APPENDIX

6 Geotechnical Investigation

If technical reports are required in an alternative format for accessibility needs, please contact:

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SOIL-MAT ENGINEERS & CONSULTANTS LTD.

401 Grays Road · Hamilton, ON · L8E 2Z3

www.soil-mat.ca info@soil-mat.ca 905.318.7440 / 800.243.1922 (*toll free*) 905.318.7455

PROJECT NO.: SM 220432-G April 18, 2024

RV ANDERSON ASSOCIATES LIMITED
43 Church Street – Suite 104
St. Catharines, Ontario
L2R 7E1

Attention: Andrew McGregor

GEOTECHNICAL INVESTIGATION
PROPOSED INTERSECTION IMPROVEMENTS AND REALIGNMENT
THIRTY ROAD AND YOUNG STREET
WEST LINCOLN, ONTARIO

Dear Mr. McGregor,

Further to your authorisation, SOIL-MAT ENGINEERS & CONSULTANTS LTD. has completed the fieldwork, laboratory testing, and report preparation in connection with the above noted project. The investigation and reporting were undertaken in general accordance with our proposal P220432, dated May 25, 2022. Our comments and recommendations based on our findings at the sixteen [16] borehole locations and six [6] test pits are presented in the following paragraphs.

1. INTRODUCTION

We understand that the project will include improvements to the intersection of Thirty Road and Young Street in West Lincoln, Ontario, including realignment of the northern portion of Thirty Road. The purpose of this geotechnical investigation work was to assess the existing pavement structure and subsurface soil conditions, and to provide our comments and recommendations with respect to the design and construction of the proposed intersection improvements, from a geotechnical point of view.

This report is based on the above summarised project, and on the assumption that the design and construction will be performed in accordance with the applicable codes and standards. Significant deviations from the proposed project design may possibly nullify the recommendations made in this report. If significant changes are to be made to the proposed design, this office must be consulted to review the new changes with respected to the results of this investigation.

2. PROCEDURE

A total of ten [10] sampled boreholes were advanced at the locations illustrated in the attached Borehole Location Plan, Drawing No. 1. The boreholes were advanced using continuous flight power auger equipment to termination at depths of approximately 3.4 to 6.0 metres below the existing grade on February 27 and 28, 2024, under the direction and supervision of a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD. Upon completion of drilling all boreholes were backfilled in general accordance with Ontario Regulation 903, and the grade reinstated even with the existing road surface using a pre-mixed asphalt 'cold patch' product.

Additionally, a total of six [6] borehole logs were provided to SOIL-MAT by a representative of RV Anderson Associates Limited, identified as the logs of Borehole Nos. 34 to 39 from Inspec Sol Report Reference No. T060074-A1, dated June 12, 2012, advanced along Young Street. The information contained within these reports was considered in preparation of this report.

Representative samples of the subsoils were recovered from the borehole locations at selected depth intervals using split barrel sampling equipment driven in accordance with the requirements of the ASTM test specification D1586, Standard Penetration Resistance Testing. After undergoing a general field examination, the soil samples were preserved and transported to the SOIL-MAT laboratory for visual, tactile, and olfactory classifications. Routine moisture content tests were performed on all soil samples recovered from the borings.

The boreholes were located in the field by a representative of SOIL-MAT ENGINEERS & CONSULTANTS LTD., in general accordance with the drawing provided to our office, based on accessibility over the site and clearance of underground services. The ground surface elevation at each of the borehole locations have been referenced to the existing roadway surface.

Details of the conditions encountered in the boreholes, together with the results of the field and laboratory tests, are presented in the Log of Borehole Nos. 1 to 10, inclusive, following the text of this report, as well as the Log of Borehole Nos. 34 to 39 from Inspec Sol referenced above. It is noted that the boundaries of soil types indicated on the borehole logs are inferred from non-continuous soil sampling and observations made during drilling. These boundaries are intended to reflect transition zones for the purpose of geotechnical design and therefore should not be construed as the exact planes of geological change.

3. SITE DESCRIPTION AND SUBSURFACE CONDITIONS

The project area consists of Thirty Road from 600 metres north to 250 metres south of Young Street, and along Young Street from 250 metres east to 250 metres west of Thirty Road. The asphalt paved roadways bound a salt plant facility [Smithville Yard]. Generally, the roadways have grass ditches for stormwater control. The project site is bounded by agricultural land on all sides.

The subsurface conditions encountered at the borehole locations are summarised as follows:

Pavement Structure

All of the boreholes were advanced through the pavement structure of the existing roadway, which generally consisted of approximately 75 to 275 millimetres of asphaltic concrete, overlaying 175 to 250 millimetres of compact granular base materials. The pavement surface was generally noted to be in good condition, exhibiting little to no alligator cracking, rutting, potholes, etc. The pavement structures encountered at each of the borings have been summarised as follows:

TABLE A – PAVEMENT STRUCTURE SUMMARY [SOIL-MAT BOREHOLES]

Borehole No.	1	2	3	4	5	6	7	8	9	10
Asphaltic Concrete (mm)	75	100	250	225	250	225	200	275	150	150
Granular Material (mm)	225	200	250	175	175	175	225	250	200	200

TABLE B – PAVE STRUCTURE SUMMARY [INSPEC SOL BOREHOLES]

Borehole No.	34	35	36	37	38	39
Asphaltic Concrete (mm)	75	75	75	75	100	100
Granular Material (mm)	325	325	300	150	300	250

Silty Clay/Clayey Silt

Native silty clay/clayey silt was encountered beneath the pavement structure at all of the borehole locations and beneath the surficial topsoil layer at all test pits. The cohesive soil was brown in colour, weathered in appearance/reworked in the upper levels, contained trace gravel, and generally stiff to very stiff in consistency. Native silty clay/clayey silt was proven to auger refusal at depths of approximately 3.1 and 3.7

metres at Boreholes 1 and 3 respectively, and to termination at depths of approximately 3.7 to 6.0 metres at all remaining borehole locations. Based on the conditions described in the Inspec Sol boreholes, the auger refusal appears to be due to the presence of a hard layer comprised of cobbles/boulders. This layer is evident due to the sharp increase in 'N-values' and auger performance at various borehole locations at depths of between approximately 2.5 and 4 metres, and should be expected across the site.

In addition to the boreholes, a series of test excavations were advanced within the field at the locations illustrated in the attached Drawing No. 1, Borehole Location Plan. A summary of the conditions encountered in the test pits are summarized as follows:

TABLE C – TEST PIT SUMMARY

Test Pit No.	Depth (m)	Soil Description
1	0 – 0.4	**Topsoil** – Approximately 400 millimetres of topsoil.
	0.4 – 0.6	**Silty Clay/Clayey Silt** – Brown, reworked in appearance, trace gravel, generally stiff in consistency.
2	0 – 0.4	**Topsoil** – Approximately 400 millimetres of topsoil
	0.4 – 0.6	**Silty Clay/Clayey Silt** – Brown, reworked in appearance, trace sand and gravel, generally stiff in consistency.
3	0 – 0.35	**Topsoil** – Approximately 300 millimetres of topsoil.
	0.35 – 0.6	**Silty Clay/Clayey Silt** – Brown, reworked in appearance, trace sand and gravel, generally stiff in consistency.
4	0 – 0.4	**Topsoil** – Approximately 400 millimetres of topsoil
	0.4 – 0.8	**Silty Clay/Clayey Silt** – Brown, reworked in appearance, trace sand, generally stiff in consistency.
5	0 – 0.3	**Topsoil** – Approximately 300 millimetres of topsoil.
	0.3 – 0.9	**Silty Clay/Clayey Silt** – Brown, trace sand and gravel, generally stiff in consistency, wet at 0.65 metres.
6	0 – 0.35	**Topsoil** – Approximately 400 millimetres of topsoil
	0.35 – 1.05	**Silty Clay/Clayey Silt**– Brown, trace to some sand, generally stiff in consistency.

It is noted that the upper levels of the silty clay/clayey silt encountered generally had a reworked or weathered appearance, and may be disturbed or fill associated with the construction of the roadway, underground infrastructure, etc., having been subjected to ongoing freeze-thaw cycles and traffic loads. The upper levels of the soil encountered at the test pit locations within the field were also disturbed, likely due to agricultural activities.

Laboratory Soil Classification

Grain size analyses were conducted on selected samples of the native soils recovered from the boreholes. The results of this grain size testing can be found appended to the end of this report, and are summarized as follows:

TABLE D – GRAIN SIZE ANALYSIS

Sample ID	Depth (m)	% Clay	% Silt	% Sand	% Gravel	Estimated Permeability, k [cm/sec]	Estimated Infiltration Rate [mm/hr]
BH5 SS3	2.6	37	41	19	3	10^{-8}	<5
BH9 SS2	1.8	43	37	16	4	10^{-8}	<5

The field and laboratory testing demonstrate the native soils to consist of clay and silt mixtures with some sand and a trace of gravel. According to the Unified Soil Classification System (USCS), the soils are generally classified as M.L. – Inorganic silts and very fine sands, clayey silts with slight plasticity and C.L. – Inorganic clays of low plasticity and M.L. – Inorganic clays of low to medium plasticity, silty clays. These soils have an estimated coefficient of hydraulic conductivity on the order of 10^{-7} to 10^{-8} cm/sec and are considered to be effectively impermeable, not suitable for LID stormwater infiltration systems.

A review of available published information [Quaternary Geology of Ontario, Southern Sheet Map 2556] indicate the native soils to comprise of clayey to silt-textured till to glaciolacustrine deposits of silt and clay with minor sand and gravel. These conditions are consistent with our experience in the area and observations made during drilling.

Groundwater Observations

All of the boreholes were noted to be open and ‘dry’ upon completion of drilling. It is noted that insufficient time would have passed for the static groundwater level to stabilise in the open boreholes. In cohesive soils such as the silty clay/clayey silt encountered, the static groundwater level typically coincides with the transition in colour from brown to grey. Based on observations made during drilling and our experience in the area, the static groundwater level is conservatively estimated at depths of perhaps 3 to 4 metres, fluctuating depending on the season, below the anticipated depths of construction. Regardless, shallower perched deposits of water within permeable seams, as well as from surface runoff should be anticipated, especially during the ‘wet’ times of the year.

4. EXCAVATIONS

Excavations for the installation of underground services are expected to extend to depths of up to about 2 to 3 metres below the existing grade. Excavations through the silty clay/clayey silt would be expected to remain stable at inclinations of up to 45 to 60 degrees to the horizontal for the short construction period. Where wet seams are encountered, during periods of extended precipitation, or where excavations extend below the static ground water level, excavations may locally "slough in" to inclinations of 3 horizontal to 1 vertical, or flatter, especially during the 'wet' times of the year.

Notwithstanding the foregoing, all excavations must comply with the requirements of the current Occupational Health and Safety Act and Regulations for Construction Projects. The silty clay/clayey silt soils encountered would generally be considered Type 2 soils, as outlined in the Ontario Health and Safety Act, Part III – Excavations. Excavations sloped steeper than those required in the Safety Act must be supported and a senior geotechnical engineer from this office should monitor the work.

As noted above, the static groundwater level is anticipated to be below the depths of construction. Regardless, some infiltration of water from more permeable seams, as well as from surface runoff, should be anticipated, especially during the wet times of the year. The rate of infiltration should be sufficiently low that groundwater should be adequately controlled using conventional construction 'dewatering' techniques such as pumping from sumps and ditches. Increased volumes of water should be anticipated when making connections to existing services, or in the event that excavations extend into the cobble layer. Surface water should be directed away from the excavations.

The base of the excavations in the native soils should generally remain firm and stable, even in the event that excavations extend near to slightly below the groundwater level. Regardless, instability may be experienced due to weather conditions, infiltration of water through existing service trenches, permeable seams, etc., or where excavations are left exposed to the elements for extended periods of time. Excavation bases that experience such base instability may require sub-excavation of disturbed soils, additional bedding material or other base stabilisation measures such as the provision of a layer of coarse crushed clear stone 'punched' into the excavation base.

With firm and stable excavation base conditions, stabilised where required, standard pipe bedding material as specified by the Town of West Lincoln or Ontario Provincial Standard Specification [OPSS] should be satisfactory. The bedding should be well compacted to provide sufficient support to the pipes and components (i.e. valve

chambers, manholes etc.), and to minimise settlements of the roadway above the service trenches. Special attention should be paid to compaction under the pipe haunches.

Any utility poles, light poles, etc. located within 3 metres of the top of an excavation slope should be braced to ensure their stability. Likewise, temporary support might be required for other existing above and below ground structures, including existing underground services, depending on their proximity to the trench excavations.

5. BACKFILL CONSIDERATIONS

The excavated soils are anticipated to consist of the granular materials from the pavement structure and silty clay/clayey silt encountered in the boreholes, as described above. The majority of the excavated silty clay/clayey silt soils encountered are generally considered suitable for use as engineered fill, service trench backfill provided that they are free of organics, construction debris, or other deleterious materials, and the moisture content can be controlled within 3 per cent of the material's standard Proctor optimum value. Some selective sorting of the excavated materials should be anticipated to remove any such deleterious materials. Depending on the weather conditions at the time of construction, some moisture conditioning of the excavated materials may be required to achieve adequate compaction in order to minimise long-term settlements. The on-site soils encountered are generally considered to be near to slightly 'dry' of their optimum moisture content. Care should be taken to separate the granular materials from the pavement structure from the silty clay/clayey silt soils encountered, to maintain their respective properties. It may be possible to reuse the granular materials from the existing pavement structure, such as to raise the grade in the area of the proposed realignment, or even as granular sub-base layers within the new pavement structure, however this would be best assessed at the time of construction.

Alternatively, the service trenches may be backfilled with quality imported granular materials, such as an OPSS Granular 'B' Type II (crushed bedrock) or approved equivalent. Such granular materials are less sensitive to moisture conditions and more readily compacted in the often-restricted access areas of service trenches. Any imported fill should have its moisture content within 3 per cent of its optimum moisture content, conform to the project specifications with regards to material type and gradation, and meet the necessary environmental guidelines.

It is noted that where the backfill material is placed and compacted near or slightly above its optimum moisture content the potential for long-term settlement due to ingress of groundwater and collapse of the fill structure is reduced. Correspondingly, the shear strength of the 'wet' backfill material is also lowered, thereby reducing its ability to support construction traffic and therefore impacting roadway construction. If the soil is well dry of its optimum value, it will appear to be very strong when compacted, but will tend to settle with time as the moisture content in the fill increases to equilibrium condition. Therefore, it is very important that the moisture content of the fill at the time of placement and compaction is within three per cent of its standard Proctor optimum moisture content. Any imported fill required in service trenches or to raise the subgrade elevation should exhibit respective moisture contents within three per cent of its optimum moisture content and meet the necessary environmental guidelines.

The backfill should be placed in loose lifts not exceeding 300 millimetres to a minimum of 98 per cent of its standard Proctor maximum dry density [SPMDD], and should be compacted with the heaviest possible equipment that will not damage the underlying service pipe. Compaction should be achieved with the appropriate equipment for the fill soil type, using a pad toe ("sheepsfoot") roller in cohesive soils and a smooth drum roller or vibratory plate for granular soils.

A representative of SOIL-MAT should be retained to monitor the backfilling and compaction operations to confirm uniform compaction of the backfill material to project specification requirements. Close supervision is prudent in areas that are not readily accessible to compaction equipment, for instance near the end of compaction 'runs'. A method should be developed to assess compaction efficiency employing the on-site compaction equipment and backfill materials during construction.

6. PAVEMENT RECONSTRUCTION CONSIDERATIONS

It is understood that the existing roadway surface will be reconstructed as part of the intersection improvements, and new pavement structure provided in the area of the realignment upon raising the grade. The existing pavement surface exhibited occasional to frequent signs of longitudinal, transverse, and alligator cracking, rutting, and potholes, suggesting areas of potential subgrade failure and/or age related distress, consistent with the relatively limited depth of granular material encountered, with Clayson Road and Thirty Road being in generally worse condition than Young Street.

Given the conditions of the roadway and observed granular depths, a full depth reconstruction should be considered, especially along Thirty Road and Clayson Road where signs of subgrade failure were evident. A partial depth reconstruction may also be considered if the grade is able to be raised with additional granular material, which may be preferred along Young Street where the road condition was generally better than Thirty Road and Clayson Road. It is noted that a partial depth reconstruction is expected to have a reduced lifespan and higher maintenance costs with a lower initial cost, and would not allow for removal of any unsuitable subgrade materials which may be present, where a full depth reconstruction would have a higher initial cost, with reduced maintenance requirements, and would allow for the repair/removal of unsuitable subgrade soils.

PARTIAL DEPTH RECONSTRUCTION

Partial depth reconstruction of the pavement structure would consist of a 'peel and pave' or 'pulverised and pave' method. A 'peel and pave' approach would involve complete removal of the existing asphalt layers, re-grading, and compaction of the existing granular base material. A 'pulverise and pave' approach would include the pulverisation of existing asphalt materials, combining it with the underlying granular materials. Similarly, the road would be re-graded and new granular base materials would be placed and compacted. Given the relatively deep asphalt thickness, a specialty contractor should be consulted regarding the feasibility of pulverising the asphalt. The new asphaltic concrete layers would then be placed at the surface.

The addition of granular materials would increase the granular depth, and therefore improve the stability and lifespan of the new pavement structure. It is recommended that a minimum of 600 millimetres of granular base be provided, consistent with a typical heavy duty pavement structure, based on the conditions encountered and anticipated traffic loads. The existing and any additional granular base materials to be added during reconstruction should be compacted to a minimum of 98 per cent of their standard Proctor maximum dry density [SPMDD].

The new asphalt layers should be compacted to a minimum of 92 per cent of their Marshall maximum density [MRD]. Considering a minimum of 600 millimetres of granular base materials, a typical heavy duty pavement structure to support vehicles such as cars, larger trucks, emergency vehicles, etc. for the anticipated use of the roadway would consist of the following, at a minimum:

SP12.5 asphalt surface course	40 millimetres
SP19 asphalt binder course	80 millimetres

The outlined partial depth pavement reconstruction may be expected to have an approximate lifetime of 10 to 15 years, assuming that regular maintenance is performed.

FULL DEPTH RECONSTRUCTION

A full depth reconstruction would consist of the complete removal of existing asphalt layers and granular base materials to the proposed subgrade elevation. This approach would provide a full depth of granular base material, which therein increases the lifespan of the pavement structure. Additionally, the existing grade of the roadway would be maintained, where raising the grade is not feasible. The existing asphaltic concrete could be pulverised into a well-graded granular product which would be reused within the sub-base course material, depending on its gradation. Laboratory sieve analyses would be required to assess the suitability of the crushed granular material for the project. The subgrade level would be lowered where needed in order to accommodate the full depths of the new pavement structure and finished grade.

The exposed subgrade should be cleared of any organic or otherwise unsuitable materials, and then proofrolled with 3 to 4 passes of a fully loaded tandem axle dump truck in the presence of a representative of SOIL-MAT prior to the placement of the sub-base material. Areas of visible distress revealed during this process or by any other means, should be sub-excavated and then replaced with suitable backfill material such as available on-site granular materials (i.e., pulverised asphaltic concrete, recycled granular material, etc.) or imported OPSS Granular ‘B’, Type II (crushed limestone bedrock) or approved alternative, compacted to a minimum of 98 per cent of its SPMDD. Alternatively, the soft areas may be repaired by ‘punching’ coarse aggregate such as 50-millimetre clear crushed stone or rip rap, into the soft areas. In severe cases, the use of a stabilising geograid and/or geofabric separator may be warranted. The need for sub-excavation or stabilisation of softened subgrade materials will be reduced if the construction is undertaken during the dry summer months of the year.

Good drainage provisions will optimise the long-term performance of the pavement structure. The subgrade must be properly crowned and shaped to promote drainage to the subdrain system. Subdrains should be installed to intercept excess subsurface water, and to prevent the softening of the subgrade material. Subdrains would typically consist of a minimum 100-millimetre diameter perforated plastic pipe encased in a geofabic ‘sock’. Surface water should not be allowed to pond adjacent to the outer limits of the paved areas.

The proposed new pavement structure, including any driveway aprons which are to be reconstructed as part of the project, should conform to the appropriate Town of West Lincoln Standard for the applicable roadway/driveway section. Alternatively, a typical heavy pavement structure to support vehicles such as cars, large trucks, emergency vehicles, etc. for the anticipated use would consist of a minimum of:

SP12.5 asphalt surface course	40 millimetres
SP19 asphalt binder course	80 millimetres
Base course granular [OPSS Granular 'A']	150 millimetres
Sub-base course granular [OPSS Granular 'B', Type II]	450 millimetres

It is our opinion that this design is suitable for use on the subject roadway, provided that the subgrade has been prepared as detailed above before any sub-base material is placed. If the subgrade is soft, remedial measures as discussed previously should be implemented, and/or the sub-base thickness should be increased. The granular sub-base and base courses should be compacted to a minimum of 98 per cent of their SPMDD, and the asphaltic concrete layers should be compacted to a minimum of 92 per cent of their MRD. A program of in-place density testing must be undertaken to monitor that the compaction requirements are being met.

The outlined full depth pavement reconstruction may be expected to have an approximate 20-year lifespan, assuming that regular maintenance is performed. Should a more detailed pavement structure design be required, site specific traffic information would be needed, together with detailed laboratory testing of the subgrade soils.

In the event that a concrete apron is provided at the roundabout, a typical heavy duty concrete pavement structure would consist of a minimum of the following:

Concrete	200 millimetres
Base course granular [OPSS Granular 'A']	150 millimetres
Sub-base course granular [OPSS Granular 'B', Type II]	300 millimetres

It is reiterated that where the pavement structure is to be assumed by the Town of West Lincoln, it should conform to the applicable Town standard.

GENERAL ASPHALT PLACEMENT CONDITIONS

To minimise segregation of the finished asphalt mat, the asphalt temperature must be maintained uniform throughout the mat during placement and compaction. All too often, significant temperature gradients exist in the delivered and placed asphalt with the cooler portions of the mat resisting compaction and presenting a honey combed surface. As the spreader moves forward, a responsible member of the paving crew should

monitor the pavement surface, to ensure a smooth uniform surface. Surface segregation can be mitigated by 'back-casting' or scattering shovels of the full mix material over the segregated areas and raking out the coarse particles during compaction operations. Of course, the above assumes that the asphalt mix is sufficiently hot to allow the 'back-casting' to be performed.

Where the road is to be widened/realigned, all organic or otherwise unsuitable materials from within the new road alignment should be removed, and the exposed subgrade well compacted and proof-rolled with a fully loaded tandem-axle truck in the presence of a representative of SOIL-MAT ENGINEERS. Any 'soft spots' delineated by this work should be sub-excavated prior to raising the grade to the design subgrade elevation. Granular fill would be preferred for such grading work, as this material is more readily compacted in areas of restricted access, and generally provides a more uniform support condition for the proposed roadway. It should be possible to make use of the granular materials within the existing roadway for such an application, however this would be best assessed at the time of construction.

7. GENERAL COMMENTS

The comments provided in this document are intended only for the guidance of the design team. The material in it reflects SOIL-MAT ENGINEERS' best judgement in light of the information available to it at the time of preparation. The subsurface descriptions and borehole information are intended to describe conditions at the borehole locations only. It is the contractors' responsibility to determine how these conditions will affect the scheduling and methods of construction for the project. 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. SOIL-MAT ENGINEERS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

We trust that this geotechnical report is sufficient for your present requirements. Should you require any additional information or clarification as to the contents of this document, please do not hesitate to contact the undersigned.

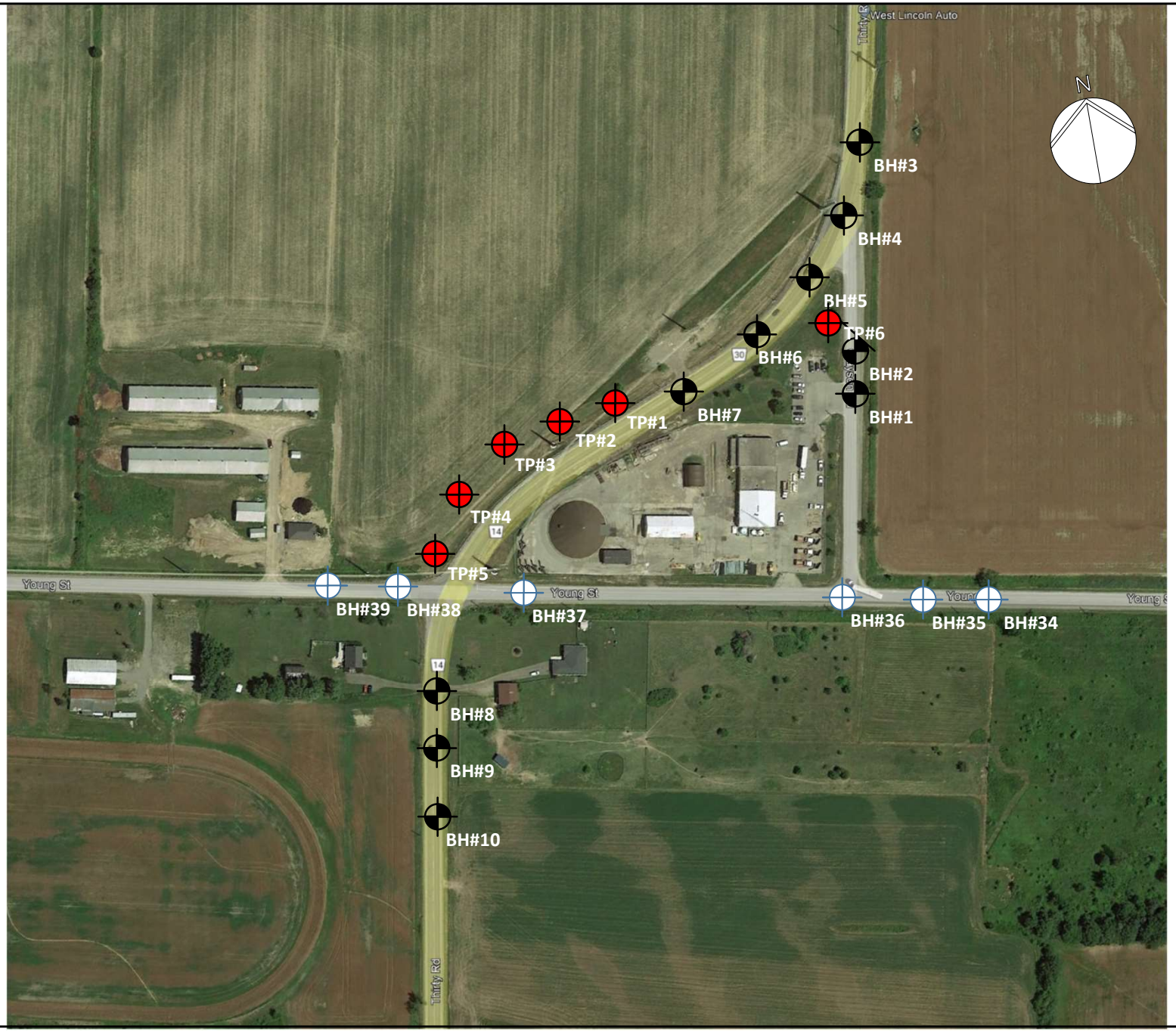
Yours very truly,
SOIL-MAT ENGINEERS & CONSULTANTS LTD.

Malcolm Green, B.Tech.
Junior Engineer

Kyle Richardson, P.Eng.
Project Engineer

Enclosures: Drawing No. 1, Borehole Location Plan
Logs of Boreholes Nos. 1 to 10, inclusive
Logs of Borehole Nos. 34 to 39 from Inspec Sol

Distribution: RV Anderson [pdf]



LEGEND

- BH# — Soil-Mat Borehole Location
- BH# — Inspec Sol Borehole Location
- TP# — Soil-Mat Test Pit Location

NOTES

1. This drawing should be read in conjunction with SOIL-MAT ENGINEERS & CONSULTANTS LTD. Report No. SM 220432-G

2. Borehole locations are approximate.

SOIL-MAT

ENGINEERS & CONSULTANTS LTD.

Proposed Intersection Improvement
Thirty Rd and Young St
West Lincoln, Ontario

Borehole Location Plan

Project No. SM 220432-G

Date: March 2024

Drawn: MG

Checked: KR

Drawing No. 1

Log of Borehole No. 1

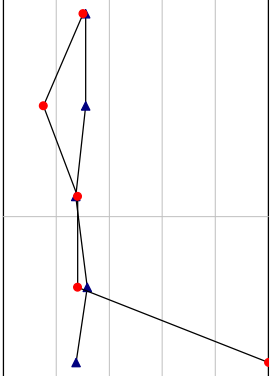
Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775120
E: 619148

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.30	**Pavement Structure** Aproximately 75 millimetres of asphaltic concrete overlying 225 millimetres of compact granular base.		SS	1	45,20,10,11	30			
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, trace sand in the upper levels, very stiff.		SS	2	11,7,8,12	15		>4.5	
7 / 2				SS	3	8,14,14,18	28		>4.5	
9 / 3				SS	4	8,14,14,26	28		>4.5	
10 / 3	-3.10	End of Borehole Auger Refusal		SS	5	50+	50+			

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 27, 2024 to auger refusal at a depth of 3.1 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 27, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

Soil-Mat Engineers & Consultants Ltd.
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www.soil-mat.ca · E: info@soil-mat.ca

Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 2

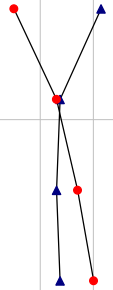
Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775155
E: 619154

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.30	**Pavement Structure** Aproximately 100 millimetres of asphaltic concrete overlying 200 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, stiff to hard.		SS	1	6,5,5,6	10		>4.5	
7 / 2				SS	2	8,13,13,21	26		>4.5	
10 / 3				SS	3	7,17,17,42	34		>4.5	
11 / 3				SS	4	10,18,22,31	40			
12 / 4	-3.70	End of Borehole								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 27, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 27, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 3

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775265
E: 619179

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.30	**Pavement Structure** Aproximately 250 millimetres of asphaltic concrete overlying 250 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace to some gravel increasing with depth, stiff.		SS	1	3,4,6,9	10		4.5	
6 / 2				SS	2	3,7,8,13	15		4.5	
9 / 3				SS	3	7,7,7,6	14		4.0	
11 / 3				SS	4	2,3,8,10	11		>4.5	
12 / 4	-3.70	End of Borehole Auger Refusal								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to auger refusal at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 4

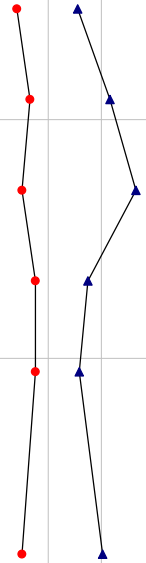
Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775229
E: 619165

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0–2 / 0–0.6	-0.40	**Pavement Structure** Aproximately 225 millimetres of asphaltic concrete overlying 175 millimetres of compact granular base.								
2–11 / 0.6–3.3		**Silty Clay/Clayey Silt** Brown, trace gravel, increasing in clay content with depth, stiff.		SS	1	2,3,5,8	8			
				SS	2	2,5,8,12	13		>4.5	
				SS	3	2,4,6,10	10		4.5	
	-3.30	Transition to grey in colour.		SS	4	2,7,8,10	15		>4.5	
11–19 / 3.3–6.0				SS	5	6,6,9,13	15		4.0	
				SS	6	2,4,6,7	10		3.5	
	-6.00	End of Borehole								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 6.0 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 5

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775195
E: 619134

Depth (ft / m)	Elevation (m)	Symbol	Description	Well Data	SAMPLE Type	SAMPLE Number	SAMPLE Blow Counts	SAMPLE Blows/300mm	SAMPLE Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00		Ground Surface								
0–1 / 0	-0.40		**Pavement Structure** Aproximately 250 millimetres of asphaltic concrete overlying 175 millimetres of compact granular base.								
1–3 / 1			**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, increasing in clay content with depth, stiff to hard.		SS	1	2,4,5,11	9		>4.5	
4–7 / 2					SS	2	4,8,12,16	20		>4.5	
8–10 / 3					SS	3	4,8,13,20	21		>4.5	
11 / 3	-3.70				SS	4	12,19,20,37	39		2.5	
12 / 4			End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

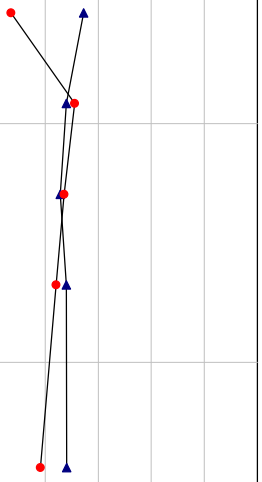
Log of Borehole No. 6

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775179
E: 619103

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0–2 / 0–0.4	-0.40	**Pavement Structure** Aproximately 225 millimetres of asphaltic concrete overlying 175 millimetres of compact granular base.								
2–12 / 0.4–3.8		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace to some gravel increasing with depth, increasing in silt content with depth, stiff to very stiff.		SS	1	2,3,4,7	7		4.5	
				SS	2	12,15,16,16	31		>4.5	
				SS	3	10,12,15,23	27		>4.5	
				SS	4	5,9,15,20	24		>4.5	
12 / 3.8	-3.80	Transition to grey in colour.								
16–17 / 5	-5.20	End of Borehole		SS	5	4,10,8,26	18		3.5	

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 5.2 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 7

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775160
E: 619053

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.40	**Pavement Structure** Aproximately 200 millimetres of asphaltic concrete overlying 225 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, increasing in silt content with depth, stiff to hard.		SS	1	4,6,8,12	14		>4.5	
6 / 2				SS	2	4,8,9,18	17		>4.5	
9 / 3				SS	3	4,11,16,21	27		>4.5	
11 / 3	-3.70			SS	4	7,18,20,35	38		4.0	
12 / 4		End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 8

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775038
E: 618895

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
	-0.50	**Pavement Structure** Aproximately 275 millimetres of asphaltic concrete overlying 200 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace to some gravel in the lower levels, stiff to hard.		SS	1	4,2,5,10	7		2.5	
6 / 2				SS	2	3,8,13,16	21		>4.5	
9 / 3				SS	3	5,12,16,25	28		4.0	
11 / 3.5				SS	4	10,16,20,24	36		>4.5	
12 / 4	-3.70	End of Borehole								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)

NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

Log of Borehole No. 9

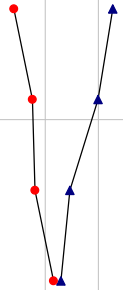
Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4775016
E: 618890

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.30	**Pavement Structure** Aproximately 150 millimetres of asphaltic concrete overlying 200 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, stiff to very stiff.		SS	1	3,3,5,9	8		2.5	
6 / 2				SS	2	5,5,10,15	15		4.5	
9 / 3				SS	3	5,5,11,16	16		>4.5	
11 / 3				SS	4	4,10,13,20	23		>4.5	
12 / 4	-3.70	End of Borehole								

Moisture Content w% (10 20 30 40)

Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
Checked by: KR
Sheet: 1 of 1

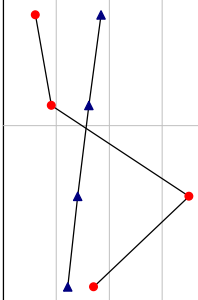
Log of Borehole No. 10

Project No: SM 220432-G
Project: Proposed Intersection Improvements
Location: West Lincoln, On
Client: RV Anderson

Project Manager: Kyle Richardson, P.Eng.
Borehole Location: See Drawing No. 1
UTM Coordinates - N: 4774987
E: 618877

Depth (ft / m)	Elevation (m)	Description	Well Data	SAMPLE Type	Number	Blow Counts	Blows/300mm	Recovery	PP (kgf/cm2)	U.Wt.(kN/m3)
0 / 0	0.00	Ground Surface								
0 / 0	-0.30	**Pavement Structure** Aproximately 150 millimetres of asphaltic concrete overlying 200 millimetres of compact granular base.								
3 / 1		**Silty Clay/Clayey Silt** Brown, weathered appearance in the upper levels, trace gravel, stiff to hard.		SS	1	4,6,6,8	12		>4.5	
7 / 2				SS	2	6,8,10,13	18		>4.5	
10 / 3				SS	3	14,32,38,40	70		>4.5	
11 / 3				SS	4	14,16,18,21	34		>4.5	
12 / 4	-3.70	End of Borehole								

Moisture Content w% (10 20 30 40)
Standard Penetration Test blows/300mm (20 40 60 80)



NOTES:

1. Borehole was advanced using solid stem auger equipment on February 28, 2024 to termination at a depth of 3.7 metres.

2. Borehole was recorded as open and 'dry' upon completion and backfilled as per Ontario Regulation 903.

3. Soil samples will be discarded after 3 months unless otherwise directed by our client.

Drill Method: Solid Stem Auger
Drill Date: February 28, 2024
Hole Size: 150 Millimetres
Drilling Contractor: Landshark Drilling

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Datum: Road Elevation
Field Logged by: MG
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Sheet: 1 of 1

REFERENCE No.: T060074-A1 ENCLOSURE No.: 34

INSPEC-SOL

BOREHOLE No.: BH34

ELEVATION: 194.97 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA

PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN

LOCATION: SMITHVILLE, ONTARIO

DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO

DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

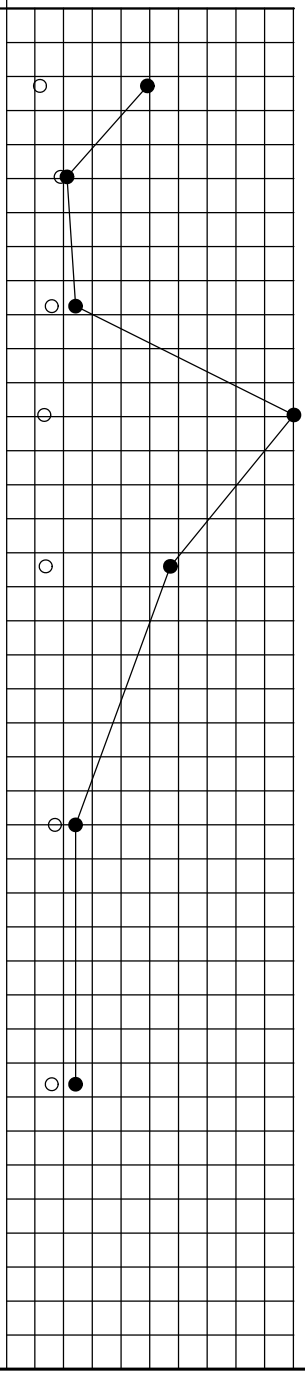
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		194.97		GROUND SURFACE						
	0.08	194.89		ASPHALT : 75 mm						
1				GRANULAR BASE : 325 mm						
	0.41	194.56		CRUSHER RUN LIMESTONE, grey						
2				NATIVE : SILTY CLAY, trace to some sand and gravel, brown, very stiff		SS-1	94	12	30-26-23-9	49
3	1.0					SS-2	61	19	5-8-13	21
4										
5						SS-3	92	16	7-9-15	24
6										
7	2.0									
	2.29	192.68								
8	2.44	192.53		SILTY CLAY TILL, trace to some sand and gravel, brown, moist, hard		SS-4	100	13	11-50/ 50mm	100
9				Probable cobble/boulders						
10	3.0									
11						SS-5	89	14	13-18-39	57
12										
13	4.0									
14										
15	4.57	190.40		SILTY CLAY, trace to some sand and gravel, brown, moist, very stiff		SS-6	100	17	7-10-14	24
16										
	5.0									
17										
18										
19										
	6.0									
20	6.10	188.87		Greyish brown		SS-7	100	16	6-11-13	24
21										
	6.55	188.42								
22				**END OF BORE HOLE**						
23	7.0			NOTE : End of Borehole at 6.55 m depth Borehole remained open and dry on completion						
24										
25										
26										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12

REFERENCE No.: T060074-A1 ENCLOSURE No.: 35

INSPEC-SOL

BOREHOLE No.: BH35

ELEVATION: 195.77 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA

PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN

LOCATION: SMITHVILLE, ONTARIO

DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO

DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth Feet	Depth Metres	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		195.77		GROUND SURFACE						
	0.08	195.69		ASPHALT : 75 mm						
				GRANULAR BASE : 325 mm						
	0.41	195.36		CRUSHER RUN LIMESTONE, grey						
				NATIVE : SILTY CLAY, trace to some sand and gravel, brown, very stiff		SS-1	87	15	30-30-24-11	54
	1.0					SS-2	50	12	9-11-13	24
	1.52	194.25		Hard		SS-3	72	14	8-13-18	31
	2.0									
						SS-4	67	15	15-32-28	60
	2.74	193.03		Probable cobble/boulders						
	3.0					SS-5	89	14	10-18-34	52
	4.0									
	4.57	191.20		Very stiff to stiff		SS-6	89	15	10-11-14	25
	5.0									
	6.0					SS-7	100	27	5-7-10	17
	6.55	189.22		**END OF BORE HOLE**						
	7.0			NOTE : End of Borehole at 6.55 m depth Borehole remained open and dry on completion						

Shear test (Cu) △ Field
Sensitivity (S) □ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90

SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12

REFERENCE No.: T060074-A1 ENCLOSURE No.: 36

INSPEC-SOL

BOREHOLE No.: BH36

ELEVATION: 196.50 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA

PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN

LOCATION: SMITHVILLE, ONTARIO

DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO

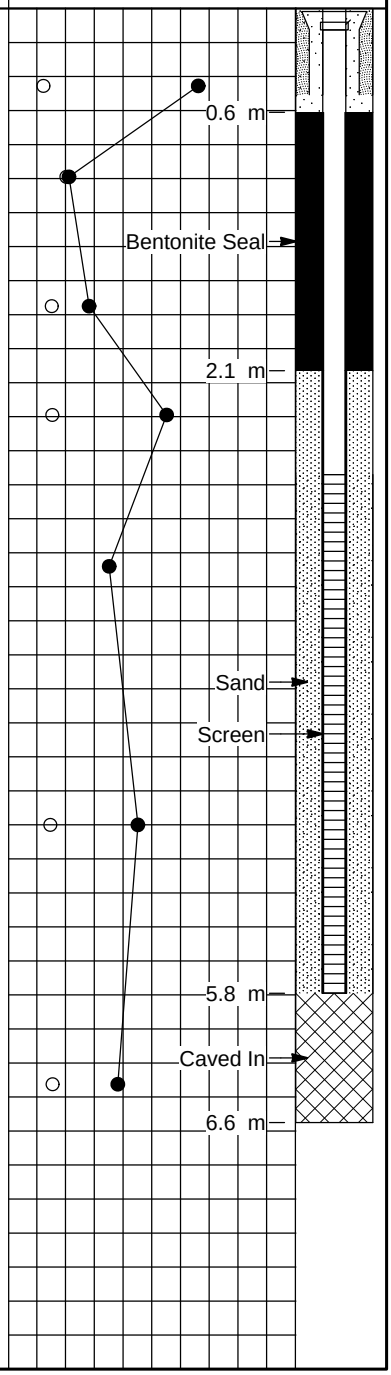
DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		196.50		GROUND SURFACE						
	0.08	196.42		ASPHALT : 75 mm						
				GRANULAR BASE : 300 mm						
	0.38	196.12		CRUSHER RUN LIMESTONE, grey						
	0.43	196.07		GRANULAR MATERIAL with ASPHALT fragments : 50 mm		SS-1	75	12	35-16-50-16	66
	1.0			NATIVE : SILTY CLAY, trace to some sand and gravel, brown, very stiff		SS-2	55	20	10-10-11	21
						SS-3	83	15	10-13-15	28
	2.0									
	2.29	194.21		Hard		SS-4	83	15	18-30-25	55
	3.0					SS-5	89	--	12-14-21	35
	4.0									
						SS-6	83	15	9-20-25	45
	5.0									
	6.0									
	6.10	190.40		Greyish brown		SS-7	55	15	8-17-21	38
	6.55	189.95								
	7.0			**END OF BORE HOLE**						

NOTE :
End of Borehole at 6.55 m depth
Borehole remained dry on completion
Borehole caved to 5.79 m depth
A 50 mm dia Monitoring well installed at 7.62 m depth in the sampled borehole



SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12

REFERENCE No.: T060074-A1 ENCLOSURE No.: 37

INSPEC-SOL

BOREHOLE No.: BH37

ELEVATION: 196.57 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA

PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN

LOCATION: SMITHVILLE, ONTARIO

DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO

DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

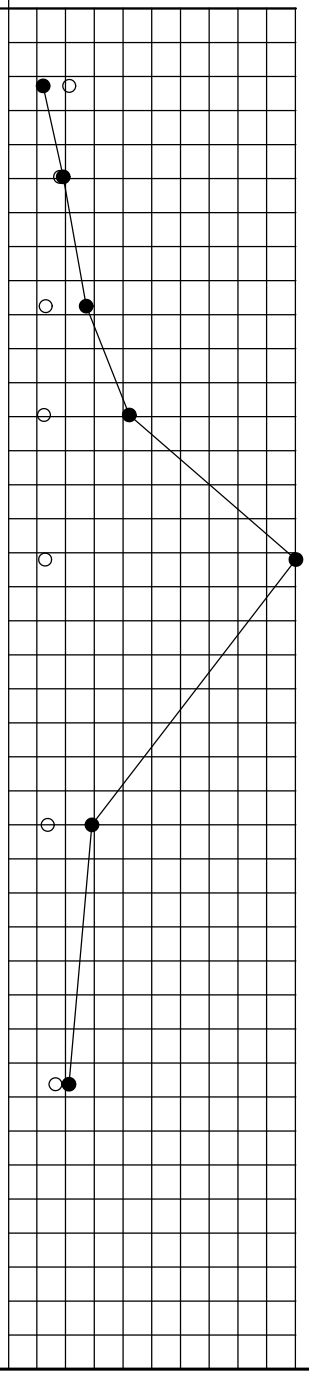
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		196.57		GROUND SURFACE						
	0.08	196.49		ASPHALT : 75 mm						
	0.23	196.34		GRANULAR BASE : 150 mm CRUSHER RUN LIMESTONE, grey						
	0.46	196.11		SURFACE TREATMENT : 225 mm		SS-1	67	21	27-8-4-7	12
				NATIVE : SILTY CLAY, trace to some sand and gravel, brown, very stiff		SS-2	44	18	4-7-12	19
	1.0					SS-3	78	13	7-13-14	27
	2.0									
	2.29	194.28		Hard		SS-4	67	12	12-19-23	42
	3.0					SS-5	89	13	18-32-50/ 75mm	100
	4.0									
	4.57	192.00		Greyish brown, very stiff		SS-6	89	14	12-13-16	29
	5.0									
	6.0					SS-7	67	16	5-9-12	21
	6.55	190.02		**END OF BORE HOLE**						
	7.0			NOTE : End of Borehole at 6.55 m depth Borehole remained open and dry on completion						

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12

REFERENCE No.: T060074-A1 ENCLOSURE No.: 38

INSPEC-SOL

BOREHOLE No.: BH38

ELEVATION: 196.40 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA

PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN

LOCATION: SMITHVILLE, ONTARIO

DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO

DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

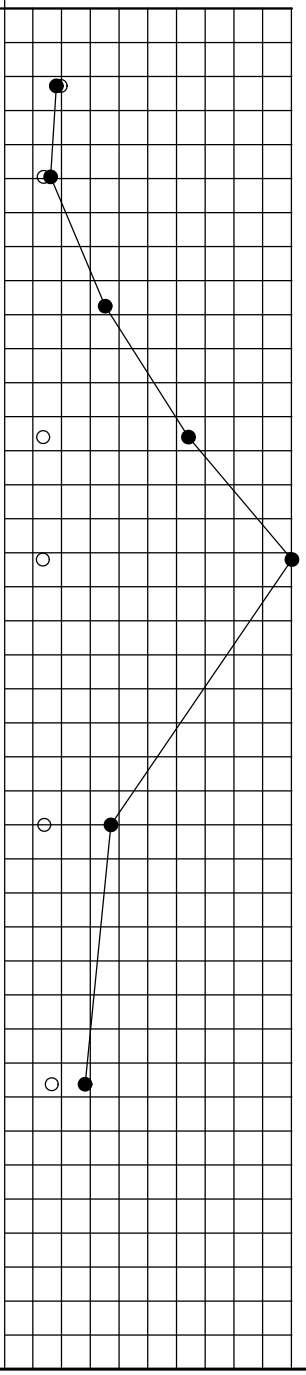
LEGEND

- SS - SPLIT SPOON
- ST - SHELBY TUBE
- AU - AUGER PROBE
- ▼ - WATER LEVEL

Depth (Feet)	Depth (Metres)	Elevation (m)	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetraion Index N
		196.40		GROUND SURFACE						
	0.10	196.30		ASPHALT : 100 mm						
				GRANULAR BASE : 300 mm						
	0.40	196.00		CRUSHER RUN LIMESTONE, grey						
				NATIVE : SILTY CLAY, trace to some sand and gravel, brown, stiff to hard		SS-1	83	20	15-11-7-5	18
	1.0					SS-2	100	14	6-6-10	16
						SS-3	94	--	6-13-22	35
	2.0					SS-4	100	13	10-22-42	64
	3.0					SS-5	73	13	15-27-50/ 75mm	100
	4.0									
	5.0					SS-6	89	14	10-15-22	37
	6.0									
	6.10	190.30		Very stiff		SS-7	89	16	8-11-17	28
	6.55	189.85		**END OF BORE HOLE**						
	7.0			NOTE : End of Borehole at 6.55 m depth Borehole remained open and dry on completion						

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12

REFERENCE No.: T060074-A1 ENCLOSURE No.: 39

iNSPEC·SOL

BOREHOLE No.: BH39
ELEVATION: 196.38 m

BOREHOLE REPORT

Page: 1 of 1

CLIENT: REGIONAL MUNICIPALITY OF NIAGARA
PROJECT: GEOTECHNICAL INVESTIGATION - SMITHVILLE SPS AND FORCEMAIN
LOCATION: SMITHVILLE, ONTARIO
DESCRIBED BY: C. JEAUROND CHECKED BY: D. ADEYEMO
DATE (START): June 12, 2012 DATE (FINISH): June 12, 2012

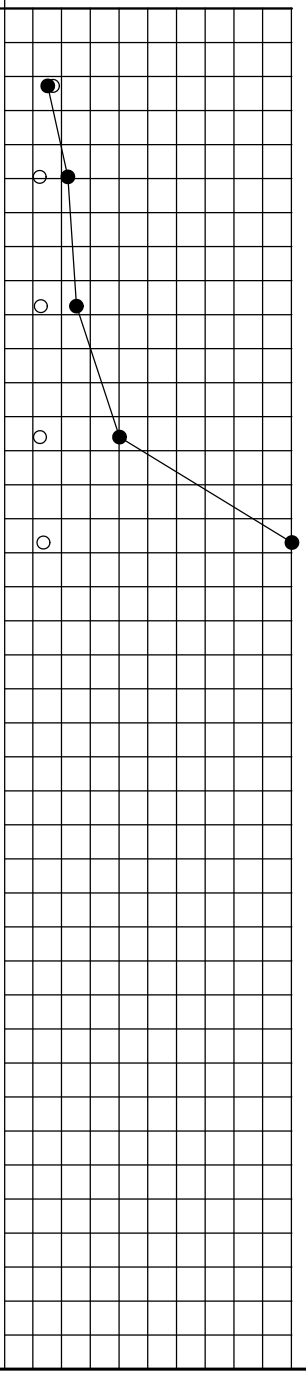
LEGEND

- PQ - PQ size continue coring
- ST - SHELBY TUBE
- RC - ROCK CORE
- ▼ - WATER LEVEL

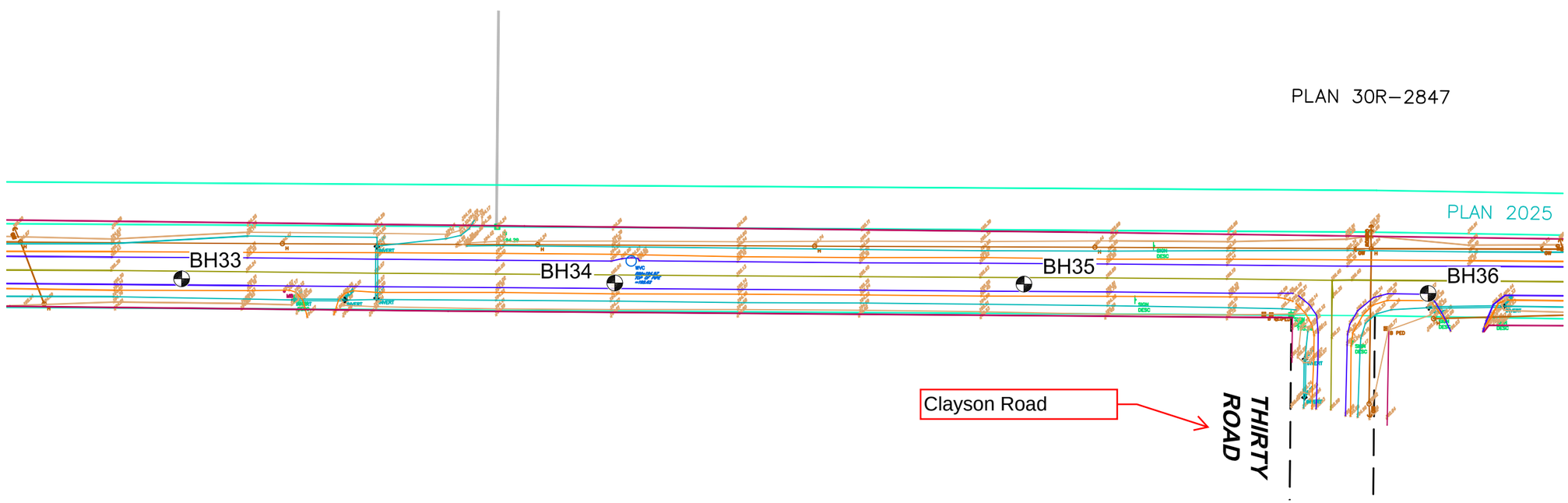
Depth (bgs) Feet	Depth (bgs) Metres	Elevation (m) 196.38	Stratigraphy	DESCRIPTION OF SOIL AND BEDROCK	State	Type and Number	Recovery %	Moisture Content	Blows per 6 in. / 15 cm or RQD	Penetration Index N
				GROUND SURFACE						
	0.10	196.28		ASPHALT : 100 mm						
1	0.35	196.03		GRANULAR BASE : 250 mm CRUSHER RUN LIMESTONE, grey						
2				NATIVE : SILTY CLAY, trace to some sand and gravel, cobble pieces, brown, very stiff		SS-1	92	17	12-10-5-6	15
3	1.0					SS-2	39	12	3-8-14	22
4										
5						SS-3	78	13	9-10-15	25
6	2.0									
7						SS-4	78	12	12-17-23	40
8										
9										
10	3.0	193.33				SS-5	86	14	10-50/ 25mm	100
	3.05			Cobble/boulders						
	3.23	193.15		BEDROCK (LIMESTONE/DOLOSTONE), weathered, medium strong, light grey		RUN-1	86	--	20% Very Poor	2 2 4
13	3.96 4.0	192.42		CLAY						
14						SS-6		--		--
15										
	4.72	191.66								
16				**END OF BORE HOLE**						
	5.0			NOTE : End of Borehole at 3.23 m depth due to Bedrock Borehole remained open and dry on completion Rock coring from 3.23 m depth Clay layer from 3.96 m depth						
19										
20	6.0									
21										
22										
23	7.0									
24										
25										
26										

Shear test (Cu) △ Field
Sensitivity (S) ☐ Lab
○ Water content (%)
W_p W_l Atterberg limits (%)
● "N" Value (blows / 12 in.-30 cm)

10 20 30 40 50 60 70 80 90



SOIL LOG WITH GRAPH+WELL T060074.GPJ INSPEC_SOL.GDT 8/2/12



SOURCE:
Niagara Region Public Works
Consultant File No : 11-37
Dated : January, 2012

Scale
Horizontal - 1:500
Vertical - 1:50

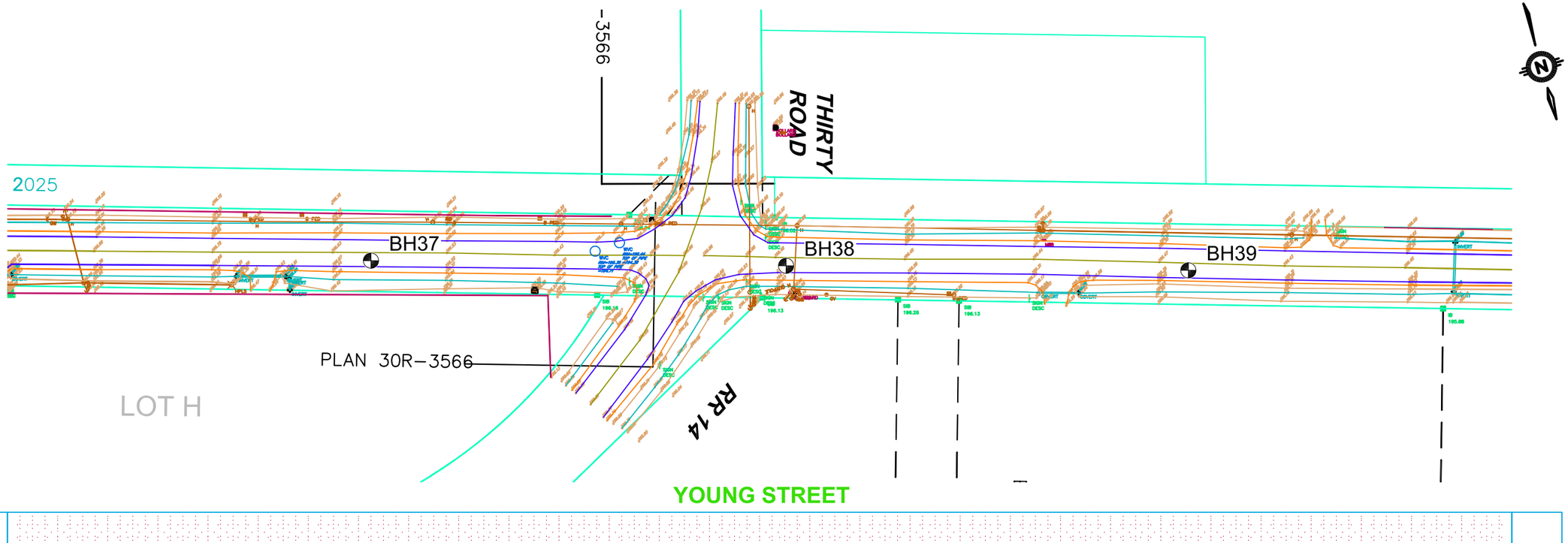
LEGEND :
BOREHOLE LOCATION ⊕ BH

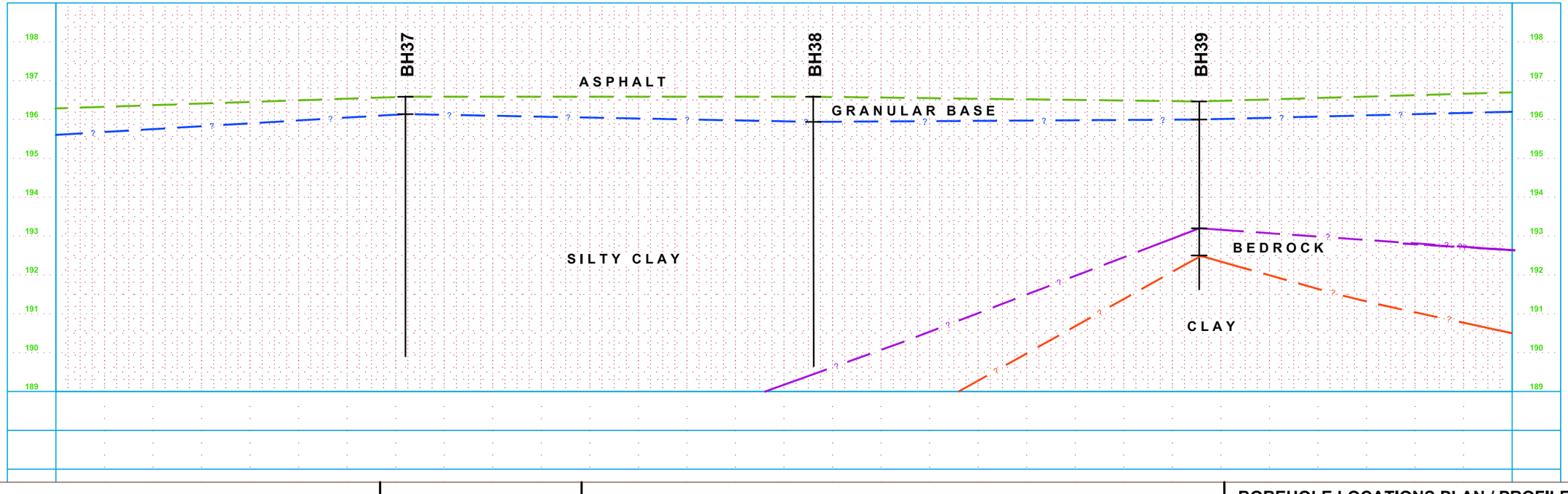
iNSPEC·SOL

SMITHVILLE SEWAGE PUMPING STATION UPGRADE
REGIONAL ROAD 20, INDUSTRIAL PARK ROAD, YOUNG STREET,
SOUTH GRIMSBY ROAD 6 AND PARK ROAD
TOWNSHIP OF WEST LINCOLN

BOREHOLE LOCATIONS PLAN / PROFILE

DRAWN BY: S.F.T.	SCALE: AS SHOWN	REFERENCE NO.: T060074-A1
CHECKED BY: D.A.	DATE: JUNE, 2012	FIGURE NO.: Drawing 12





SOURCE:
Niagara Region Public Works
Consultant File No : 11-37
Dated : January, 2012

Scale
Horizontal - 1:500
Vertical - 1:50

LEGEND :
BOREHOLE LOCATION ◓ BH

iNSPEC·SOL

SMITHVILLE SEWAGE PUMPING STATION UPGRADE
REGIONAL ROAD 20, INDUSTRIAL PARK ROAD, YOUNG STREET,
SOUTH GRIMSBY ROAD 6 AND PARK ROAD
TOWNSHIP OF WEST LINCOLN

BOREHOLE LOCATIONS PLAN / PROFILE

DRAWN BY: S.F.T.	SCALE: AS SHOWN	REFERENCE NO.: T060074-A1
CHECKED BY: D.A.	DATE: JUNE, 2012	FIGURE NO.: Drawing 13