SOLA ENGINEERING

RE: GEOTECHNICAL INVESTIGATION
PROPOSED HOTEL
380 HAGEY BOULEVARD
WATERLOO, ONTARIO

FOR: Kothari Group Inc. / 380 Hagey, Waterloo
141 Brunel Road, Suite 201
Mississauga, Ontario
L4Z 1X3

ATTENTION: Ms. Carine Arce

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PDF Copy: Kothari Group Inc. / 380 Hagey, Waterloo
- Ms. Carine Arce [carine@kotharigroup.com]
- Mr. Anupam Kothari [anupam@kotharigroup.com]

Goldberg Group
- Mr. Adam Layton [alayton@goldberggroup.ca]

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390 Edgeley Blvd., Units 25 & 26,
Vaughan, Ontario L4K 3Z6
T : 905-760-9501 | F : 905-761-1822
W : www.solaengineering.ca

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1.0 INTRODUCTION

Sola Engineering Inc. (Sola) was retained by Kothari Group Inc. / 380 Hagey, Waterloo (the Client) to carry out a geotechnical investigation for the proposed hotel building to be located at 380 Hagey Boulevard, Waterloo, Ontario (the subject site or site). Authorization to proceed with the investigation was received on February 1, 2025, through the acceptance of Sola's Proposal No. 2024-4058 dated November 29, 2024.

As per the scope of services detailed in Sola's proposal, the purpose of this investigation is to collect information on the soil and groundwater conditions at the subject site and, based on the investigation data, to provide recommendations to assist with the geotechnical design of the proposed hotel building.

This report presents the details of Sola's fieldwork and laboratory testing, outlines the soil and groundwater conditions at the site, and provides comments on the aforementioned items.

In this report, standard site investigation procedures have been adopted. The procedures including those developed by the Ontario Building Code (OBC), Canadian Foundation Engineering Manual (CFEM), American Society for Testing and Materials (ASTM), Ontario Ministry of Transportation (MTO), and Toronto Transit Commission (TTC), are considered by far the most accepted methods by the local geotechnical society for the general engineering purposes. Soil Classification Systems used for developing this report have been in general conformance with those outlined in the above-mentioned procedures, with modifications where appropriate. Where in doubt, this office must be contacted for further interpretation or clarification.

This report has been prepared for the Client, and their nominated engineers and designers. Third-party use or reproduction, in part or in full, of this report, is prohibited without written authorization from Sola. This report is also subject to the *Statement of Limitations* which forms an integral part of this document.

2.0 SITE SETTING

2.1 SITE LOCATION, DESCRIPTION AND PROPOSED DEVELOPMENT

The subject site is located at 380 Hagey Boulevard, Waterloo, Ontario and is currently vacant. The subject site is bounded to the north by Wes Graham Way, to the east by a commercial property, to the south by an institutional property and to the west by Hagey Boulevard.

The Client is contemplating developing the site with a nine-storey hotel building with slab-on-grade construction with a connected 1-storey conference/banquet facility.

2.2 PUBLISHED GEOLOGY

Based on a review of the existing geological publication for the site area, Ontario Geological Survey (OGS) Map M2559: *"Quaternary Geology, Stratford Area"*, the site physiography surrounding area is underlain by Tavistock Till (clayey silt till). According to the OGS Map 2544: *"Bedrock Geology of Ontario – Southern Sheet"*, the surficial geology is underlain by the bedrock of the Upper Silurian Salina Formation, comprising limestone, dolostone, shale, sandstone, gypsum and salt.

3.0 GROUND INVESTIGATION

3.1 FIELD INVESTIGATION

3.1.1 Soil Investigation

Prior to undertaking field drilling, Sola obtained clearances of existing public utility services to the site from all applicable agencies and companies. In addition, private utility locates were also carried out.

The geotechnical field program was carried out on March 13, 2025, and comprised the drilling of five (5) geotechnical boreholes (BH1 through BH5). The boreholes were advanced through the existing ground surface to depths ranging from approximately 6.5 m (BH5) to 9.6 m (BH2) below the ground surface (mBGS) using a track-mounted drill rig equipped for split spoon sampling and standard penetration testing. The approximate locations of the boreholes are shown in **Enclosure 1**.

All drilling equipment was supplied and operated by Terra Firma Services Ltd. of North York, Ontario, and the geotechnical drilling supervision, field testing and sampling works were completed under the full-time supervision of a qualified Sola Technician.

Standard Penetration Tests (SPTs) split spoon samples were collected in the drilled boreholes using a 50 mm outer diameter and 35 mm inner diameter split barrel sampler driven with a 63.5 kg automatic hammer freely dropping a vertical distance of 760 mm. All soil samples were logged in the field and returned to Sola's laboratory in Vaughan for review and subsequent laboratory testing.

The logs of the boreholes completed are presented on **Enclosures 2 through 6**.

3.1.2 Groundwater Investigation

Groundwater level observations were made during drilling and in the open boreholes upon completion of the drilling of each borehole. Details of groundwater observations for the boreholes are presented on the borehole logs on **Enclosures 2 through 6**. Further discussion on groundwater is provided in **Section 4.2** of this report.

3.1.3 Survey

The borehole locations were established with reference to the existing site features (existing building, garages, poles, fence lines, etc.). The ground surface elevations for the borehole locations were estimated from the survey drawing provided by the Client, entitled "*Plan of Survey and Topographic Sketch of Part of Block 1 Registered Plan 58M-272 in the City of Waterloo, Regional Municipality of Waterloo*", dated March 10, 2025, prepared by McKechnie Surveying Ltd. with file number of 25-018. The elevations provided in this report should therefore be considered approximate.

3.2 GEOTECHNICAL LABORATORY TESTING

All soil samples were submitted to Sola's laboratory for natural moisture content determination. The results of the moisture content tests are presented on the borehole logs on **Enclosures 2 through 6**. In addition, two (2) representable soil samples were submitted for testing of particle size distribution. The results of the particle size distribution test are provided in **Enclosures 9 and 10.**

4.0 SUBSURFACE CONDITIONS

Detailed descriptions of the sub-soil conditions encountered at each borehole location are given on the Borehole Logs on **Enclosures 2 through 6**.

The borehole data collected by Sola only represents the subsurface conditions at the borehole locations. It should be pointed out that the material boundaries indicated on the Borehole Logs are approximate and are based on visual observations and interpolation between successive samples. These boundaries typically represent a transition from one material type to another and should not be regarded as an exact plane of geological change. It should also be noted that the subsurface conditions may vary across the site.

A summary of the characteristics of each unit of subsoil encountered within the borehole depths is given in the following paragraphs.

4.1 SOIL CHARACTERISATION

4.1.1 Topsoil

A layer of topsoil was encountered at all borehole locations. The thicknesses of the topsoil at the borehole locations were measured to be approximately 125 mm (BH3) to 200 mm (BH1) thick.

It is important to note that topsoil thicknesses may vary throughout the site area, depending upon their location. As such, these findings should not be relied upon for any estimation of topsoil quantities to be stripped prior to construction.

4.1.2 Fill Materials

Fill materials were encountered below the topsoil layer in all boreholes at depths ranging from approximately 0.1 m (BH3) to 0.2 m (BH5) below the existing ground surface. The fill was found to extend to depths ranging from approximately 1.5 m (BH1, BH3, BH4 and BH5) to 2.3 m (BH2) below the existing ground surface.

Fill materials generally consisted of sandy silt to silty sand and clayey silt to silty clay which included trace of rootlets in BH3. The fill was generally brown in colour In-situ resistance testing results ranged from 8 (BH3) to 31 (BH1) blows per 300 mm of spoon penetration, indicating that the fill was probably not constructed under engineering control.

In the fill materials, the measured moisture contents of the samples recovered from the boreholes ranged from 10.9% (multiple) to 23.9% (BH4), indicating a moist condition.

4.1.3 Cohesionless Soil Deposits

Cohesionless soil deposits consisting of (fine) sandy silt to silt were encountered below the fill materials or below/interbedded in the cohesive soil deposits and glacial till deposit in al boreholes at depths ranging from approximately 1.5 m (BH1) to 4.6 m (BH4 and BH5). These deposits extended to depths ranging from 2.6 m in BH3 to the termination depth of 9.6 m below the ground surface in BH2. Boreholes BH2, BH4 and BH5 were terminated in these deposits

SPT “N” values for these deposits were recorded from 15 (BH2) to more than 79 (BH5) blows per 300 mm of spoon penetration, indicating the soil to be in a compact to very dense condition, but generally in a compact to dense condition.

In these deposits, the measured moisture contents of the samples recovered from the boreholes ranged from approximately 9.4% (BH4) to 25.0% (BH3), indicating a moist to wet condition.

4.1.4 Cohesive Soil Deposits

Cohesive soil deposits consisting of clayey silt and silty clay were encountered below the fill materials or cohesionless soil deposits in all boreholes at depths ranging from approximately 1.5 m (BH3 through BH5) to 4.6 m (BH1 and BH2) below the ground surface and extended to depths ranging from approximately 2.3 m (BH5) to the termination depth of 6.6 m (BH1 and BH3) below the existing ground surface. Boreholes BH1 and BH3 were terminated in these deposits.

SPT "N" values for the cohesive soil deposits were recorded from 12 (BH1 and BH2) to 36 (BH3) blows per 300 mm of spoon penetration, indicating the deposits have a stiff to hard consistency.

In the cohesive soil deposits, the measured moisture contents of the samples recovered ranged from approximately 18.0% (BH3) to % 36.9 (BH2), indicating a moist to wet condition.

4.1.5 Clayey Silt Till

Clayey silt till deposit was encountered below the cohesive soil deposit in borehole BH5 at a depth of approximately 2.3 m below the ground surface and extended to a depth of approximately 4.6 m below the existing ground surface.

The presence of cobbles and boulders should always be anticipated in glacial till deposits, owing to the mode of their deposition.

SPT "N" values for the clayey silt till deposit were recorded to be 29 and 39 blows per 300 mm of spoon penetration, indicating the deposit has a very stiff to hard consistency.

In the clayey silt till deposit, the measured moisture contents of the samples recovered was of approximately 17.4%, indicating a moist condition.

4.2 GROUNDWATER

The groundwater conditions encountered, and cave-in depth observations were made during drilling and in the open boreholes upon completion of the drilling of each borehole and are presented on the borehole logs in **Enclosures 2 through 6** as well as in **Table 1**.

Table 1: Borehole Elevation, Water Depth and Cave-in

Borehole Number	Elevation (m)	Upon Drilling Completion		Groundwater Level Measured by Project Hydrogeologist on March 18, 2025 (mBGS)
		Water Depth (mBGS)	Cave-in Depth (mBGS)	
BH1	346.9	5.5	Open	Not a Monitoring Well
BH2	346.4	5.8	7.0	6.98
BH3	348.1	5.8	6.0	3.29
BH4	347.3	5.3	Open	3.52
BH5	347.9	Dry	Open	4.73

Note: mBGS = meters below ground surface

It should be noted that water levels can vary in response to seasonal fluctuations and major weather events. In addition, a perched water condition can occur due to the accumulation of surface water in the more pervious deposits (i.e. granular ground cover, sandy fill soils and cohesionless deposits) overlying less pervious deposits (i.e. cohesive fill and native soils and glacial till deposit), especially during seasonally wetter periods.

Long-term "stabilized" groundwater level measurements should refer to the Project Hydrogeology Study.

5.0 DISCUSSION AND RECOMMENDATIONS

The investigation and comments should be considered ongoing as new information on the underground conditions will continue to become available, for example, when foundation construction is underway and more specific information is available with respect to soil conditions. The interpretation and recommendations of this report must, therefore, be checked through field inspections carried out by Sola to validate the information for use during construction.

The Client is contemplating developing the site with a nine-storey hotel building with slab-on-grade construction with a connected 1-storey conference/banquet facility.

Based on the ground conditions found at the site, our recommendations are presented in the following sections.

5.1 Frost Protection

All footings and structural elements exposed to seasonal freezing conditions must have at least 1.4 meters of permanent soil cover, or equivalent artificial insulation, for frost protection.

5.2 CONVENTIONAL SPREAD OR STRIP FOUNDATIONS

At the time of preparation of this report, design loading requirements have not been made available. The following discussions are provided to assist the preliminary design phase of the proposed site development. For geotechnical design purposes, it is assumed that the footings will be positioned on an undisturbed native stratum and below the frost penetration depth, i.e., 1.4 m or more below the finished grade.

Based on borehole data, the proposed hotel building can be supported by spread and strip footings founded on undisturbed native soil and designed for geotechnical reactions at Serviceability Limit States (SLS) and factored geotechnical resistances at Ultimate Limit States (ULS) at the depths as outlined in **Table 2**, assuming subsurface conditions beneath the depth drilled are as favourable or better than those encountered in the boreholes.

Table 2: Preliminary Bearing Resistances and Founding Depths

BOREHOLE NUMBER	SLS (KPA)	ULS (KPA)	FOUNDING DEPTHS BELOW EXISTING GROUND SURFACE (M)	FOUNDING STRATUM
BH1	220	330	1.5	Dense fine sandy silt
BH2	220	330	2.3	Compact sandy silt
BH3	220	330	1.5	Very stiff clayey silt
BH4	220	330	1.5	Very stiff clayey silt
BH5	220	330	1.5	Very stiff clayey silt

The design values provided above are based on the presumption that the foundation size will not exceed 1.5 m for strip and 3.0 m for spread footing foundations and the geotechnical resistance at SLS is governed by total and differential settlements of 25 mm and 20 mm respectively, and the structure will tolerate an angular distortion of 1 in 300. These resistances are provided with the understanding that the site will be dewatered to at least 0.8 m below the proposed founding levels, at the time of construction.

Where it is necessary to place footings on the soil at a different level, the upper footing must be founded below an imaginary 10 horizontal to 7 vertical line (10H:7V) drawn up from the base of the lower footing. The lower footing must be installed first to minimize the risk of undermining the upper footing.

The minimum size of the footing should be 0.6 m. Footings and any foundation walls should be reinforced as per the design to be provided by the Structural Engineer of the project.

The recommended bearing resistances and the corresponding founding depths would need to be confirmed during construction by geotechnical engineering staff at the site prior to pouring footing concrete.

It should be noted that the recommended bearing resistances have been calculated by Sola from the borehole information for the design stage only. Should higher bearing values be required, this office should be contacted to review this report.

Where construction is undertaken during winter conditions, footing subgrades should be protected from freezing. Foundation walls and columns should be protected against heave due to soil adfreeze.

It should be pointed out that an approximately 1.5 m thick, relatively weaker layer of silty clay (with an "N" value of 12 blows per 300 mm) was contacted at a depth of 4.6 m below the existing ground surface in boreholes BH1 and BH2. As well, the soil varies from cohesive (i.e. slow consolidation settlement) to non-cohesive (i.e. relatively faster settling) soils across the site. These could lead to excessive differential settlement, owning to time rate of settlement. For this reason, when the foundation design is completed, the design should be checked by this office to verify the recommendations provided in this report.

5.3 EARTHQUAKE CONSIDERATIONS

Using the information provided by the site investigation, the general soil profile comprises *"Stiff Soil – Site Class D"* as defined by Table 4.1.8.4.A *"Site Classification for Seismic Site Response"* of the Ontario Building Code.

If a higher site class is sought by the structural designer, it is recommended that site-specific shear wave velocity testing is carried out by a specialist.

5.4 FLOOR SLABS AND PERMANENT DRAINAGE CONSIDERATIONS

The floor slab for the proposed hotel can be adequately supported at the improved fill (re-compacted as required under Sola's supervision) or exposed native subgrade. After stripping and excavation, if unsuitable soils are encountered, they should also be removed and discarded. Once the required subgrade has been developed, Sola recommends that the exposed subgrade be inspected, evaluated, and approved by the Geotechnical Engineer before the placement of any granular fill or concrete. Any fill used to raise the grade to the underside of the underfloor granular layer should consist of approved, environmentally acceptable on-site excavated sandy soil or imported granular materials, such as Granular 'A' or Granular 'B' materials. If on-site excavated sandy soil is used, the upper 0.8 m of the underfloor fill should consist of imported Granular 'A' or Granular 'B' materials. It should be pointed out that silty soils may be difficult to handle and compact and may need to be wasted. All underfloor fills

should be placed in layers not exceeding 300 mm when first placed and compacted to not less than 98% of the SPMDD to within 1.0 m within the underside of the floor slab and to 100% above this level.

A granular layer consisting of at least a 200 mm thick layer of 19 mm Crusher Run Limestone (CRL) or OPSS Granular A should be installed under the floor slab as a bedding layer, this enhances the under-slab moisture condition. Such a layer has been proven to be an effective moisture barrier for conventional floor surfaces. However, if special floor coverings such as sheet PVC with heat-sealed seams are considered, either a high-efficiency vapour barrier or venting may be added to the granular layer to prevent moisture from accumulating between the concrete floor and the PVC flooring.

Completed excavations for floor slabs (as well as foundation excavations) should not be left open before pouring concrete for any period longer than 24 hours, particularly if the floor construction works are being completed during the winter months or wet weather periods. The base of any floor slab excavation that is to be left exposed for longer than 24 hours should be suitably covered and protected from water ponding, and/or protected to prevent degradation of the exposed founding stratum with the construction of a lean concrete mud mat.

Prior to placing the stone bedding, the final subgrade should be proof-rolled and approved by the Geotechnical Engineer.

The design of the concrete slabs on native soils may be made on the basis of a value of modulus of subgrade reaction which is 20 MPa/m on the surface of the granular moisture barrier.

The floor slab should be structurally independent from any load-bearing structural elements.

Should the lowest construction element extend below the site's permanent water table, proper permanent water control provisions, i.e., watertight structure considerations, positive pumping plus backup systems, waterproofing, etc., must be included in the design and construction. Further, depending on the results of the hydrogeological study, the Client may wish to consider the installation of waterproofing or an under-slab drainage system.

5.5 SITE PREPARATORY WORKS

The site preparation works may include stripping of the ground cover and the existing fill in order to develop the required construction. Depending on the final grading plan, stripping depths will likely vary locally and should be adjusted to remove all unsuitable materials.

It is recommended that the Geotechnical Engineer monitors the stripping operations to ensure that unsuitable materials have been fully removed prior to construction works. Unacceptable

areas identified are to be remediated as soon as practicable and the procedures would be dependent upon the conditions encountered.

5.6 EXCAVATION AND BACKFILL

5.6.1 Excavatability and Site Excavations

It has been assumed that the general excavations for the proposed hotel and utilities will be open cut. In order to enable entry into excavations during the construction process, all excavations must comply with the definitions prescribed by the *"Occupational Health and Safety Act"* (OHSA), Ontario Regulation 213/91 *"Construction Projects"*.

The borehole data indicate that the fill soil and cohesionless, and stiff cohesive deposits should present as Type 3 soil above the groundwater table and Type 4 below the groundwater table, as defined in the OHSA and Regulations for Construction Projects (Part III Excavations, Section 226). The very stiff to hard cohesive deposits, as well as the very stiff to hard clayey silt glacial till can be expected to behave as Type 2 soils above the groundwater table and Type 3 below during the excavation. Excavations in all these materials should be constructed in conformance with the regulations. It is noted that the above soil classifications have been estimated based on small and discontinuous samples from the boreholes. The excavation conditions must be confirmed and/or modified on the basis of field inspections during the construction stage when large-scale observations can be made with ease.

As defined by the OHSA, excavation walls within the Type 3 soils will require battering back at slopes no steeper than 1H (horizontal):1V (vertical) and flatter for Type 4 material. Within the fill materials, a flatter than 1:1 side slope may be required even above the water table.

Depending on the construction feasibility the excavation walls can be supported by temporary shoring systems. During excavations, adjacent existing structures, and public right of way, if present, must be protected by proper shoring or sloping.

Based on the findings of the investigation, it is considered that the excavation of the overburden fill and native soils at the site can be carried out using a conventional backhoe excavator.

It is important to note that the above discussion about the excavation is for information purposes only. Contractors bidding on the projects must make their own assessment based on the real site conditions.

The presence of cobbles and boulders should always be expected in glacial till deposits and possibly in the existing fill materials. The contractor carrying out the excavation work should account for removing cobbles and boulders in their site excavation work.

It is assumed that, where necessary, the groundwater will be lowered to 0.8 m below the required excavation depth in the overburden to enable the construction to be carried out in a 'dry' condition. It is expected that the 'perched water', if any, can be controlled by the conventional 'sump and pump' methodology. If a large volume discharge of water is required, the contractor should implement a more aggressive measure with the consultation of a dewatering specialist. The dewatering requirements should be discussed with the Project Hydrogeologist.

5.6.2 Construction Dewatering

The construction dewatering requirements should refer to the project Hydrogeology Study. Any dewatering must be implemented without causing settlements to the adjacent structures, if any.

5.7 Earth Pressures (Where Applicable)

It is expected that shoring may not be required for the proposed hotel building. However, if the proposed hotel is close to the public right of way and shoring is required, a specialist shoring contractor should be consulted to establish the most appropriate design and seating depths for the construction shoring solution.

The shoring system may be designed in accordance with the Canadian Foundation Engineering Manual (CFEM), the 4th Edition. Though not a design code, the CFEM design manual provides a comprehensive guide for shoring and anchor design and is still considered the most widely used and accepted design approach in the Greater Toronto Area (herein "GTA").

Shoring subject to unbalanced earth pressures must be designed to resist a pressure distribution that can be calculated as follows:

$$p = K [\gamma (h-h_w) + \gamma' h_w + q] + \gamma_w h_w$$

where: p = Lateral earth pressure in kPa acting at depth h
K = parameters are provided below
h = the depth below the ground surface (m)
h_w = the depth below the groundwater level (m)
γ = the bulk unit weight of soil, (kN/m^3) use 20.0

γ' = the submerged unit weight of the exterior soil, (γ - 9.8 kN/m^3)
q = equivalent value of surcharge on the ground surface in kPa (min 12 kPa)

Where the backfill against the buried structure can be drained effectively to eliminate hydrostatic pressures on the wall, this equation can be simplified to:

$$p = K(\gamma h + q)$$

The soil parameters estimated to be applicable for this design are as follows in **Table 3**:

Table 3: Soil Parameters for Shoring

Material	Undrained Shear Strength c_u (kPa)	Effective Cohesion c' (kPa)	Effective Friction Angle ϕ' (deg)	Unit Weight γ (kN/m^3)	Coeff. of Active Earth Pressure, Ka	Coeff. of Passive Earth Pressure, Kp	Coeff. of At-rest Earth Pressure, Ko
OPSS Granular A or B	–	0	34	22	0.28	3.6	0.44
Fill	–	0	27	18	0.38	2.7	0.55
Sandy silt to silt	–	0	31	20.5	0.32	3.1	0.49
Clayey silt to silty clay	–	0	27	19.5	0.38	2.7	0.55
Clayey silt till	-	0	28	20.5	0.36	2.7	0.53

For a global stability check:

ϕ = 30°
γ = 20 kN/m^3

Wall friction should be considered negligible.

The design groundwater table should refer to the Project Hydrogeological Study. The surcharge needs should be determined by the Structural Engineer but should not be less than 12 kPa.

Design calculations should be submitted to Sola for geotechnical review.

Movement of the shoring system is considered inevitable. The magnitude of this movement can be controlled by sound construction practices, and it is anticipated that the horizontal movement will be in the range of 0.1% H to 0.25% H. Vertical movements increase the horizontal movements because of the reduced stress in the inclined anchors. For this reason,

the shoring design must be carried out to minimize the vertical movement of the shoring system.

To ensure that movements of the shoring are within an acceptable range, monitoring must be undertaken throughout the site development process. Vertical and horizontal targets must be located and surveyed before excavation begins. Weekly readings during excavation should show that the movements will be within those predicted; if not, the monitoring results should enable directions to be given to improve the shoring.

5.8 CONSTRUCTION DEWATERING

The construction dewatering requirements should refer to the project hydrogeological study. Any dewatering must be implemented without causing settlements to the adjacent structures. A perched water condition may exist in the fill. Some seepage problems can therefore be expected during excavation. However, the construction dewatering requirements should refer to the project hydrogeological study.

Dewatering must be carried out in a manner as to prevent unwanted settlements on the adjacent structures, services, etc.

5.9 ENGINEERED FILL

On-site excavated, clean inorganic overburden (native and/or fill), if environmentally acceptable for on-site reuse, may selectively be reused as engineered fill material, provided that the moisture contents are strictly controlled. As mentioned previously, silty soils can be difficult to handle and compact, as they can be expected to dilate, especially in the presence of water.

If imported inorganic mineral soils are used for engineered fill construction, they must meet the applicable environmental guidelines, and their moisture contents should be sufficiently close to their respective optimum water content values.

The soil should be placed in thin lifts and suitable compaction equipment should be employed, to achieve the specified degree of field density. However, vibrations due to compaction may need to be reduced or curtailed to prevent damage to the existing structures and public right of way.

Consideration may also be given to backfilling excavations with well-graded, compacted granular soil such as Granular B as it, if thoroughly compacted, would reduce the post-construction settlements to an acceptable level and may also expedite the compaction process.

The entire process should be conducted under the supervision of the geotechnical personnel from this office. An SLS value of 150 to 200 kPa and a ULS value of 225 to 300 kPa can be utilized depending on the property of the imported granular fill used and compaction procedures, including the degree of compaction.

For slab construction, fill materials required for replacing locally softened soils or raising grades within the footprint of the structures are to comprise suitably organic-free materials approved for use by the Geotechnical Engineer. Fill materials are to be placed in lifts of a maximum thickness of 300 mm and compacted, using appropriate compaction equipment, to at least 98% of its SPMDD for floor slab construction to within 1.0 m below the underside of the slab and to 100% above this level.

Fill located under paved areas should be compacted to at least 95% of the material's SPMDD below 1.0 m of the subgrade level, and then to at least 98% of its SPMDD up to the required subgrade. Imported granular fill used in confined areas should be compacted using hand-held compaction equipment only.

As mentioned previously, silty soils can be expected to be difficult to handle and compact and may need to be wasted or used in landscaping areas only. This should be taken into consideration in planning.

Sola recommends that any and all engineered subgrades beneath the proposed structure including pavements be inspected and proof-rolled prior to construction.

5.10 CONSTRUCTION CONSIDERATIONS

Load-bearing soils are susceptible to disturbance from environmental factors (temperature, moisture change, etc.) and construction activity and, as such, due care should be given to minimizing trafficking of such areas during periods of excavation and the construction of floor slab and footings to minimize disturbance of the bearing materials.

Any excessive disturbances of the load-bearing and underlying deposits affected during construction works could influence the long-term settlement of the structures and will, therefore, require further excavation and replacement of such impacted materials with suitable engineered fill.

During winter seasons, foundations and floor slab construction should be carried out to avoid pouring concrete on frozen materials. Foundations must be adequately protected at all times from cold weather and freezing conditions.

A Geotechnical Engineer should evaluate all subgrade surfaces to confirm that the subgrade and founding conditions are consistent with the recommendations given by this report.

5.11 PAVEMENT

Pavement structures adjoining the proposed construction areas should be protected from damage resulting from construction activities. All heavy vehicles should be appropriately planned and re-routed to avoid such damage.

5.11.1 Pavement Thickness Design

After stripping of unsuitable materials, i.e., organics, new pavement can be supported by the existing fill soils (re-compacted as required under Sola's supervision) and/or engineered fill.

It is anticipated that the final subgrade will comprise predominantly on-site improved fill (by proof-rolling and surface compaction). Accordingly, given the frost susceptibility and drainage characteristics of the final subgrade soils, the following pavement designs presented in **Table 4** are recommended based on the City of Waterloo Engineering Manual. It is assumed that there will be only occasional delivery truck travels allowed for medium-duty areas. In the areas where haul routes are expected, a heavy-duty pavement design should be implemented.

Table 4: Recommended Pavement Design (New Construction)

Pavement Layer	Layer Thicknesses (mm)		Compaction Requirements
	Medium Duty (At Grade Parking Lots for Passenger Cars)	Heavy Duty (Driveways, Fire Routes, etc.)	
Asphaltic Concrete Surface Course (HL-3)	40	40	Minimum of 92.0% of Maximum Relative Density (MRD)
Asphaltic Concrete Binder Course (HL-8)	60	90	
Granular Base (Granular A)	150	150	100% SPMDD
Granular Sub-Base (Granular B-Type I)	400	500	

All pavement component materials should be produced and laid in accordance with current OPSS requirements. Asphaltic concrete materials would be compacted to 92% of their Maximum Relative Density (MRD) or higher. Granular materials would be compacted to at least 100% of their SPMDD.

The pavement design as presented above in **Table 4** is based on the assumption that construction will be undertaken under dry weather conditions and that the subgrade is stable and not heaving under construction equipment traffic. However, if the construction conditions are non-ideal, with the final subgrade being wet and/or unstable, additional imported subbase material may become necessary.

Prior to placing the granular subbase, the final subgrade should be proof-rolled to identify soft spots, if any, and rectified as required in consultation with a Geotechnical Engineer.

The recommended pavement structure should be considered for preliminary design purposes only. The functional design life of ten (10) to twelve (12) years has been used to establish pavement recommendations. This represents the number of years to the first rehabilitation, assuming regular maintenance is carried out.

If required, a more refined pavement structure can be designed based on specific traffic data and design life requirements. Such further analysis will also involve specific laboratory tests to determine frost susceptibility and strength characteristics of the subgrade soils, as well as specific traffic loading data input from the Client.

Pavement Drainage: The ability of the soils to provide adequate subgrade support is reduced if allowed to become too wet. Therefore, in order to intercept infiltrating water and provide drainage of the subgrade and pavement material, it is recommended that 100 mm diameter sub-drains, wrapped in filter cloth, be provided along both sides of the driveways; in addition, similar sub-drains should be installed in four (4) directions from the catch basins and at strategic locations under the parking lot pavement. Furthermore, the subgrade should be graded to promote the flow of water toward the sub-drains. In the cases where the sub-drains connecting to the municipal sewer system are not preferred, the pavement profile should be adjusted to direct any runoff flow of water to an on-site stormwater management system, i.e., infiltration gallery.

5.11.2 Pavement Construction Considerations

For pavement construction, the subgrade must be compacted to not less than 98% SPMDD for at least the upper 300 mm unless an alternative is approved by Sola.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures should be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Additional comments on the construction of pavement areas are as follows:

- The subgrade preparation should include stripping of any objectionable materials, e.g., loose fill with organics. The base should be properly shaped and thoroughly proof rolled using a loaded truck in the presence of the geotechnical personnel. Soft and/or unstable subgrade areas should be further sub-excavated and backfilled to the design subgrade level using an approved material, placed in thin lifts, and compacted to not less than 98% of its SPMDD;
- The locations and extent of sub-drainage required within the paved areas should be reviewed by this office in conjunction with the proposed grading. Assuming that satisfactory cross falls in the order of 3.0% have been provided, sub-drains extending from and between catch basins may be satisfactory. In the event that flatter cross falls are considered, a more extensive system of sub-drainage may be necessary and should be reviewed by Sola; and,
- The most severe loading conditions on the pavement areas and subgrade may occur during construction. Consequently, special provisions such as restricted access routes, half-loads during paving, etc., may be required, especially if construction is carried out during unfavourable weather.

It is recommended that Sola be retained to review the final pavement structure designs and drainage plans prior to construction to ensure that they are consistent with the recommendations in this report.

5.12 SERVICE INSTALLATION CONSIDERATIONS (WHERE APPLICABLE)

5.12.1 General

The native materials found in the boreholes generally consist of sufficiently competent soils in their undisturbed state and can be considered suitable for pipe support. In general, the site materials are suitable for pipeline support. Localized loose/soft subgrade conditions, if encountered during construction, should be sub-excavated to a depth of at least 300 mm or a firm base, if shallower, and backfilled with clean, compactable materials and stabilized as per the project specifications.

Where the invert falls within the existing fills, these may need to be removed and replaced with engineered fill, as directed by the geotechnical engineer.

Prior to the placement of bedding, the exposed subgrade at the bottom of each servicing trench excavation should be inspected by a Geotechnical Engineer to identify any soft, loose, or disturbed base conditions. All disturbed soils resulting from construction activities should be removed and replaced as noted above.

Design and construction considerations for both flexible (PVC) and rigid (concrete) pipes are included in the following sections.

5.12.2 Excavations and Health and Safety Considerations

The same recommendations as given in **Section 5.6** will generally apply to the excavations for laying the underground services. The excavated soils should be placed not closer than the depth of the trenches from the trench edge plus 1 m.

5.12.3 Bedding

The native subgrade in an undisturbed state will provide adequate support for the proposed service pipes and will allow the use of normal Class B-type bedding. Where the invert falls within the existing fill materials, the fill should be removed from the surface of native soil and replaced with engineered fill. Alternatively, an increased thickness of bedding can be used as directed by the geotechnical engineer. The bedding should conform to the current Ontario Provincial Standard Specifications (OPSS 1010) and/or the City of Waterloo standards for bedding stone gradation requirements. The pipes should be placed with a minimum bedding thickness in conformance with Ontario Provincial Standard Drawing OPSD 802.010 (for flexible pipes) or OPSD 802.031/802.032 (for rigid pipes), though the bedding thickness will be subject to variation and ultimately be based on the proposed pipe diameter, bedding specifications used, etc.

On completion of the servicing pipe installation, a granular surround of the same bedding material should be placed around the pipe to cover it to at least 300 mm above the pipe obvert. The bedding materials should be well-graded soil to prevent silty soils from infiltrating into the voids of the bedding materials. The use of a geo-fabric may be necessary for separation purposes, especially where the subgrade consist of silt below the groundwater table. In view of the possible upward gradient, the geo-fabric should be carefully chosen.

The backfill above the bedding and cover materials may consist of a clean, compactable fill that possesses similar properties to the existing subgrade soil. Based on the borehole data it is anticipated that the local soil material may be reused as trench backfill. Some moisture conditioning of the soil may be required to facilitate soil compaction. The sandy silt fill, sandy silt and silt native soils, however, can be expected to be difficult to handle and compact (as these will dilate in the presence of water) and may be difficult to reuse, especially in the presence of the narrow confines of service trenches. If imported soil is used as a trench backfill, it must be ensured that the drainage properties of the subgrade are maintained and that there is no differential frost movement. Trench backfills should be compacted to at least 95% of the material's SPMDD, or the City of Waterloo standards,

whichever is more stringent. Where the trench is located within future pavement area, the degree of compaction should be increased to not less than 98% within the upper 1 m of the subgrade level.

5.12.4 Trench Backfill

Backfilling During Dry-Weather Conditions

The excavated fill and native soils, if environmentally suitable and approved by the Geotechnical personnel at the time of construction, are considered suitable for re-use as fill to backfill service trenches, provided that suitable compaction equipment can be used to compact the fill material. As mentioned before, the silty fills and native soils would be difficult to handle and to compact. Such soils may need to be wasted or used elsewhere at the site. The use of heavy compactors in the narrow-confined service trenches may not be feasible. In confined areas, consideration may also be given to backfilling the areas with a well-graded, compacted granular soil such as Granular 'B' material. As such material, if thoroughly compacted, would reduce the post-construction settlements to an acceptable level and may also expedite the compaction process. However, proper tapering should be provided to prevent differential frost heave of the paved surface.

Each lift should be no greater than 300 mm thick and compacted using an appropriate heavy compaction machine to at least 95 % of the material's SPMDD to within 1 m of the top of the subgrade, and then to 98 % SPMDD up to the required grade.

Exposed, excavated soil stockpiles that are to be reused as fill on-site should be compacted at the surface or temporarily covered during wet weather to help maintain their original moisture content. Such stockpiles are prone to wet weather exposure and, as such, the increased moisture contents will make these materials too wet to achieve the required levels of compaction.

Conversely, if the excavated native soils are too dry to achieve the required levels of compaction, some moisture addition/conditioning by means of water hosing or misting should be expected.

We recommend the subgrade be observed and approved by a Geotechnical Engineer prior to the placement of the bedding material to confirm that the subgrade conditions are consistent with the recommendations given in this report. Where unsuitable subgrade conditions are observed, remedial procedures can be established in the field to avoid construction delays.

Backfilling During Winter Months

Should this project proceed during the winter months or when the ambient temperatures are below freezing, the following additional recommendations will apply in order to avoid any detrimental effects of frost.

In this situation, it is imperative that the excavation and backfilling operations follow simultaneously. This procedure is required to avoid time gaps between the two construction stages, as prolonged exposure to frost may lead to the inclusion of frozen material during backfilling. It is recommended that prior to resuming backfilling over the frozen surface, all frost should be removed to achieve a satisfactory bond between the current and previously laid fills. Also, this procedure would prevent leaving frozen layers of soil which could cause long-term settlements while undergoing slow thawing.

It is further recommended that any accumulation of water or ice in the sheepsfoot footprint overnight or on weekends should be prevented by adequately shaping up and back-blading the compacted grades prior to leaving the site.

In order to ensure that no frozen material is being backfilled in the trenches, it is recommended that the backfilling and compaction operations should be supervised and closely monitored by Sola on a continuous basis.

For the construction of the road/driveway, the final subgrade should be prepared during 'dry weather' conditions so as to achieve a satisfactory end product.

6.0 MATERIAL TESTING AND INSPECTION

It is recommended that Sola be appointed to carry out field inspection and materials testing during construction to ensure that the construction complies with the design recommendations.

7.0 DRAWING REVIEW

Once the final design drawings for this project are prepared, it is recommended that one (1) set of the drawings should be submitted to Sola for review and to make any amendments to our recommendations that may be required, prior to starting construction.

Sola should also be retained for a general review of the final design and specifications to verify that this report has been properly interpreted and implemented. If not accorded the privilege of making this review, Sola will assume no responsibility for the interpretation of the recommendations in this report.

The comments given in this report are preliminary and intended only for the guidance of design engineers. Contractors bidding on or undertaking the works should make their own interpretations of the factual borehole results, so that they may draw their own conclusions on how the subsurface conditions may affect them.

The information in this report in no way reflects on the environmental aspects of soil conditions at the site and has not been addressed in this report since this aspect was beyond the scope and terms of reference.

8.0 CLOSURE

This report is subject to the *Statement of Limitations* which forms an integral part of this document. The Statement of Limitations is not intended to reduce the level of responsibility accepted by Sola, but rather to ensure that all parties who have been given reliance for this report are aware of the responsibilities each assumes in so doing.

We trust that this report meets your needs. Should you have any queries, please contact the Sola office.

Sincerely,
SOLA ENGINEERING INC.

LICENSED PROFESSIONAL ENGINEER
Bill Feng
B. FENG
100050651
Apr. 22, 2025
PROVINCE OF ONTARIO

PP. George Hao P. Eng.
Geotechnical Engineer

Bill Feng P. Eng.
Chief Engineer

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Enclosures

STATEMENT OF LIMITATIONS

Standard of Care and Basis of this Report
Sola Engineering Inc. ("Sola Engineering") has prepared this report in a manner consistent with generally accepted engineering and/or environmental practices in the jurisdiction in which the specified services were provided. The information and conclusions set out in this report reflects Sola Engineering's best professional judgment in light of the information available to Sola Engineering at the time of preparation. Sola Engineering disclaims any and all warranties, express or implied, including without limitation any warranty of merchantability and/or fitness for a particular purpose, and makes no representations concerning the legal effect, interpretation or significance of this report or the information, conclusions or recommendations contained in it.

The conclusions and recommendations provided in this report have been prepared in relation to the specified site (the "Site") and the proposed project (the "Project"), as described by the Client to Sola Engineering. Given the nature of the work undertaken by Sola Engineering as part of this report, the Client acknowledges that ground conditions may vary over distances and may change over time. Should there arise any changes to the conditions of the Site or the Project (as to purpose or design), Sola Engineering is to be notified within a reasonable period of time, and in any event within 24 hours of the Client's learning of such changes, so as to give Sola Engineering an opportunity to review and revise this report in light of such changes. Sola Engineering accepts no liability or responsibility for any use of this report or reliance on this report following any changes to the conditions of the Site or the Project.

The scope of professional services provided by Sola Engineering for the Project are as set out in this report. Should such services be limited to those of a geotechnical nature, Sola Engineering shall not be held liable or responsible for any environmental services that may be required, nor shall this report be interpreted to reflect any environmental aspects of the Project. Alternatively, should such services be limited to those of an environmental nature, Sola Engineering shall not be held liable or responsible for any geotechnical services that may be required, nor shall this report be interpreted to reflect any geotechnical aspects of the Project.

This report is not intended to provide recommendations for possible future conditions or use of the Site or adjoining properties. Should the need arise for such recommendations Sola Engineering may need to conduct further investigations.

Use of this Report
This report is intended to be read and used in its entirety. No reliance may be made upon any individual portion or section of this report without reference to the entire report as a whole. In preparing this report, Sola Engineering has relied on information, instructions and communications given by the Client to Sola Engineering, the applicability, truth and accuracy of which is the sole responsibility of the Client.

This report with the information, sampling data, analysis, conclusions and recommendations contained in it (if any), has been prepared for and may only be used by the Client and only for the specific purpose as specified by the Client to Sola Engineering in connection with the Project. Without prior written consent from Sola Engineering, use of this report or any portion thereof by any person or entity other than the Client, or for any purpose other than as communicated by the Client to Sola Engineering, is strictly prohibited. Sola Engineering accepts no liability or responsibility for the unauthorized use of this report. This report and all documents that form part of it are the sole property of Sola Engineering. Sola Engineering relies on and retains any and all intellectual property rights it has in this report, including any copyright to which it is entitled. The Client shall not give, lend or sell this report, or any portion thereof, to any entity, person or association without the express prior written consent of Sola Engineering. This report and the information contained herein shall be treated as strictly confidential.

The contents of this report, inclusive of Sola Engineering's conclusions and recommendations in relation to the Project, are intended only for the guidance of the Client in carrying out the specified services for the Project, as described by the Client to Sola Engineering. Accordingly, Sola Engineering does not accept any liability or responsibility for any inaccuracy contained in this report arising as a result of or in any way connected with any exclusion, oversight or falsification of the information provided to Sola Engineering by the Client. This report, including the effect of the subsurface conditions as described in this report, is to be interpreted at the risk and discretion of the Client and any contractors or others bidding on or undertaking contractual work to be performed as part of the Project who may come into possession of or learn of this report or its contents. It is exigent that all contractors bidding or undertaking the work are to rely on their own interpretations of the data contained in this report in addition to their own investigations and conclusions. Sola Engineering shall not be held liable or responsible for any interpretation of or conclusions that may be drawn from the data or information contained in this report.

The information, recommendations and conclusions presented in this report are based on Sola Engineering's interpretation of conditions revealed through the limited investigation conducted within a defined scope of services. In no event will Sola Engineering be held responsible or liable to the Client or any other person or entity for any special, indirect, incidental, punitive or consequential loss or damage (including, loss of use, lost profits or expenses incurred) resulting from or in any way related to the independent interpretations, interpolations, conclusions or decisions of the Client or any other person or entity, based on the information contained in this report. The restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.

Notwithstanding the exclusions of liability contained herein but without in any way limiting their effect or generality, if there is found to be any finding of liability or responsibility whatsoever on the part of Sola Engineering which in any way relates to or arises from this report, or the information, conclusions or recommendations contained in it, such liability and/or responsibility shall cease and forever be extinguished from and after the date which is two (2) years from the date of this report. In no event shall any liability or responsibility of Sola Engineering exceed the fees charged by Sola Engineering to the Client for the preparation of this report (excluding any arms' length disbursements or expenditures made or incurred by Sola Engineering as a result thereof and reimbursed by the Client).

Site Conditions
The material conditions, classifications, conclusions and recommendations contained in this report were based on the site conditions observed or tested by Sola Engineering or otherwise communicated to Sola Engineering by the Client. The description, identification and classification of soils, rocks, chemical contamination and other materials have been made based on limited investigations, sampling and testing of materials performed by Sola Engineering and its qualified representatives in reliance on the use of relevant or applicable equipment, all in accordance with commonly acceptable standards in the geotechnical and/or environmental disciplines. Accordingly, this report may include assumptions of conditions which are based on discrete sample locations and thus some conditions may not have been detected. The Client accepts all liability and risk for the use of this report and the information and data contained in it. Sola Engineering shall not be held liable or responsible for any conditions beyond the scope of tests conducted on samples of the subsurface and soil conditions of the subject property as set out in this report.

For clarity, the Client acknowledges and accepts that unique risks exist whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive sampling and testing program may fail to detect certain conditions. The environmental, geological, geotechnical, geochemical and hydrogeological conditions that Sola Engineering interprets to exist between sampling points may differ from those that actually exist. As a result, the Client acknowledges and accepts that because of the inherent uncertainties in subsurface evaluations, unanticipated underground conditions may occur or become known subsequent to Sola Engineering's investigation that could affect conclusions, recommendations, total Project cost and/or execution.

Indemnification of Risk
Though Sola Engineering adheres to the highest degree of integrity and employs due diligence in limiting the potential release of toxins and hazardous substances, the risk of accidental release of such substances is a possibility when providing geotechnical and environmental services.

In consideration of the provision of services by Sola Engineering, the Client agrees to defend, indemnify and hold Sola Engineering and its employees and agents harmless from and against any and all claims, liabilities, damages, causes of action, judgments, costs or expenses (including reasonable legal fees and disbursements), resulting from or arising by reason of the death or bodily injury to persons, damage to property, or other loss, whether related to an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project or otherwise, and whether or not resulting from Sola Engineering's negligent actions or omissions. This indemnification shall include and extend to any and all third party claims brought or threatened against Sola Engineering under any federal or provincial law or statute as a result of Sola Engineering conducting work on the Project. In addition to and notwithstanding the foregoing, the Client further agrees to unconditionally and irrevocably release Sola Engineering from, and not to bring any claims against Sola Engineering in connection with, any of the aforementioned claims or causes.

Subconsultants and Contractor Services
In conjunction with the services provided by Sola Engineering's own employees, external services provided by other persons or entities that are specializing in services other than those offered by Sola Engineering, such as drilling, excavation and laboratory testing, are often employed in order to carry out the defined scope of work. If such external services have been employed for this Project, the Client acknowledges that Sola Engineering is not in any way liable or responsible for any costs, claims or damages in relation to the services rendered by such other persons or entities or payment therefor, nor shall Sola Engineering be liable or responsible for damages for errors, omissions or negligence caused by such other persons or entities while providing such external services.

Work and Job Site Safety
Sola Engineering shall be responsible only for its activities and that of its employees on the Site. Sola Engineering shall not direct any of the fieldwork nor the work of any other person or entity on the Project. The presence of Sola Engineering staff on the Site does not relieve the Client or any contractor on the Site from their responsibilities pertaining to site safety. The Client at all times retains any and all responsibility for the safety of those individuals present on the Site and/or working on the Project, including Sola Engineering's employees.



SOLA ENGINEERING	Project No: 11425-S0770-GEO	**BH Location Plan**	The figure provided is for the intended purpose of presenting the approximate borehole locations. This figure should not be used for any other purposes including construction, architecture or for accuracy of dimensions and orientation of objects.	Enclosure No.: **1**
	Report Number: 2025-21162	**Proposed Residential Development**		
		380 Hagey Boulevard, Waterloo, Ontario		
	Date: March 2025	**Kothari Group**		Not to Scale

SOLA ENGINEERING

ENCLOSURE No. 2

RECORD OF BOREHOLE No. BH1

1 OF 1

METRIC

PROJECT NUMBER 11425 | LOCATION 380 Hagey, Waterloo, Ontario | ORIGINATED BY CC

NAME Proposed Hotel | CLIENT Kothari Group Inc | METHOD Solid Stem Augers | COMPILED BY RT

DATUM Geodetic | DATE 2025.03.13 - 2025.03.13 | NORTHING | EASTING | CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.9	Topsoil										
0.0 / 346.7	TOPSOIL - 200 mm thick		1A								
0.2	FILL - sandy silt, trace gravel, brown, moist		1B	SS	18						
			2	SS	31		346				
345.4											
1.5	FINE SANDY SILT - trace to some clay, trace gravel, brown, compact to dense, wet		3	SS	31		345				
			4	SS	25						
343.9							344				
3.0	SILT - trace clay, trace sand, brown, compact, very moist		5	SS	27						
342.3							343				
4.6	SILTY CLAY - brownish grey, stiff, very moist		6	SS	12		342				
340.8							341				
6.1	CLAYEY SILT - trace sand, grey, very stiff, wet		7	SS	28						
340.3											
6.6	End of Borehole at Targeted Depth; Borehole Was Open and Water at 5.5 m Below Existing Ground Surface Upon Completion of Drilling Period.										

$+^{3}$, $\times^{3}$: Numbers refer to Sensitivity

$\circ^{3\%}$ STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 3

RECORD OF BOREHOLE No. BH2

1 OF 2

METRIC

PROJECT NUMBER 11425 | LOCATION 380 Hagey, Waterloo, Ontario | ORIGINATED BY CC

NAME Proposed Hotel | CLIENT Kothari Group Inc | METHOD Solid Stem Augers | COMPILED BY RT

DATUM Geodetic | DATE 2025.03.13 - 2025.03.13 | NORTHING | EASTING | CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
346.4	Topsoil									
0.0 / 346.2	TOPSOIL - 150 mm thick		1A							
0.2	FILL - silty sand, trace gravel, trace clay, brown, moist		1B	SS	16		346			
			2	SS	23					
			3	SS	24		345			
344.1										
2.3	SANDY SILT - trace clay, brown, compact, moist		4	SS	25		344			
343.4										
3.0	SILT - trace clay, brown, compact, very moist		5	SS	21		343			
341.8										
4.6	SILTY CLAY - brownish grey, stiff, very moist		6	SS	12		342			
							341			

Continued Next Page

$+^3$, $\times^3$: Numbers refer to Sensitivity

○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 3

RECORD OF BOREHOLE No. BH2 2 OF 2 METRIC

PROJECT NUMBER 11425 LOCATION 380 Hagey, Waterloo, Ontario ORIGINATED BY CC

NAME Proposed Hotel CLIENT Kothari Group Inc METHOD Solid Stem Augers COMPILED BY RT

DATUM Geodetic DATE 2025.03.13 - 2025.03.13 NORTHING EASTING CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
340.3											
6.1	SANDY SILT - trace clay, brownish grey, compact to very dense, wet		7	SS	40		340		○		
			8	SS	15		339		○		
			9	SS	53		338		○		
336.8							337				
9.6	End of Borehole at Targeted Depth; Borehole Caved at 7.0 m and Water at 5.8 m Below Existing Ground Surface Upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 4

RECORD OF BOREHOLE No. BH3 1 OF 1 METRIC

PROJECT NUMBER 11425 LOCATION 380 Hagey, Waterloo, Ontario ORIGINATED BY CC

NAME Proposed Hotel CLIENT Kothari Group Inc METHOD Solid Stem Augers COMPILED BY RT

DATUM Geodetic DATE 2025.03.13 - 2025.03.13 NORTHING EASTING CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
348.1	Topsoil										
348.0 / 0.0	TOPSOIL - 125 mm thick		1A				348				
0.1	FILL - clayey silt, trace gravel, trace rootlets, brown, moist		1B	SS	11						
			2	SS	8		347				
346.6											
1.5	CLAYEY SILT - trace gravel, brown, very stiff, moist		3	SS	19		346				
345.8											
2.3	FINE SANDY SILT - brown, compact, wet		4A	SS	22						
345.5			4B								
2.6	CLAYEY SILT - brown, very stiff to hard, moist		5	SS	20		345				
			6	SS	23		344				
							343				
			7	SS	36		342				
341.5											
6.6	End of Borehole at Targeted Depth; Borehole Caved at 6.0 m and Water at 5.8 m Below Existing Ground Surface Upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

SOLA ENGINEERING

ENCLOSURE No. 5

RECORD OF BOREHOLE No. BH4 1 OF 1 METRIC

PROJECT NUMBER 11425 LOCATION 380 Hagey, Waterloo, Ontario ORIGINATED BY CC

NAME Proposed Hotel CLIENT Kothari Group Inc METHOD Solid Stem Augers COMPILED BY RT

DATUM Geodetic DATE 2025.03.13 - 2025.03.13 NORTHING EASTING CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE) (20 40 60 80 100)	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
347.3	Topsoil										
0.0 / 347.1	TOPSOIL - 175 mm thick		1A								
0.2	FILL - silty clay, trace gravel, brown, moist		1B	SS	9		347				
			2	SS	15						
345.8							346				
1.5	CLAYEY SILT - brown, very stiff, moist to wet		3	SS	20						
			4	SS	25		345				
	- trace sand		5	SS	20		344				
342.7							343				
4.6	FINE SANDY SILT - trace clay, brown, dense, wet		6	SS	37						
341.2							342				
6.1	SILT - brown, very dense, moist		7	SS	53		341				
340.7											
6.6	End of Borehole at Targeted Depth; Borehole Was Open and Water at 1.2 m Below Existing Ground Surface Upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

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ENCLOSURE No. 6

RECORD OF BOREHOLE No. BH5 1 OF 1 METRIC

PROJECT NUMBER 11425 LOCATION 380 Hagey, Waterloo, Ontario ORIGINATED BY CC

NAME Proposed Hotel CLIENT Kothari Group Inc METHOD Solid Stem Augers COMPILED BY RT

DATUM Geodetic DATE 2025.03.13 - 2025.03.13 NORTHING EASTING CHECKED BY RT

ELEV / DEPTH	DESCRIPTION	STRAT PLOT	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT (20 40 60 80 100) / SHEAR STRENGTH kPa (20 40 60 80 100): ○ UNCONFINED, ● QUICK TRIAXIAL, + FIELD VANE, × LAB VANE	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L — WATER CONTENT (%) (20 40 60)	UNIT WEIGHT γ kN/m³	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
347.9	Topsoil										
0.0 / 347.7	TOPSOIL - 150 mm thick		1A								
0.2	FILL - clayey silt, trace gravel, brown, moist		1B	SS	18						
			2	SS	26		347				
346.4											
1.5	CLAYEY SILT - trace gravel, trace sand, brown, very stiff, moist		3	SS	25		346				
345.6											
2.3	GLACIAL TILL - clayey silt, trace gravel, greyish brown, very stiff to hard, moist		4	SS	29		345				
			5	SS	39						
343.3							344				
4.6	SILT - some clay, greyish brown, very dense, moist		6	SS	53		343				
341.8											
6.1	FINE SANDY SILT - some clay, greyish brown, very dense, wet		7	SS	79/ 28 cm		342				
341.4											
6.5	End of Borehole at Targeted Depth; Borehole Was Open and Dry Upon Completion of Drilling Period.										

$+^3$, $\times^3$: Numbers refer to Sensitivity ○ 3% STRAIN AT FAILURE

KEY TO SYMBOLS

Enclosure No.: 7

PROJECT NUMBER 11425

PROJECT NAME Proposed Hotel

LOCATION 380 Hagey boulevard, Waterloo, Ontario

CLIENT Kothari Group Inc

LITHOLOGIC SYMBOLS (Unified Soil Classification System)


CL-SL: clayey silt


CL-SL-TL: clayey silt till


FILL: TTC Fill (made ground)


SL: silt


SL-CL: silty clay


SN-SL: sandy silt


TOPSOIL: Topsoil/peat/organics

SAMPLER SYMBOLS


Split Spoon Sample

WELL CONSTRUCTION SYMBOLS


Bentonite Seal: 1 pipe group, 1 pipe


Concrete: 1 pipe group, 1 pipe


Filter Pack: 1 pipe group, 1 pipe


Slotted Pipe: 1 pipe group, 1 pipe


Slough at bottom of hole

Notes:

Terms describing RELATIVE DENSITY, based on Standard Penetration Test "N"-Value for COURSE GRAINED soils (major portion retained on No. 200 seive):

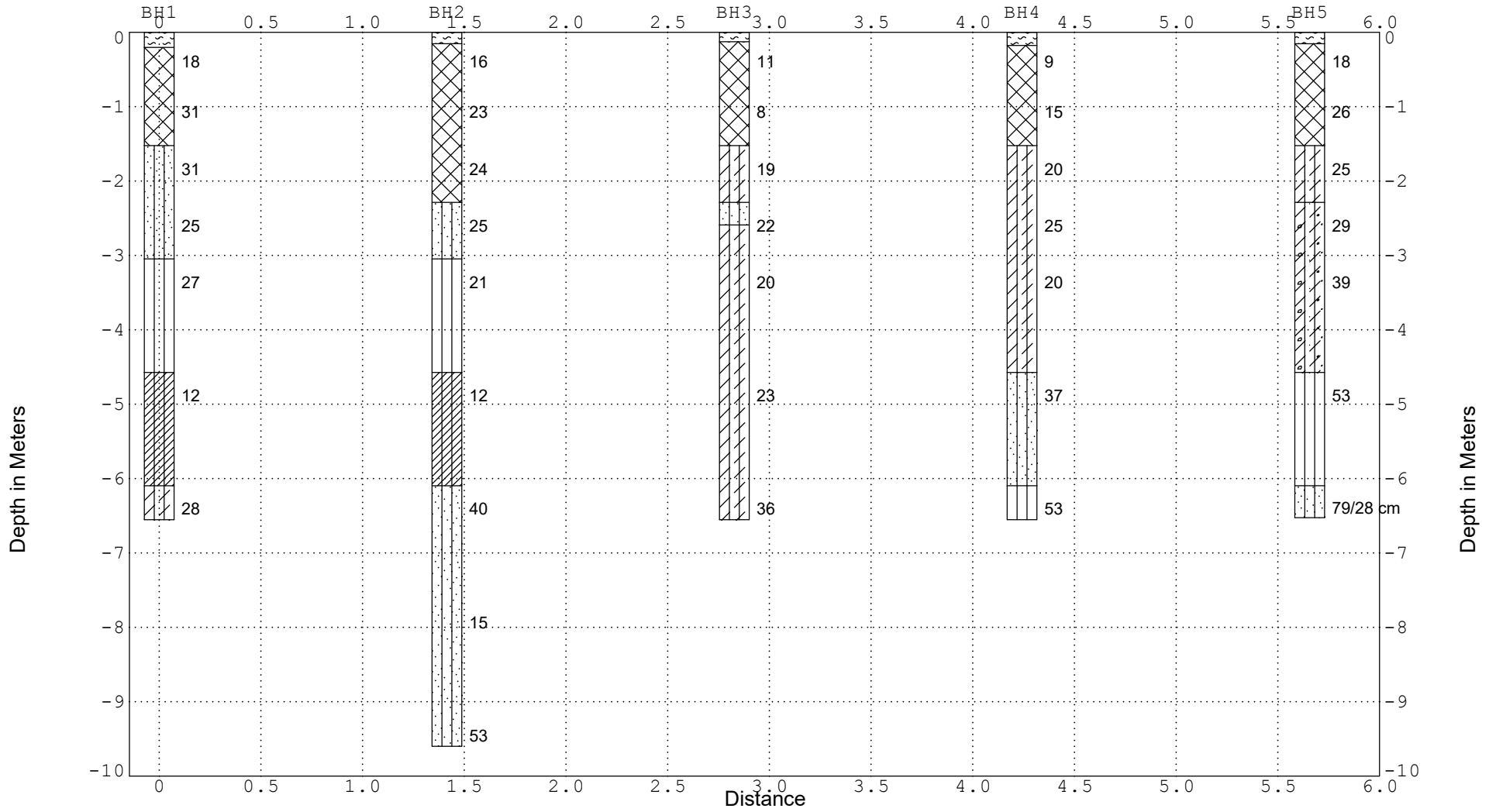
DESCRIPTIVE TERM ["N"-Value (blows/0.3m), Relative Density (%)]

- **Very Loose [less than 4, less than 15]**
- **Loose [4 to 10, 15 to 35]**
- **Compact or Medium [10 to 30, 35 to 65]**
- **Dense [30 to 50, 65 to 85]**
- **Very Dense [greater than 50, greater than 85]**

Terms describing CONSISTENCY, based on Standard Penetration Test "N"-Value for FINE GRAINED soils (major portion passing No. 200 sieve):

DESCRIPTIVE TERM [Unconfined Compressive Strength (kPa), "N"-Value (blows/0.3m)]

- **Very Soft [less than 25, less than 2]**
- **Soft [25 to 50, 2 to 4]**
- **Firm [50 to 100, 4 to 8]**
- **Stiff [100 to 200, 8 to 15]**
- **Very Stiff [200 to 400, 15 to 30]**
- **Hard [greater than 400, greater than 30]**



Plan View

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CONCEPTUAL SOIL PROFILE

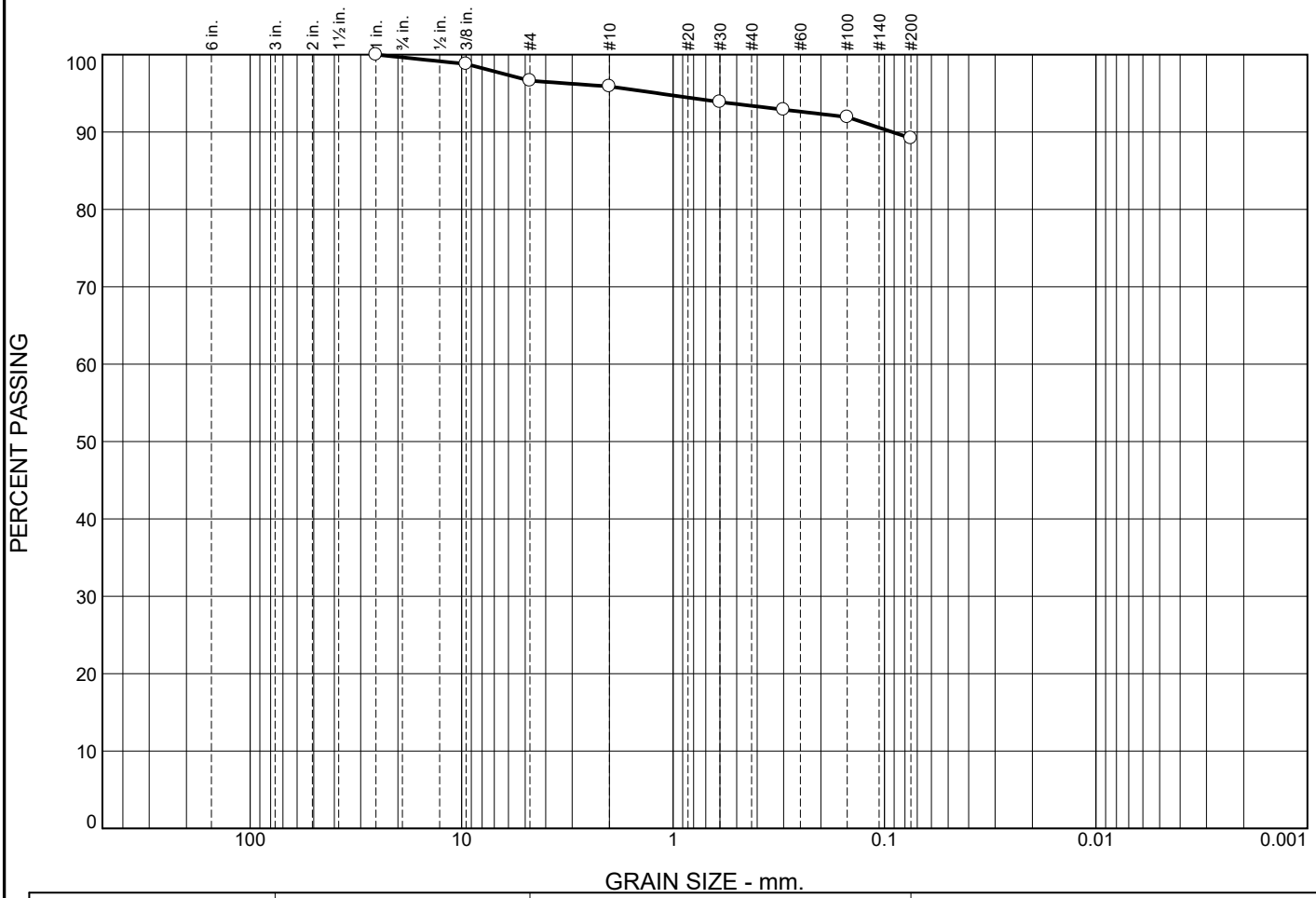
Horizontal Scale:	Drawn By:	
Vertical Scale:	Approved By:	

Proposed Hotel
380 Hagey boulevard, Waterloo, Ontario

Project Number: 11425

Enclosure No.: 8

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines
		Coarse	Fine	Coarse	Medium	Fine	
○	0	0	3	1	3	4	89

	Colloids	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○											

Material Description	USCS	AASHTO
○ BH4-SS6-15'-16'6"		

Project No. 11425 **Client:** Kothari Group Inc. / 380 Hagey, Waterloo

Project: Proposed Hotel

○ **Location:** BH4-SS6-15'-16'6" **Depth:** 15'-16'6" **Sample Number:** 25-034

Date: ○

Remarks:

○Date Sampled: March 13, 2025
Sampled By: Clement Chan
Report No.: 2025-21162
Note: Addotional information is available upon request.

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Enclosure No. 9