January 18, 2021
Reference Number: T20828-1

Mattamy Development Corporation
433 Steeles Ave. E., Suite #110
Milton, Ontario
L9T 8Z4

Attention: **Mr. Ryan Oosterhoff**

Subject: **Test Pit Investigation on the North Parcel**
Proposed Residential Development
Erin Property
5520 8th Line, Erin, Ontario

Dear Mr. Oosterhoff,

As requested, Shad & Associates Inc. has carried out a test pit investigation on the north part of the above captioned property, as shown in Figure 1. We wish to note that a test pit investigation was previously carried out on the southern portion of the site and our findings together with recommendation were provided via Shad Report T20828 dated November 9, 2020. Based on the preliminary information provided to us, we understand that the site is being considered for potential purchase and may be developed for residential purposes. We have assumed the development to consist of two storey structures with one level of basement and associated underground services and a stormwater management pond.

The purpose of the test pit investigation was to obtain some general information about the existing subsurface conditions at the site by means of excavating some test pits, and based on the findings, to make some preliminary recommendations pertaining to site grading and design at the site.

It should be noted that the exact design details were not available at the time of preparation of this test pit report. We recommend that once the project details are known, we should be given the opportunity to review the details to ensure that the provided recommendations are applicable as well as to provide supplementary recommendations by carrying out a detailed geotechnical borehole investigation at the entire site.

This report contains the findings of our test pit investigation. The comments made in this report are based on factual information and are intended only for use by the design engineers.

We recommend on-going liaison with Shad & Associates Inc. during the design and construction phases of the project in order to ensure that the subsurface conditions encountered are as per the findings in this report. Also, any queries concerning the geotechnical aspects of the proposed project should be directed to Shad & Associates Inc. for further elaboration and/or clarification.

INVESTIGATION PROCEDURES

The fieldwork was performed on January 12, 2021 and consisted of excavating and sampling twelve test pits down to depths ranging from about 4.1 to 5.0 m below the existing ground surface. The test pit locations were staked out on site by Dekay Construction (1987) Limited who also provided us with their geodetic ground surface elevations. The approximate test pit locations are shown in Figure 2.

The test pits were excavated with a track-mounted excavator (CAT 394F supplied by DeKay) under the supervision of an experienced Geotechnical Engineer from our office. The test pits were at least 2 m wide and 5 to 6 m long. The soils within the test pits were inspected and assessed by carrying out visual and tactile examinations as well as by probing with a steel rod. Occasional field density and moisture content tests were also performed at higher elevations using a Nuclear Densometer Gauge. The findings are summarized in Table 1 and the photographs taken during the test pitting operation are presented in Enclosure A.

SUB-SURFACE CONDITIONS

Based on the subsurface conditions encountered within the test pits, the site is predominantly underlain by a surficial 0.2 to 0.4 m thick topsoil and occasional silty sand to silty sand fill, overlying an organic stained silty sand with some gravel that extended down to depths ranging from approximately 0.4 to 1.5 m below existing ground surface. These were predominantly underlain by a silty sand till with occasional silt, sand and gravel and/or silty sand to sandy silt seams/interbeddings, extending down to the completion of all test pits at 4.1 to 5.0 m below existing grade.

Occasional field density and natural moisture content tests were performed within the predominant silty sand till and the results are summarised below:

Bulk Unit Weight:	2011 to 2250 kN/m^3
Natural Moisture Content:	8 to 15%

Considering the above results and the visual and tactile examination of the excavated material, the silty sand till is generally dense to very dense and damp with occasional moist seams. However, at immediately below the near-surface organic stained silty sand deposit, the glacial till was noted to be generally compact. It should also be noted that a wet sand and gravel interbedding was noted at Test Pits 106, 109 and 111 between depths of about 2 and 3.5 m below existing grade where some water seepage was also observed

The groundwater condition at the test pit locations were monitored during and up to 8 hours following their excavation. During this period, Test Pits 101, 103, 107,110 and 112 were dry, and at the remaining locations the water level was measured at depths ranging from about 2.8 to 5.0 m below existing ground surface. It should however be noted that the groundwater level would fluctuate seasonally and is expected to be high during the spring and fall months. Furthermore, a perched water condition may also exist within the fill overlying the relatively less permeable glacial till deposit.

The test pit walls were noted to be generally stable and to stand close to vertical. However, some cave-in was noted below a depth of about 3 m below existing grade, specially where groundwater seepage was also noted from higher elevations. Due to site safety, all test pits were backfilled upon completion of fieldwork.

It should be noted that the thickness of topsoil and/or fill could vary significantly in between and beyond the test pit locations and therefore, it is recommended that allowance be made for possible variations when making construction estimates.

The occurrence of cobbles and boulders should always be expected when working in glacial till deposits.

The Record of Test Pits is presented in the following Table 1.

TABLE 1: RECORD OF TEST PITS

Test Pit No.	Elevation (m)	Approx. Depth (m)	Soil Description
101	447.6	0 - 0.2 0.2 - 0.6 0.6 – 4.2	Topsoil Organic stained Silty Sand with some gravel, damp Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Hard excavating from 2.0 m to completion depth. Test pit dry upon completion and 0.5 hours afterwards. No cave-in of the sides and no water seepage observed.
102	425.4	0 - 0.2 0.2 - 0.4 0.4 – 4.1	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp to moist Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Bulk unit weight @ 1.5 m: 2177 kN/m^3, Natural moisture content (NMC): 8%. Test pit dry upon completion and open for 4.0 hours. After 4.0 hours, slow water seepage observed at about 2.5 m below existing grade and water level was at 3.0m below existing grade.
103	416.3	0 - 0.4 0.4 – 1.0 1.0 – 2.0	Topsoil Organic stained Silty Sand with some gravel, moist Mottled brown/grey Silty Sand, with some gravel, damp to moist

		2.0 - 4.2	Brown Silty Sand Till, with some cobbles and boulders, compact to very dense, damp with some moist seams Bulk unit weight @ 2.0 m: 2018 kN/m^3,NMC:12%. Test pit dry upon completion and backfilled immediately due to soft ground surface. Cave-in of sides observed at about 3.8 m below existing grade.
104	422.3	0 - 0.2 0.2 - 0.6 0.6 - 4.5	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Bulk unit weight @ 1.4 m: 2119 kN/m^3, NMC: 9%. Test pit dry upon completion and open for 4.5 hours. No cave-in of the sides observed and slow water seepage observed at 3.0 m below existing grade. After 4.5 hours, water level was observed at 4.2 m below existing grade.
105	414.7	0 - 0.3 0.3 – 1.5 1.5 – 4.3	Topsoil Organic stained Silty Sand with some gravel, damp to moist Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Bulk unit weight @ 1.4 m: 2194, NMC:15%. Test pit dry upon completion and open for 4.0 hours. No cave-in of the sides and no water seepage observed. After 4.0 hours, cave-in of sides observed and water level at 3.0 m below existing grade. Note: ground surface was soft in this area.
106	398.2	0 - 0.25 0.25 - 0.6 0.6 – 2.5 2.5 – 3.5 3.5 – 4.5	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp to moist Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Brown sand and gravel, with boulders, wet (fast water seepage) Greyish brown Sandy Silt/Silty Sand Till, dense, damp Bulk unit weight @1.3 m: 2250 kN/m^3, NMC:10%. Fast water seepage from sand and gravel seam was observed upon completion. Test pit was opened for 0.75 hours and cave-in and water level was observed at 3.8 m below existing grade.
107	408.1	0 - 0.4 0.4 – 1.5 1.5 -4.5	Topsoil Organic stained Sandy Silt/Silty Sand with some gravel, damp to moist Brown Silty Sand Till, with some cobbles and boulders, compact to very dense, damp Bulk unit weight @1.5 m: 2042 kN/m^3, NMC:13%.

			Test pit dry upon completion and opened for 4.0 hours. After 4.0 hours, test pit was dry and no cave-in observed.
108	406.7	0 - 0.25 0.2 - 0.6 0.6 - 4.3	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Bulk unit weight @ 1.2 m: 2154 kN/m^3, NMC: 14%. Test pit dry upon completion and open for 8.0 hours. No water seepage and cave-in of the sides observed. After 8.0 hours water level was observed at 4.3 m below existing grade (at base). Slow water seepage was observed at 2.5 m below existing grade.
109	412.6	0 - 0.6 0.6 - 0.8 0.8 – 2.0 2.0-2.5 2.5-4.5	Organic stained/brown silty sand/sandy silt Fill, moist Topsoil Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp. Sand and Gravel seam/interbedding, moderate to fast water seepage Brown Silty Sand Till, some silty seam with boulders and cobbles, Dense to very dense, damp, some moist seams of silt and sand Bulk unit weight @1.2 m, 2200 kN/m^3, NMC: 11%. Upon completion, water level was 4.0 m below existing grade and after 5.0 hours, water level was at 2.8 m below existing grade. No cave-in of the sides observed.
110 (Test pit was moved 40 m to south due to close proximity to wooden structure and material storage).	408.7	0 - 0.3 0.3 - 0.8 0.8 – 5.0	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp to moist Brown Silty Sand Till, with some silty seams, cobbles and boulders, compact to very dense, damp Test pit dry upon completion and backfilled immediately due to safety concerns.
111	410.5	0 - 0.2 0.2 – 0.5 0.5 - 2.4 2.4 - 2.8 2.8 - 3.5 3.5 – 5.0	Topsoil Organic stained Silty Sand with some gravel, moist Brown Silty Sand Till, with some cobbles and boulders, compact to very dense, damp with some moist seams Sand and Gravel, wet, slow water seepage observed Brown Silty Sand/Sandy Silt, Dense, moist Brown Sandy Silt Till, Dense to very dense, damp Bulk unit weight @1.2 m: 2102 kN/m^3, NMC: 11%. Water level at 5.0 m upon completion and test pit was backfilled immediately due to safety concerns.

112	433.2	0 - 0.2 0.2 - 0.8 0.8 - 4.4	Topsoil Organic stained Silty Sand with some gravel and rootlets, damp Brown Silty Sand Till, with some silty seams, cobbles and boulders, damp Bulk unit weight @1.4 m: 2011 kN/m^3, NMC: 9%. Test pit dry upon completion and open for 4.5 hours. After 4.5 hours, test pit was dry and no cave-in of the sides observed.

DISCUSSION

As the development details were not available at the time of preparation of this report, the following discussions and recommendations should therefore be considered as general in nature and minimal in content and would need to be reviewed/revised/supplemented once the project details are available.

- Site Grading

The development of the site will require clearing and stripping of the existing topsoil and fill. Since all areas could be developed as either residential lots and/or roads/driveways, it is recommended that all fill be placed as engineered fill to provide competent subgrade. Prior to placement of engineered fill, all the surficial topsoil and any fill containing excessive organic matters should be stripped from planned fill areas to expose the inorganic subgrade. The exposed subgrade should then be proof-rolled with a suitably heavy roller to identify weak areas. Any weak or excessively wet zones identified during proof-rolling should be sub-excavated and replaced with compacted competent material to establish stable and uniform conditions. Prior to placement of engineered fill, the subgrade should be inspected and approved by a geotechnical engineer.

- Foundations

The field investigation has shown the presence of surficial topsoil and organic stained silty sand deposits at all test pit locations. These deposits are not suitable to support spread footings and the footings should be extended deeper into the underlying native compact to very dense silty sand till. Based on the visual and tactile examination along with iron rod probing of the competent native till deposits, an allowable soil bearing capacity of 150 kPa is generally available at about 1.5 m below existing grade. It should be noted that due to the presence of a wet sand and gravel interbedding at some test pits, if this layer is encountered at or above the footing invert levels, the respective foundation walls would need to be waterproofed and the walls would need to be properly designed with adequate drainage measures to permanently control the water source. The building slab may also require subdrains. Alternatively, they could be designed as watertight structures with due consideration for the hydrostatic pressure.

Design frost penetration depth for the general area is 1.2 m. Therefore, a permanent soil cover of 1.2 m or its thermal equivalent is required for frost protection of foundations. All exterior footings and footings beneath unheated areas should have at least 1.2 m of earth cover or equivalent synthetic insulation for frost protection.

For footings designed and constructed in accordance with the above criteria, total and differential settlements should be less than 25 mm and 15 mm, respectively. These values are usually within tolerable limits for most types of structures.

In conformance to the Criteria in Table 4.1.8.4.A of the Ontario Building Code (OBC 2012), for footings designed as recommended above, the subject site is classified as Site Class "D-Stiff Soil". The four values of the Spectral Response Acceleration Sa (T) for the different periods and the peak ground acceleration (PGA) as well as the design values of F_a and F_v for the project site should be calculated in accordance to the code.

- Site Servicing

We have assumed that the depth of sewer and watermain pipes to be within 4 m below existing grades. The following discussion is based on this assumption.

Trench excavations should be carried out as per the Safety Regulations of the Province of Ontario. The test pits show that the trenches will be predominantly dug through the existing topsoil and organic stained silty sand and down into the compact to very dense silty sand till with occasional interbeddings of sand and gravel.

Within these soils, the side slopes of excavations are expected to be temporarily stable at 1H:1V, although above the groundwater level in dense to very dense silty sand till, the bottom 1.2 m of the trench walls could be excavated close to vertical. It should also be noted that flatter slopes may be required within the surficial topsoil and silty sand as well as within the moist silt seams and wet sand and gravel interbeddings within the till deposit.

Considering the subsurface conditions encountered at the test pits, groundwater seepage from the silty sand till should be minor and manageable by gravity drainage and pumping from filtered sumps, if required. However, increased seepage should be expected from any perched water within the overlying silty sand, surface water flow as well as from the more permeable silt seams as well as the wet sand and gravel interbeddings within the till deposit. We are of the opinion that these should generally be manageable by gravity drainage and increased number of filtered sump pumps, if required. However, depending on the season for site servicing and the pipe inverts, the wet sand and gravel layer may require some depressurization prior to is excavation. We would recommend that once the pipe inverts are known, the groundwater condition at the site to be further assessed prior to construction to ensure that the most reliable and economical dewatering measure is chosen.

To prevent disturbance of the soil at the bedding level, the groundwater table must be lowered to at least 0.8 m below the invert of the trench. In no case should the pipes be placed on dilated or disturbed subsoil.

Attention is called to the possible presence of cobbles and/or boulders that may be encountered during the excavation in the glacial till deposits.

Normal excavation equipment will be suitable for making trenches within overburden soils in which the proposed underground services will be installed. The terms describing the compactness (compact, dense, very dense) of soil strata give an indication of the effort needed for excavation. The occurrence of cobbles and boulders should always be expected when working in glacial till deposits where some extra effort may be required.

The test pits have shown that the sewer pipes would be laid within compact to very dense silty sand till, which is considered to be suitable to support the pipes. The recommended minimum thickness of granular bedding for normal Class 'B' Type of bedding (i.e., compacted granular bedding material – OPSD-802) below the invert is 150 mm. The thickness of the bedding may, however, have to be increased depending on the pipe diameter or if wet or weak subgrade conditions are encountered. Care must be exercised not to disturb the pipe subgrade during excavation or any dewatering at the site.

Based on the visual and tactile examination of the soil samples, the inorganic on-site excavated soils could be re-used as backfill in service trenches. The moisture contents at the time of construction should be at or near optimum. It should however be noted that the silty deposits are quite sensitive to moisture content and would require more strict quality control during placement. The backfill should be placed in maximum 200 mm thick layers at or near (±2%) their optimum moisture content, and each layer should be compacted to at least 95% Standard Proctor Maximum Dry Density. This value should be increased to at least 98% within 0.6 m of the road subgrade surface.

The excavated soils may require reconditioning (e.g., wetting or drying) prior to reuse. The on-site excavated soils should not be used in confined areas (e.g., around catch-basins and laterals under roadways) where heavy compaction equipment cannot be operated. The use of good backfill together with an appropriate frost taper would be preferable in confined areas. Unsuitable materials such as organic soils, boulders, cobbles, frozen soils, etc., should not be used for backfilling.

We recommend that frost tapers be provided at backfilled trenches to ensure gradual transition from the frost-free materials to the frost susceptible natural soil, otherwise differential frost heaving may occur. Frost taper would not be necessary if the backfill material can be matched within the frost zone (i.e. within about 1.2 m depth below the pavement surface) with subgrade-type material.

-Stormwater Management Pond

According to the preliminary information provided to us, we understand that a stormwater management pond may be constructed near Test Pits 108 or 110. Based on the subsurface conditions encountered at these test pits, below the surficial topsoil and organic stained silty sand, both potential sites were predominantly underlain by compact to very dense silty sand till, that extended down to their completion. During the test pitting program, the short-term groundwater level was measured at 4.3 m below the existing ground surface at Test Pit 108 and Test Pit 110 was found to be dry.

Considering the above information, an impermeable liner would be required to minimize any surface water infiltration or groundwater exfiltration. Furthermore, although the wet sand and gravel interbedding was not contacted at the location of Test Pits 108 or 110, should this layer be encountered during the excavation of the pond, the layer would need to be stabilized by installing proper subdrains to ensure liner integrity.

We would recommend that once the pond design is available, we should review and carry out slope stability analysis to ensure pond stability under various ponding and loading conditions.

We would recommend that once the project invert details are available, we should be given the opportunity to review and assess the need for additional recommendations and/or a borehole investigation.

We trust that this preliminary information report meets your current requirements. Should you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,
Shad & Associates Inc.

Stephen Chong, P. Eng.
Senior Engineer

Houshang Shad, Ph. D., P. Eng.
Principal

STATEMENT OF LIMITATION

The conclusions and recommendations given in this report are based on information obtained at the testhole locations. Subsurface and groundwater conditions between and beyond the testholes may differ from those encountered at the testhole locations, and conditions may become apparent during construction which could not be detected or foreseen at the time of the site investigation.

The information contained herein in no way reflects on the environmental aspects of the project, unless stated otherwise.

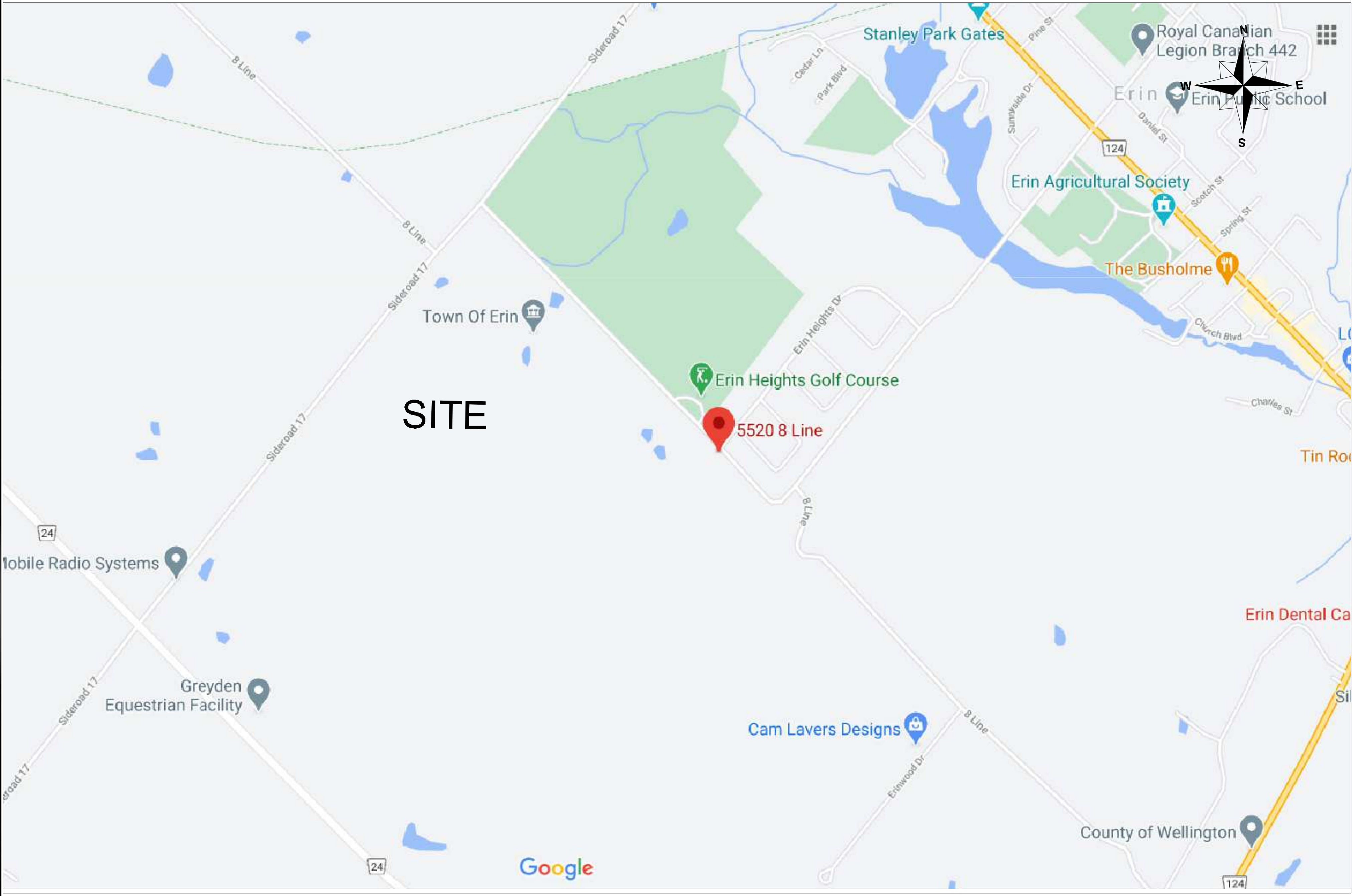
The benchmark and elevations used in this report are primarily to establish relative elevation differences between the testhole locations and should not be used for other purposes, such as planning, grading, excavating, etc.

The design recommendations given in this report are project as well as site specific and then only if constructed substantially in accordance with the details stated in this report. We recommend, therefore, that we be retained during the final design stage to review the design drawings and to verify that they are consistent with our recommendations or the assumptions made in our analysis.

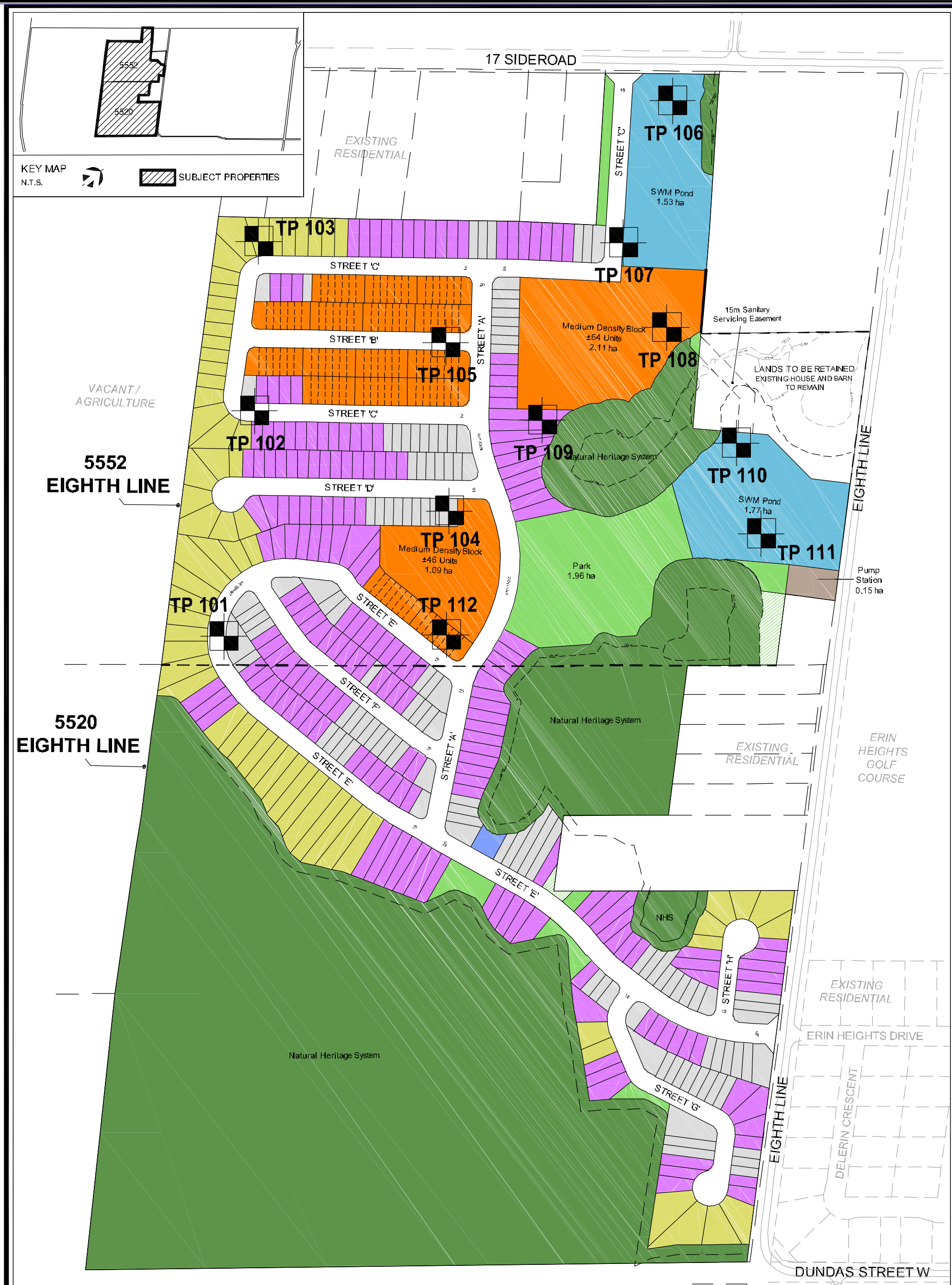
The comments given in this report on potential construction problems and possible methods are intended only for the guidance of the designer. The number of the testholes may not be sufficient to determine all the factors that may affect construction methods and costs. The contractors bidding on this project or undertaking construction should, therefore, make their own interpretation of the factual information presented and draw their own conclusions as to how the subsurface conditions may affect their work.

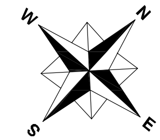
We recommend that we be retained during construction to confirm that the subsurface conditions throughout the site do not deviate materially from those encountered in the testholes.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, is the responsibility of such third party. We accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.



CLIENT: **Mattamy Development Corporation**	**Drawn By:** R.H.	**TITLE:** **SITE LOCATION PLAN**	Date: January, 2021
	Checked By: H.S.		Project No.: **T20828-1**
SHAD & ASSOCIATES INC. GEOTECHNICAL, ENVIRONMENTAL AND MATERIALS ENGINEERS 83 Citation Drive, Unit 9 Vaughan, Ontaruio, L4K 2Z6 Tel: (905) 760-5566 Fax: (905) 760-5567	**Datum:** -	**PROJECT:** **Proposed Residential Subdivision** Erin Property - North Parcel 5520 8th Line, Erin, Ontario	Figure No.: **1**
	Projection: -		
	Scale: -		





LEGEND:

TP 101

Test Pit Locations

NOTES:

1. Test Pit locations are approximate.
2. Drawing not to scale.
3. The base drawing was provided by client.
4. The drawing should be read in conjunction with the associated reports by Shad & Associates Inc., T20828-1.

CLIENT:

Mattamy Development Corporation

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Drawn By:	R.H.
Checked By:	H.S.
Datum:	-
Projection:	-
Scale:	N.T.S.

TITLE:

TEST PIT LOCATION PLAN

PROJECT:

Proposed Residential Development

Erin Property
5520 8th Line, Erin, Ontario

Date:	May, 2022
Project No.:	T20828-1
Figure No.:	2

ENCLOSURE A:

TEST PIT PHOTOS


Photograph 1- View of excavated soils for TP 101. Test pit was dry upon completion and no water seepage observed.


Photograph 2 – View of excavation for TP 102. Test pit was dry upon completion, however, after 4 hours, slow water seepage was observed at 2.5 m below existing grade.


Photograph 3- View of excavation for TP 103. Sides caved in at about 3.8 m below existing grade.


Photograph 4 – View of excavation for TP 104. Test pit was dry upon completion, however after 4.5 hours, slow water seepage was observed at 3.0 m below existing grade.

Photograph 5- Excavated soils from TP 105. After 4.0 hours, cave-in of sides and water level were observed at 3.0 m below existing grade.

Photograph 6- View of excavation for TP 106. Note fast water seepage from sand and gravel seam at about 2.5 to 3.5 m below the existing grade.


Photograph 7- View of TP 106, note cave-in and water level approximately 0.75 hours after excavation.


Photograph 8- View of excavation for TP 107. After 4.0 hours, test pit was dry and no cave-in observed.

Photograph 9- View of excavated soils for TP108. Test pit was dry upon completion.

Photograph 10- View of TP 108, approximately 8 hours after completion. Slow water seepage was observed at 2.5 m below the existing grade.

Photograph 11- View of excavation for TP 109. Water seepage was from sand and gravel seam at 2.0 to 2.5 m below existing grade.

Photograph 12- View of TP 109 approximately 5 hours after completion.

Photograph 13- Location of TP 110. Test pit was moved approximately 40 m south due to close proximity to wooden structure and construction material storage in area.

Photograph 14- View of excavated soil being used to backfill TP 110.

Photograph 15- View of BH 111-water at base was from slow water seepage from sand and gravel seam at 2.4 to 2.8 m below existing grade.

Photograph 16- View of excavated soils from TP 112. After 4.5 hours, test pit was dry and no cave-in observed.