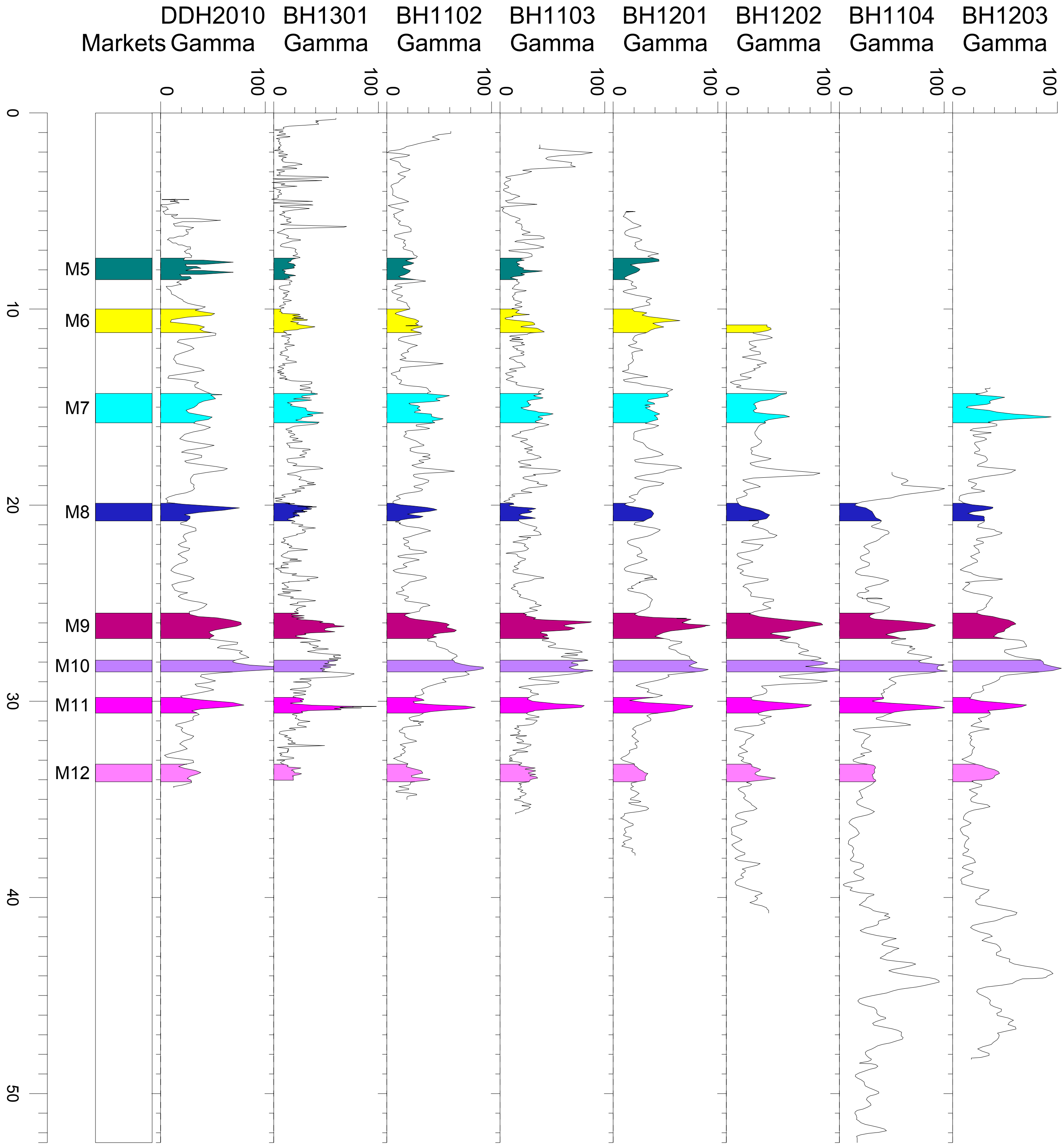
Setting Up System – BH1203

The IFG BMP06 Probe – BH1102

Adjusted Natural Gamma Logs

Depth Adjsuted to Markers of DDH1001

ElginBurg, On, December 10, 2013



APPENDIX D: Rock Testing Report – DDH10-01

Stantec
Stantec Consulting Ltd.
2781 Lancaster Road Suite 200
Ottawa ON K1B 1A7
Tel: (613) 738-0708
Fax: (613) 738-0721

January 31, 2013
Project No. 122410825

Mr. Anthony West, Ph.D., P.Eng.
Senior Geo-Environmental Engineer/Practice Leader
Morrison Hershfield
2440 Don Reid Drive
Ottawa, ON K1H 1E1

Dear Dr. West:

Reference: Laboratory Testing of Rock Core Samples – OPSS 1002

Further to your request, Stantec Consulting Ltd. has completed the above testing for four (4) rock core samples delivered to our laboratory on December 21, 2012. The evaluation was carried out on selected properties in general accordance with Ontario Provincial Standard Specifications 1002 (OPSS 1002) – Material Specification for Aggregates – Concrete and the LS test methods. All tests were carried out on laboratory prepared samples.

Upon completion of the tests, the results were compared with OPSS 1002 Table 5, Physical Requirements – Coarse Aggregates for Concrete. The table below provides a summary of tested physical property results. The individual certificate is attached to this letter for your reference.

The reported test results are obtained from core samples delivered to our laboratory on December 21, 2012 and hand prepared in our laboratory. The physical properties of the production material could vary with the location of material and production process. Quality control testing program should be implemented to monitor and ensure consistent quality during production.

We trust this meets your present requirements. If you have any questions or we may be of further assistance, please do not hesitate to contact the undersigned.

Yours very truly,

STANTEC CONSULTING LTD.

Jeff Weng, M.Sc., M.Eng., P.Eng., LEED® AP
Senior Associate

V:\01224\active\1224108XX\122410825\Task 215-Rock core testing\December 21_2012, Rock Core, Physical Testing, Cruickshank\Letter report.Jan 31.2013.doc

Stantec

Reference: **Laboratory Testing of Rock Core Samples – OPSS 1002**

OPSS 1002, Table 5 – Physical Requirements – Coarse Aggregates for Concrete

MTO or CSA Laboratory Test	MTO or CSA Test No.	Acceptance Criteria for Structures	Test Results	
			Sample Depth	Results
Absorption, % maximum	LS604	2.0	CS-1 @ 0'-31'8" & 48'8"-67'7"	0.45%
			CS-2 @ 31'8"-48'8"	Not tested
			CS-3 @ 67'7"-84'11"	Not tested
			CS-4 @ 85'6"-94'10" & 103'4"-112'4"	0.49%
Micro-deval abrasion, % loss maximum	LS618	17	CS-1 @ 0'-31'8" & 48'8"-67'7"	13.6%
			CS-2 @ 31'8"-48'8"	19.5%
			CS-3 @ 67'7"-84'11"	18.8%
			CS-4 @ 85'6"-94'10" & 103'4"-112'4"	8.9%
MgSO4 Soundness	LS606	12	CS-1 @ 0'-31'8" & 48'8"-67'7"	9.9%
			CS-2 @ 31'8"-48'8"	Not tested
			CS-3 @ 67'7"-84'11"	Not tested
			CS-4 @ 85'6"-94'10" & 103'4"-112'4"	6.5%
Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rock	CSA A23.2-26A	Chemical composition must plot in the non-expansive field of Fig.1 of test method	CS-1 @ 0'-31'8" & 48'8"-67'7"	non- expansive
			CS-2 @ 31'8"-48'8"	Not tested
			CS-3 @ 67'7"-84'11"	Not tested
			CS-4 @ 85'6"-94'10" & 103'4"-112'4"	Potentially expansive
Petrographic number, maximum	LS609	140	CS-1 @ 0'-31'8" & 48'8"-67'7"	116
			CS-2 @ 31'8"-48'8"	115
			CS-3 @ 67'7"-84'11"	Not tested
			CS-4 @ 85'6"-94'10" & 103'4"-112'4"	107

- The sample will be retained for a month and disposed of unless instructed otherwise

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – CONCRETE
Physical Properties – Coarse Aggregate (SP 110S11)

Contract No.: MH Project #213013500	Contract Location: n/a	Contractor: n/a	
Testing Laboratory: Stantec Consulting Ltd. (Ottawa - Lancaster Rd.)		Telephone No.: 613-738-0708	Fax No.: 613-738-0721
Sampled by (Print Name): Morrison Hershfield		Date Sampled: (YY/MM/DD) n/a	
Nominal maximum Size: rock cores, 19 mm	Lot No.: n/a	Quantity (tonnes): n/a	
Source Name/ Location: CS1 0' to 31'8" & 48'8"-67'7"		Aggregate Inventory Number (AIN): n/a	

Laboratory Test and Number	Requirement		Concrete ASL (✓)	Test Result		
	Pavement *(see Note 1)*	Structures, Sidewalks, Curb & Gutter, Concrete Base		Reference Material	Sample	Meets Requirement (Y / N)
Salt Scaling, maximum loss @ 50 cycles, LS-412 (see Notes 2, 3 and 4)	0.80 kg/m^2				n/a	
Wash Pass 75 μm sieve, % maximum, LS-601	1.0 (gravel) 2.0 (crushed rock)				n/a	
Absorption, % maximum, LS-604 or CSA A23.2-12A	2.0 (see note 5)				0.45	yes
Flat & Elongated Particles, % maximum, LS-608	20				n/a	
Petrographic Number, Concrete, maximum, LS-609	125 (Attach PN report)	140 (Attach PN report)			116	yes
Unconfined Freeze-Thaw loss, % maximum LS-614 or CSA A23.2-24A (see Note 6)	6				n/a	
Micro-Deval Abrasion loss, % maximum, LS-618 or CSA A23.2-29A	14	17 (see Note 7)		14.2	13.6	yes
Accelerated Mortar Bar Expansion, % maximum @ 14 days, LS-620 or CSA A23.2-25A (see Notes 3 and 8)	0.150 (see Notes 9 and 10)				n/a	
Concrete Prism Expansion, % maximum @ 1 year, CSA A23.2-14A (see Notes 3, 8, 11)	0.040				n/a	
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2-26A (see Note 12)	Chemical composition must plot in non-expansive field of Fig. 1			Attach data	Attach graph	yes
Concrete Freeze-Thaw, ASTM C666, Procedure A (see Notes 3 and 13)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days				n/a	

Alternative Requirement to Unconfined Freeze-Thaw (LS–614 or CSA A23.2-12A)					
Magnesium Sulphate Soundness loss, 5 cycles % maximum, LS-606 (see Note 6)	12		11.2	9.9	yes

Issued by (Testing Laboratory Representative):

Jeff Weng	J. W	02/01/2013
PRINT NAME	SIGNATURE	DATE

Received by (Contract Administrator Representative):

PRINT NAME	SIGNATURE	DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

AGGREGATE TEST DATA – CONCRETE

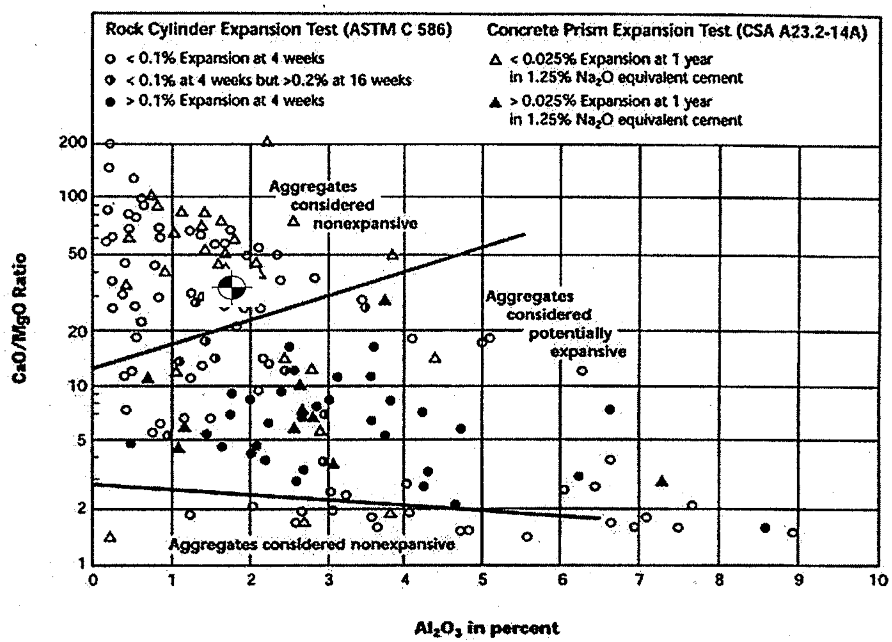
Physical Properties – Coarse Aggregate (SP110S11)

Notes:

1. Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
2. This test only needs to be done at the time of first use of a source for concrete aggregate.
3. Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
4. Coarse aggregate composed of more than 80% siliceous aggregates, as determined by petrographic examination (LS-609), shall be tested, together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate. The concrete shall be proportioned with 355 kg/m^3 of Type GU hydraulic cement, shall have a plastic air content of 7.0 ±1.5% and a slump of 80 ± 20 mm.
5. For air-cooled blast-furnace slag aggregate, the allowable maximum value for absorption shall conform to the Owner's requirements for slag aggregate.
6. Compliance with the unconfined freeze-thaw test, LS-614 or CSA A23.2-24A is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606.
7. For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures.
8. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be shown as a coarse aggregate on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
9. If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 days.
10. An aggregate that fails this requirement may be accepted provided the requirement for CSA A23.2- 14A is met.
11. An aggregate needs to meet the requirement for CSA A23.2-14A only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. If this test is conducted for an aggregate deemed potentially expansive according to CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested. Test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work
12. This requirement only applies to aggregates quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.
13. The following apply to this test:
    - Coarse aggregates from limestone and dolostone bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
    - The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
    - The bench within the quarry from which the aggregate is selected for testing shall be defined. Acceptance will only apply to the bench of the quarry from which the selected aggregate was taken. Aggregate processed from other benches within the same quarry will require further testing prior to use.
    - The concrete for the test shall be proportioned with 37.5 – 4.75 mm stone meeting the combined grading shown in Table 4, of SSP 110S11, with 325 kg/m^3 of Type GU hydraulic cement, a plastic air content of 6.5 ± 1.5%, and a slump of 50 ± 20 mm.
    - Procedure A shall be modified so that each freeze cycle takes 10.5 ± 1 hours; and the test shall be conducted for 350 cycles.

Stantec

Determination of Potential Alkali-Carbonate Reactivity of Quarry Carbonate Rocks by Chemical Composition
CSA A23.2-26A



Sample Results

Sample No	CS-1	Project No	122410825
Project	Source Demonstration of Compliance		
Client	Morrison Hershfield Limited		
Source	CS-1 @ 0'-31'8" & 48'8"-67'7"		
Nominal Size	N/A		
Date Sampled	21-Dec-12		
Inventory No.	N/A		

Issued By Brian Prevost

Brian Prevost, Laboratory Supervisor

Date: January 30, 2013

Reviewed by

Denis Ridriguez, Laboratory Technician

Date: January 30, 2013

Remarks: Aggregate is **NOT** considered potentially expansive.

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – CONCRETE
Physical Properties – Coarse Aggregate (SP 110S11)

Contract No.: MH Project #213013500	Contract Location: n/a	Contractor: n/a	
Testing Laboratory: Stantec Consulting Ltd. (Ottawa - Lancaster Rd.)		Telephone No.: 613-738-0708	Fax No.: 613-738-0721
Sampled by (Print Name): Morrison Hershfield		Date Sampled: (YY/MM/DD) n/a	
Nominal maximum Size: rock cores, 19 mm	Lot No.: n/a	Quantity (tonnes): n/a	
Source Name/ Location: CS2 31'8" to 48'8"		Aggregate Inventory Number (AIN): n/a	

Laboratory Test and Number	Requirement		Concrete ASL (✓)	Test Result		
	Pavement *(see Note 1)*	Structures, Sidewalks, Curb & Gutter, Concrete Base		Reference Material	Sample	Meets Requirement (Y / N)
Salt Scaling, maximum loss @ 50 cycles, LS-412 (see Notes 2, 3 and 4)	0.80 kg/m^2				n/a	
Wash Pass 75 μm sieve, % maximum, LS-601	1.0 (gravel) 2.0 (crushed rock)				n/a	
Absorption, % maximum, LS-604 or CSA A23.2-12A	2.0 (see note 5)				n/a	
Flat & Elongated Particles, % maximum, LS-608	20				n/a	
Petrographic Number, Concrete, maximum, LS-609	125 (Attach PN report)	140 (Attach PN report)			115	yes
Unconfined Freeze-Thaw loss, % maximum LS-614 or CSA A23.2-24A (see Note 6)	6				n/a	
Micro-Deval Abrasion loss, % maximum, LS-618 or CSA A23.2-29A	14	17 (see Note 7)		14.2	19.5	no
Accelerated Mortar Bar Expansion, % maximum @ 14 days, LS-620 or CSA A23.2-25A (see Notes 3 and 8)	0.150 (see Notes 9 and 10)				n/a	
Concrete Prism Expansion, % maximum @ 1 year, CSA A23.2-14A (see Notes 3, 8, 11)	0.040				n/a	
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2-26A (see Note 12)	Chemical composition must plot in non-expansive field of Fig. 1			Attach data	Attach graph	n/a
Concrete Freeze-Thaw, ASTM C666, Procedure A (see Notes 3 and 13)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days				n/a	

Alternative Requirement to Unconfined Freeze-Thaw (LS–614 or CSA A23.2-12A)					
Magnesium Sulphate Soundness loss, 5 cycles % maximum, LS-606 (see Note 6)	12			n/a	

Issued by (Testing Laboratory Representative):

Jeff Weng — PRINT NAME

SIGNATURE

02/01/2013 — DATE

Received by (Contract Administrator Representative):

PRINT NAME

SIGNATURE

DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

AGGREGATE TEST DATA – CONCRETE

Physical Properties – Coarse Aggregate (SP110S11)

Notes:

1. Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
2. This test only needs to be done at the time of first use of a source for concrete aggregate.
3. Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
4. Coarse aggregate composed of more than 80% siliceous aggregates, as determined by petrographic examination (LS-609), shall be tested, together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate. The concrete shall be proportioned with 355 kg/m^3 of Type GU hydraulic cement, shall have a plastic air content of 7.0 ±1.5% and a slump of 80 ± 20 mm.
5. For air-cooled blast-furnace slag aggregate, the allowable maximum value for absorption shall conform to the Owner's requirements for slag aggregate.
6. Compliance with the unconfined freeze-thaw test, LS-614 or CSA A23.2-24A is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606.
7. For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures.
8. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be shown as a coarse aggregate on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
9. If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 days.
10. An aggregate that fails this requirement may be accepted provided the requirement for CSA A23.2- 14A is met.
11. An aggregate needs to meet the requirement for CSA A23.2-14A only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. If this test is conducted for an aggregate deemed potentially expansive according to CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested. Test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work
12. This requirement only applies to aggregates quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.
13. The following apply to this test:
    - Coarse aggregates from limestone and dolostone bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
    - The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
    - The bench within the quarry from which the aggregate is selected for testing shall be defined. Acceptance will only apply to the bench of the quarry from which the selected aggregate was taken. Aggregate processed from other benches within the same quarry will require further testing prior to use.
    - The concrete for the test shall be proportioned with 37.5 – 4.75 mm stone meeting the combined grading shown in Table 4, of SSP 110S11, with 325 kg/m^3 of Type GU hydraulic cement, a plastic air content of 6.5 ± 1.5%, and a slump of 50 ± 20 mm.
    - Procedure A shall be modified so that each freeze cycle takes 10.5 ± 1 hours; and the test shall be conducted for 350 cycles.

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – CONCRETE
Physical Properties – Coarse Aggregate (SP 110S11)

Contract No.: MH Project #213013500	Contract Location: n/a	Contractor: n/a	
Testing Laboratory: Stantec Consulting Ltd. (Ottawa - Lancaster Rd.)		Telephone No.: 613-738-0708	Fax No.: 613-738-0721
Sampled by (Print Name): Morrison Hershfield		Date Sampled: (YY/MM/DD) n/a	
Nominal maximum Size: rock cores, 19 mm	Lot No.: n/a	Quantity (tonnes): n/a	
Source Name/ Location: CS3 67'7" to 84'11"		Aggregate Inventory Number (AIN): n/a	

Laboratory Test and Number	Requirement		Concrete ASL (✓)	Test Result		
	Pavement *(see Note 1)*	Structures, Sidewalks, Curb & Gutter, Concrete Base		Reference Material	Sample	Meets Requirement (Y / N)
Salt Scaling, maximum loss @ 50 cycles, LS-412 (see Notes 2, 3 and 4)	0.80 kg/m^2				n/a	
Wash Pass 75 μm sieve, % maximum, LS-601	1.0 (gravel) 2.0 (crushed rock)				n/a	
Absorption, % maximum, LS-604 or CSA A23.2-12A	2.0 (see note 5)				n/a	
Flat & Elongated Particles, % maximum, LS-608	20				n/a	
Petrographic Number, Concrete, maximum, LS-609	125 (Attach PN report)	140 (Attach PN report)			n/a	
Unconfined Freeze-Thaw loss, % maximum LS-614 or CSA A23.2-24A (see Note 6)	6				n/a	
Micro-Deval Abrasion loss, % maximum, LS-618 or CSA A23.2-29A	14	17 (see Note 7)		14.2	18.8	no
Accelerated Mortar Bar Expansion, % maximum @ 14 days, LS-620 or CSA A23.2-25A (see Notes 3 and 8)	0.150 (see Notes 9 and 10)				n/a	
Concrete Prism Expansion, % maximum @ 1 year, CSA A23.2-14A (see Notes 3, 8, 11)	0.040				n/a	
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2-26A (see Note 12)	Chemical composition must plot in non-expansive field of Fig. 1			Attach data	Attach graph	n/a
Concrete Freeze-Thaw, ASTM C666, Procedure A (see Notes 3 and 13)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days				n/a	

Alternative Requirement to Unconfined Freeze-Thaw (LS–614 or CSA A23.2-12A)					
Magnesium Sulphate Soundness loss, 5 cycles % maximum, LS-606 (see Note 6)	12		11.2	n/a	

Issued by (Testing Laboratory Representative):

Jeff Weng — PRINT NAME

SIGNATURE

02/01/2013 — DATE

Received by (Contract Administrator Representative):

PRINT NAME

SIGNATURE

DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – CONCRETE

Physical Properties – Coarse Aggregate (SP110S11)

Notes:

1. Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
2. This test only needs to be done at the time of first use of a source for concrete aggregate.
3. Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
4. Coarse aggregate composed of more than 80% siliceous aggregates, as determined by petrographic examination (LS-609), shall be tested, together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate. The concrete shall be proportioned with 355 kg/m^3 of Type GU hydraulic cement, shall have a plastic air content of 7.0 ±1.5% and a slump of 80 ± 20 mm.
5. For air-cooled blast-furnace slag aggregate, the allowable maximum value for absorption shall conform to the Owner's requirements for slag aggregate.
6. Compliance with the unconfined freeze-thaw test, LS-614 or CSA A23.2-24A is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606.
7. For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures.
8. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be shown as a coarse aggregate on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
9. If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 days.
10. An aggregate that fails this requirement may be accepted provided the requirement for CSA A23.2- 14A is met.
11. An aggregate needs to meet the requirement for CSA A23.2-14A only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. If this test is conducted for an aggregate deemed potentially expansive according to CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested. Test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work
12. This requirement only applies to aggregates quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.
13. The following apply to this test:
    - Coarse aggregates from limestone and dolostone bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
    - The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
    - The bench within the quarry from which the aggregate is selected for testing shall be defined. Acceptance will only apply to the bench of the quarry from which the selected aggregate was taken. Aggregate processed from other benches within the same quarry will require further testing prior to use.
    - The concrete for the test shall be proportioned with 37.5 – 4.75 mm stone meeting the combined grading shown in Table 4, of SSP 110S11, with 325 kg/m^3 of Type GU hydraulic cement, a plastic air content of 6.5 ± 1.5%, and a slump of 50 ± 20 mm.
    - Procedure A shall be modified so that each freeze cycle takes 10.5 ± 1 hours; and the test shall be conducted for 350 cycles.

Ontario

Ministry of Transportation

AGGREGATE TEST DATA – CONCRETE
Physical Properties – Coarse Aggregate (SP 110S11)

Contract No.: MH Project #213013500	Contract Location: n/a	Contractor: n/a	
Testing Laboratory: Stantec Consulting Ltd. (Ottawa - Lancaster Rd.)		Telephone No.: 613-738-0708	Fax No.: 613-738-0721
Sampled by (Print Name): Morrison Hershfield		Date Sampled: (YY/MM/DD) n/a	
Nominal maximum Size: rock cores, 19 mm	Lot No.: n/a	Quantity (tonnes): n/a	
Source Name/ Location: CS4 85'6" to 94'10" & 103'4" to 112'4"		Aggregate Inventory Number (AIN): n/a	

Laboratory Test and Number	Requirement		Concrete ASL (✓)	Test Result		
	Pavement *(see Note 1)*	Structures, Sidewalks, Curb & Gutter, Concrete Base		Reference Material	Sample	Meets Requirement (Y / N)
Salt Scaling, maximum loss @ 50 cycles, LS-412 (see Notes 2, 3 and 4)	0.80 kg/m^2				n/a	
Wash Pass 75 μm sieve, % maximum, LS-601	1.0 (gravel) 2.0 (crushed rock)				n/a	
Absorption, % maximum, LS-604 or CSA A23.2-12A	2.0 (see note 5)				0.49	yes
Flat & Elongated Particles, % maximum, LS-608	20				n/a	
Petrographic Number, Concrete, maximum, LS-609	125 (Attach PN report)	140 (Attach PN report)			107	yes
Unconfined Freeze-Thaw loss, % maximum LS-614 or CSA A23.2-24A (see Note 6)	6				n/a	
Micro-Deval Abrasion loss, % maximum, LS-618 or CSA A23.2-29A	14	17 (see Note 7)		14.2	8.9	yes
Accelerated Mortar Bar Expansion, % maximum @ 14 days, LS-620 or CSA A23.2-25A (see Notes 3 and 8)	0.150 (see Notes 9 and 10)				n/a	
Concrete Prism Expansion, % maximum @ 1 year, CSA A23.2-14A (see Notes 3, 8, 11)	0.040				n/a	
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2-26A (see Note 12)	Chemical composition must plot in non-expansive field of Fig. 1			Attach data	Attach graph	no
Concrete Freeze-Thaw, ASTM C666, Procedure A (see Notes 3 and 13)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days				n/a	

Alternative Requirement to Unconfined Freeze-Thaw (LS-614 or CSA A23.2-12A)					
Magnesium Sulphate Soundness loss, 5 cycles % maximum, LS-606 (see Note 6)	12		11.2	6.5	yes

Issued by (Testing Laboratory Representative):

Jeff Weng — PRINT NAME

SIGNATURE

02/01/2013 — DATE

Received by (Contract Administrator Representative):

PRINT NAME

SIGNATURE

DATE

Copies to: ☐ Contract Administrator; ☐ Contractor; ☐ Regional Quality Assurance; ☐ Regional Geotechnical; ☐ MERO (Soils and Aggregates)

AGGREGATE TEST DATA – CONCRETE

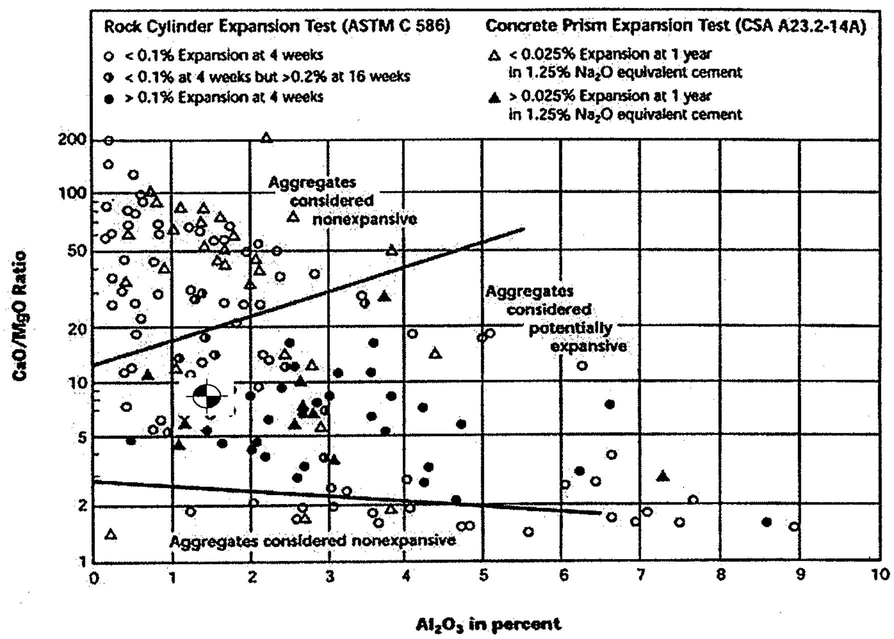
Physical Properties – Coarse Aggregate (SP110S11)

Notes:

1. Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.
2. This test only needs to be done at the time of first use of a source for concrete aggregate.
3. Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
4. Coarse aggregate composed of more than 80% siliceous aggregates, as determined by petrographic examination (LS-609), shall be tested, together with either the fine aggregate that the coarse aggregate is intended to be used with, or a fine aggregate from the same geographic area as the coarse aggregate. The concrete shall be proportioned with 355 kg/m^3 of Type GU hydraulic cement, shall have a plastic air content of 7.0 ±1.5% and a slump of 80 ± 20 mm.
5. For air-cooled blast-furnace slag aggregate, the allowable maximum value for absorption shall conform to the Owner's requirements for slag aggregate.
6. Compliance with the unconfined freeze-thaw test, LS-614 or CSA A23.2-24A is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606.
7. For air-cooled blast-furnace slag aggregate, the allowable maximum value for Micro-Deval shall be 21% for structures.
8. If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be shown as a coarse aggregate on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
9. If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay Formations, the expansion shall be less than 0.100% after 14 days.
10. An aggregate that fails this requirement may be accepted provided the requirement for CSA A23.2- 14A is met.
11. An aggregate needs to meet the requirement for CSA A23.2-14A only if it fails the requirements of either CSA A23.2-25A or CSA A23.2-26A. If this test is conducted for an aggregate deemed potentially expansive according to CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested. Test data shall have been obtained within the past 18 months from aggregate from the same location within the source as that to be used in the work
12. This requirement only applies to aggregates quarried from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.
13. The following apply to this test:
    - Coarse aggregates from limestone and dolostone bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
    - The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
    - The bench within the quarry from which the aggregate is selected for testing shall be defined. Acceptance will only apply to the bench of the quarry from which the selected aggregate was taken. Aggregate processed from other benches within the same quarry will require further testing prior to use.
    - The concrete for the test shall be proportioned with 37.5 – 4.75 mm stone meeting the combined grading shown in Table 4, of SSP 110S11, with 325 kg/m^3 of Type GU hydraulic cement, a plastic air content of 6.5 ± 1.5%, and a slump of 50 ± 20 mm.
    - Procedure A shall be modified so that each freeze cycle takes 10.5 ± 1 hours; and the test shall be conducted for 350 cycles.

Determination of Potential Alkali-Carbonate Reactivity of Quarry Carbonate Rocks by Chemical Composition

CSA A23.2-26A



Sample Results			
Sample No	CS-4	Project No	122410825
Project	Source Demonstration of Compliance		
Client	Morrison Hershfield Limited		
Source	CS-4 @85'6"-94'10" & 103'4"-112'4"		
Nominal Size	N/A		
Date Sampled	21-Dec-12		
Inventory No.	N/A		

Issued By Brian Prevost
Brian Prevost, Laboratory Supervisor

Date: January 30, 2013

Reviewed by
Denis Ridriguez, Laboratory Technician

Date: January 30, 2013

Remarks: **Aggregate is considered potentially expansive.**

APPENDIX E: Rock Testing Report BH13-01

06 March 2014
File: TB142006

Morrison Hershfield Ltd.
2440 Don Reid Dr.
Ottawa, ON
K1H 1E1

Attention: **Mr. Anthony West, PhD, PEng**
Senior Geo-Environmental Engineer / Practice Leader

RE: AGGREGATE INVESTIGATION OF ROCK CORE FOR USE AS CONCRETE COARSE AGGREGATE
CRUICKSHANK ELGINBURG QUARRY
KINGSTON, ONTARIO

1.0 INTRODUCTION

In January 2014, AMEC Environment & Infrastructure, a Division of AMEC Americas Limited (AMEC) presented a work proposal via email to Morrison Hershfield Limited to provide a detailed rock core log and laboratory testing of rock core. The rock core would be provided by Morrison Hershfield Limited. The laboratory testing would be conducted to determine the potential of the rock unit represented by the rock core for use as a concrete coarse aggregate.

It is AMEC's understanding that the rock core was collected on 9 and 10 December 2013 from the Cruickshank Elginburg Quarry in Kingston, Ontario. The core was drilled by George Downing Estate Drilling Ltd and drilling was supervised by a representative of Morrison Hershfield Ltd. AMEC received the rock core on 13 January 2014.

This report outlines the methodology used, laboratory tests conducted and the results of this testing.

2.0 METHODLOGY

A total of 26.98m of rock core (from borehole # 2130039) was received in the AMEC Hamilton Laboratory. It is understood that a representative of Morrison Hershfield Ltd logged the rock core prior to shipping the sample to AMEC. Once at the AMEC Hamilton laboratory, the rock core was geologically logged and photographed using the protocol outlined in MTO MI-17 – *Guide to the Description of Rock for Engineering Purposes*. The borehole log can be found in

Appendix A of this report with the relevant photographs found in Appendix B of this report. The borehole sample was split into four rock quality zones, as defined by Morrison Hershfield Ltd. These zones were defined as follows:

- **RQ1**: 0.76m to 6.96m
- **RQ2**: 6.96m to 13.16m
- **RQ3**: 13.16m to 19.36m
- **RQ4**: 19.36m to 25.56m

These zones were individually crushed using a laboratory crusher at AMEC's Hamilton laboratory, to produce four zones of 19mm coarse aggregate samples to be tested for potential use as concrete coarse aggregate.

The rock quality zones were then used to create three composite samples, the proportions of which were provided to AMEC by Morrison Hershfield Ltd. These samples comprised as described in Table 1.

Table 1: Summary of Sample Composition

Sample Name	Sample Interval (m)	Sample Composition			
		RQ1 0.76m to 6.96m	**RQ2** 6.96m to 13.16m	**RQ3** 13.16m to 19.36m	**RQ4** 19.36m to 25.56m
RQ1-4	0.76-25.56	25%	25%	25%	25%
RQ2-4	6.96-25.56	N/A	33%	33%	33%
RQ3-4	13.16-25.56	N/A	N/A	50%	50%

**all percentages represent material by weight

These samples were then graded to meet OPSS 1002, rev 04/2013, Table 3 specifications for a 19mm concrete coarse aggregate for the physical and chemical testing portion of this project.

The physical and chemical durability characteristics of the rock core were determined by conducting a staged approach to testing. The testing was broken down as follows:

Stage 1

- *Relative Density and Absorption of Coarse Aggregate* (MTO LS-604)
- *Petrographic Analysis of Coarse aggregate* (MTO LS-609)

Stage 2

- *Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus* (MTO LS-618)
- *Soundness of Aggregates by use of Magnesium Sulphate* (MTO LS-606)
- *Determination of Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rocks by Chemical Composition* (CSA A23.2-09 26A)

Following each stage, test results were compared to OPSS 1002, rev 04/2013, Table 5 concrete coarse aggregate specifications. Morrison Hershfield Ltd then provided direction as to which sample would then advance to the next stage of testing. The results of this testing can be found in section 3.0 of this report.

3.0 PHYSICAL AND CHEMICAL TESTING RESULTS

Presented in Table 2 are the results of the physical and chemical testing on the crushed core composite samples, as compared to OPSS 1002, rev 04/2013, Table 5 specification requirements. (These results can also be found in Appendix C, Enclosures 1 to 3 on aggregate test data sheets.)

Table 2. Results of the Physical and Chemical Testing on Crushed Core Samples

Test Name	Test Method	OPSS 1002 Specification (Maximum)		RQ1-4	RQ2-4	RQ3-4
	MTO	Pavement	Structures, Sidewalk, Curb & Gutter & Concrete Base	(0.76m to 25.56m)	(6.96m to 25.56m)	(13.16m to 25.56m)
Absorption	LS-604	2.0	2.0	0.48	0.50	0.59
Relative Density	LS-604	-	-	2.707	2.708	2.704
Petrographic Analysis (PN)	LS-609	125	140	133	141	170
Micro Deval Abrasion (% loss)	LS-618	14	17	12.9%	14.5%	n/a
Magnesium Sulphate Soundness	LS-606	12	12	7.6%	9.1%	n/a
Alkali Carbonate Reactivity	A23.2-26A	Non-Expansive	Non-Expansive	Non-Expansive	Non-Expansive	n/a

3.1 Stage 1 of Testing – Absorption, Relative Density & Petrographic Analysis

All three samples tested (RQ1-4, RQ2-4 & RQ3-4) had absorption results that met OPSS 1002 specifications for all types of concrete stone.

Appendix D, Enclosures 1 to 6 presents the petrographic analysis results completed for each of the three composite samples (RQ1-4, RQ2-4 and RQ3-4).

Enclosures 1 and 2 show that the sample RQ1-4 comprised carbonate, shaley carbonate and shale and had a weighted PN of 133. This result exceeds the specification maximum limit of 125 for aggregate used in pavement, but meets the specification for aggregate used in structures, sidewalks, curb & gutter and concrete base, as per OPSS 1002, rev 04/2013, Table 5.

Enclosures 3 and 4 provide the PN results for sample RQ2-4. This sample comprised carbonate, shaley carbonate and shale and had a weighted PN of 141. This result exceeds the specification maximum limit of 125 for aggregate used in pavement and marginally exceeds the specification for aggregate used in structures, sidewalks, curb & gutter and concrete base, as per OPSS 1002, rev 04/2013, Table 5.

Enclosures 5 and 6 provide the PN results for sample RQ3-4. This sample comprised carbonate, shaley carbonate and shale and had a weighted PN of 170. This result exceeds the specification maximum limit of 140 for aggregate used in concrete, as per OPSS 1002, rev 04/2013, Table 5.

Following this stage of testing, crushed core samples RQ1-4 and RQ2-4 advanced to the next stage of testing

3.2 Stage 2 of Testing – Micro Deval Abrasion, Magnesium Sulphate Soundness & Alkali Carbonate Reactivity

As Table 2 of this report indicates, testing of sample RQ1-4 during this stage yielded results that met OPSS 1002, rev 04/2013, Table 5 for the tests conducted. Test results for sample RQ2-4 also met OPSS 1002 requirements with the exception of the micro deval abrasion loss testing. This testing yielded a result which marginally exceeds the specification maximum for material to be used in pavement, but meets the specification for aggregate used in structures, sidewalks, curb & gutter and concrete base.

Appendix D, Enclosures 7 and 8 present the potential for alkali-carbonate reactivity of the crushed core for each of the two composite samples (RQ1-4 & RQ2-4). These enclosures indicate that both samples are non-expansive.

4.0 DISCUSSION AND CONCLUSION

Based on the physical and chemical testing completed on the three crushed core composite samples, the following conclusions can be drawn.

4.1 RQ1-4

The crushed core composite sample RQ1-4 appears suitable for use as aggregate used in structures, sidewalks, curb & gutter and concrete base, as per OPSS 1002, rev 04/2013, Table 5. The elevated PN result of 133 indicates that the material is not suitable for use in pavement, however the other physical and chemical test performed on the sample met the OPSS 1002 specifications.

4.2 RQ2-4

Sample RQ2-4 marginally exceeded micro deval abrasion loss requirements for aggregate used in pavement and marginally surpassed the PN requirements for use in structures, sidewalks, curb & gutter and concrete base, as per OPSS 1002, rev 04/2013, Table 5. The material met all other specifications of the physical and chemical test performed.

4.3 RQ3-4

Crushed core composite sample RQ3-4 did not proceed beyond the first stage of testing due to the elevated PN result of 170, which surpassed the PN requirements for use in structures, sidewalks, curb & gutter and concrete base, as per OPSS 1002, rev 04/2013, Table 5.

5.0 CLOSURE

This report is based on AMEC's professional knowledge and experience in concrete aggregate and concrete technology. It has been prepared for the exclusive use of Morrison Hershfield Ltd for specific application to the sampled rock core represented within this report. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. AMEC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. It has been prepared in accordance with generally accepted materials engineering practices. No other warranty, expressed or implied is made.

Please contact us if you have any questions, or if we can be of further service evaluating aggregate sources.

Yours truly,

AMEC Environment & Infrastructure
A Division of AMEC Americas Limited

Reviewed by,

Amy McCulloch, P.Geo.
Staff Geoscientist

Ivan Severinsky, P.Geo
Senior Associate Geologist

am;IS

APPENDIX A

BOREHOLE LOG

AMEC Rock Core Log

STRENGTH (MPa)

VH = Very High = > 200
H = High = 50 - 200
M = Medium = 15 - 50
L = Low = 4 - 15
VL = Very Low = 1- 4

DISCONTINUITY TYPE

B = Bedding Joint
J = Cross Joint
F = Fault
S = Shear Plane
Fr = Fracture

SPACING

VW = Very Wide = > 3 m
W = Wide = 1 - 3 m
M = Moderate = 0.3 - 1 m
C = Close = 5 - 30 cm
VC = Very Close = < 5 cm

FILLING

T = Tight, Hard
O = Oxidized
SA = Slightly Altered, Clay Free
S = Sandy, Clay Free
Si = Sandy, Silt, Minor Clay
NC = Non-softening Clay
SC = Swelling Clay

WEATHERING

U = Unweathered = No Signs
S = Slightly = Oxidized
M = Moderately = Discoloured
H = Highly = Friable
C = Completely = Soil-like

ORIENTATION

F = Flat = 0 - 20°
D = Dipping = 20 - 50°
V = n-Vertical = >50°

Point Load Testing

I_s = Uncorrected Point Load Strength Index

ROUGHNESS

RU = Rough Undulating
RP = Rough Planar
SU = Smooth Undulating
SP = Smooth Planar
LU = Slickensided Undulating
LP = Slickensided Planar

Shift Start Time ____________
Shift End Time ____________

Client: Morrison Hershfield
Date: 19 January 2014
Project Number: TB142006
Logger: AM/JS

BOREHOLE # 2130039

Contractor: George Downing Estate Drilling Ltd.
Head Driller: Unspecified
Crew: Unspecified
Rig Type: Unspecified
Core Size: HQ
Location: Cruickshank Elginburg Quarry, Kingston, Ontario
Co-ordinates: Unspecified
Weather: Unspecified

DEPTH TO	RUN #	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES: NUMBER	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	OCCASIONAL FEATURES	DRILLING OBSERVATIONS
0.76m	1	0.36m 100%	0.10m 28%	1.12m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasionally interbedded with lime mudstone, moderately hard, thinly to moderately bedded	H/M	U	3	FR	F	VC/C	SP	<1mm	Clay/ Shale	calcite eyelets	
1.12m	**2**	1.52m 98%	1.02m 66%	2.67m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasionally interbedded with lime mudstone, moderately hard, thinly to moderately bedded	H/M	U	5+	FR	F	VC/C	SP	<1mm	Clay/ Shale	1.30m - 1.91m vertical fracture, calcite eyelets	
								1	FR	V	-	SP	-	-		
2.67m	**3**	1.57m 98%	1.35m 84%	4.27m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasionally interbedded with lime mudstone, moderately hard, thin-moderately bedded	H/M	U	7	FR	F	VC/C	SP	<1mm	Clay/ Shale		
4.27m	**4**	1.53m 100%	1.37m 90%	5.80m	**4.27m - 5.05m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasionally interbedded with lime mudstone, moderately hard, thin-moderately bedded **5.05m - 5.80m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasional bioclastic zones increasing with depth, increase in amount of lime mudstone interbeds, moderately hard, moderately bedded	H/M	U	8	FR	F	VC/C	SP	<1mm	Clay/ Shale		
5.80m	**5**	1.52m 100%	1.32m 87%	7.32m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasional bioclastic, lime mudstone interbeds, moderately hard, moderately bedded	H/M	U	6	FR	F	VC/C	SP	<1mm	Clay/ Shale		
7.32m	**6**	1.52m 100%	1.52m 100%	8.84m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey,micritic-medium grained, crystalline, occasional bioclastic zones, lime mudstone interbeds, moderately hard, moderately bedded	H/M	U	2	FR	F	VC/C	SP	<1mm	Clay/ Shale		

DEPTH TO	RUN #	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES							OCCASIONAL FEATURES	DRILLING OBSERVATIONS
								NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING		
8.84m	**7**	1.45m 100%	1.45m 100%	10.29m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasional bioclastic zones, lime mudstone interbeds, moderately hard, moderately bedded	H/M	U	1	FR	F	VC/C	SP	<1mm	Clay/ Shale		
10.29m	**8**	1.55m 97%	1.50m 94%	11.89m	**10.29m - 11.63m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, occasional bioclastic zones, lime mudstone interbeds, moderately hard, moderately bedded **11.63m - 11.89m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** medium to dark blue grey, micritic-medium grained, crystalline, sugary texture, occasional styolites, occasional fossils, occasional calcite eyelets, moderately hard, thickly bedded	H/M	U	5	FR	F	VC/C	SP	<1mm	Clay/ Shale		
11.89m	**9**	1.47m 100%	1.45m 99%	13.36m	**11.63m - 12.24m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** medium to dark blue grey, micritic-medium grained, crystalline, sugary texture, occasional stylolites, occasional fossils, occasional calcite eyelets, moderately hard, thickly bedded **12.24m - 13.36m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, extensive lime mudstone bedding (up to 10cm in thickness), occasional intraclastic zones, occasional bioclastic zones, moderately soft-moderately hard, moderately-thickly bedded	H/M	U	4	FR	F	VC/C	SP	<1mm	Clay/ Shale		
13.36m	**10**	1.58m 100%	1.58m 100%	14.94m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, extensive lime mudstone bedding (up to 10cm in thickness), occasional intraclastic zones, occasional bioclastic zones, moderately hard, moderately-thickly bedded	M	U	7	FR	F	VC/C	SP	<1mm	Clay/ Shale		
14.94m	**11**	1.42m 100%	1.32m 93%	16.36m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, extensive lime mudstone bedding (up to 10cm in thickness), occasional intraclastic zones, occasional bioclastic zones, moderately hard, moderately-thickly bedded	M	U	8	FR	F	VC/C	SP	<1mm	Clay/ Shale		
16.36m	**12**	1.60m 100%	1.60m 100%	17.96m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, extensive limemudstone bedding (up to 10cm), occasional intraclastic zones, occasional bioclastic zones, moderately hard, moderately-thickly bedded	M	U	6	FR	F	VC/C	SP	<1mm	Clay/ Shale		
17.96m	**13**	1.42m 100%	1.35m 95%	19.38m	**17.96m - 19.13m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, crystalline, extensive lime mudstone bedding (up to 10cm in thickness), occasional intraclastic zones, occasional bioclastic zones, moderately hard, moderately-thickly bedded **19.13m - 19.38m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, occasional intraclastic zones, occasional styolites, occasional bioclasts, occasional lime mudstones zones, moderately hard, moderately-thickly bedded	H/M	U	4	FR	F	VC/C	SP	<1mm	Clay/ Shale		
19.38m	**14**	1.58m 100%	1.55m 98%	20.96m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, occasional intraclastic zones, occasional styolites, occasional bioclasts, occasional lime mudstones interbedding (up 3cm), moderately hard, moderately-thickly bedded	H/M	U	4	FR	F	VC/C	SP	<1mm	Clay/ Shale		

DEPTH TO	RUN #	% CORE RECOVERY	% RQD	DEPTH TO	GENERAL DESCRIPTION (Rock Type/s, %, Colour, Texture, etc.)	STRENGTH	WEATHERING	DISCONTINUITIES NO. OF SETS	TYPE/S	ORIENTATION	SPACING	ROUGHNESS	APERTURE	FILLING	OCCASIONAL FEATURES	DRILLING OBSERVATIONS
20.96m	**15**	1.49m 100%	1.47m 99%	22.45m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, occasional intraclastic zones, occasional styolites, occasional bioclasts, occasional lime mudstones interbedding (up 3cm), moderately hard, moderately-thickly bedded	H/M	U	1	FR	D	VC/C	SP	-	-	21.00m - 21.41m lime mudstone zone 21.31m - 21.34m vertical fracture	
								7	FR	F	VC/C	SP	<1mm	Clay/ Shale		
								1	FR	V	-	SP	-	-		
22.45m	**16**	1.53m 100%	1.53m 100%	23.98m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, occasional intraclastic zones, occasional styolites, occasional bioclasts, occasional lime mudstones interbedding (up 3cm), moderately hard, moderately-thickly bedded	H/M	U	4	FR	F	VC/C	SP	<1mm	Clay/ Shale		
23.98m	**17**	1.52m 100%	1.30m 86%	25.50m	**23.98m - 24.61m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** light to dark blue grey, micritic-medium grained, occasional intraclastic zones, occasional styolites, occasional bioclasts, occasional lime mudstones interbedding (up 3cm), moderately hard, moderately-thickly bedded **24.61m - 25.5m** GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** medium to dark blue grey, micritic-medium grained, occasional lime mudstone zones, occasionally fossiliferous, occasional intraclastic zones, very soft-moderately hard, thinly-thickly bedded	H/M	U								24.69m - 24.92m broken rock with clay infill	
25.50m	**18**	0.81m 55%	0.81m 55%	26.98m	GULL RIVER FORMATION, BLACK RIVER GROUP - **LIMESTONE** medium to dark blue grey, micritic-medium grained, occasional lime mudstone zones, occasionally fossiliferous, occasional intraclastic zones, very soft-moderately hard, thinly-thickly bedded	H/M	U								26.67m - 26.98m contains grey-green argillaceous lime mudstone	

APPENDIX B

PHOTOGRAPHS

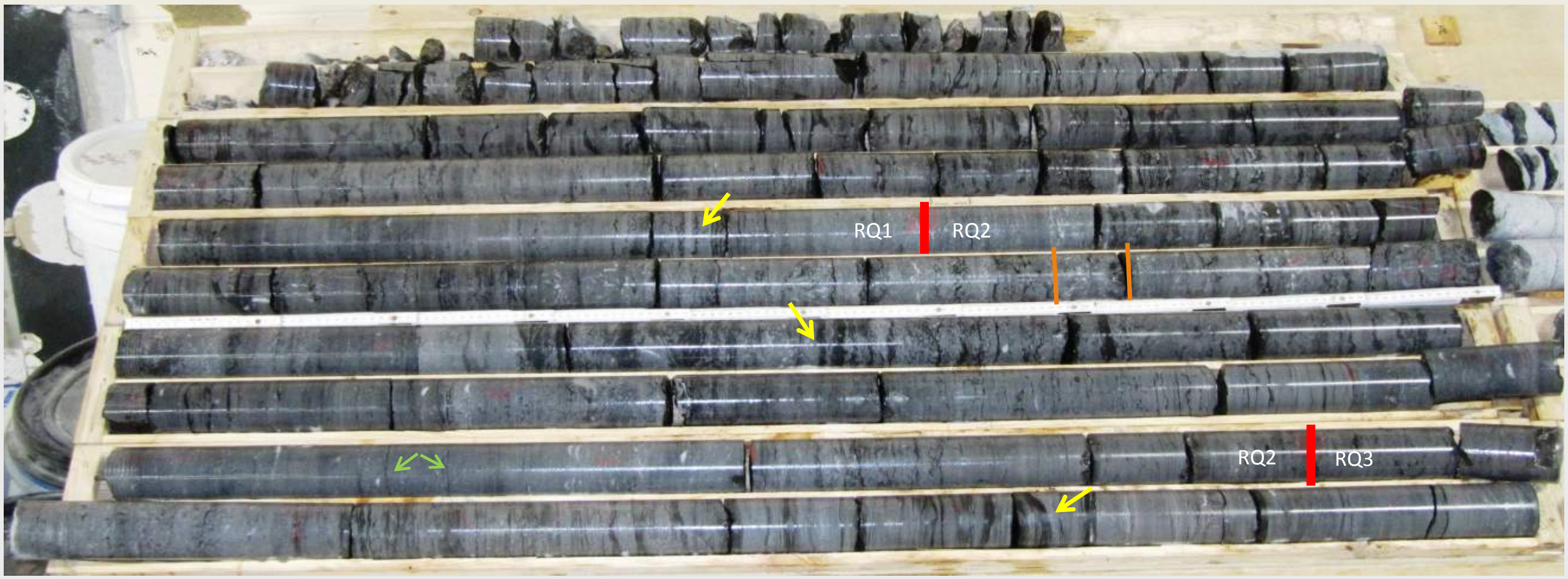
PHOTOGRAPHS

PROJECT NO. TB142006

PROJECT Aggregate Testing on Crushed Rock

LOCATION Kingston, Ontario

PHOTOGRAPH	1



PHOTOGRAPH	1	Description

Photograph of core from borehole # 2130039 displaying zones RQ1, RQ2 and some of RQ3 to be tested for concrete coarse aggregate. The borehole contained limestone that ranged from light to dark blue grey, micritic to medium grained with varying features such as occasional lime mudstone interbeds (yellow arrows), bioclastic zones (between orange lines) and occasional stylolites (green arrows).

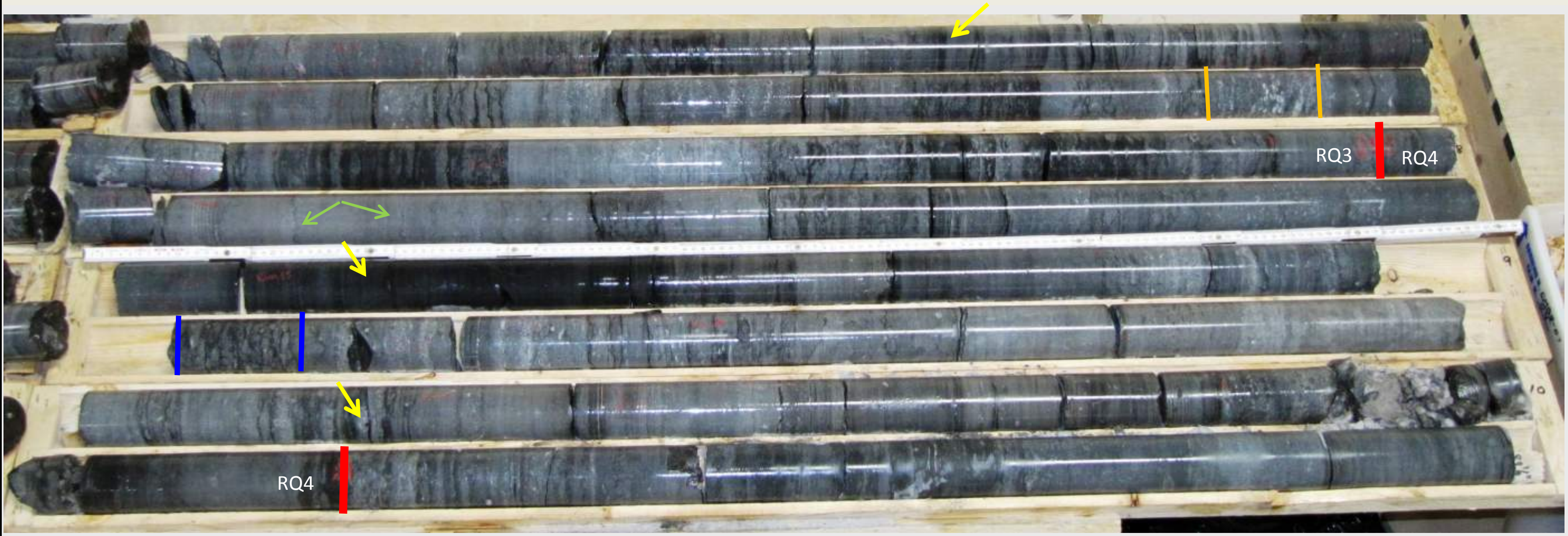
PHOTOGRAPHS

PROJECT NO. TB142006

PROJECT Aggregate Testing on Crushed Rock

LOCATION Kingston, Ontario

PHOTOGRAPH	2



PHOTOGRAPH	2	Description

Photograph of borehole #2130039 displaying zones RQ3 and RQ4 to be tested for concrete coarse aggregate. The borehole contained limestone that ranged from light to dark blue grey, micritic to medium grained with various features observed such as lime mudstone both thinly and thickly interbedded (yellow arrows), occasional bioclastic zones (between orange lines), occasional intraclastic zones (between blue lines) and occasional stylolites (green arrows).

PHOTOGRAPHS

PROJECT NO. TB142006

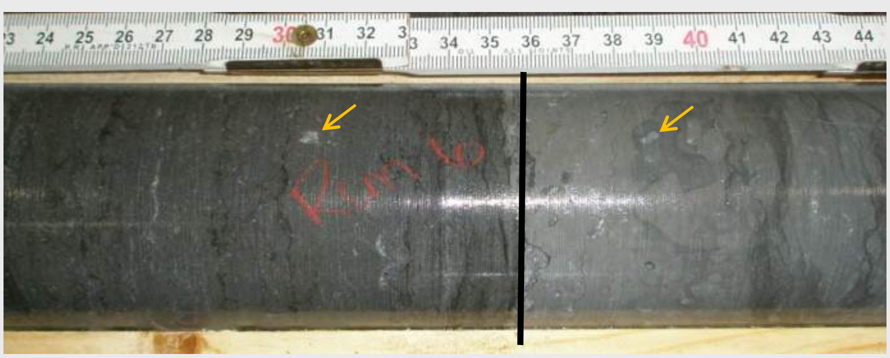
PROJECT Aggregate Testing of Crushed Rock

LOCATION Kingston, Ontario

PHOTOGRAPH	3

Description

Photograph 2 displays lime mudstone (between yellow lines) at 21.00m to 21.41m. In addition intraclastic zones (between blue lines) were noted.



PHOTOGRAPH	4

Description

Photograph 3 shows a change in the colour of limestone (black line), along with occasional bioclasts (orange arrows).

PHOTOGRAPHS

PROJECT NO. TB142006

PROJECT Aggregate Testing of Crushed Rock

LOCATION Kingston, Ontario

PHOTOGRAPH	5

Description
Photograph 4 displays occasional bioclasts (orange arrows) and lime mudstone interbeds (yellow arrows).

PHOTOGRAPH	6

Description
Photograph 5 displays lime mudstone.

PHOTOGRAPHS

PROJECT NO. TB142006

PROJECT Aggregate Testing of Crushed Rock

LOCATION Kingston, Ontario

PHOTOGRAPH	7

Description

Photograph 6 displays bioclastic zones (between orange lines) and lime mudstone interbeds (yellow arrows).

PHOTOGRAPH	8

Description

Photograph 7 displays a close up of the varying thickness of interbedded lime mudstone present wtihin the core.

APPENDIX C

AGGREGATE TEST DATA SHEETS

COARSE CONCRETE AGGREGATE TEST DATA

Ontario Provincial Standard Specification 1002, OPSS.PROV 1002 Rev. April 2013
Table 5

AMEC Job No.:	Client:	Sampled By:	Enclosure:
TB142006	Morrison Hershfield Ltd.	A representative of Morrison Hershfield Ltd.	1

Name of Testing Laboratory:	Telephone No.:	Fax No.:
AMEC Environment & Infrastructure	905-312-0700	905-312-0771

Sample Lab No.:	Sample Source:
S067-14	Cruickshank Elginburg Quarry, Kingston, Ontario

Sample Type:	Date Sampled:
Crushed Core - RQ1-RQ4	9-10 December 2013

COARSE CONCRETE AGGREGATE

Nominal Max. Size (mm):	Aggregate Inventory No.:	Gradation Results:	Meets Spec: (Y/N)
19.0		Please See Enclosure	Y

PHYSICAL PROPERTY REQUIREMENTS

Laboratory Test and Number	Acceptance Requirements		Reference Material Results	Sample Results	Aggregate is on concrete ASL ✓	Meets Spec. Y or N
	Pavement	Structures, Sidewalks, Curb & Gutter, Base				
Wash Pass 75 µm Sieve Guideline A, LS - 601	1.0 % maximum (gravel) 2.0% maximum (crushed rock)		-	-		-
Absorption LS - 604 or CSA A23.2 -12A (see notes)	2.0% maximum		0.38%	**0.48%**		**Y**
Flat and Elongated Particles LS - 608	20% maximum		-	-		-
Petrographic Number, Concrete, LS - 609	125 maximum (See attached description)	140 maximum (See attached description)	-	**133**		**N/Y**
Unconfined Freeze-Thaw LS - 614 or CSA A23.2 - 24A (see notes)	6 % loss maximum (not required if Magnesium Sulphate Soundness (LS-606), meets Specification		-	-		-
Micro-Deval Abrasion LS - 618 or CSA A23.2 - 29A (see notes)	14% loss maximum	17% loss maximum	13.9%	**12.9%**		**Y**
Accelerated Mortar Bar Expansion LS - 620 or CSA A23.2 - 25A (see notes)	0.150% maximum @ 14 days		-	-		-
Salt Scaling, LS - 412 (see notes)	0.80 kg/m^2 loss maximum after 50 cycles of freezing and thawing		-	-		-
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2 - 26A (see notes)	Chemical composition must plot in non-expansive field		-	**See enclosure**		**Y**
Concrete Prism Expansion Test, CSA A23.2 - 14A (see notes)	0.040% maximum at 1 year		-	-		-
Concrete Freeze-Thaw, ASTM C666, Procedure A (see notes)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days		-	-		-
Alternative Requirement for LS-614						
Magnesium Sulphate Soundness loss, LS - 606 (see notes)	12 % loss maximum		10.9%	**7.6%**		**Y**

I hereby certify that testing has been carried out by a properly qualified / certified test technician:

Issued By: Kristen Hand — *Print Name*

K 3 8 — *Testing Laboratory Representative Signature*

6 March 2014 — *Date*

AMEC Enviornment & Infrastructure
A Division of AMEC Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

COARSE CONCRETE AGGREGATE TEST DATA

Ontario Provincial Standard Specification 1002, OPSS.PROV 1002 Rev. April 2013
Table 5

AMEC Job No.: TB142006	Client: Morrison Hershfield Ltd.	Sampled By: A representative of Morrison Hershfield Ltd.	Enclosure: 2
Name of Testing Laboratory: AMEC Environment & Infrastructure	Telephone No.: 905-312-0700	Fax No.: 905-312-0771	
Sample Lab No.: S068-14	Sample Source: Cruickshank Elginburg Quarry, Kingston, Ontario		
Sample Type: Crushed Core - RQ2-RQ4	Date Sampled: 9-10 December 2013		

COARSE CONCRETE AGGREGATE

Nominal Max. Size (mm):	Aggregate Inventory No.:	Gradation Results:	Meets Spec: (Y/N)
19.0		Please See Enclosure	Y

PHYSICAL PROPERTY REQUIREMENTS

Laboratory Test and Number	Acceptance Requirements: Pavement	Acceptance Requirements: Structures, Sidewalks, Curb & Gutter, Base	Reference Material Results	Sample Results	Aggregate is on concrete ASL ✓	Meets Spec. Y or N
Wash Pass 75 µm Sieve Guideline A, LS - 601	1.0 % maximum (gravel) 2.0% maximum (crushed rock)		-	-		-
Absorption LS - 604 or CSA A23.2 -12A (see notes)	2.0% maximum		0.38%	0.50%		Y
Flat and Elongated Particles LS - 608	20% maximum		-	-		-
Petrographic Number, Concrete, LS - 609	125 maximum (See attached description)	140 maximum (See attached description)	-	141		N
Unconfined Freeze-Thaw LS - 614 or CSA A23.2 - 24A (see notes)	6 % loss maximum (not required if Magnesium Sulphate Soundness (LS-606), meets Specification		-	-		-
Micro-Deval Abrasion LS - 618 or CSA A23.2 - 29A (see notes)	14% loss maximum	17% loss maximum	13.9%	14.5%		N/Y
Accelerated Mortar Bar Expansion LS - 620 or CSA A23.2 - 25A (see notes)	0.150% maximum @ 14 days		-	-		-
Salt Scaling, LS - 412 (see notes)	0.80 kg/m^2 loss maximum after 50 cycles of freezing and thawing		-	-		-
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2 - 26A (see notes)	Chemical composition must plot in non-expansive field		-	see enclosure		Y
Concrete Prism Expansion Test, CSA A23.2 - 14A (see notes)	0.040% maximum at 1 year		-	-		-
Concrete Freeze-Thaw, ASTM C666, Procedure A (see notes)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days		-	-		-

Alternative Requirement for LS-614

Magnesium Sulphate Soundness loss, LS - 606 (see notes)	12 % loss maximum		10.9%	9.1%		Y

I hereby certify that testing has been carried out by a properly qualified / certified test technician:

Issued By: Kristen Hand (*Print Name*) K.38 (*Testing Laboratory Representative Signature*) 6 March 2014 (*Date*)

AMEC Enviornment & Infrastructure
A Division of AMEC Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

COARSE CONCRETE AGGREGATE TEST DATA

Ontario Provincial Standard Specification 1002, OPSS.PROV 1002 Rev. April 2013
Table 5

AMEC Job No.:	Client:	Sampled By:	Enclosure:
TB142006	Morrison Hershfield Ltd.	A representative of Morrison Hershfield Ltd.	3

Name of Testing Laboratory:	Telephone No.:	Fax No.:
AMEC Environment & Infrastructure	905-312-0700	905-312-0771

Sample Lab No.:	Sample Source:
S069-14	Cruickshank Elginburg Quarry, Kingston, Ontario

Sample Type:	Date Sampled:
Crushed Core - RQ3-RQ4	9-10 December 2013

COARSE CONCRETE AGGREGATE

Nominal Max. Size (mm):	Aggregate Inventory No.:	Gradation Results:	Meets Spec: (Y/N)
19.0		Please See Enclosure	Y

PHYSICAL PROPERTY REQUIREMENTS

Laboratory Test and Number	Acceptance Requirements: Pavement	Acceptance Requirements: Structures, Sidewalks, Curb & Gutter, Base	Reference Material Results	Sample Results	Aggregate is on concrete ASL ✓	Meets Spec. Y or N
Wash Pass 75 µm Sieve Guideline A, LS - 601	1.0 % maximum (gravel) 2.0% maximum (crushed rock)		-	-		-
Absorption LS - 604 or CSA A23.2 -12A (see notes)	2.0% maximum		0.38%	0.59%		Y
Flat and Elongated Particles LS - 608	20% maximum		-	-		-
Petrographic Number, Concrete, LS - 609	125 maximum (See attached description)	140 maximum (See attached description)	-	170		N
Unconfined Freeze-Thaw LS - 614 or CSA A23.2 - 24A (see notes)	6 % loss maximum (not required if Magnesium Sulphate Soundness (LS-606), meets Specification		-	-		-
Micro-Deval Abrasion LS - 618 or CSA A23.2 - 29A (see notes)	14% loss maximum	17% loss maximum	-	-		-
Accelerated Mortar Bar Expansion LS - 620 or CSA A23.2 - 25A (see notes)	0.150% maximum @ 14 days		-	-		-
Salt Scaling, LS - 412 (see notes)	0.80 kg/m^2 loss maximum after 50 cycles of freezing and thawing		-	-		-
Potential Alkali-Carbonate Reactivity, Carbonate Rock, CSA A23.2 - 26A (see notes)	Chemical composition must plot in non-expansive field		-	-		-
Concrete Prism Expansion Test, CSA A23.2 - 14A (see notes)	0.040% maximum at 1 year		-	-		-
Concrete Freeze-Thaw, ASTM C666, Procedure A (see notes)	Average Δ length ≤ ± 0.0350% Average FTF ≥ 90% of FTF @ 14 days		-	-		-

Alternative Requirement for LS-614

Magnesium Sulphate Soundness loss, LS - 606 (see notes)	12 % loss maximum	-	-		-

I hereby certify that testing has been carried out by a properly qualified / certified test technician:

Issued By: Kristen Hand — *Print Name*

K.38 — *Testing Laboratory Representative Signature*

6 March 2014 — *Date*

AMEC Enviornment & Infrastructure
A Division of AMEC Americas Limited
505 Woodward Avenue, Unit 1
Hamilton, Ontario
Canada L8H 6N6

COARSE CONCRETE AGGREGATE TEST DATA

Ontario Provincial Standard Specification 1002, OPSS.PROV 1002 Rev. April 2013 Table 5

Enclosure **3**

Notes:

- Where a concrete surface is exposed to vehicular traffic, the physical requirements for "Pavement" shall apply to the aggregate used.

Accelerated Mortar Bar Test (CSA A23.2-25A)

- Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
- An Aggregate that fails this requirement may be accepted provided the requirements of CSA A23.2-14A are met.
- Fine aggregate that contains more than 1.0% chert, measured by LS-616, that fails the 14 day requirement may be accepted provided the expansion after 28 days does not exceed 0.33%.
- If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
- If the aggregate is a quarried sandstone, siltstone, granite or gneiss, the expansion shall be less than 0.080% after 14 days. For quarried aggregates of the Gull River, Bobcaygeon, Verulam and Lindsay formations, the expansion shall be less than 0.100% after 14 days.

Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rock (CSA A23.2-26A)

- Compliance with this requirement only applies to quarried rock from the Gull River and Bobcaygeon Formations of southern and eastern Ontario. These dolomitic limestones outcrop on the southern margin of the Canadian Shield from Midland to Kingston and in the Ottawa-St Lawrence Lowlands near Cornwall.

Concrete Test Expansion Test (CSA A23.2-14A)

- Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
- If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, the aggregate must meet the requirement of CSA A23.2-14A, even though it may be on the MTO regional Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates or the Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.
- An Aggregate needs to meet this requirement only if it fails the requirement of CSA A23.2-25A or CSA A23.2-26A.
- Test data shall be from a sample of material from the same source and processed in the same manner as the material intended for use. The data shall have been obtained within the past 18 months.
- If the aggregate is potentially expansive due to alkali-carbonate reaction as determined by CSA A23.2-26A, then a chemical analysis (CSA A23.2-26A) shall be provided to show that the aggregate intended for use has the same chemical composition as the material tested.

Salt Scaling Test (LS-412)

- Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
- Coarse aggregate composed of more than 80% siliceous and silicate mineral rock types shall be tested, together with either the fine aggregate intended for use, or a fine aggregate from the same geographic area as the coarse aggregate.
- This test shall be done at the time of first use of a source for aggregate in concrete.

Concrete Freeze Thaw Test (ASTM C666 - Procedure A)

- The concrete for this test shall be proportioned with 37.5-4.75 mm stone meeting the combined grading shown in Table 4, of SSP110S11, with 325kg/m^3 of Type GU hydraulic cement, a plastic air content of 6.5+/-1.5% and a slump of 50 +/- 20 mm.
- Coarse aggregate from carbonate (limestone and dolostone) bedrock quarries for concrete pavement and concrete base shall be tested, except for aggregate produced from the Oxford, Gull River or Bobcaygeon Formations.
- Compliance with this requirement is waived if the aggregate source is on the MTO regional Aggregate Source List for Structural Concrete - Fine and Coarse Aggregates, or the MTO regional Aggregate Source List for Concrete Base/Pavement Coarse Aggregates.
- The fine aggregate shall be either the fine aggregate intended for use or a fine aggregate from the same geographic area as the coarse aggregate.
- The bench within the quarry from which the aggregate is selected for testing shall be defined. Approval of aggregate for concrete pavement will only apply to the bench of the quarry from which the aggregate was taken. Aggregate processes from other benches within the same quarry will require testing prior to use.
- Procedure A shall be modified so that each freeze cycle takes 10.5 +/- 1 hour; and the test shall be conducted for 350 cycles.

Unconfined Freeze-Thaw Test (LS-614)

- Compliance with this requirement is waived if the aggregate meets the alternative requirement for magnesium sulphate soundness loss, LS-606 A23.2-24A.

Absoprtion %maximum (LS-604)

- For air-cooled blast-furnace slag aggregate, the allowable maximum value shall conform to the Owner's requirements for slag aggregate.

Micro-Deval Abrasion Loss (LS-618)

- For air-cooled blast-furnace slag aggregate, the allowable maximum value shall be 21% for structures.

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APPENDIX D

LABORATORY RESULTS

Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: **1**
Project: TB142006

Client: Morrison Hershfield Ltd.

AMEC Lab No.: S067-14

Sample Type: Core - RQ1-4

Source: Cruickshank Elginburg Quarry, Kingston, ON

Date Sampled: 9-10 December 2013

Sampled By: Representative of Morrison Hershfield

Date Received: 13 January 2014

Date Tested: 06 February 2014

Test Fraction: - 19.0 + 9.5 mm

Petrographic Number of **132** for fraction (-19.0 + 9.5 mm)
Weighted Petrographic Number for the Entire Sample is **133**

Rock Types	QUALITY (%)			
	Good	**Fair**	**Poor**	**Deleterious**
01 - Carbonate (hard)	51.0			
20 - Carbonate (silty, slightly shaley, med. hard)	38.3			
01 - Carbonate (hard) *trace sulphide	0.2			
20 - Carbonate (silty, slightly shaley, med. hard) *trace sulphide	0.3			
35 - Carbonate (silty soft, slightly shaley)		6.5		
43 - Carbonate (shaley, clayey)			3.7	
61 - Shale				0.0
	89.8	6.5	3.7	0.0

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: **2**
Project: TB142006

Client:	Morrison Hershfield Ltd.	**Date Sampled:**	9-10 December 2013
AMEC Lab No.:	S067-14	**Sampled By:**	Representative of Morrison Hershfield
Sample Type:	Core - RQ1-4	**Date Received:**	13 January 2014
Source:	Cruickshank Elginburg Quarry, Kingston, ON	**Date Tested:**	06 February 2014
		Test Fraction:	- 9.5 + 6.7 mm

Petrographic Number of **137** for fraction (-9.5 + 6.7 mm)
Weighted Petrographic Number for the Entire Sample is **133**

Rock Types	QUALITY (%)			
	Good	Fair	Poor	Deleterious
01 - Carbonate (hard)	66.3			
20 - Carbonate (silty, slightly shaley, med. hard)	19.3			
35 - Carbonate (silty soft, slightly shaley)		11.8		
43 - Carbonate (shaley, clayey)			2.6	
	85.6	11.8	2.6	0.0

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: 3
Project: TB142006

Client:	Morrison Hershfield Ltd.	**Date Sampled:**	9-10 December 2013
AMEC Lab No.:	S068-14	**Sampled By:**	Representative of Morrison Hershfield
Sample Type:	Rock Core - RQ2-4	**Date Received:**	13 January 2014
Source:	Cruickshank Elginburg Quarry, Kingston, ON	**Date Tested:**	09 February 2014
		Test Fraction:	- 19.0 + 9.5 mm

Petrographic Number of **134** for fraction (-19.0 + 9.5 mm)
Weighted Petrographic Number for the Entire Sample is **141**

Rock Types	**QUALITY (%)**			
	Good	**Fair**	**Poor**	**Deleterious**
01 - Carbonate (hard)	45.2			
20 - Carbonate (silty, slightly shaley, med. hard)	40.8			
20 - Carbonate (med.hard) * <10% calcite	0.7			
20 - Carbonate (silty, slightly shaley, med. hard) *trace sulphide	0.2			
35 - Carbonate (silty soft, slightly shaley)		10.6		
43 - Carbonate (shaley, clayey)			2.5	
	86.9	10.6	2.5	0.0

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: 4
Project: TB142006

Client: Morrison Hershfield Ltd.

AMEC Lab No.: S068-14

Sample Type: Rock Core - RQ2-4

Source: Cruickshank Elginburg Quarry, Kingston, ON

Date Sampled: 9-10 December 2013

Sampled By: Representative of Morrison Hershfield

Date Received: 13 January 2014

Date Tested: 09 February 2014

Test Fraction: - 9.5 + 6.7 mm

Petrographic Number of **161** for fraction (-9.5 + 6.7 mm)
Weighted Petrographic Number for the Entire Sample is **141**

Rock Types	QUALITY (%) Good	Fair	Poor	Deleterious
01 - Carbonate (hard)	55.8			
20 - Carbonate (silty, slightly shaley, med. hard)	28.2			
20 - Carbonate (med.hard) * <10% calcite	0.4			
35 - Carbonate (silty soft, slightly shaley)		5.7		
43 - Carbonate (shaley, clayey)			9.9	
	84.4	5.7	9.9	0.0

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

AMEC Environment & Infrastructure, a Division of AMEC Americas Limited, 505 Woodward Ave., Unit 1, Hamilton, ON, L8H 6N6
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Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: 5
Project: TB142006

Client:	Morrison Hershfield Ltd.	**Date Sampled:**	9-10 December 2013
AMEC Lab No.:	S069-14	**Sampled By:**	Representative of Morrison Hershfield
Sample Type:	Rock Core - RQ3-4	**Date Received:**	13 January 2014
Source:	Cruickshank Elginburg Quarry, Kingston, ON	**Date Tested:**	04 February 2014
		Test Fraction:	- 19.0 + 9.5 mm

Petrographic Number of **171** for fraction (-19.0 + 9.5 mm)
Weighted Petrographic Number for the Entire Sample is **170**

Rock Types	QUALITY (%)			
	Good	Fair	Poor	Deleterious
01 - Carbonate (hard)	46.6			
20 - Carbonate (silty, slightly shaley, med. hard)	31.8			
01 - Carbonate (hard) * trace sulphide	0.3			
20 - Carbonate (silty, slightly shaley, med. hard) *trace sulphide	0.5			
35 - Carbonate (silty soft, slightly shaley)		11.0		
43 - Carbonate (shaley, clayey)			9.4	
43 - Carbonate (shaley, clayey) *trace sulphide			0.3	
61 - Shale				0.1
	79.2	11.0	9.7	0.1

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

Petrographic Analysis Of Coarse Aggregate
MTO LS-609

Enclosure: 6
Project: TB142006

Client: Morrison Hershfield Ltd.

AMEC Lab No.: S069-14

Sample Type: Rock Core - RQ3-4

Source: Cruickshank Elginburg Quarry, Kingston, ON

Date Sampled: 9-10 December 2013

Sampled By: Representative of Morrison Hershfield

Date Received: 13 January 2014

Date Tested: 04 February 2014

Test Fraction: - 9.5 + 6.7 mm

Petrographic Number of **166** for fraction (-9.5 + 6.7 mm)
Weighted Petrographic Number for the Entire Sample is **170**

Rock Types	QUALITY (%)			
	Good	**Fair**	**Poor**	**Deleterious**
01 - Carbonate (hard)	69.3			
20 - Carbonate (silty, slightly shaley, med. hard)	10.7			
35 - Carbonate (silty soft, slightly shaley)		11.4		
43 - Carbonate (shaley, clayey)			8.1	
43 - Carbonate (shaley, clayey) *trace sulphide			0.3	
61 - Shale				0.2
	80.0	11.4	8.4	0.2

TESTED BY: J. McKenna

REVIEWED BY: Amy McCulloch, P.Geo.

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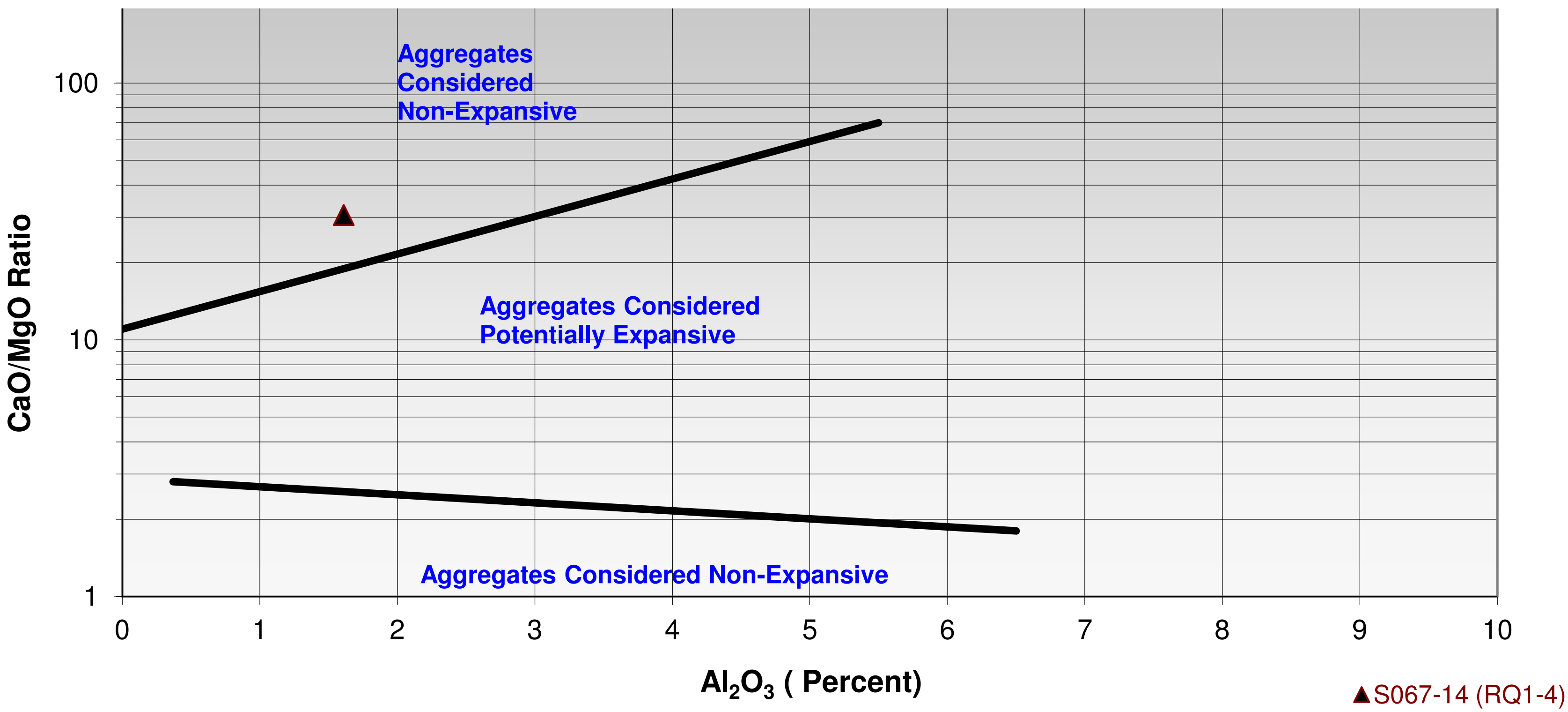
Enclosure: 7

Laboratory Test Results for Determination of Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rocks by Chemical Composition (LS-615)

Areas on the graph where non-expansive and potentially expansive alkali-carbonate reactive rocks are identified are based on the correlation of Rock Cylinder Expansion Test (ASTM C 586) and Concrete Prism Expansion Test (CSA A23.2-14A)



SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
5.78	1.61	0.61	1.6	49	0.12	0.5	0.06	0.02	0.02	< 0.01	< 0.01	40.2	99.5

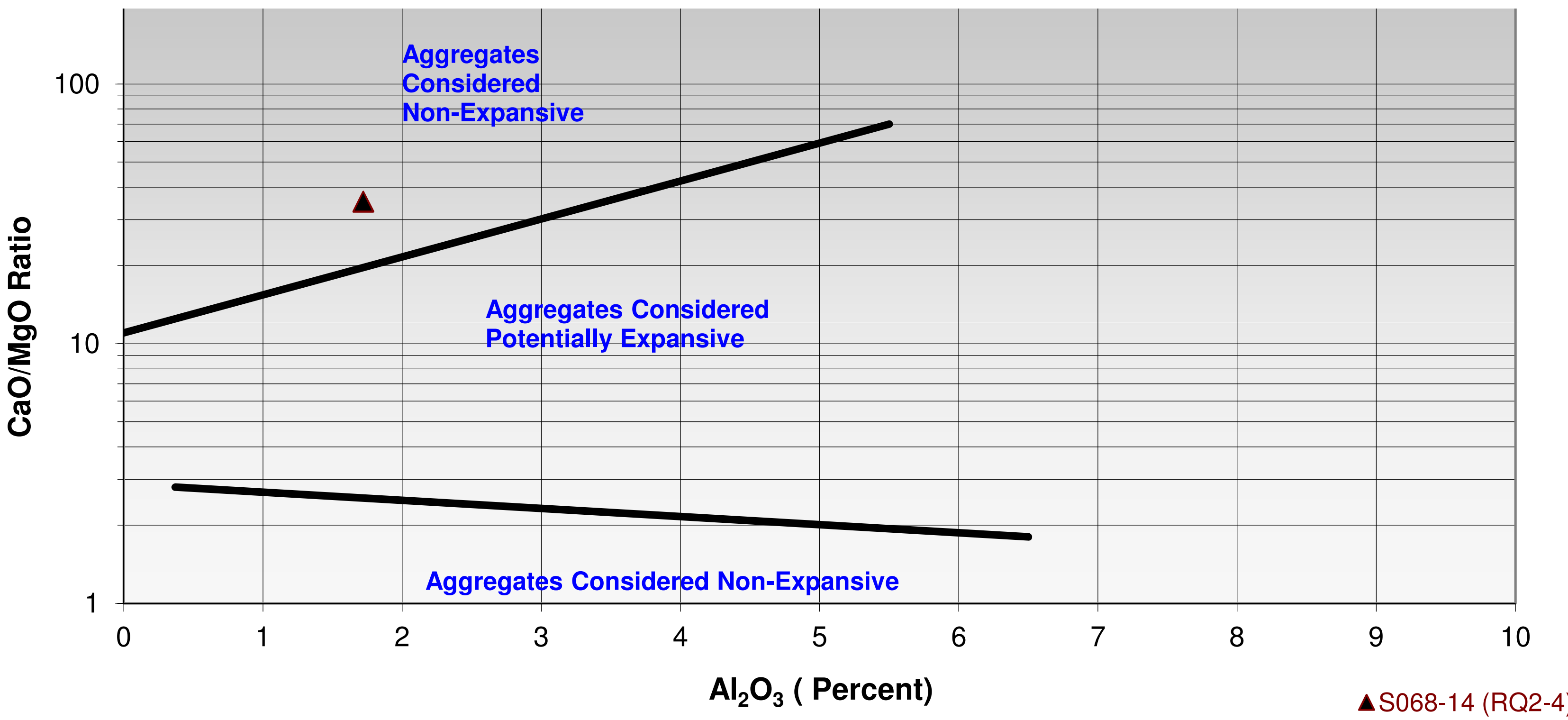
Project No.: TB142006
Source: Cruickshank Elginburg Quarry, Kingston, ON
Date: 24 February 2014

amec

Enclosure: 8

Laboratory Test Results for Determination of Potential Alkali-Carbonate Reactivity of Quarried Carbonate Rocks by Chemical Composition (LS-615)

Areas on the graph where non-expansive and potentially expansive alkali-carbonate reactive rocks are identified are based on the correlation of Rock Cylinder Expansion Test (ASTM C 586) and Concrete Prism Expansion Test (CSA A23.2-14A)



SiO2 %	Al2O3 %	Fe2O3 %	MgO %	CaO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	Cr2O3 %	V2O5 %	LOI %	Sum %
6.09	1.72	0.67	1.38	48.7	0.11	0.55	0.07	0.02	0.02	< 0.01	< 0.01	40	99.3

Project No.: TB142006
Source: Cruickshank Elginburg Quarry, Kingston, ON
Date: 24 February 2014

APPENDIX F: Preliminary Aggregate Assessment (Golder, 2011)

June 20, 2011

Project No. 10-1127-0091

Ken Bangma, Operations Manager
Cruickshank Construction Limited
751 Dalton Avenue
Kingston, Ontario
K7M 8N6

PRELIMINARY AGGREGATE RESOURCE EVALUATION, CRUICKSHANK CONSTRUCTION LIMITED, PROPOSED EXPANSION OF ELGINBURG QUARRY, ELGINBURG, ONTARIO

Dear Ken:

Further to our meeting on June 3, 2011, this submission presents and discusses the available geological and geophysical data obtained from the boreholes drilled in 2010 and 2011 at the Cruickshank Construction Limited ("Cruickshank") Elginburg Quarry (Ministry of Natural Resources License No. 2901) and adjoining lands owned by Cruickshank which are referred to as the Brash and Milligan properties. Laboratory test results on the rock core obtained from diamond drill hole DDH10-01 are also presented and discussed. Based on our discussions on June 3, 2011, it is understood that the highest quality aggregate historically quarried on the Elginburg Quarry property is from the uppermost bedrock units which correspond to Unit 6 and 7 of the Gull River Formation as defined in the geological logging of borehole DDH10-01. As such, Golder Associates was requested to provide an estimate of the potential quantity of high quality aggregate on the Brash and Milligan properties. It is understood that this information is required by Cruickshank so that they can decide on whether it is economically viable to proceed with the licensing of the Brash and Milligan properties under the *Aggregate Resources Act*.

The approximate property boundaries for the Elginburg Quarry as well as the Brash and Milligan properties are shown on Figure 1. The locations of the boreholes are also shown on Figure 1. Borehole DDH10-01 is a cored borehole (HQ-size) drilled by Marathon Drilling Co. Ltd. Boreholes BH11-02, BH11-03 and BH11-04 are air rotary boreholes drilled by Knox Well Drilling. Boreholes BH11-05 and BH11-06 were drilled by Cruickshank using an air track drill. Each of the boreholes was geophysically logged for apparent conductivity and natural gamma using the Geonics EM39 (RT) system. Borehole DDH10-01 was geologically logged by Golder Associates. The core recovered from borehole DDH10-01 was split longitudinally. During our meeting on April 11, 2011, five depth intervals from the rock core were selected for aggregate laboratory testing for the purpose of assessing the quality of the rock from the perspective of concrete production. The depth intervals selected for laboratory testing were as follows:

Table 1: Aggregate Quality Sample Numbers and Test Intervals Borehole DDH10-01

Sample Identification	Depth Interval (metres below ground surface)
Sample "A"	0.15 – 6.00 metres
Sample "B"	6.00 – 9.65 metres
Sample "C"	9.65 – 14.85 metres
Sample "D"	14.85 – 20.60 metres
Sample "E"	20.60 – 25.88 metres

The laboratory analyses included the following tests: Petrographic Number (LS-609); Micro-Deval abrasion loss (LS-618); Potential Alkali-Carbonate Reactivity (CSA A.23.2-26A); and, Magnesium Sulphate Soundness loss (LS-606).

The area which is available for extraction on the Brash and Milligan properties is shown in yellow on Figure 1. This is the area that is beyond the 500 metre setback from existing development and considers allowances for standard regulatory setbacks.

SITE GEOLOGY

The geological and geophysical log for borehole DDH10-01 is presented in **Attachment A**. The borehole was drilled to a total depth of 36.4 metres and penetrated 0.15 metres of overburden before encountering limestone of the Gull River Formation in which the borehole was terminated. Based on the geological and geophysical logging of borehole DDH10-01, the Gull River Formation was subdivided into seven lithologically distinct units.

AGGREGATE QUALITY DATA

The result of the testing carried out on the five depth intervals from the core are provided in **Attachment B**.

Samples "C" and "E" did not meet the requirements for concrete for any of the four laboratory tests. Sample "C" is from Unit 5 and the upper part of Unit 4 and consists of limestone with variable amounts of shale. Sample "E" represents Unit 2 which is a micritic limestone with a thick dolostone bed between depths of 23.04 and 23.83 metres below ground surface.

Samples "B" and "D" did meet the physical requirements for concrete aggregate based on the testing that was carried out. Sample "B" is from the lower part of Unit 7 and Unit 6 and consists of argillaceous (shaley) limestone. Sample "D" represents the lower part of Unit 4 and Unit 3 and consists primarily of a lithographic limestone.

Sample "A" did meet the physical requirements for concrete aggregate based on the testing that was carried out with the exception of the Petrographic Number of 159 which exceeded the maximum acceptable value of 140. Sample "A" comprises Unit 7 and consists of micritic limestone. It is understood from Cruickshank that this upper rock unit at the Elginburg Quarry historically produces the highest quality aggregate.

Based on the results of the laboratory testing and discussions with Cruickshank personnel, it is understood that the highest quality aggregate in the area of the Elginburg Quarry represents Units 6 and 7. Units 6 and 7 represent the upper 9.65 metres of the rock core recovered from borehole DDH10-01. Therefore, the distribution of Units 6 and 7 across the Brash and Milligan properties is critical in terms of the viability of licensing these properties under the *Aggregate Resources Act.*

ORIENTATION OF LIMESTONE ROCK UNITS

To estimate of the potential quantity of high quality aggregate on the Brash and Milligan properties, the strike and dip/slope (i.e., orientation) of the rock units must be understood. The first step in defining the orientation of the rock units involved the selection of a common stratigraphic position that was encountered in each of the six boreholes and to use this position as the horizontal correlation line. The horizontal correlation line is the geophysical gamma and conductivity spikes observed in borehole DDH10-01 at a depth of 25.6 metres below ground surface which appears to correspond with a clayey calcareous shale bed. These same gamma and conductivity spikes were observed in the geophysical logs from the other five boreholes at different depths below ground surface.

The elevations at which the horizontal correlation lines appear in each of the six boreholes are presented on Figure 2. For boreholes DDH10-01, BH11-02, BH11-03, BH11-05 and BH11-06, the elevations of the horizontal correlation lines ranged narrowly from elevation 109.0 to 109.7 metres above sea level (mASL) which suggests that the limestone rock units are nearly flat-lying in the intervening areas between these boreholes. At borehole BH11-04 on the Milligan property and near the escarpment for Collins Creek, the elevation of the horizontal correlation line is approximately at elevation 113.7 mASL. The elevation contours presented on Figure 2 have been developed based on the assumption that there is a gradual slope in the stratigraphic surface between the highest elevation of 113.7 mASL at borehole BH11-04 and the lower elevations at boreholes DDH10-01, BH11-03 and BH11-05. This interpretation of the gradual sloping limestone units is referred to herein as "**Scenario 1**".

An alternate interpretation for the orientation of the limestone units involves faulting of the limestone units in close proximity to the escarpment such that the limestone in the area of borehole BH11-04 is displaced upwards in close proximity to the escarpment. Under this "**Scenario 2**" , it is interpreted that the elevations of the horizontal correlation line in the area between immediately north of borehole BH11-04 and boreholes DDH10-01, BH11-03 and BH11-05 is between elevations 109.0 and 109.7 mASL with the faulted upward displacement at borehole BH11-04 being localized adjacent to the escarpment. The position and orientation of the "fault" shown on Figures 4 and 6 is provided for illustrative purposes only and does not represent a geological feature that has been mapped in the field.

POTENTIAL QUANTITY OF HIGH QUALITY AGGREGATE (CONCRETE)

As discussed above, the highest quality aggregate in the area of the Elginburg Quarry represents Units 6 and 7. This section of the report provides estimates of the quantity of Units 6 and 7 on the adjacent lands (associated with the Brash and Milligan property) and on the existing Elginburg Quarry based upon Scenarios 1 and 2 as described in the previous section. The contours presented on Figure 3 represent the bottom of Unit 6 based on Scenario 1. The contours presented on Figure 4 represent the bottom of Unit 6 based on Scenario 2. The interpreted thickness of Units 6 and 7 under Scenarios 1 and 2 are shown on Figures 5 and 6, respectively.

These volumes and tonnage estimates are based on the following considerations and assumptions: standard regulatory setbacks from the property boundaries; similar adjacent land setbacks on the pipeline to those adopted for the Elginburg Quarry; a common boundary between the Milligan property and the existing Elginburg Quarry; bedrock surface exposed at ground surface with no overburden cover; existing ground surface elevations as presented on base plans prepared by The Base Mapping Co. Ltd (Photo Date November 2, 2009);

vertical faces for the quarry walls with no consideration for benching of the quarry face; stockpiles on the Elginburg Quarry property have been included in the volume and tonnage estimates; and, no consideration of hydrogeological, hydrological, natural environment or noise constraints to quarry development as these constraints (if any) have not been identified at this point in time.

The existing limit of extraction on the Elginburg Quarry is 45.1 hectares. The potential limit of extraction (quarry footprint) on the Brash and Milligan properties is 36 hectares which is the area shown in yellow on Figure 1 with allowance for regulatory setbacks. The limits of extraction are illustrated on also Figure 1.

The following table presents the aggregate tonnage estimates.

Table 2: Aggregate Tonnage Estimates (Units 6 and 7 of Gull River Formation)

Quarry Development Scenario	Volumes (m^3)	Conversion Factor (m^3 to tonnes)	Tonnage Estimates*
Existing Elginburg Quarry – Scenario 1	964,000	2.6	2,506,400
Existing Elginburg Quarry – Scenario 2	1,107,000	2.6	2,878,200
Brash and Milligan Properties – Scenario 1	1,068,000	2.6	2,776,800
Brash and Milligan Properties – Scenario 2	1,532,000	2.6	3,983,200

*The tonnage estimates include the tonnage estimates in Table 2.

The licensed base elevation of the Elginburg Quarry is 103 mASL. Assuming that a similar licensed base elevation would be considered for the Brash and Milligan properties, the following table presents total licensed reserve remaining on the Elginburg Quarry and the potential total reserve available on the Brash and Milligan properties (based on the above considerations and assumptions).

Table 3: Aggregate Tonnage Estimates (to elevation 103 mASL)

Quarry Development Scenario	Volumes (m^3)	Conversion Factor (m^3 to tonnes)	Tonnage Estimates*
Existing Elginburg Quarry	10,650,000	2.6	27,690,000
Brash and Milligan Properties	9,530,000	2.6	24,778,000

*The tonnage estimates include the tonnage estimates in Table 2.

CONCLUDING COMMENTS

The potential quantity of high quality aggregate on the Brash and Milligan properties is highly dependent on the actual orientation of the limestone rock units beneath these lands. Under Scenario 1, the potential quantity of high quality aggregate on the Brash and Milligan properties is 2,776,800 tonnes whereas under Scenario 2 the potential quantity is 3,983,200 tonnes. To further refine this tonnage estimate for decision making purposes, it would be necessary to define the thickness of Units 6 and 7 beneath the Brash and Milligan properties and between existing boreholes DDH10-01, BH11-03 and BH11-04. This can most economically be accomplished by drilling a series of air track holes within this area and geophysically logging the air track holes.

LIMITATIONS

This report was prepared for the exclusive use of Cruickshank Construction Limited. The report, which specifically includes all tables, figures and attachments, is based on data and information collected by Golder

Associates and is based solely on the conditions of the property at the time of the work or at the time that the air photos were taken. Any use which a third party makes of this report, or any reliance on, or decisions to be made based of it, are the responsibilities of such third parties. Golder accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this report.

The assessment of environmental conditions and possible hazards at this site has been made using the results of physical measurements from a number of locations. The site conditions between testing locations have been inferred based on conditions observed at the testing locations. Actual conditions may deviate from the inferred values. The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

We trust that you find this submission satisfactory. If you have any questions, please contact the undersigned.

GOLDER ASSOCIATES LTD.

PROFESSIONAL GEOSCIENTISTS
KRIS A. MARENTETTE
PRACTISING MEMBER
0287
ONTARIO

Kris A. Marentette, M.Sc., P.Geo.
Senior Hydrogeologist/Principal

KAM/TJN/sg
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Attachments: Figure 1 – Approximate Property Boundaries
Figure 2 – Contour of Horizontal Correlation Line (Scenario 1)
Figure 3 – Contour of Base of Gull River Formation Unit 6 (Scenario 1)
Figure 4 – Contour of Base of Gull River Formation Unit 6 (Scenario 2)
Figure 5 – Interpreted Thickness of Gull River Formation Units 6 and 7 (Scenario 1)
Figure 6 - Interpreted Thickness of Gull River Formation Units 6 and 7 (Scenario 2)
Attachment A – Log for Borehole DDH10-01
Attachment B – Aggregate Test Data - Concrete

FIGURES

ATTACHMENT A

Log for Borehole DDH10-01

LIST OF ABBREVIATIONS

The abbreviations commonly employed on Records of Boreholes, on figures and in the text of the report are as follows:

I. SAMPLE TYPE

AS	Auger sample
BS	Block sample
CS	Chunk sample
DO	Drive open
DS	Denison type sample
FS	Foil sample
RC	Rock core
SC	Soil core
ST	Slotted tube
TO	Thin-walled, open
TP	Thin-walled, piston
WS	Wash sample
DT	Dual Tube sample

II. PENETRATION RESISTANCE

Standard Penetration Resistance (SPT), N:
The number of blows by a 63.5 kg. (140 lb.) hammer dropped 760 mm (30 in.) required to drive a 50 mm (2 in.) drive open Sampler for a distance of 300 mm (12 in.)
DD- Diamond Drilling

Dynamic Penetration Resistance; N_d:
The number of blows by a 63.5 kg (140 lb.) hammer dropped 760 mm (30 in.) to drive Uncased a 50 mm (2 in.) diameter, 60^0 cone attached to "A" size drill rods for a distance of 300 mm (12 in.).

PH: Sampler advanced by hydraulic pressure
PM: Sampler advanced by manual pressure
WH: Sampler advanced by static weight of hammer
WR: Sampler advanced by weight of sampler and rod

Peizo-Cone Penetration Test (CPT):
An electronic cone penetrometer with a 60^0 conical tip and a projected end area of 10 cm^2 pushed through ground at a penetration rate of 2 cm/s. Measurements of tip resistance (Q_t), porewater pressure (PWP) and friction along a sleeve are recorded Electronically at 25 mm penetration intervals.

III. SOIL DESCRIPTION

(a) Cohesionless Soils

Density Index (Relative Density)	**N** Blows/300 mm Or Blows/ft.
Very loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very dense	over 50

(b) Cohesive Soils

Consistency	**C_u or S_u** Kpa	Psf
Very soft	0 to 12	0 to 250
Soft	12 to 25	250 to 500
Firm	25 to 50	500 to 1,000
Stiff	50 to 100	1,000 to 2,000
Very stiff	100 to 200	2,000 to 4,000
Hard	Over 200	Over 4,000

IV. SOIL TESTS

w	water content
w_p	plastic limited
w_l	liquid limit
C	consolidaiton (oedometer) test
CHEM	chemical analysis (refer to text)
CID	consolidated isotropically drained triaxial test[1]
CIU	consolidated isotropically undrained triaxial test with porewater pressure measurement[1]
D_R	relative density (specific gravity, G_s)
DS	direct shear test
M	sieve analysis for particle size
MH	combined sieve and hydrometer (H) analysis
MPC	modified Proctor compaction test
SPC	standard Proctor compaction test
OC	organic content test
SO_4	concentration of water-soluble sulphates
UC	unconfined compression test
UU	unconsolidated undrained triaxial test
V	field vane test (LV-laboratory vane test)
γ	unit weight

Note:
1. Tests which are anisotropically consolidated prior shear are shown as CAD, CAU.

LIST OF SYMBOLS

Unless otherwise stated, the symbols employed in the report are as follows:

I. GENERAL

π	= 3.1416
ln x, natural logarithm of x	
$\log_{10}$ x or log x, logarithm of x to base 10	
g	Acceleration due to gravity
t	time
F	factor of safety
V	volume
W	weight

II. STRESS AND STRAIN

γ	shear strain
Δ	change in, e.g. in stress: $\Delta\sigma'$
ε	linear strain
ε_v	volumetric strain
η	coefficient of viscosity
ν	Poisson's ratio
σ	total stress
σ'	effective stress ($\sigma' = \sigma''$-u)
σ'_{vo}	initial effective overburden stress
$\sigma_1\sigma_2\sigma_3$	principal stresses (major, intermediate, minor)
σ_{oct}	mean stress or octahedral stress $= (\sigma_1+\sigma_2+\sigma_3)/3$
τ	shear stress
u	porewater pressure
E	modulus of deformation
G	shear modulus of deformation
K	bulk modulus of compressibility

III. SOIL PROPERTIES

(a) Index Properties

$\rho(\gamma)$	bulk density (bulk unit weight*)
$\rho_d(\gamma_d)$	dry density (dry unit weight)
$\rho_w(\gamma_w)$	density (unit weight) of water
$\rho_s(\gamma_s)$	density (unit weight) of solid particles
γ'	unit weight of submerged soil ($\gamma'=\gamma-\gamma_w$)
D_R	relative density (specific gravity) of solid particles ($D_R= p_s/p_w$) formerly (G_s)
e	void ratio
n	porosity
S	degree of saturation

* Density symbol is p. Unit weight symbol is γ where γ=pg(i.e. mass density x acceleration due to gravity)

(a) Index Properties (cont'd.)

w	water content
w_l	liquid limit
w_p	plastic limit
I_p	plasticity Index=(w_l-w_p)
w_s	shrinkage limit
I_L	liquidity index=(w-w_p)/I_p
I_c	consistency index=(w_l-w)/I_p
e_{max}	void ratio in loosest state
e_{min}	void ratio in densest state
I_D	density index-(e_{max}-e)/(e_{max}-e_{min}) (formerly relative density)

(b) Hydraulic Properties

h	hydraulic head or potential
q	rate of flow
v	velocity of flow
i	hydraulic gradient
k	hydraulic conductivity (coefficient of permeability)
j	seepage force per unit volume

(c) Consolidation (one-dimensional)

C_c	compression index (normally consolidated range)
C_r	recompression index (overconsolidated range)
C_s	swelling index
C_α	coefficient of secondary consolidation
m_v	coefficient of volume change
c_v	coefficient of consolidation
T_v	time factor (vertical direction)
U	degree of consolidation
σ'_p	pre-consolidation pressure
OCR	Overconsolidation ratio=σ'_p/σ'_{vo}

(d) Shear Strength

$\tau_p\tau_r$	peak and residual shear strength
ϕ'	effective angle of internal friction
δ	angle of interface friction
μ	coefficient of friction=tan δ
c'	effective cohesion
c_u, s_u	undrained shear strength (ϕ=0 analysis)
p	mean total stress $(\sigma_1+\sigma_3)/2$
p'	mean effective stress $(\sigma'_1+\sigma'_3)/2$
q	$(\sigma_1-\sigma_3)/2$ or $(\sigma'_1-\sigma_3)/2$
q_u	compressive strength $(\sigma_1-\sigma_3)$
S_t	sensitivity

Notes: 1. τ=c'σ' tan |'
2. Shear strength=(Compressive strength)/2

GEOPHYSICAL LOG OF: DDH10-01

PROJECT: 10-1127-0091

LOCATION: See Site Plan

DRILLING DATE: Dec. 13, 2010

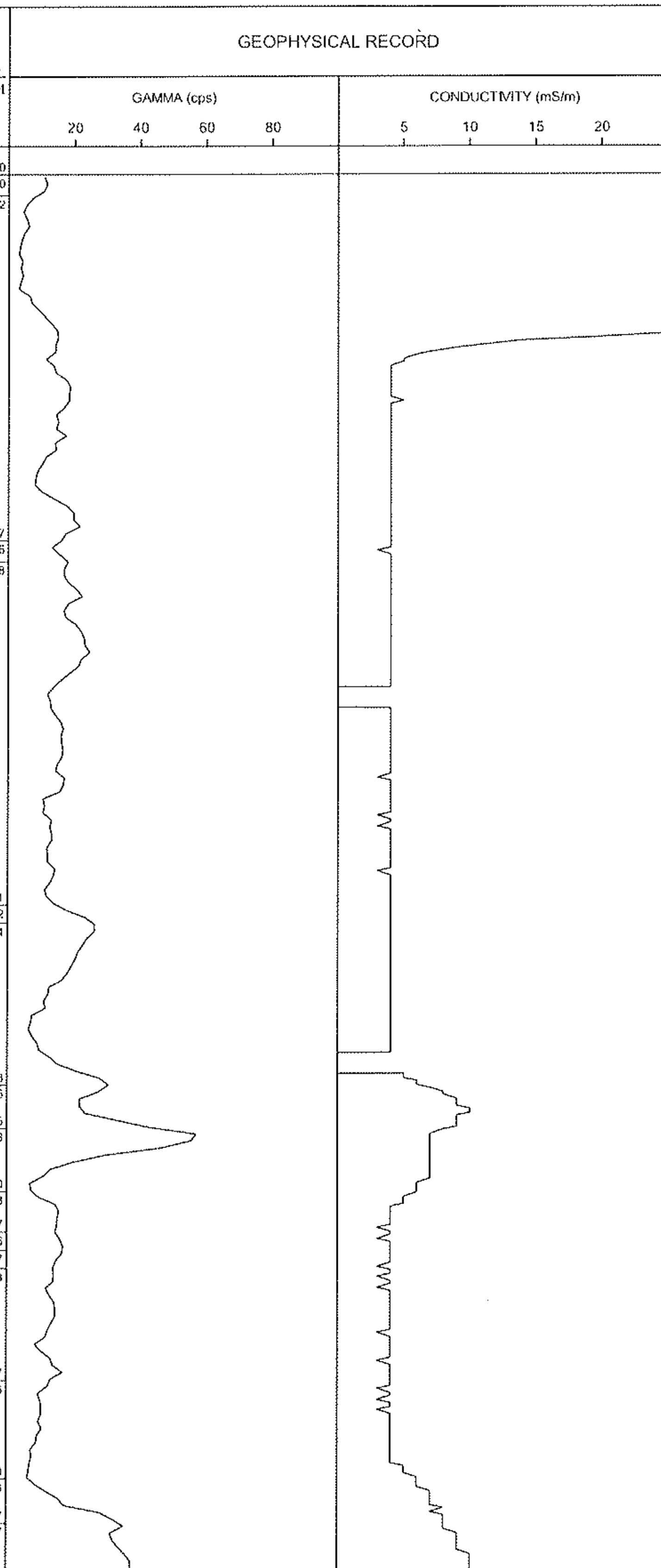
DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling Co. Ltd.

SHEET 1 OF 4

DATUM:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	GEOPHYSICAL RECORD	PIEZOMETER OR STANDPIPE INSTALLATION
		GROUND SURFACE		135.30		
0		**OVERBURDEN, 0.0 m to 0.15 m**		0.00		
		BEDROCK SURFACE, 0.15 m, GULL RIVER FORMATION, 0.15 m to 36.37 m		0.2		
2		**UNIT 7, 0.15 m to 7.28 m**, Weathered broken rock, 0.15 m to 3.00 m, partly broken to 0.91 m. Fresh, medium brownish grey, fine grained partly crystalline with disseminated medium grained calcite crystals, thinly bedded **MICRITIC LIMESTONE** with secondary interlaminations of medium grained calcarenite, occasional argillaceous partings, minor bioturbation associated with horizontal burrow casts 2 to 10 mm dia. Becomes medium bedded with traces of brachiopod fossils, extensive bioturbation associated with horizontal burrow casts 1 to 10 mm dia infilled with fine to medium grained calcarenite, below 3.66 m. Micritic lithoclastic bed with fossils occurs between 2.62 and 2.77 m. Medium brownish grey, oolitic, partly crystalline micrite bed occurs from 5.23 to 5.36 m. Laminated, dark grey, argillaceous micritic limestone and fine grained calcarenite occur from 6.52 to 6.63 m. Light brownish grey fine to medium grained argillaceous calcarenite from 6.63 to 6.83 m.		132.7 / 2.6; 2.8; 130.1 / 5.2; 5.4; 128.8 / 6.5; 128.5 / 6.8; 128.0		
7		**UNIT 6, 7.28 m to 9.65 m**, Fresh, medium brownish grey, fine grained partly crystalline, thinly to medium bedded, nodular textured **MICRITIC LIMESTONE**. Nodular beds occur between 7.28 and 7.57 m, 7.70 and 7.83 m, 8.63 and 9.33 m. Fine to medium grained, porous oolitic, calcarenite occur between 7.57 and 7.70 m, 7.83 and 8.63 m, with medium crystalline calcarenite with argillaceous partings between 9.33 and 9.65 m.		7.3; 127.7 / 7.6; 7.7; 7.8; 126.7 / 8.6; 126.0 / 9.3; 125.7		
9		**UNIT 5, 9.65 m to 11.66 m**, Fresh, medium dark grey,		9.7		
10		*CONTINUED NEXT PAGE*				



DEPTH SCALE

1 : 50

LOGGED: RDB

CHECKED: RDB

Golder Associates

PROJECT: 10-1127-0091

GEOPHYSICAL LOG OF: DDH10-01

LOCATION: See Site Plan

DRILLING DATE: Dec. 13, 2010

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling Co. Ltd.

DATUM:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	GEOPHYSICAL RECORD: GAMMA (cps) / CONDUCTIVITY (mS/m)	PIEZOMETER OR STANDPIPE INSTALLATION

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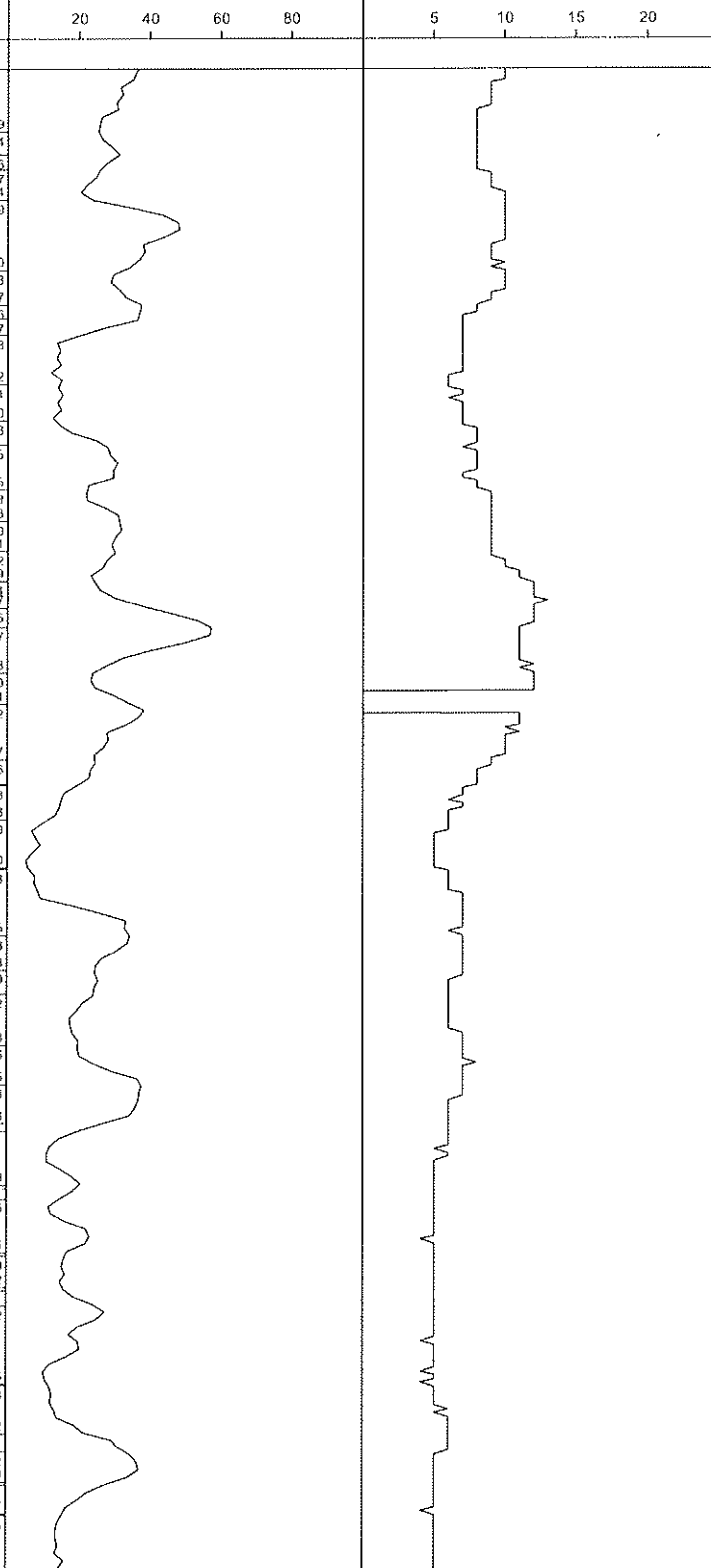
interlaminated to very thinly interbedded very fine to medium grained micritic and calcarenitic **LIMESTONE** with argillaceous partings and minor bioturbation.
Partly crystalline oolitic micrite beds occur between 10.42 and10.57 m, 10.67 and 10.87 m.
Poorly developed lithoclastic argillaceous micritic limestone bed occurs between 11.34 and 11.57 m.

UNIT 4, 11.66 m to 16.50 m,
Fresh, light to medium brownish grey, interbedded sequence of fine to medium grained, medium bedded lithoclastic **CALCARENITIC LIMESTONE** and medium bedded argillaceous, laminar to nodular textured **MICRITIC LIMESTONE**, transitional contact with overlying unit marked by change from argillaceous micrite to laminated micrite and calcarenite. Lithoclastic calcarenite beds comprised of 1 to 10 mm dia. subrounded micrite clasts in calcarenite matrix occur between 11.77 and 12.10 m (first well developed lithoclastic bed), 12.34 and 12.50 m (argillaceous calcarenite), 13.01 and 13.21 m, 13.41 and 13.59 m (fossiliferous), 13.59 and 13.72 m (bioturbated), 14.02 and 14.23 m (argillaceous calcarenite), 14.60 and 14.76 m, 16.00 and 16.16 m.
Argillaceous oalcarenite beds occur between 12.10 and 12.34 m (porous, oolitic), 12.50 and 12.80 m (partly oolitic). Argillaceous, laminar to nodular textured micrite beds occur between 11.66 and 11.77 m, 13.21 and 13.41 m (lithoclastic), 13.72 and 14.02 m (dark grey), 14.23 and 14.60 m (nodular, bioturbated), 14.77 and 15.00 m, 15.00 and 15.32 m (first lithographic bed with fine stylolites and burrow casts), 15.33 and 15.77 m (nodular, bioturbated), 15.77 and 16.00 m (medium to dark grey with Lithoclasts), 16.16 and 16.50 (bioturbated). Black argillaceous to shaley bedding partings occur between 14.76 and 14.77 m, 15.32 and 15.33 m.

Unit 3, 16.50 m to 20.60 m,
Fresh, medium brownish grey, very fine to fine grained with disseminated calcite crystals, medium to thickly bedded, massive textured **LITHOGRAPHIC LIMESTONE** with black argillaceous to shaley bedding partings and interbedded layers of lithoclastic calcarenite and argillaceous micritic limestone.
Individual lithographic beds occur between 16.50 and 16.76 m, 17.07 and 17.43 m, 18.23 and 19.08 m, 19.42 and 20.60 m.
Lithoclastic calcarenite beds with shaley partings occur between 17.52 and 18.23 m.
Lithoclastic micrite beds occur between 17.45 and 17.52 m, 19.08 and 19.20 m, 19.20 and 19.40 (argillaceous).
Dark grey laminar textured, argillaceous to shaley micrite bed occurs between 16.76 and 17.02 m.
Black, very thin shaley bedding partings occur between 17.02 and .07 m, 17.43 and .45 m, 17.88 and .90 m, 18.11 and .13 m, 18.75 and .76 m, 19.40 and .42, 19.61 and .62 m, 20.04 and .06 m, 20.21 and .23 m, 20.37 and 39 m.

ELEV. / DEPTH (m): 124.9, 10.4, 10.6, 10.7, 124.4, 10.9, 124.0, 11.3, 123.7, 11.6, 11.7, 11.8, 123.2, 12.1, 123.0, 12.3, 12.5, 122.5, 12.8, 122.3, 13.0, 122.1, 13.2, 121.9, 13.4, 121.7, 13.6, 13.7, 121.3, 14.0, 121.1, 14.2, 120.7, 14.6, 14.8, 120.3, 15.0, 120.0, 15.3, 119.5, 15.8, 119.3, 16.0, 16.2, 118.8, 16.5, 118.5, 16.8, 118.3, 17.1, 117.9, 17.5, 117.4, 17.9, 117.2, 18.1, 18.2, 116.6, 18.8, 116.2, 19.1, 19.2, 115.9, 19.4, 115.7, 19.6



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PROJECT: 10-1127-0091

LOCATION: See Site Plan

GEOPHYSICAL LOG OF: DDH10-01

DRILLING DATE: Dec. 13, 2010

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling Co. Ltd.

DATUM:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	GEOPHYSICAL RECORD: GAMMA (cps)	GEOPHYSICAL RECORD: CONDUCTIVITY (mS/m)	PIEZOMETER OR STANDPIPE INSTALLATION

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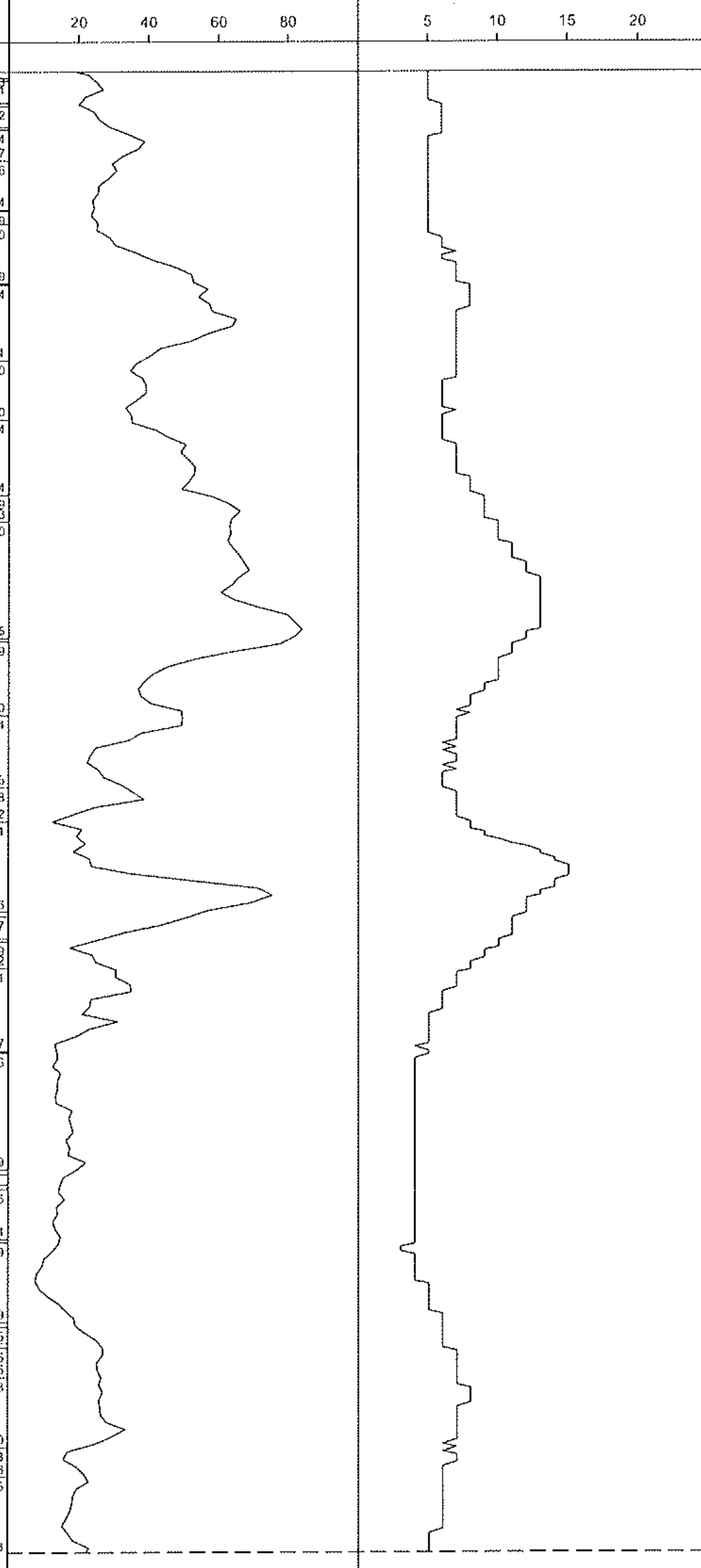
Unit 2, 20.60 m to 25.88 m,
Fresh, light to medium grey, fine grained, medium to thickly bedded, massive textured to bioturbated **MICRITIC LIMESTONE** with interbeds of micrite and calcarenite, lithoclastic micrite and calcarenite and shaley partings.
Distinct medium grey, fine crystalline, massive textured, thick dolostone bed occurs between 23.04 and 23.83 m with a 1 cm grey shale bottom overlying dolomitic limestone between 23.84 and 24.35 m.
Lithoclastic calcarenite with fining upward clasts occurs between 20.60 and 20.93 m, 21.95 and 22.35 m (tabular clasts, partly oolitic).
Lithoclastic micrite bed occurs between 20.93 and 21.03 m, 24.84 and 25.07 m.
Light grey, fine to medium grained, massive textured calcarenite between 22.35 and 22.86 m.
Black, shaley argillaceous partings occur between 20.93 and 20.94 m, 21.43 and 21.44 m.
Medium grey, fissile, clayey, calcareous shale beds occur between 23.84 and 23.85 m, 25.68 and 25.71 m, 25.86 and 25.88 m.

UNIT 1, 25.88 m to 36.37 m,
Fresh, light to medium grey, fine grained partly crystalline, medium to thickly bedded, non fossiliferous, massive textured, **MICRITIC LIMESTONE** with well developed fine stylolites and occasional interbeds of darker grey micritic dolomitic limestone and numerous 1 to 5 mm thick argillaceous bedding partings. Top of unit marked by light grey, partly crystalline, lithoclastic micritic limestone between 25.88 and 26.06 m.
Dolomitic limestone beds occur between 28.59 and 28.82 m, 29.29 and 29.49 m (argillaceous, fossiliferous), 33.83 and 34.23 m, 35.63 and 36.37 m.
Dark grey, laminar textured argillaceous micrite beds occur between 33.51 and 33.59 m, 34.93 and 35.20 m.
Light grey lithographic micrite bed occurs between 32.03 and 32.31 m.
Argillaceous bedding partings 1 to 5 mm thick occur at 26.62 m, 27.42 m, 27.52 m, 27.89 m, 28.45 m, 28.59 m, 30.01 m, 30.18 m, 30.51 m, 31.68 m, 32.31 m, 32.84 m, 33.12 m, 34.23 m.
Limestone breccia infilled with vuggy coarse grained calcite occurs between 35.57 and 35.63 m.

ELEV. / DEPTH (m): 115.0 / 20.1; 20.2; 20.4; 114.7 / 20.6; 114.4 / 20.9; 21.0; 113.9 / 21.4; 113.4 / 22.0; 113.0 / 22.4; 112.4 / 22.9; 112.3 / 23.0; 111.5 / 23.9; 111.0 / 24.4; 110.5 / 24.8; 110.2 / 25.1; 109.6 / 25.7; 25.9; 109.2 / 26.1; 108.7 / 26.6; 107.9 / 27.6; 107.4 / 27.9; 106.9 / 28.5; 28.6; 106.5 / 28.8; 106.0 / 29.3; 105.8 / 29.5; 105.3

Depth scale: 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30



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DEPTH SCALE
1 : 50

Golder Associates

LOGGED: RDB
CHECKED: RDB

PROJECT: 10-1127-0091

GEOPHYSICAL LOG OF: DDH10-01

LOCATION: See Site Plan

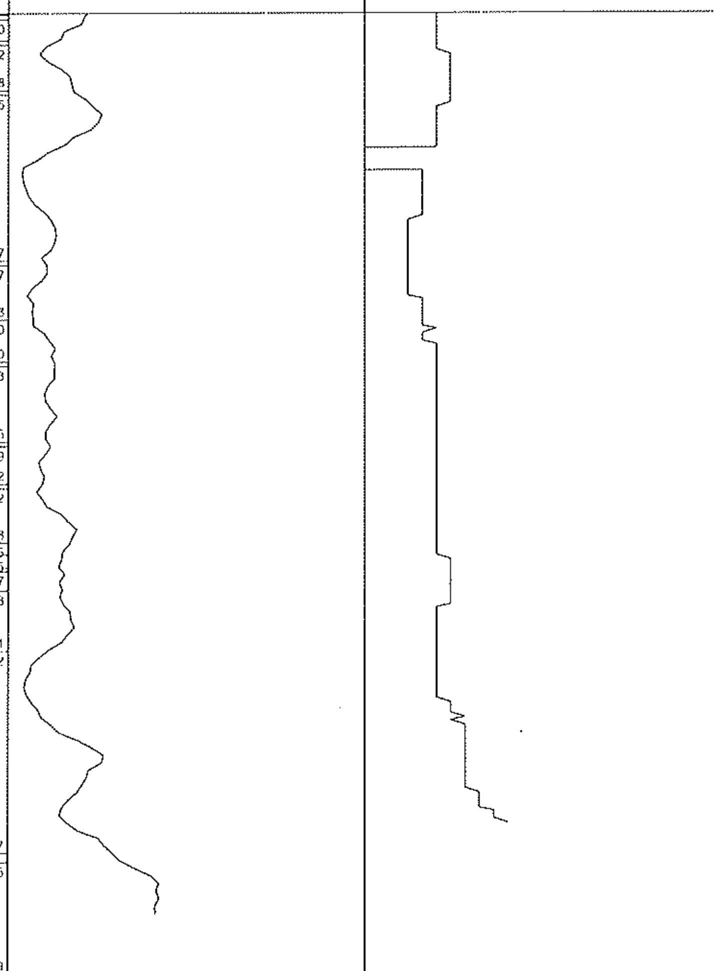
DRILLING DATE: Dec. 13, 2010

DRILL RIG: CME 55

DRILLING CONTRACTOR: Marathon Drilling Co. Ltd.

DATUM:

DEPTH SCALE METRES	DRILLING RECORD	DESCRIPTION	SYMBOLIC LOG	ELEV. DEPTH (m)	GEOPHYSICAL RECORD: GAMMA (cps) 20 40 60 80	CONDUCTIVITY (mS/m) 5 10 15 20	PIEZOMETER OR STANDPIPE INSTALLATION
		... CONTINUED FROM PREVIOUS PAGE ...					
30				30.0			
				30.2			
				104.8 / 30.5			
31							
				103.7 / 31.7			
32				103.3 / 32.0			
				103.0 / 32.3			
				102.5 / 32.9			
33				102.2 / 33.2			
				101.8 / 33.5			
				33.6			
				33.7			
				33.8			
34				101.1 / 34.2			
35				99.7 / 35.6			
36				98.9			
		36.37 m, End Of Borehole.		36.4			
37							
38							
39							
40							



DEPTH SCALE

1 : 50

Golder Associates

LOGGED: RDB

CHECKED: RDB

SAMPLE "E"

TBT ENGINEERING
CONSULTING GROUP

TBT Engineering Limited
LABORATORY
711 Harold Cres., Thunder Bay, ON P7C 5H8
PH: (807) 624-5162 FAX: (807) 624-5163
E-Mail: tbte@tbte.ca

Petrographic Analysis - Coarse Aggregate

Client:	Golder Associates Ltd.	TBTE Project No.:	11-020
Client Project No.:	10-1127-0091 Ph. 5012	Lab No.:	11-0348
Client Sample No.:	G-11-074	Petrographic Analyst:	Terry Dupuis TD
Source of Material:	Undisclosed		
Inventory Number:	Undisclosed	Date Tested:	April 28, 2011
Type of Material:	Coarse Aggregate		

Fraction: R/9.5 mm

Categories	Type	%
% Good Aggregate	CARBONATE (surf. weath.; silty, surf. weath.; med. hard; silly, med. hard)	60.8
	CARBONATE (hard; silty, hard)	12.1
% Fair Aggregate	CARBONATE (soft; silty, soft; slightly shaley)	24.9
% Poor Aggregate	CARBONATE (shaley; clayey; silty, clayey)	2.0
% Deleterious Aggregate	SHALE	0.2

PETROGRAPHIC NUMBER = 162

Remarks: Test Method LS 609

CCIL Certified

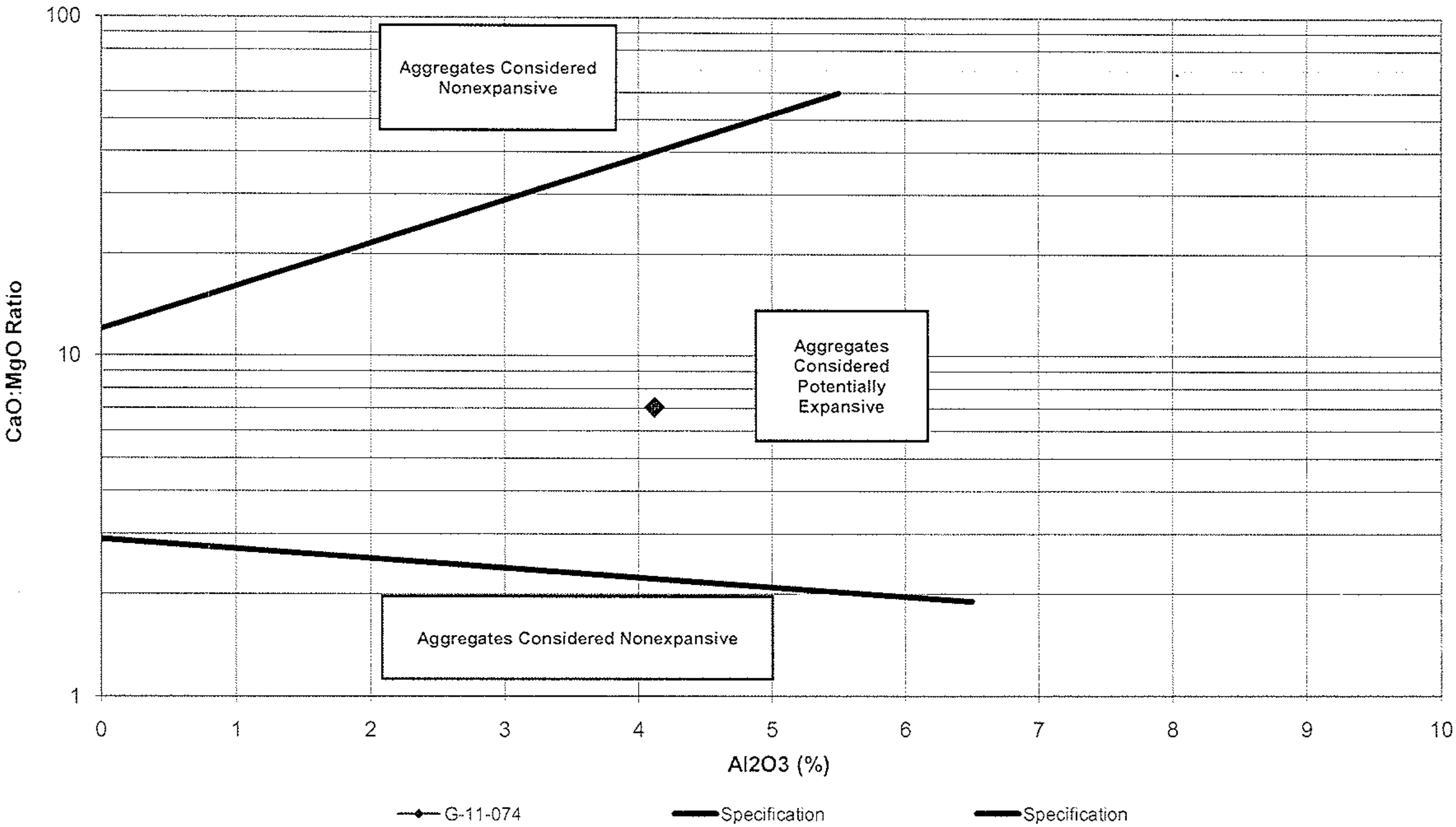
Figure No. 1

Elginburg Quarry - Drill Hole 10-01, 20.60m - 25.88m

10-1127-0091-5012

SAMPLE "E"

Potential Alkali-Carbonate Reactivity (ACR)
19mm Concrete Stone



Golder Associates Ltd.

May 11, 2011

SGS Canada Inc.
P.O. Box 4300 - 185 Concession St.
Lakefield - Ontario - KOL 2HO
Phone: 705-652-2000 FAX: 705-652-6365

Golder Associates
Attn : John Taylor

100 Scotia Court
Whitby, Ontario
L1N 8Y6, Canada

Phone: 905-723-2727
Fax:905-723-2182

Friday, April 29, 2011

Date Rec. : 26 April 2011
LR Report : **CA03469-APR11**
Client Ref : 10-1127-0091 Ph 5012

CERTIFICATE OF ANALYSIS

Final Report

Sample ID	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5	MnO	Cr_2O_3	V_2O_5	LOI	Sum
	%	%	%	%	%	%	%	%	%	%	%	%	%	%
1: 10-1127-0091 G-11-070	4.89	1.23	0.50	1.75	49.4	0.08	0.38	0.05	0.01	0.02	< 0.01	< 0.01	40.8	99.1
2: 10-1127-0091 G-11-071	2.84	0.74	0.36	1.17	51.6	0.05	0.23	0.03	0.01	0.01	< 0.01	< 0.01	42.0	99.0
3: 10-1127-0091 G-11-072	9.98	2.80	1.01	1.82	44.5	0.15	0.97	0.12	0.03	0.01	< 0.01	< 0.01	37.6	99.0
4: 10-1127-0091 G-11-073	6.06	1.75	0.71	1.17	48.5	0.10	0.60	0.08	0.02	0.02	< 0.01	< 0.01	39.6	98.6
5: 10-1127-0091 G-11-074	23.3	4.12	1.25	4.62	32.6	0.36	1.66	0.20	0.03	0.03	< 0.01	< 0.01	30.5	98.6

Control Quality Analysis

Debbie Waldon
Debbie Waldon
Project Coordinator,
Minerals Services, Analytical