# UPDATED GEOTECHNICAL INVESTIGATION
# PROPOSED HELICOPTER HANGER
# 350 GARFIELD WRIGHT BOULEVARD
# EAST GWILLIMBURY, ONTARIO

Prepared for:

**PARKIN ARCHITECTS LIMITED**


**PATRIOT ENGINEERING LTD.**
**Consulting Engineers**


Project 44148A
October 17, 2024


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Project 44148A

October 17, 2024

Parkin Architects Limited
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Toronto, Ontario
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Attention: Mr. Lind Nyman
Principal

**Updated Geotechnical Investigation**
**Proposed Helicopter Hangar**
**350 Garfield Wright Boulevard**
**East Gwillimbury, Ontario**

## 1.0 INTRODUCTION

It is our understanding that the proposed development at the above site will consist of constructing a helicopter hangar and an attached one storey building without a basement. An above grade helicopter pad, an apron pad and a parking lot will also be constructed.

In light of this, Patriot Engineering Ltd., has carried out a geotechnical investigation to determine the subsurface soil and groundwater conditions in order to provide geotechnical recommendations for type of foundations, safe soil bearing pressures, earthquake design parameters, earth pressure coefficients, excavation and backfill procedures, slab-on-grade floor construction, plus pavement thicknesses. Authorization to proceed with this overall investigation was provided by Mr. Lind Nyman, from Parkin Architects Limited, on behalf of the Owner.

The site is located approximately 400m north and 840m west from the intersection of Warden Avenue and Davis Drive, in East Gwillimbury, Ontario. It is vacant and unoccupied. The terrain is relatively flat. The site is generally covered with vegetation consisting of grass, shrubs and a few trees.

## 2.0 BACKGROUND

Previously, we had carried out a goetechnical investigation at the above site for a helicopter hangar and an attached one storey building without a basement that included an above grade helicopter pad, an apron pad and a parking lot. Our geotechnical findings and recommendation were presented in our Report No. 44148, dated August 30, 2024.

On August 31, 2024, we were informed by our client Mr. Lind Nyman from Parkin Architects Limited that the proposed building location and footprint, plus the helicopter pad, the apron pad and a parking lot the parking layout have changed to a different configuration. However, the proposed building will still consist of having one storey and without a basement. For reference purposes, the footprints of the original development along with that of the new development are provided on Figure A1, in Appendix A.

In general, given the above mentioned alterations, to some extent, this will now affect the borehole layout and alter the intended purpose of some of the boreholes, as it relates to the transition from the original development to the new development. For example, some boreholes that were intended for the previous building will now fall at or very close the proposed apron pad (BH3 and BH6). Also, some boreholes will now fall outside of the footprint of their intended purposes (BH1, BH11 and BH12).

A considerable portion of the new building footprint is now situated at areas that has not been explored for the building recommendations. Therefore, it is our opinion, that the new building footprint would require proper borehole representation that is conducive to its layout. It was recommended that three (3) additional boreholes would be required to provide a suitable transition from the original building to the new building. In light of this, a supplementary geotechnical investigation was carried out on September 23, 2024, consisting of these three (3) boreholes (BH19, BH20 and BH21) to 8.1m each. In this regard, we have then provided an *updated final report* that combines the findings from our original investigation plus the findings from the supplementary investigation and have designated it as Report No. 44148A, dated October 17, 2024.

## 3.0 FIELDWORK

The fieldwork for this overall investigation took place in two phases, thus resulting in a combined total of twenty-one (21) boreholes. The first or initial phase was carried out on July 25, 26 and 29, 2024, and consisted of drilling a total of eighteen (18) boreholes (BH1 to BH18). The second phase was carried out on September 23, 2024, and consisted of drilling a total of three (3) boreholes (BH19, BH20 and BH21). All boreholes were drilled using solid stem augers. A summary of the boreholes, their designations and their depths for this investigation is shown below:

(a) <u>For the Helicopter Hangar and Attached One Storey Building</u>
Six (6) boreholes (BH3, BH4, BH5, BH19, BH20 and BH21) to a depth of 8.1m each

Although Borehole BH3 fell within the footprint of the apron pad, in our opinion, it is situated sufficiently close to the footprint of the building and may also be applicable to both the building and the apron pad.

(b) <u>For the Helicopter Pad and Apron Pad</u>
Seven (7) boreholes (BH2, BH3, BH6, BH7, BH8, BH9 and BH10) to depths ranging from 5.0m to 8.1m

As mentioned above, Borehole BH3 was used for both the apron pad and for the building.

Borehole BH8 in our opinion, is situated sufficiently close to the footprint of the apron pad and is considered suitable for use for the apron pad.

(c) For the Parking Lot and Driveways
Six (6) boreholes (BH13 to BH18) to a depth of 2.0m each

Boreholes BH13, BH15 and BH16 in our opinion, are situated sufficiently close to the footprint of the parking lot and driveway areas and are considered suitable for use for the parking lot and driveway areas.

Boreholes BH1, BH11 and BH12 fell a fair distance away from the footprint of their intended purposes. Although they were not used for the above mentioned specific footprints, these boreholes generally assisted in establishing consistency and uniformity of the subsurface conditions at the overall subject site, as well as providing increased assurance contributing towards developing our geotechnical recommendations.

All boreholes were backfilled in accordance with Regulation 903.

The approximate borehole locations along with their surface elevations at the time of our first face and second phase of our drilling activities are shown on the Partial Site Plan, Figure 1.

The boreholes were drilled by using continuous flight solid stem augurs by a specialist drilling contractor under the supervision of Patriot Engineering Ltd. field engineering staff. Samples were obtained at regular depth intervals using a 50mm diameter split spoon sampler that was driven into the soil with a 63.5 kg drop hammer falling 760mm, in accordance with Standard Penetration Test (SPT) procedures (ASTM D1586). During the fieldwork, our staff member also inspected the samples and logged them. The samples were then brought to our laboratory for detailed inspections and laboratory testing. Samples were generally tested for moisture contents and selected samples were tested for gradation analysis / hydrometers.

Groundwater level readings were obtained during our drilling activities. They were obtained upon the completion of drilling of each individual borehole.

Surveying of the ground surface elevations at the borehole locations were determined by our field engineering personnel and referenced at the following datum:

Top of manhole on Garfield Wright Boulevard, near the southeast corner of the property. The location of this manhole is also shown on Figure 1.

The elevation at this point is understood to be at Elev. 272.32m.

The scope of work for the geotechnical investigation for this project is as it is presented in this report, which is being provided on the assumption that the applicable codes and standards will be met. If there are any changes in the design features relevant to the geotechnical analysis, or if there are any apparent deviations of the report from relevant codes and standards, our office should be contacted to review the design.

## 4.0 SUBSURFACE CONDITIONS

The detailed subsurface stratigraphy encountered in the boreholes is presented on the Borehole Logs, Drawings 2 to 22.

In general, all boreholes were drilled from above grass covered regions at the site and initially advanced through a topsoil layer that ranged in thickness from approximately 50mm to 75mm.

Below the topsoil layer, earth fill material was encountered in all boreholes and consisted of brown, slightly moist to saturated, silt. This silt fill layer also contained traces to some sand, some clay, plus traces of gravel, topsoil, rootlets, wood pieces, brick fragments and plastic pieces. The "N" values (blows/foot) that were recorded within this fill material ranged from 6 to 55, revealing relative densities that were loose to very dense. The moisture contents varied from 4% to 21%. Some degree of dilation was noted in a few samples that were extracted from this layer. Figures 23 and 24 show the grain size distribution test results that were performed on two samples extracted from this silt fill layer. Local variations of the composition of the material can occur at the sampling locations. It is our understanding that the location of the proposed development was part of a large construction site in the past where the subgrade was raised. Our boreholes indicate that this material was used to raise the subgrade.

The depth of the fill layer inside the boreholes which were drilled for the proposed building ranged from approximately 1.4m to 4.1m below existing grade. The depth of the fill layer inside the boreholes which were drilled for the helicopter pad and adjacent apron slab varied from 1.4m to 3.4m below existing grade. Similarly, the depth of the fill layer inside the boreholes which were drilled for the parking lot / driveway areas varied from approximately 0.7m to 1.0m below existing grade.

Below the earth fill material, all boreholes next encountered native soil that was composed of brown and/or grey, slightly moist to saturated, silt. This material also contained traces to some sand, traces to some clay, plus traces of gravel and cobbles. The "N" values that were recorded within this layer ranged from 10 to well over 50, demonstrating relative densities that were compact to very dense. The moisture contents varied from 5% to 27%. Dilation was noted in several samples that were obtained from this layer. The results from our grain size distribution tests performed on three samples obtained from this native, silt layer are shown on Figures 25, 26 and 27. All boreholes with the exception of Boreholes BH1, BH4, BH19, BH20 and BH21 were terminated within this silt layer.

In Boreholes BH1, BH4, BH19, BH20 and BH21, beneath the silt layer, the soil that was encountered next consisted of grey, moist, sandy silt. Traces to some clay, plus traces of gravel were also present within this material. The "N" values that were obtained from this layer were well over 50, displaying relative densities that were very dense. The moisture contents varied from 8% to 12%.These boreholes were terminated in this sandy silt material.

Groundwater level readings were obtained upon the completion of drilling from each borehole. These short term groundwater levels that were recorded in each borehole are indicated below on Table 1.

All groundwater level readings are also shown on the individual borehole logs.

Some seasonal fluctuations and higher water levels should be anticipated.

The soil and groundwater conditions presented in this report have been deducted from soil sampling that was noncontinuous and therefore, should not be taken to represent exact planes of geological change. Furthermore, the geotechnical recommendations and comments provided in this report have been based on boreholes that were widely spaced. Therefore, the soil and groundwater conditions between the boreholes could vary significantly. The interpretation between boreholes and the recommendations in this report must therefore be checked through field inspections, provided by our office during the construction stages, to validate the information for use.

**Table 1**
**Measured Short Term Groundwater Level Readings Obtained Upon Completion of Drilling of Each Borehole**

| Borehole No. | Depth of Borehole (m) | Borehole Surface Elevation (m) | Approximate Depth of Groundwater Level Below Existing Ground (m) | Approximate Groundwater Elevation (m) |
|---|---|---|---|---|
| BH1 | 8.1 | 273.5 | 5.0 | 268.5 |
| BH2 | 8.1 | 273.5 | 5.3 | 268.2 |
| BH3 | 8.1 | 273.4 | 5.3 | 268.1 |
| BH4 | 8.1 | 273.6 | 4.3 | 269.3 |
| BH5 | 8.1 | 273.8 | 5.3 | 268.5 |
| BH6 | 8.1 | 273.8 | 4.7 | 269.1 |
| BH7 | 5 | 273.9 | DRY | - |
| BH8 | 5 | 273.9 | DRY | - |
| BH9 | 5 | 273.7 | DRY | - |
| BH10 | 5 | 273.8 | DRY | - |
| BH11 | 2 | 273.7 | DRY | - |
| BH12 | 2 | 273.5 | DRY | - |
| BH13 | 2 | 273.9 | DRY | - |
| BH14 | 2 | 274 | DRY | - |
| BH15 | 2 | 272.9 | DRY | - |
| BH16 | 2 | 273.2 | DRY | - |
| BH17 | 2 | 273.7 | DRY | - |
| BH18 | 2 | 273.3 | DRY | - |
| BH19 | 8.1 | 273.8 | 5.0 | 268.8 |
| BH20 | 8.1 | 274.2 | 5.4 | 268.8 |
| BH21 | 8.1 | 273.9 | 5.4 | 268.5 |

## 5.0 GEOTECHNICAL RECOMMENDATIONS

The comments provided in this report are intended only for the guidance of design engineers. The amount of boreholes required to determine the localized underground conditions between boreholes that would affect construction costs, sequencing, equipment, scheduling construction techniques, and the like, would be much greater than that carried out for design purposes. Contractors and/or subcontractors bidding on or undertaking the work should, in this light, decide on their own interpretations of the factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them and their scope of work.

### 5.1 Foundations: Conventional Spread Footings

It is our understanding that the elevation of the top surface of the ground floor slab has been established at Elev. 273.8m. The anticipated footings are expected to be founded approximately 1.5m below the ground floor slab, corresponding approximately to Elev. 272.3m.

As previously mentioned, we had been informed by Parkin Architects Limited that the location of the proposed development was part of a large construction site in the past where material was used to backfill the site and raise the subgrade. At the footprint of the building, the depth that the fill material that was used ranged from approximately 1.4m to 4.1m below existing grade. We have also been provided with documentation that is available that indicates that compaction testing was carried out on the material that was used to raise the subgrade and the results showed that specified compaction was achieved.

Our review of the soil samples show that the fill material appeared to be uniform in structure. The recorded "N" values (blow/foot) that were obtained within the fill layer, especially at or near the proposed footing founding elevation, demonstrated that the existing fill layer had undergone through compaction procedures and is generally yielding densities that are in the compact to very dense state. The available records indicate that the fill material was installed approximately 9 years ago. It is expected that it has self consolidated during the course of this time duration, and therefore, it should not induce above normal settlement. Therefore, it is our opinion that the existing fill layer is considered suitable for sustaining conventional spread footings.

Based on the subsurface information recorded at the borehole locations, conventional spread footings may be used for the proposed building and shall be founded below all topsoil, wet, deleterious materials and loosened soil, on the compact to very dense, silt fill material as indicated in Boreholes BH3, BH4, BH19, BH20 and BH21, and on the native, undisturbed, compact to very dense, silt as indicated in Borehole BH5. The following soil bearing pressures and specified founding depths as shown below on Table 2 are recommended:

**Table 2**
**Soil Bearing Pressures for Spread Footings**

| Borehole No. | Serviceability Limit State (SLS) (kPa) | Factored Bearing Capacity at Ultimate Limit State (ULS) (kPa) | Approximate Founding Depth Below Existing Ground (m) | Approximate Founding Elevation (m) |
|---|---|---|---|---|
| BH3 | 75 | 115 | Below 0.8 | Below 272.6 |
| BH4 | 75 | 115 | Below 0.8 | Below 272.8 |
| BH5 | 75 | 115 | Below 0.8 | Below 273.0 |
| BH19 | 75 | 115 | Below 0.8 | Below 273.0 |
| BH20 | 75 | 115 | Below 0.8 | Below 273.4 |
| BH21 | 75 | 115 | Below 0.8 | Below 273.1 |

Foundations designed using the soil pressures pertaining to the Serviceability Limit State (SLS) condition shown above, should not exceed the total and differential settlements of 25mm (1 inch) and 20mm (3/4 inch), respectively, provided that the foundation bases are not disturbed by excavation, surface water inflow, or freezing and thawing action.

Nominal reinforcement will be required in footings and foundation walls placed on the fill material. This is a precautionary measure to ensure that soft subgrade areas, if any, are adequately bridged with the reinforcement of foundations.

In general, fills are more susceptible to the effects of weather than are natural soils. Therefore, they must be protected from excessive wetting, drying and erosion.

Foundations exposed to freezing ground conditions must be protected against frost action with a minimum of 1.2m (4 ft.) of soil cover or equivalent.

Any footings constructed at different founding levels must be stepped along a line of 7 vertical to 10 drawn from the bottom of the lower footing.

All foundation bases should be inspected by a geotechnical engineer from our office prior to placing concrete to verify the bearing pressures, plus the consistency of the founding conditions that is suggested in this report.

It is recommended that the foundation drawings be reviewed by our office for general conformance with our geotechnical recommendations.

Higher bearing capacities are also available at deeper zones of our boreholes on native soils, if required. See Section 4.2 below.

## 5.2 Alternate Foundation Method Using Helical Pier Foundations

If higher bearing capacities are required, then an alternate foundation method for the soil conditions encountered at the site is deep foundations consisting of helical piers in combination with grade beams to support the building loads. The helical piers should be supplied by Chance, or equivalent.

The installation of the helical pier foundations will transfer the building loads beyond the fill layers plus beyond the relatively weak native soils and into much deeper zones towards the bottom of our boreholes, where the soil conditions appear to be more favourable for bearing purposes.

Helical piers may be founded below all topsoil, fill, soft, loosened and deleterious soils into the native, undisturbed, very dense, silt, and/or native undisturbed, very dense, sandy silt.

The design load sustained by the individual helical piers should be provided by the Structural Engineer.

Besides the soil conditions encountered, the capacity of a helical pier also depends on the type and size selected, plus the number of helices. Therefore, the specialist contractor/supplier will finalize the selection of the pier size which will achieve this design capacity that is specified by the structural engineer. The general specifications for the installation and testing will also be provided by the specialist contractor/supplier.

A compression load test is recommended to be carried out on a minimum of one helical pier, to verify its capacity.

All helical pier installation work should be inspected on a full-time basis by a geotechnical engineer from our office to ensure that they have been installed into the specified native layers at adequate depths and have achieved the designated torque requirements.

Excavations for any new grade beams and foundations must be stepped along a line of 7 vertical to 10 horizontal where founding grades are variable and must not interfere with adjacent foundation systems, underground services and the like.

Foundations / grade beams exposed to freezing ground conditions must be protected against frost action with a minimum of 1.2m (4 ft.) of soil cover or equivalent.

Provisions should be made by the contractor when advancing through the upper fill zones which could have obstacles, oversized concrete chunks, construction rubble, caving and the like, plus in the native soils as cobbles and boulders may be present.

It is recommended that the foundation drawings be reviewed by our office for general conformance with our geotechnical recommendations.

## 5.3 Earthquake Design Parameters

In accordance to the Ontario Building Code, the site's classification for Seismic Response would be Class C.

## 5.4 Earth Pressure Coefficients

For this site, the following parameters may be used to assess the earth pressure:

| Soil | $\gamma$ ($kN/m^3$) | $\phi$ degrees | $K_a$ | $K_o$ | $K_p$ |
|---|---|---|---|---|---|
| Onsite Compacted Fill or Compacted Granular Fill - OPSS Granular B | 21 | 32 | 0.31 | 0.47 | 3.25 |
| Native Subsoil | 21.5 | 33 | 0.3 | 0.46 | 3.39 |

Where $\gamma$ = bulk unit weight of soil, $kN/m^3$

$\phi$ = internal angle of friction, degrees

$K_a$ = coefficient of active earth pressure

$K_o$ = coefficient of earth pressure at rest

$K_p$ = coefficient of passive earth pressure

Also,

$\mu$ = Coefficient of Static Friction
Between footings and Underlying Soil
use 0.4

## 5.5 Excavation and Backfill

In general, based on the groundwater levels presented on Table 1, no significant groundwater issues are expected with excavations on this site. Any flow from surface water and any minor seepage from perched water levels should be controlled with properly filtered sumps with pumps. However, given the fluctuation of the groundwater, if excavations are to be carried out to depths close to or below the groundwater level, then high capacity pumps should then be installed inside the sumps to sufficiently draw down the groundwater. Depending on the season of construction, groundwater levels can increase significantly. If so, then a well point dewatering system may be required to be installed to control and effectively reduce the groundwater levels. It is recommended that a specialist dewatering contractor be contacted to provide their recommendations during the construction stages, if excavations encounter groundwater.

Provisions should be made by the contractor during the excavations for handling possible oversized concrete chunks, construction rubble and obstructions in the fill materials, plus cobbles and boulders in the underlying native soils.

All temporary shallow excavations may be cut at 1 vertical to 1 horizontal. If some sloughing occurs at the upper fill zones, or if wet conditions are encountered, then shallower slopes may be required in localized areas. All excavations must be made to conform to regulations set out in the Occupational Health and Safety Act. Using the classification system described in the Occupational Health and Safety Act, the fill soils on site can be classified as Type 3. The native soils can also be considered as Type 3. Any wet and saturated soils, or soils located below the groundwater level are classified as Type 4.

Excavations shall not be cut below an imaginary line drawn downward from existing foundations and/or underground services at 7 vertical to 10 horizontal. If this cannot be achieved then adequate temporary shoring and/or underpinning will be required.

The on site materials are not free draining and highly susceptible to frost. They should not be used for exterior foundation backfilling as this could potentially result to damage of the foundation walls from frost adhesion. Therefore, the exterior foundations should be backfilled with approved OPSS Granular B Type I (sand and gravel) material, placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 95% Standard Proctor maximum dry density. The upper 1.2m (4 ft.) zone of backfill material should be compacted to a minimum of 98% Standard Proctor maximum dry density.

The underslab interior excavations should be backfilled with approved onsite soils and/or approved OPSS Granular B Type I (sand and gravel) material, placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 98% Standard Proctor maximum dry density.

Backfilling of service trenches under proposed pavement areas may be carried out using approved onsite soils and/or approved OPSS Granular B Type I (sand and gravel) material placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 95% Standard Proctor maximum dry density. The upper 1.2m (4 ft.) zone of backfill material should be compacted to a minimum of 98% Standard Proctor maximum dry density.

The silt materials onsite have the capacity to retain water, they are not free draining and may be too wet to be used for backfilling. In some cases, drying the material, if space restriction permit this, will assist in salvaging some portion of this material for reuse. In other cases, they may be found to be too wet and rendered unusable. In this regard, the suitability for reuse of the onsite material as backfill should be inspected and evaluated during the initial stages of construction. Materials that have been approved for reuse should be maintained within 2% of their optimum moisture content. Tarps may be required to cover and protect the approved material.

### 5.6 Slab-On-Grade Floor

From our boreholes that were drilled for the building, it is noted that fill material was present consisting of silt. The fill material extends to depths varying from approximately 1.4m to 4.1m below existing grade. This indicates that the exposed subgrade surface at the envelope of the proposed building is expected to be constructed within this fill layer. The fill material appeared to be uniform in structure. It is our opinion that the fill layer is considered suitable to remain as a subgrade. Therefore, the concrete floor may be constructed by conventional slab-on-grade techniques on an adequately prepared subgrade consisting of compact to very dense, silt fill, provided that the following items are complied with:

1. The exposed subgrade must be stripped of any topsoil, vegetation, loose, wet and deleterious materials.

2. Any weak spots encountered on the exposed subgrade must be excavated and removed.

3. The amount of organics appeared minor in the samples, however, during construction, if it becomes greater then localized areas of the fill containing excessive organics must be excavated and removed.

4. The exposed surface of the subgrade within the footprint of the proposed building must be heavily proofrolled under geotechnical supervision and compacted to a minimum of 98% Standard Proctor maximum dry density. It must be inspected and approved by a geotechnical engineer.

5. The grade must then be raised to the design subgrade level to fill any such voids as indicated on Items 2 and 3 above, and/or to fill any areas with relatively lower surface elevations with approved onsite soils and/or approved OPSS Granular B Type I (sand and gravel) material, placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 98% Standard Proctor maximum dry density.

A basecourse / moisture barrier consisting of at least 200mm (8 inch) thick of 20mm (3/4 inch) of OPSS Granular A crusher run limestone must be provided under the proposed floor slab. It shall be compacted to at least 98% Standard Proctor maximum dry density.

The proposed concrete floor may then be constructed by conventional slab-on-grade techniques directly above the Granular A crusher run limestone basecourse.

A Modulus of Subgrade Reaction ($k_s$) of 30,000 kN/m$^3$ is suggested for designing the proposed floor slab.

The general requirements for the perimeter drainage, underfloor fill and backfill are provided on Figure 28.

## 6.0 GEOTECHNICAL RECOMMENDATIONS FOR PROPOSED HELICOPTER CONCRETE PAD AND APRON CONCRETE PAD

The on site silt materials retain water, they are not free draining and are highly susceptible to frost and heave action. They have the potential to cause the development of cracks on the overlying concrete pad surfaces from the oscillations and floating movement during the freezing and thawing cycles. Taking this into consideration, for the soil and groundwater conditions encountered at their respective locations, two options may be used to construct the above concrete pads. The first option involves constructing the pads with excavations extending to 1.2m below existing grade which is discussed in Section 5.1. While the second option involves constructing the pads on a basecourse layer in combination with insulation and this is discussed in Section 5.2. The selection between these two pad options will depend on factors, such as, economics, duration of activity, availability and scheduling.

### 6.1 Concrete Pads: Option 1 - Concrete Pads Constructed with Excavations Extending to 1.2m Below Existing Grade

Given the frost susceptible soil conditions that are present at the site, it is recommended that the following geotechnical recommendations be complied with for developing the proposed concrete pads for both the helicopter pad and apron pad:

1. It is recommended that excavations for the floating concrete pads to extend to a depth of 1.2m (4 ft.) below their proposed final grade. It is expected that the exposed subgrade to consist of compact to very dense, silt fill material. The exposed subgrade must be inspected and approved by a geotechnical engineer. Any weak spots, deleterious materials and organic materials detected at the exposed surface must be sub-excavated and removed. The exposed subgrade surface must be proofrolled and compacted to a minimum of 98% Standard Proctor maximum dry density.

2. It is recommended that excavations extend laterally outward for a minimum of 1.2m (4 ft.) from the edge of the pads at sides.

3. It is recommended that weeping tiles to be placed in parallel rows of 6m centres one way, above the excavated subgrade (at 1.2m depth) leading to a positive outlet, such as manholes or catch basins. The tiles should consist of a 100mm diameter PVC perforated weeping tile surrounded with a layer of 150mm thick of 20mm Clear Stone at the top and sides of the pipe and 50mm of stone at the base. The stone should be then be wrapped with an approved geotextile cloth, type Terrafix 270R, or equivalent. The subgrade should be shaped and crowned to allow drainage into these pipes.

4. The subgrade shall then be raised to the desired level using approved OPSS Granular B (Sand and Gravel) material placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 100% Standard Proctor maximum dry density.

5. A provision shall be made to allow for a basecourse / moisture barrier, consisting of at least 300mm (12 inches) of 20mm (3/4 inch) approved OPSS Granular A crusher run limestone to be placed under the concrete slabs. The Granular A material must be compacted to at least 100% Standard Proctor maximum dry density. The proposed concrete slabs may then be constructed by conventional slab-on-grade techniques directly above the compacted Granular A basecourse.

A Modulus of Subgrade Reaction ($k_s$) of 30,000 kN/m$^3$ is suggested for designing the proposed concrete pads.

It is recommended that the concrete pad drawings be reviewed by our office for general conformance with our geotechnical recommendations.

### 6.2 Concrete Pads: Option 2 - Concrete Pads Constructed on Basecourse Layer in Combination with Insulation

Based on the frost susceptible soil conditions encountered at the borehole locations, the following procedure is recommended for constructing the concrete pads for both the helicopter pad and apron pad:

1. Figure 29 shows the general geotechnical guidelines for constructing the concrete pads. It is expected that the exposed subgrade to consist of compact to very dense, silt fill material. The exposed subgrade surface must be proofrolled and compacted to a minimum of 98% Standard Proctor maximum dry density. The exposed subgrade must be inspected and approved by a geotechnical engineer. Any weak spots, deleterious materials and organic materials detected at the exposed surface must be sub-excavated and removed. The grade can then be raised to the design subgrade level to fill any such voids using approved OPSS Granular B Type I (sand and gravel) material placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 100% Standard Proctor maximum dry density.

2. It is recommended that excavations extend laterally outward for a minimum of 1.2m (4 ft.) from the edge of the pads at sides.

3. In order to minimize the amount of oscillations and floating movement during the freezing and thawing cycles, a layer of polystyrene board insulation (SM Blue), or equivalent, consisting of a minimum thickness of 50mm be placed below the entire area of the proposed pad and extend 1.2m laterally outwards. It should be placed above the approved subgrade. Insulation requirements should be in general conformance as shown in Figure 29 and the manufacturer's specifications.

4. A basecourse / moisture barrier, consisting of at least 300mm (12 inchs) of 20mm (3/4 inch) clear stone should be provided under the concrete pads. It should be compacted and vibrated for interlocking purposes.

5. The pads may then be constructed above the basecourse layer.

A Modulus of Subgrade Reaction ($k_s$) of 30,000 kN/m$^3$ is suggested for designing the proposed concrete pads.

It is recommended that the concrete pad drawings be reviewed by our office for general conformance with our geotechnical recommendations.

## 7.0 PAVEMENT STRUCTURES

It is our understanding that the proposed development will require the construction of flexible pavement areas with light duty and heavy duty applications.

The pavement areas may be constructed on an adequately prepared subgrade, inspected and approved by a geotechnical engineer. The subgrade may consist of compact, silt fill and/or compact to dense, native, silt. The exposed subgrade must be stripped of all topsoil, vegetation, loose, wet and deleterious materials. The exposed fill portion of the subgrade surface must be proofrolled and compacted to a minimum of 98% Standard Proctor maximum dry density. While the exposed native portion of the subgrade surface must be heavily proofrolled under geotechnical supervision. If any weak or soft areas are encountered at the exposed subgrade surface they must be further sub-excavated and removed. The grade must then be raised to the design subgrade level using approved onsite materials, and/or approved OPSS Granular B Type I (sand and gravel) material, placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 98% Standard Proctor maximum dry density. Stringent construction control procedures must be maintained to ensure uniform subgrade moisture and density conditions are achieved.

Based on the subgrade conditions encountered and normal anticipated traffic loading, the pavement structures indicated below in Table 3 are recommended:

**Table 3**
**Recommended Pavement Structures and Thicknesses**

| Material | Light Duty | Heavy Duty |
|---|---|---|
| HL 3 Surface Asphalt | 40mm | 40mm |
| HL 8 Binder Asphalt | 40mm | 100mm |
| Granular Basecourse<br>OPSS Granular "A" Consisting of<br>20mm Crusher Run Limestone | 150mm | 150mm |
| Granular Subbase<br>OPSS Granular "B" Type II<br>50mm Crusher Run Limestone | 300mm | 500mm |
| Total Combined Thickness | 530mm | 790mm |
| Granular Base Equivalents (GBE) | 510mm | 770mm |

Grading of the final subgrade should be shaped and crowned to allow drainage to adequately spaced catch basins installed with subdrains leading to a positive outlet. Figure 30, shows a typical subdrain detail. We emphasize the need for adequate drainage. Catch basins must contain subdrains for drainage infiltration from the granular basecourse leading into these drainage structures. Subdrains may also be installed along the driveway areas plus be installed to extend between catch basins.

It is recommended that all granular components to be placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum 98% Standard Proctor maximum dry density. The asphalt components to be placed and compacted to be within the acceptable compaction requirements of 92.0% to 96.5% Maximum Relative Density.

The completed pavement surface must not contain any depressions and must be adequately sloped to provide effective surface drainage toward the catch basins. Additionally, surface water shall not be allowed to accumulate adjacent to the outside edges of the pavement areas. Subdrains shall be installed to collect the excess subsurface moisture and prevent the subgrade from softening.

In order to minimize the adverse affects of settlement, it is recommended that the surface asphalt course be delayed for approximately one year after the binder asphalt course is placed, where practical.

Frost action can often result in differential movement taking place between the pavement and catch basins and/or manholes. As a result, it is recommended that these structures be backfilled with granular materials which are not as susceptible to frost, such as, approved OPSS Granular B Type I (sand and gravel), placed in loose lifts with a maximum thickness of 300mm and compacted to a minimum of 98% Standard Proctor maximum dry density. Hand controlled light compaction equipment shall be used when backfilling these structures to avoid damaging them.

The quality, performance and life expectancy of the finished product is highly dependent upon adequate subgrade preparation work, the quality and proper placement of the pavement components and the compaction level achieved. Therefore, it is important that geotechnical inspections be carried out during the construction period to ensure construction practice is in conformance with design requirements.

We trust that the information contained in this report will assist you with your proposed development. Should you have any questions, please do not hesitate to contact our office.

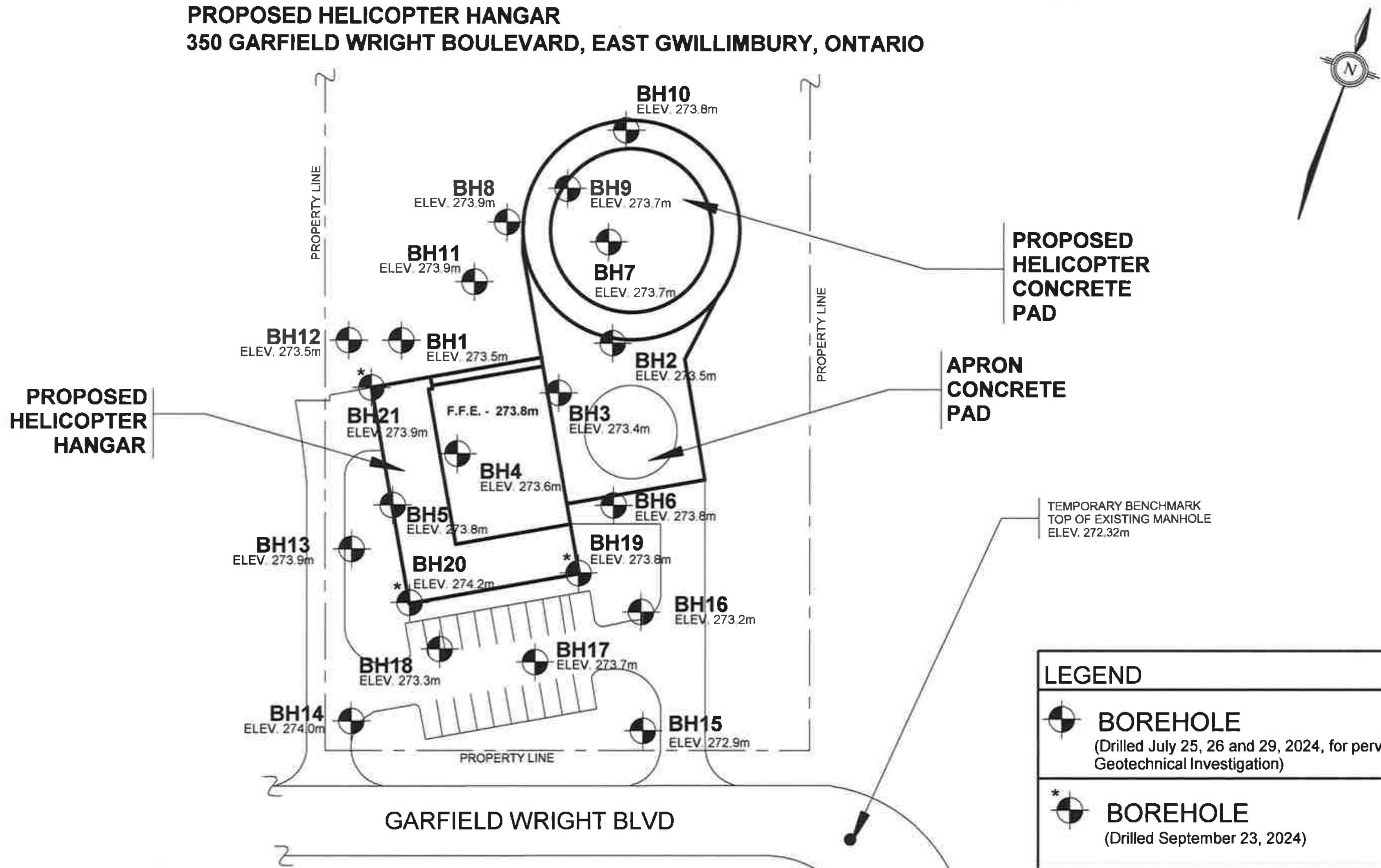
Yours truly,
**PATRIOT ENGINEERING LTD.**

LICENSED PROFESSIONAL ENGINEER
L. GALIMANIS
17 OCT. 2024
PROVINCE OF ONTARIO

Larry Galimanis, P.Eng.
Principal / Consulting Engineer

Distribution: Mr. Lind Nyman, Parkin Architects Limited (4)

**FIGURE 1: PARTIAL SITE PLAN SHOWING THE APPROXIMATE BOREHOLE LOCATIONS**
**PROPOSED HELICOPTER HANGAR**
**350 GARFIELD WRIGHT BOULEVARD, EAST GWILLIMBURY, ONTARIO**




**LEGEND**

BOREHOLE
(Drilled July 25, 26 and 29, 2024, for pervious Geotechnical Investigation)

* BOREHOLE
(Drilled September 23, 2024)

REFERENCE:
PARTIAL SITE PLAN INFORMATION ADAPTED FROM OVERALL SITE PLAN DRAWING NO. A-002, PREPARED BY PARKIN ARCHITECTS LIMITED, SUBMITTED TO US ON AUGUST 31, 2024.

| | Name | Date |
|---|---|---|
| Drawn By | M.A. | Sept '24 |
| Checked By | L.G. | Sept '24 |
| Revisions | | |
| Scale | Reduced From Original | |

**PATRIOT ENGINEERING LTD.**
Consulting Engineers

Project: 44148A
Figure: 1

**Project No:** 44148A

## Borehole #: BH1

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

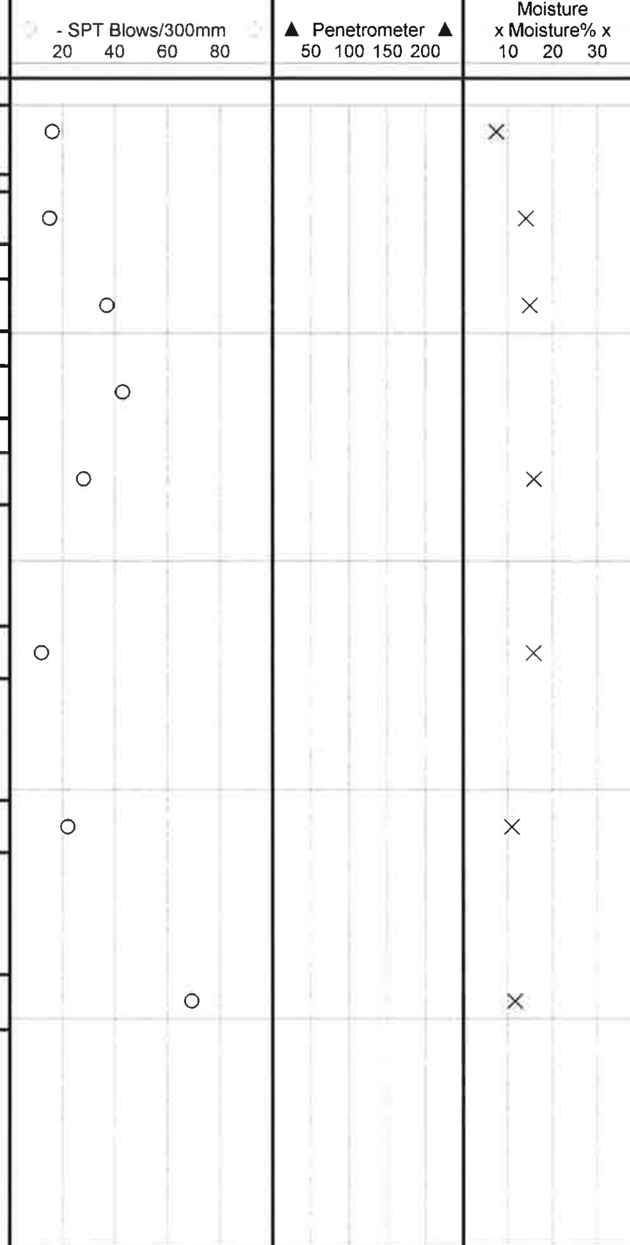
**Drawing No.:** 2

**SUBSURFACE PROFILE**

| Depth (m) | Description | Elevation (m) |
|---|---|---|
| | Ground Surface | 273.5 |
| 0 | ***TOPSOIL - 75mm*** | |
| | ***FILL - SILT*** compact to dense, brown, slightly moist to moist, some clay, some sand, trace gravel, trace topsoil, trace plastic pieces | 271.4 |
| | ***SILT*** compact to very dense, brown becoming grey below 4.6m depth, moist to saturated, trace to some clay, trace gravel, trace cobbles, dilated at Samples SS6 and SS7 | 266.4 |
| | ***SANDY SILT*** very dense, grey, moist, trace clay, trace gravel | 265.4 |
| | ***END OF BOREHOLE*** See next page for notes... | |

**SAMPLE**

| Type | N = Blows/300mm | Recovery (%) | U.Wt. (kN/m3) |
|---|---|---|---|
| SS1 | 16 | 80 | |
| SS2 | 15 | 65 | |
| SS3 | 37 | 75 | |
| SS4 | 43 | 0* | |
| SS5 | 28 | 85 | |
| SS6 | 12 | 100 | |
| SS7 | 22 | 100 | |
| SS8 | 69 | 100 | |




Depth (m): 0 1 2 3 4 5 6 7 8 9 10

Drill Method: S/S Auger

Drill Date: July 25 & 26, 2024

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Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | ***Borehole #: BH1*** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 2 |

| SUBSURFACE PROFILE | | | | SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | - SPT Blows/300mm 20 40 60 80 | ▲ Penetrometer ▲ 50 100 150 200 | Moisture x Moisture% x 10 20 30 |
| 11–20 | | Notes:<br><br>* There was no sample recovered in the spoon. The auger sample was not representative.<br><br>1. Boreholes advanced using solid stem augers to 8.1m depth on July 25 & 26, 2024.<br><br>2. Short term groundwater water level measured at 5.0m depth upon completion of drilling. | | | | | | | | |

Drill Method: S/S Auger

Drill Date: July 25 & 26, 2024

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Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | **Borehole #: BH2** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 3 |

| SUBSURFACE PROFILE | | | | SAMPLE | | | | - SPT Blows/300mm (20 40 60 80) | ▲ Penetrometer ▲ (50 100 150 200) | Moisture x Moisture% x (10 20 30) |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | | | |
| | | Ground Surface | 273.5 | | | | | | | |
| 0 | | ***TOPSOIL - 75mm*** | | SS1 | 10 | 45 | | | | |
| | | ***FILL - SILT*** compact to dense, brown, slightly moist to moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 272.1 | SS2 | 31 | 85 | | | | |
| | | ***SILT*** compact to very dense, brown, moist to saturated, some clay, trace sand, trace gravel, isolated pockets of clay, oxidized, minor dilation at Samples SS5, SS6, SS7 and SS8 | | SS3 | 44 | 100 | | | | |
| | | | | SS4 | 16 | 50 | | | | |
| | | | | SS5 | 19 | 90 | | | | |
| | | | | SS6 | 19 | 80 | | | | |
| | | | | SS7 | 27 | 100 | | | | |
| 8 | | | 265.3 | SS8 | 55 | 100 | | | | |
| | | ***END OF BOREHOLE*** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on July 25, 2024. 2. Short term groundwater water level measured at 5.3m depth upon completion of drilling. | | | | | | | | |
| 10 | | | | | | | | | | |

Drill Method: S/S Auger

Drill Date: July 25, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

**Project:** Proposed Helicopter Hanger

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Client:** Parkin Architects Limited

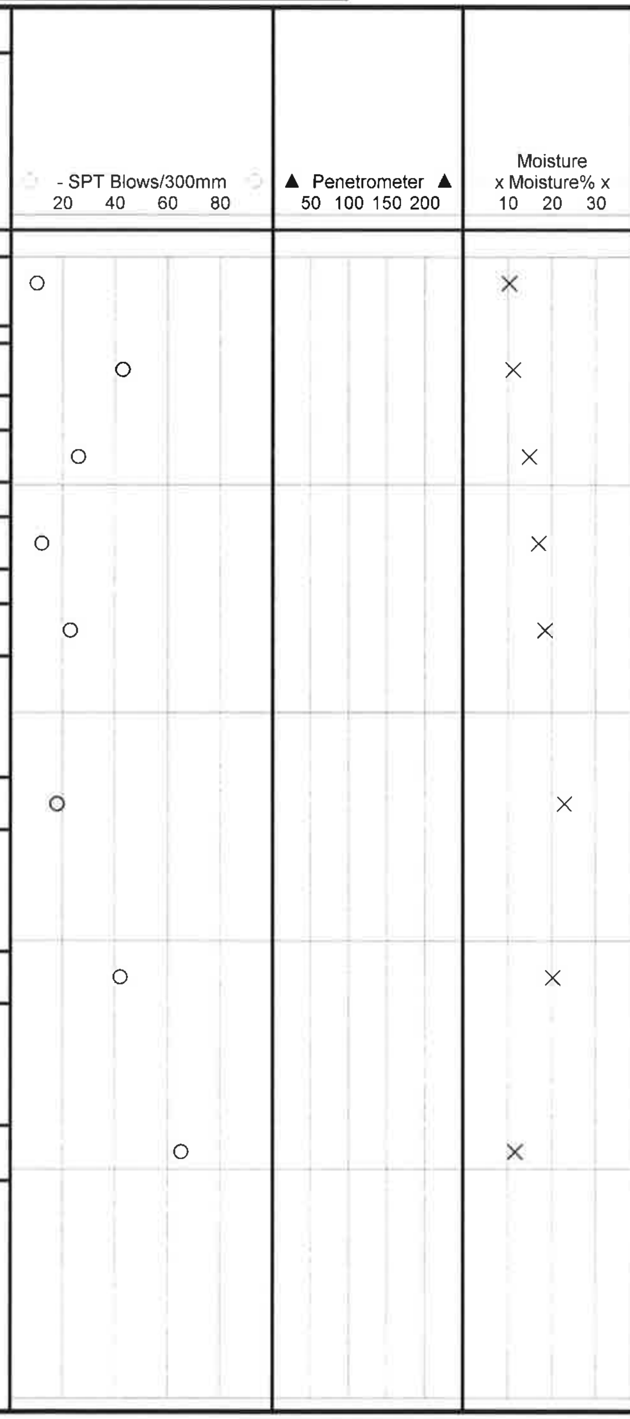
## *Borehole #: BH3*

**Borehole Location:** See Figure 1

**Project Engineer:** L.G.

**Drawing No.:** 4

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
| | | Ground Surface | 273.4 | | | | |
| 0 | | ***TOPSOIL - 75mm*** | | SS1 | 10 | 65 | |
| | | ***FILL - SILT*** compact to dense, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, minor dilation at Samples SS4 and SS5 | | SS2 | 43 | 60 | |
| | | | | SS3 | 26 | 80 | |
| | | | | SS4 | 12 | 75 | |
| | | | 270.0 | SS5 | 23 | 70 | |
| | | ***SILT*** compact to very dense, brown becoming grey below 4.6m depth, moist to saturated, trace clay, some sand, trace gravel, isolated pockets of clay, oxidized, dilated at Samples SS6 and SS7 | | SS6 | 18 | 100 | |
| | | | | SS7 | 42 | 100 | |
| | | | 265.3 | SS8 | 65 | 100 | |
| | | ***END OF BOREHOLE*** Notes: 1. Borehole advanced using solid stem augers to 8.1m depth on July 25, 2024. 2. Short term groundwater level measured at 5.3m depth upon completion of drilling. | | | | | |
| 10 | | | | | | | |




Drill Method: S/S Auger

Drill Date: July 25, 2024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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH4

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

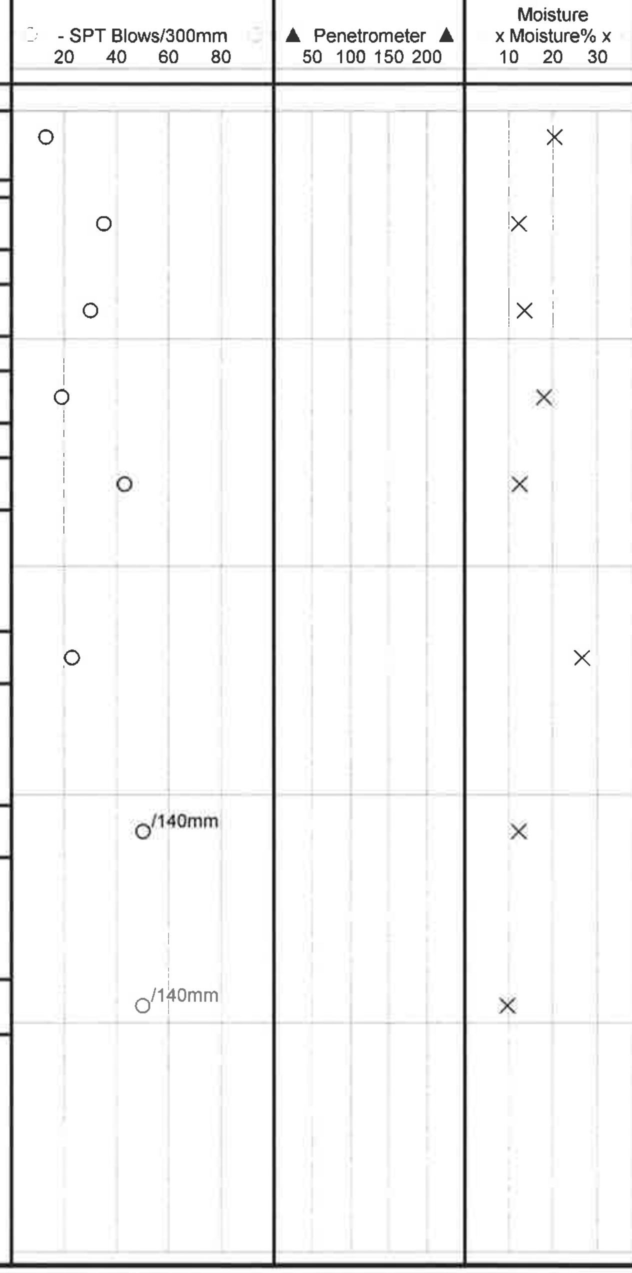
**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 5

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| | Ground Surface | 273.6 | | | | |
| 0 | ***TOPSOIL - 55mm*** | | SS1 | 13 | 45 | |
| | ***FILL - SILT*** compact to dense, brown, very moist to moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | | SS2 | 35 | 85 | |
| | | | SS3 | 30 | 100 | |
| | | | SS4 | 19 | 50 | |
| | | 270.2 | SS5 | 43 | 90 | |
| | ***SILT*** compact to very dense, brown becoming grey below 4.6m depth, moist to saturated, some clay, some sand, trace gravel, isolated pockets of clay, oxidized, dilated at Sample SS6 | | SS6 | 23 | 80 | |
| | | 266.5 | SS7 | 50 | 100 | |
| | ***SANDY SILT*** very dense, grey, moist, trace clay, trace gravel | 265.5 | SS8 | 50 | 100 | |
| | ***END OF BOREHOLE*** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on July 25, 2024. 2. Short term groundwater water level measured at 4.3m depth upon completion of drilling. | | | | | |




Drill Method: S/S Auger

Drill Date: July 25, 2024

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Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | **Borehole #: BH5** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 6 |

| SUBSURFACE PROFILE | | | SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | SPT Blows/300mm (20 40 60 80) | Penetrometer (50 100 150 200) | Moisture x Moisture% x (10 20 30) |
| | Ground Surface | 273.8 | | | | | | | |
| 0 | ***TOPSOIL - 75mm*** | | SS1 | 14 | 80 | | | | |
| | ***FILL - SILT*** compact to very dense, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, trace wood peices | 272.4 | SS2 | 52 | 70 | | | | |
| | ***SILT*** compact to very dense, brown becoming grey below 6.2m depth, slightly moist to saturated, some sand, trace clay, trace gravel, isolated pockets of clay, oxidized, dilated in Samples SS6, SS7 and SS8 | | SS3 | 57 | 85 | | | | |
| | | | SS4 | 37 | 80 | | | | |
| | | | SS5 | 27 | 55 | | | | |
| | | | SS6 | 26 | 80 | | | | |
| | | | SS7 | 42 | 100 | | | | |
| 8 | | 265.7 | SS8 | 50 | 85 | | /50mm | | |
| | ***END OF BOREHOLE*** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on July 25, 2024. 2. Short term groundwater water level measured at 5.3m depth upon completion of drilling. | | | | | | | | |

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Drill Method: S/S Auger

Drill Date: July 25, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH6

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 7

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| | Ground Surface | 273.8 | | | | |
| 0 | **TOPSOIL - 60mm** | | SS1 | 7 | 45 | |
| | **FILL - SILT** loose to very dense, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | | SS2 | 38 | 95 | |
| | | | SS3 | 55 | 100 | |
| | | | SS4 | 51 | 10 | |
| | | 270.4 | SS5 | 31 | 100 | |
| | **SILT** compact to very dense, brown becoming grey below 4.6m depth, moist to saturated, some sand, trace clay, trace gravel, isolated pockets of clay, oxidized, dilated in Samples SS6, SS7 and SS8 | | SS6 | 13 | 100 | |
| | | | SS7 | 66 | 100 | |
| | | 265.7 | SS8 | 50 | 55 | |
| | **END OF BOREHOLE** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on July 25, 2024. 2. Short term groundwater water level measured at 4.7m depth upon completion of drilling. | | | | | |

Chart columns: ○ - SPT Blows/300mm ○ (20, 40, 60, 80); ▲ Penetrometer ▲ (50, 100, 150, 200); Moisture x Moisture% x (10, 20, 30)

/125mm

Drill Method: S/S Auger

Drill Date: July 25, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH7

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 8

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.9 | | | | |
| | ***TOPSOIL - 55mm*** | | SS1 | 12 | 55 | |
| 1 | ***FILL - SILT*** compact, brown, slightly moist to moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, isolated pockets of topsoil | 272.5 | SS2 | 10 | 90 | |
| 2 | ***SILT*** compact to very dense, brown, moist, some sand, trace clay, trace gravel | | SS3 | 17 | 80 | |
| 3 | | | SS4 | 55 | 100 | |
| 4 | | | SS5 | 78 | 90 | |
| 5 | | 268.9 | SS6 | 28 | 85 | |
| | ***END OF BOREHOLE*** | | | | | |

SUBSURFACE PROFILE / SAMPLE

Depth (m): 0 1 2 3 4 5 6 7 8 9 10

- SPT Blows/300mm: 20 40 60 80

▲ Penetrometer ▲: 50 100 150 200

Moisture x Moisture% x: 10 20 30

Notes:

1. Boreholes advanced using solid stem augers to 5.0m depth on July 26, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 26, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

## Borehole #: BH8

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 9

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt (kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.9 | | | | |
| | ***TOPSOIL - 75mm*** | | | | | |
| | ***FILL - SILT*** compact, brown, slightly moist to moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, oxidized | | SS1 | 10 | 45 | |
| | | | SS2 | 13 | 80 | |
| | | 272.2 | | | | |
| | ***SILT*** compact to dense, brown becoming grey below 4.6m, moist, some sand, trace clay, trace gravel, oxidized | | SS3 | 28 | 90 | |
| | | | SS4 | 39 | 70 | |
| | | | SS5 | 29 | 100 | |
| | | 268.9 | SS6 | 30 | 80 | |
| 5 | ***END OF BOREHOLE*** | | | | | |

Notes:

1. Boreholes advanced using solid stem augers to 5.0m depth on July 26, 2024.

2. Borehole was found to be dry upon completion of drilling.

Chart columns: ○ - SPT Blows/300mm ○ (20, 40, 60, 80); ▲ Penetrometer ▲ (50, 100, 150, 200); Moisture x Moisture% x (10, 20, 30)

Drill Method: S/S Auger

Drill Date: July 26, 2024


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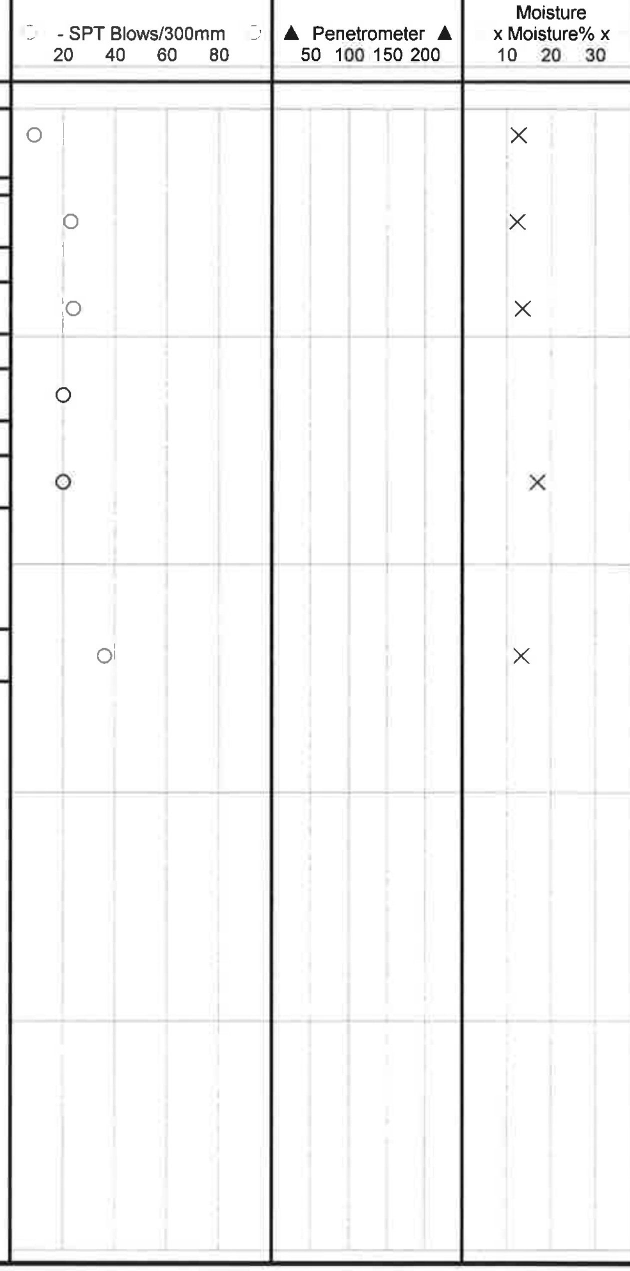
Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | # Borehole #: BH9 |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 10 |

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| | Ground Surface | 273.7 | | | | |
| 0 | ***TOPSOIL - 75mm*** | | | | | |
| | ***FILL - SILT*** loose to compact, brown, moist, some clay, som sand, trace gravel, trace topsoil, trace rootlets | | SS1 | 9 | 55 | |
| 1 | | | SS2 | 23 | 80 | |
| | | 272.0 | | | | |
| 2 | ***SILT*** compact to dense, brown, moist, some sand, trace clay, trace gravel, oxidized, minor dilation in Sample SS4 | | SS3 | 24 | 95 | |
| | | | SS4 | 20 | 100 | |
| 3 | | | SS5 | 20 | 65 | |
| 4 | | | | | | |
| 5 | | 268.7 | SS6 | 36 | 100 | |
| | ***END OF BOREHOLE*** | | | | | |
| 6 | Notes: 1. Boreholes advanced using solid stem augers to 5.0m depth on July 26, 2024. 2. Borehole was found to be dry upon completion of drilling. | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |




Drill Method: S/S Auger

Drill Date: July 26, 2024

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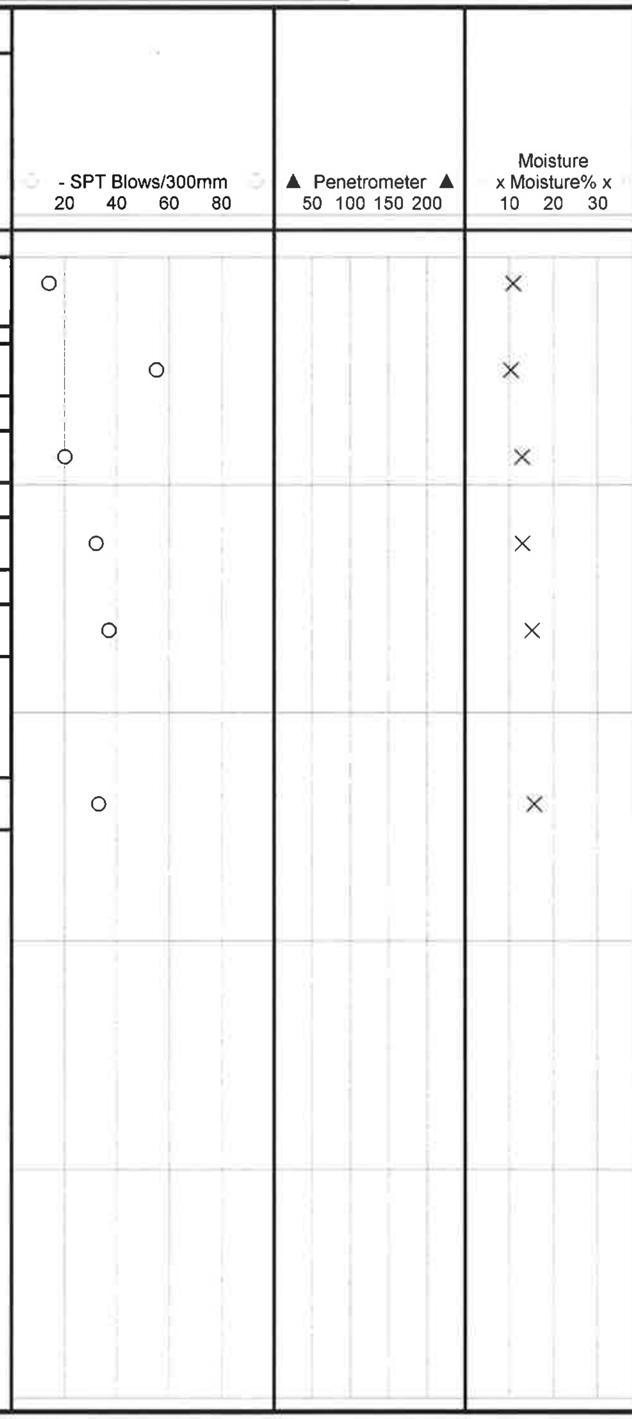
Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | **Borehole #: BH10** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 11 |

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
| | | Ground Surface | 273.8 | | | | |
| 0 | | ***TOPSOIL - 50mm*** | | SS1 | 14 | 85 | |
| 1 | | ***FILL - SILT*** compact to very dense, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, trace brick fragments | | SS2 | 55 | 95 | |
| 2 | | | 271.6 | SS3 | 20 | 65 | |
| 3 | | ***SILT*** dense, brown, moist, some sand, trace clay, trace gravel, oxidized | | SS4 | 32 | 65 | |
| 4 | | | | SS5 | 37 | 55 | |
| 5 | | | 268.7 | SS6 | 33 | 100 | |
| 6 | | ***END OF BOREHOLE*** | | | | | |
| 7 | | Notes: | | | | | |
| 8 | | 1. Boreholes advanced using solid stem augers to 5.0m depth on July 26, 2024. | | | | | |
| 9 | | 2. Borehole was found to be dry upon completion of drilling. | | | | | |
| 10 | | | | | | | |




| | | |
|---|---|---|
| Drill Method: S/S Auger | PATRIOT ENGINEERING LTD. | Datum: Geodetic |
| Drill Date: July 26, 2024 | 80 Nashdene Road., Unit 62, Toronto, ON, M1V 5E4<br>Phone: (416) 293-7716 Fax: (416) 293-6722<br>e-mail: info@patrioteng.ca | Checked by: L.G. |

**Project No:** 44148A

# *Borehole #: BH11*

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 12

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | SPT Blows/300mm (20 40 60 80) | Penetrometer (50 100 150 200) | Moisture x Moisture% x (10 20 30) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.7 | | | | | | | |
| | ***TOPSOIL - 65mm*** | | | | | | | | |
| | ***FILL - SILT*** compact, brown, slightly moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 273.0 | SS1 | 10 | 60 | | | | |
| 1 | ***SILT*** very dense to dense, brown, slightly moist to moist, some sand, trace clay, trace gravel | | SS2 | 59 | 95 | | | | |
| | | 271.7 | SS3 | 32 | 85 | | | | |
| 2 | ***END OF BOREHOLE*** | | | | | | | | |

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 29, 2024

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e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

**Borehole #: BH12**

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 13

| SUBSURFACE PROFILE | | | | SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | - SPT Blows/300mm (20 40 60 80) | ▲ Penetrometer ▲ (50 100 150 200) | Moisture x Moisture% x (10 20 30) |
| | | Ground Surface | 273.5 | | | | | | | |
| 0 | | ***TOPSOIL - 50mm*** | | | | | | | | |
| | | ***FILL - SILT*** compact to loose, brown, moist to saturated, some clay, some sand, trace gravel, trace topsoil, trace rootlets, dilated at Sample SS2 | | SS1 | 13 | 65 | | | | |
| 1 | | | | SS2 | 6 | 80 | | | | |
| | | | 271.9 | | | | | | | |
| | | ***SILT*** dense, brown, moist, some sand, trace clay, trace gravel | 271.5 | SS3 | 30 | 70 | | | | |
| 2 | | ***END OF BOREHOLE*** | | | | | | | | |
| | | Notes: 1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024. 2. Borehole was found to be dry upon completion of drilling. | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |

Drill Method: S/S Auger

Drill Date: July 29, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

## Borehole #: BH13

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 14

| SUBSURFACE PROFILE | | | | SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | - SPT Blows/300mm 20 40 60 80 | ▲ Penetrometer ▲ 50 100 150 200 | Moisture x Moisture% x 10 20 30 |
| 0 | | Ground Surface | 273.9 | | | | | | | |
| | | ***TOPSOIL - 50mm*** | | | | | | | | |
| | | ***FILL - SILT*** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 273.2 | SS1 | 11 | 45 | | | | |
| 1 | | ***SILT*** compact, brown, moist, some sand, trace clay, trace gravel | | SS2 | 22 | 90 | | | | |
| | | | 272.0 | SS3 | 23 | 80 | | | | |
| 2 | | ***END OF BOREHOLE*** | | | | | | | | |

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 29, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH14

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 15

| SUBSURFACE PROFILE | | | | SAMPLE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) | SPT Blows/300mm (20 40 60 80) | ▲ Penetrometer ▲ (50 100 150 200) | Moisture x Moisture% x (10 20 30) |
| | | Ground Surface | 274.0 | | | | | | | |
| 0 | | ***TOPSOIL - 60mm*** | | | | | | | | |
| | | ***FILL - SILT*** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 273.3 | SS1 | 20 | 60 | | | | |
| 1 | | ***SILT*** compact, brown, moist to saturated, some sand, trace clay, trace gravel, minor dilation in Sample SS3 | | SS2 | 14 | 80 | | | | |
| | | | 272.0 | SS3 | 22 | 100 | | | | |
| 2 | | ***END OF BOREHOLE*** | | | | | | | | |

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 29, 2024

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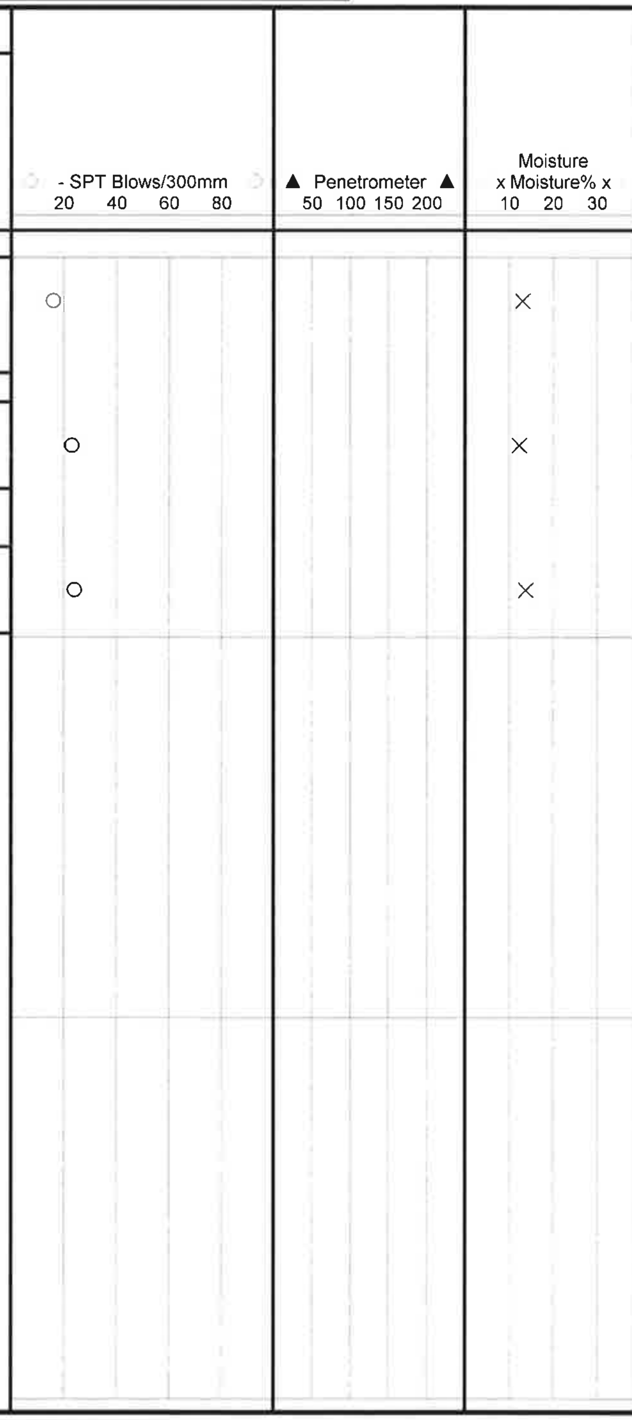
e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

| | |
|---|---|
| **Project No:** 44148A | ***Borehole #: BH15*** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 16 |

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
| | | Ground Surface | 272.9 | | | | |
| 0 | | ***TOPSOIL - 75mm*** | 272.9 | | | | |
| | | ***FILL - SILT*** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 272.2 | SS1 | 16 | 100 | |
| 1 | | ***SILT*** compact, brown, moist, some sand, trace clay, trace gravel | | SS2 | 23 | 80 | |
| | | | 271.0 | SS3 | 24 | 70 | |
| 2 | | ***END OF BOREHOLE*** | | | | | |
| | | Notes: | | | | | |
| | | 1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024. | | | | | |
| 3 | | 2. Borehole was found to be dry upon completion of drilling. | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |




| | | |
|---|---|---|
| Drill Method: S/S Auger | PATRIOT ENGINEERING LTD. | Datum: Geodetic |
| Drill Date: July 29, 2024 | 80 Nashdene Road., Unit 62, Toronto, ON, M1V 5E4<br>Phone: (416) 293-7716 Fax: (416) 293-6722<br>e-mail: info@patrioteng.ca | Checked by: L.G. |

| | |
|---|---|
| **Project No:** 44148A | **Borehole #: BH16** |
| **Project:** Proposed Helicopter Hanger | **Borehole Location:** See Figure 1 |
| **Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON | **Project Engineer:** L.G. |
| **Client:** Parkin Architects Limited | **Drawing No.:** 17 |

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.2 | | | | |
| | ***TOPSOIL - 75mm*** | 273.1 | | | | |
| | ***FILL - SILT*** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | | SS1 | 14 | 100 | |
| 1 | | 272.2 | | | | |
| | ***SILT*** compact, brown, moist, some sand, trace clay, trace gravel | | SS2 | 20 | 90 | |
| | | | SS3 | 21 | 70 | |
| 2 | | 271.2 | | | | |
| | ***END OF BOREHOLE*** | | | | | |

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

- SPT Blows/300mm (20 40 60 80) · ▲ Penetrometer ▲ (50 100 150 200) · Moisture x Moisture% x (10 20 30)

Drill Method: S/S Auger

Drill Date: July 29, 2024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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

## Borehole #: BH17

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 18

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.7 | | | | |
| | **TOPSOIL - 75mm** | 273.6 | | | | |
| | **FILL - SILT** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, trace wood pieces | | SS1 | 13 | 60 | |
| 1 | | | SS2 | 14 | 95 | |
| | **SILT** dense, brown, moist, some sand, trace clay, trace gravel | 272.1 | SS3 | 30 | 80 | |
| 2 | **END OF BOREHOLE** | 271.7 | | | | |

Chart columns: - SPT Blows/300mm (20, 40, 60, 80); ▲ Penetrometer ▲ (50, 100, 150, 200); Moisture x Moisture% x (10, 20, 30)

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 29, 2024

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Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH18

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 19

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.3 | | | | |
| | **TOPSOIL - 75mm** | 273.2 | | | | |
| | **FILL - SILT** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets, trace wood peices | 272.4 | SS1 | 11 | 60 | |
| 1 | **SILT** compact, brown, moist, some sand, trace clay, trace gravel | 271.3 | SS2 | 25 | 95 | |
| | | | SS3 | 24 | 80 | |
| 2 | **END OF BOREHOLE** | | | | | |

Chart columns: - SPT Blows/300mm (20, 40, 60, 80); ▲ Penetrometer ▲ (50, 100, 150, 200); Moisture x Moisture% x (10, 20, 30)

Depth scale: 0, 1, 2, 3, 4, 5, 6

**END OF BOREHOLE**

Notes:

1. Boreholes advanced using solid stem augers to 2.0m depth on July 29, 2024.

2. Borehole was found to be dry upon completion of drilling.

Drill Method: S/S Auger

Drill Date: July 29, 2024

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Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH19

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

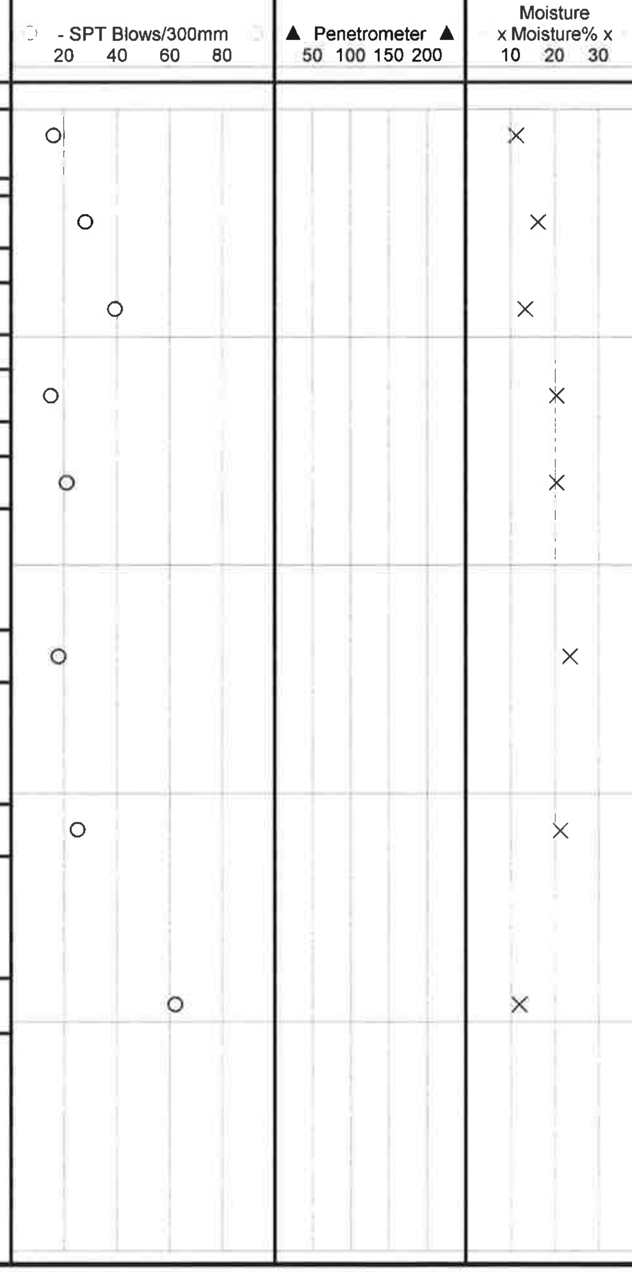
**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 20

| SUBSURFACE PROFILE | | | | SAMPLE | | | |
|---|---|---|---|---|---|---|---|
| Depth (m) | Symbol | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt (kN/m3) |
| | | Ground Surface | 273.8 | | | | |
| 0 | | ***TOPSOIL - 60mm*** | | SS1 | 16 | 100 | |
| | | ***FILL - SILT*** compact to dense, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | | SS2 | 28 | 95 | |
| 2 | | | 271.7 | SS3 | 39 | 100 | |
| | | ***SILT*** compact to very dense, brown becoming grey below 4.6m depth, moist to saturated, some sand, trace clay, trace gravel, isolated pockets of clay, oxidized, dilated | | SS4 | 15 | 100 | |
| 3 | | | | SS5 | 21 | 100 | |
| 5 | | | | SS6 | 18 | 100 | |
| 6 | | | | SS7 | 25 | 100 | |
| 7 | | | 266.8 | | | | |
| | | ***SANDY SILT*** very dense, grey, moist, some clay, trace gravel, minor dilation | | | | | |
| 8 | | | 265.7 | SS8 | 62 | 100 | |
| | | ***END OF BOREHOLE*** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on September 23, 2024. 2. Short term groundwater water level measured at 5m depth upon completion of drilling. | | | | | |
| 10 | | | | | | | |




Drill Method: S/S Auger

Drill Date: September 23, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH20

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 21

## SUBSURFACE PROFILE

| Depth (m) | Description | Elevation (m) |
|---|---|---|
| | Ground Surface | 274.2 |
| 0 | ***TOPSOIL - 60mm*** | |
| | ***FILL - SILT*** compact, brown, moist, some clay, some sand, trace gravel, trace topsoil, trace rootlets | 272.1 |
| 2 | ***SILT*** compact, brown becoming grey below 4.6m depth, moist to saturated, some sand, trace clay, trace gravel, isolated pockets of clay, oxidized, dilated | 268.6 |
| 5.5 | ***SANDY SILT*** very dense, grey, moist, trace clay, trace gravel | 266.1 |
| 8.1 | ***END OF BOREHOLE*** | |

## SAMPLE

| Type | N = Blows/300mm | Recovery (%) | U.Wt. (kN/m3) |
|---|---|---|---|
| SS1 | 17 | 100 | |
| SS2 | 25 | 100 | |
| SS3 | 23 | 100 | |
| SS4 | 17 | 100 | |
| SS5 | 10 | 100 | |
| SS6 | 19 | 100 | |
| SS7 | 56 | 100 | |
| SS8 | 50 | 30 | |

- SPT Blows/300mm (20 40 60 80) ▲ Penetrometer ▲ (50 100 150 200) Moisture x Moisture% x (10 20 30)

SS8: 50/125mm

**END OF BOREHOLE**

Notes:
1. Boreholes advanced using solid stem augers to 8.1m depth on September 23, 2024.
2. Short term groundwater water level measured at 5.4m depth upon completion of drilling.

Drill Method: S/S Auger

Drill Date: September 23, 2024

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Datum: Geodetic

Checked by: L.G.

**Project No:** 44148A

# Borehole #: BH21

**Project:** Proposed Helicopter Hanger

**Borehole Location:** See Figure 1

**Location:** 350 Garfield Wright Boulevard, East Gwillimbury, ON

**Project Engineer:** L.G.

**Client:** Parkin Architects Limited

**Drawing No.:** 22

| Depth (m) | Description | Elevation (m) | Type | N = Blows/300mm | Recovery (%) | U.Wt.(kN/m3) |
|---|---|---|---|---|---|---|
| 0 | Ground Surface | 273.9 | | | | |
| | ***TOPSOIL - 75mm*** | | | | | |
| | ***FILL - SILT*** compact, brown, moist, some clay, trace to some sand, trace gravel, trace topsoil, trace rootlets, trace wood pieces | | SS1 | 17 | 100 | |
| | | | SS2 | 20 | 100 | |
| | | | SS3 | 42 | 90 | |
| | | | SS4 | 36 | 100 | |
| | | | SS5 | 30 | 100 | |
| | | 269.8 | | | | |
| | ***SILT*** compact to very dense, brown becoming grey below 4.6m depth, slightly moist to saturated, trace sand, some clay, trace gravel, isolated pockets of clay, oxidized, dilated at Sample SS6 | | SS6 | 11 | 100 | |
| | | | SS7 | 85 | 100 | |
| | | 266.9 | | | | |
| | ***SANDY SILT*** very dense, grey, slightly moist, trace clay, trace gravel | | SS8 | 50 | 20 | |
| | | 265.8 | | | | |
| 10 | ***END OF BOREHOLE*** Notes: 1. Boreholes advanced using solid stem augers to 8.1m depth on September 23, 2024. 2. Short term groundwater water level measured at 5.4m depth upon completion of drilling. | | | | | |

- SPT Blows/300mm: 20 40 60 80 (SS8: /125mm)

▲ Penetrometer ▲: 50 100 150 200

Moisture x Moisture% x: 10 20 30

Drill Method: S/S Auger

Drill Date: September 23, 2024

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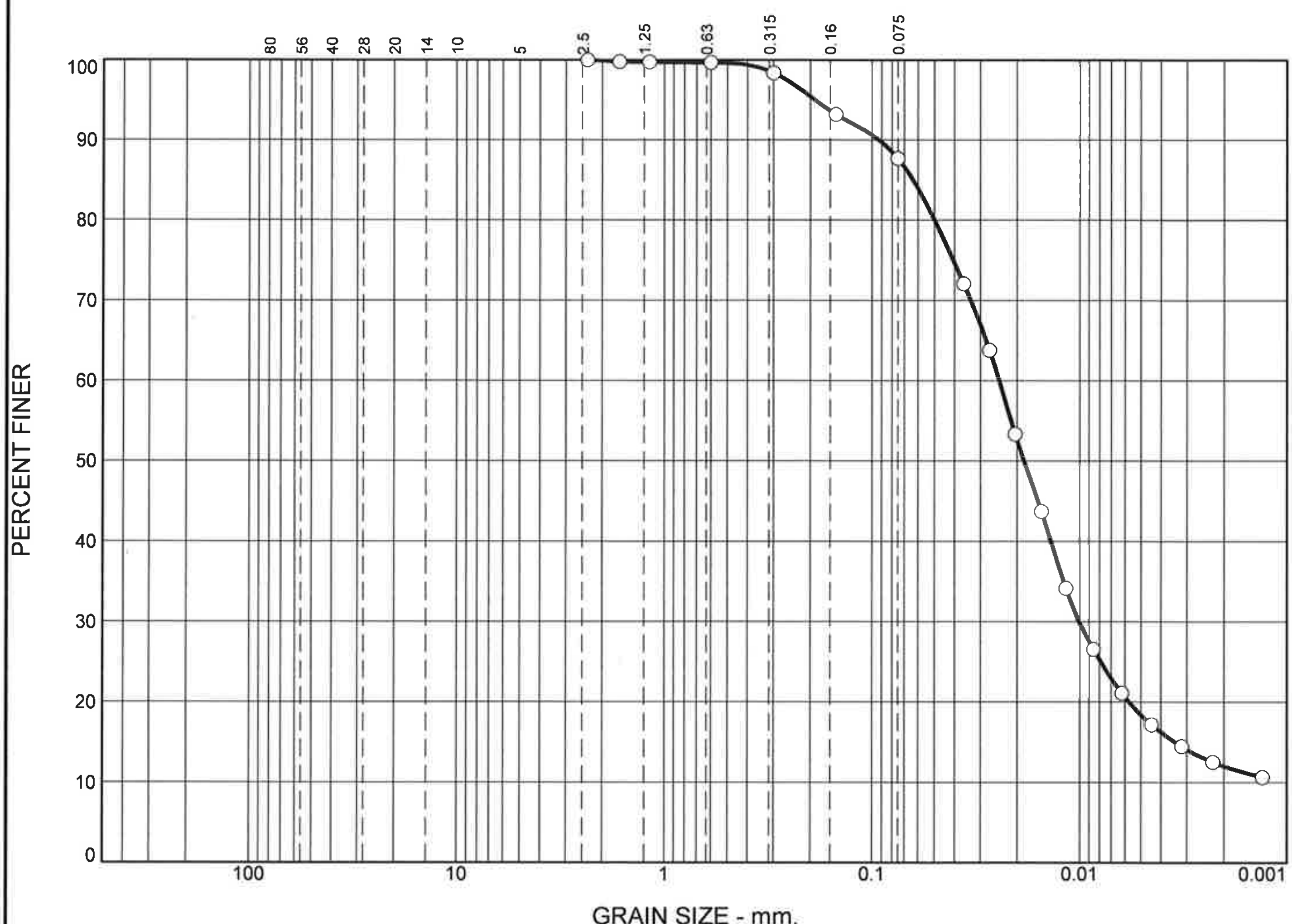
e-mail: info@patrioteng.ca

Datum: Geodetic

Checked by: L.G.

# Particle Size Distribution Report




| | % Cobbles | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.1 | 0.4 | 11.8 | 75.7 | 12.0 |
| | | | | | | | | |
| | | | | | | | | |

| | LL | PL | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 0.0635 | 0.0244 | 0.0185 | 0.0101 | 0.0034 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| Material Description | USCS | AASHTO |
|---|---|---|
| ○ Silt, some sand, some clay | | |

**Project No.** 44148A **Client:** Parkin Architects Limited

**Project:** Proposed Helicopter Hangar, 350 Garfield Wright Boulevard, East Gwillimbury, Ontario

○ **Source:** BH4 SS3 **Depth:** 5' to 6.5' **Sample No.:** R5071

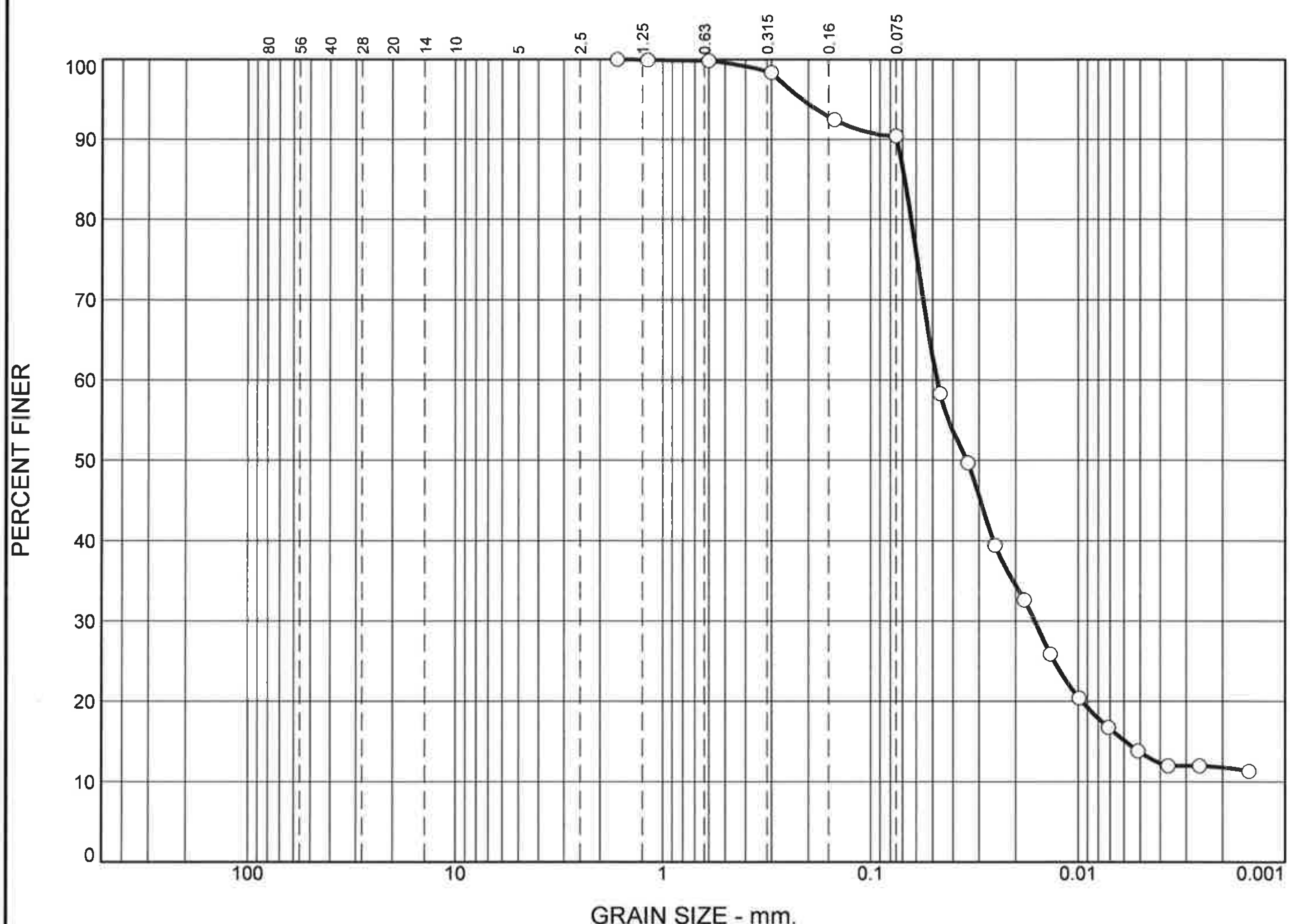
**Remarks:**

○ Date of Sampling: July 25, 2024

**PATRIOT ENGINEERING LTD. - CONSULTING ENGINEERS**

**Figure** 23

# Particle Size Distribution Report




| | % Cobbles | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 8.9 | 76.8 | 13.6 |

| | LL | PL | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 0.0682 | 0.0476 | 0.0343 | 0.0162 | 0.0059 | | | |

| Material Description | USCS | AASHTO |
|---|---|---|
| ○ silt, some clay, trace sand | | |

**Project No.** 44148A **Client:** Parkin Architects Limited

**Project:** Proposed Helicopter Hangar, 350 Garfield Wright Boulevard, East Gwillimbury, Ontario

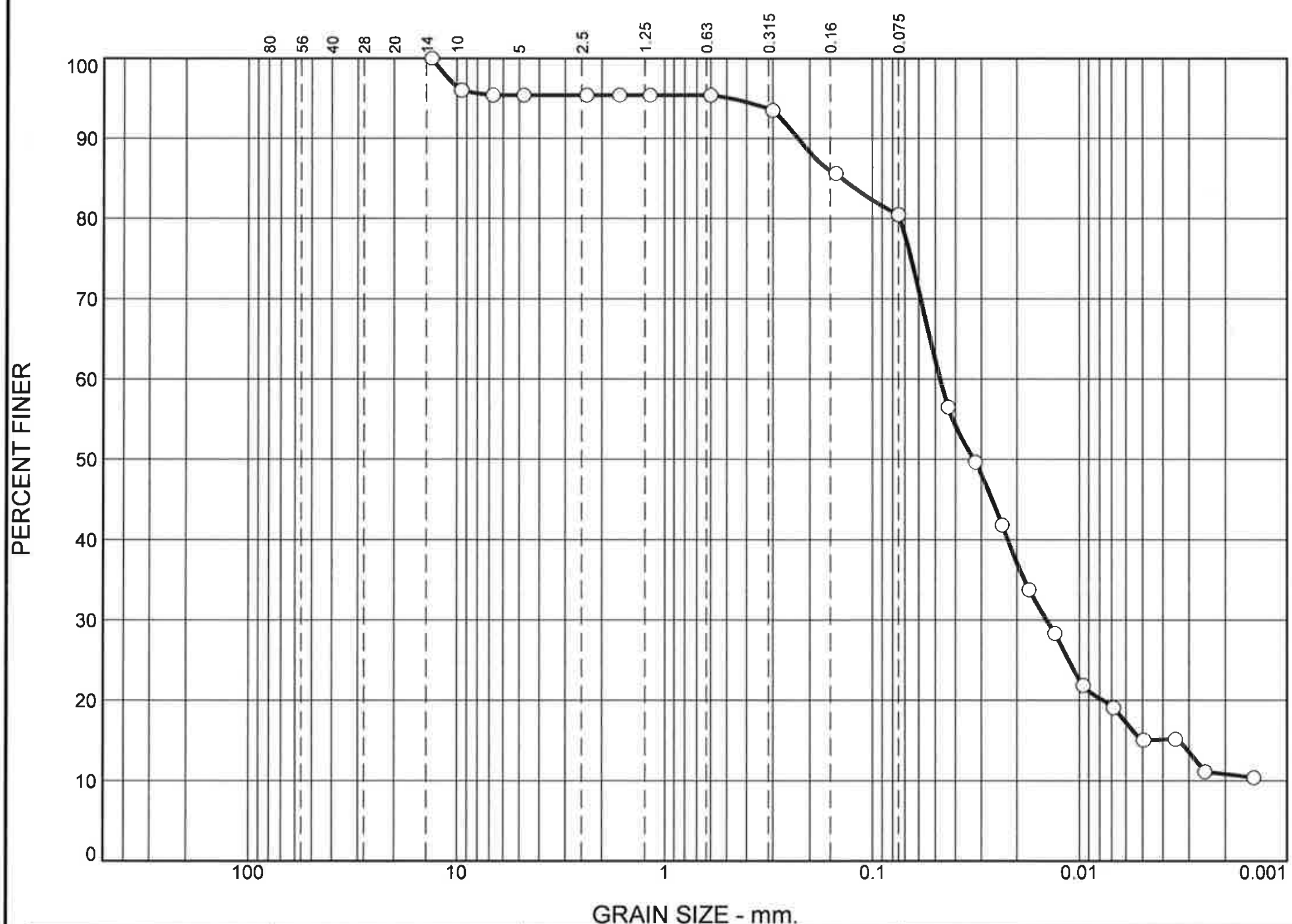
○ **Source:** BH21 SS3 **Depth:** 5' to 6.5' **Sample No.:** R5078

**Remarks:**
○ Date of Sampling
September 23, 2024

**PATRIOT ENGINEERING LTD. - CONSULTING ENGINEERS**

**Figure** 24

# Particle Size Distribution Report




| | % Cobbles | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 4.6 | 0.0 | 0.7 | 14.2 | 69.7 | 10.8 |
| | | | | | | | | |
| | | | | | | | | |

| | LL | PL | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 0.1403 | 0.0475 | 0.0327 | 0.0144 | 0.0034 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| Material Description | USCS | AASHTO |
|---|---|---|
| ○ Silt, some clay, some sand, trace gravel | | |

**Project No.** 44148A **Client:** Parkin Architects Limited

**Project:** Proposed Helicopter Hangar, 350 Garfield Wright Boulevard, East Gwillimbury, Ontario

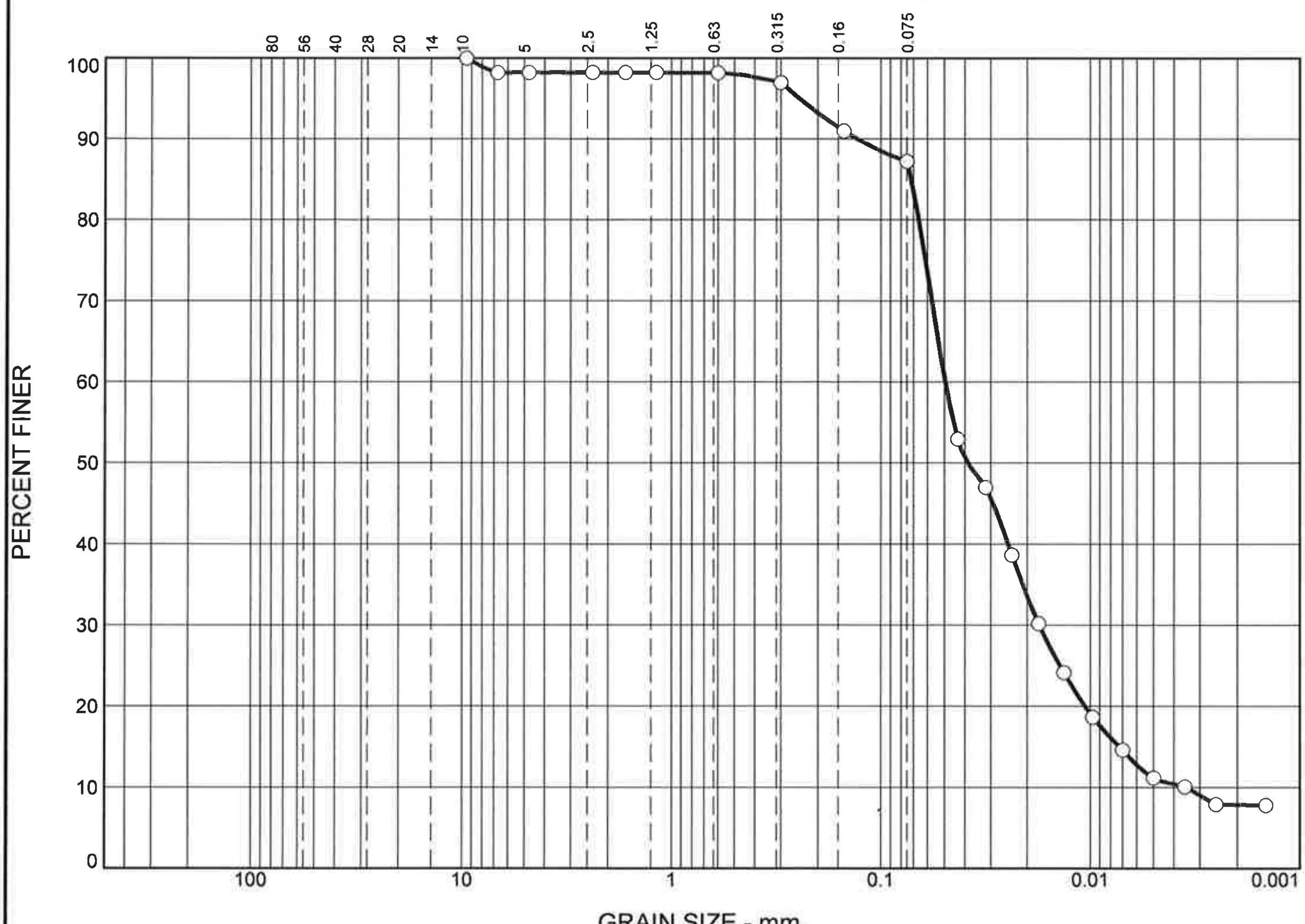
○ **Source:** BH2 SS3 **Depth:** 7.5' to 9' **Sample No.:** R5063

**Remarks:**
○Date of Sampling; July 25, 2024

**PATRIOT ENGINEERING LTD. - CONSULTING ENGINEERS**

**Figure** 25

# Particle Size Distribution Report




| | % Cobbles | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 1.8 | 0.0 | 0.5 | 10.5 | 79.4 | 7.8 |

| | LL | PL | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 0.0717 | 0.0495 | 0.0388 | 0.0175 | 0.0073 | 0.0035 | 1.77 | 14.12 |

| Material Description | USCS | AASHTO |
|---|---|---|
| ○ Silt, some sand, trace clay, trace gravel | | |

**Project No.** 44148A **Client:** Parkin Architects Limited

**Project:** Proposed Helicopter Hangar, 350 Garfield Wright Boulevard, East Gwillimbury, Ontario

○ **Source:** BH5 SS3 **Depth:** 7.5' to 9' **Sample No.:** R5064

**Remarks:**
○Date of Sampling, July 25, 2024

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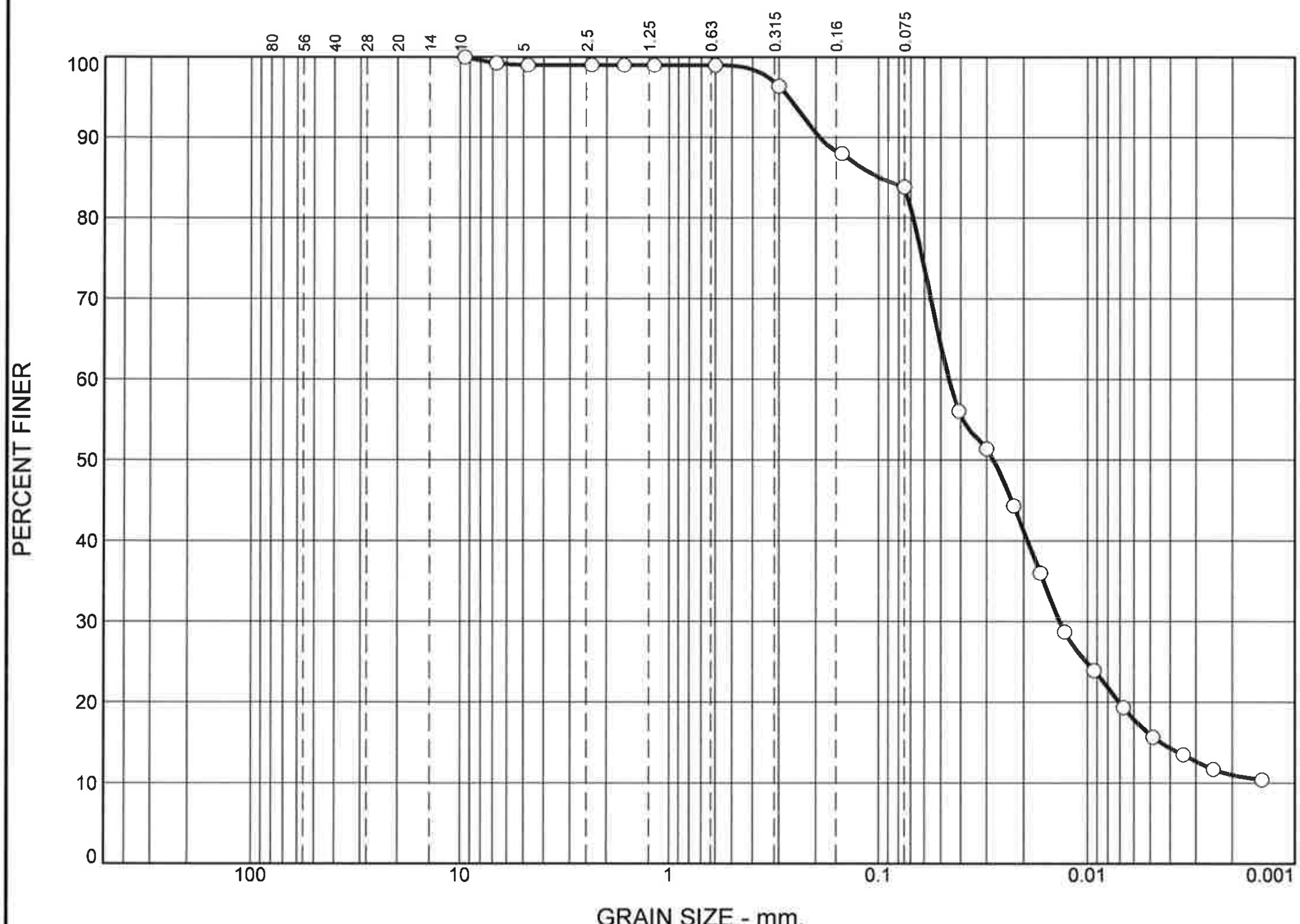
**Figure** 26

# Particle Size Distribution Report




| | % Cobbles | % Gravel | | % Sand | | | % Fines | |
|---|---|---|---|---|---|---|---|---|
| | | Coarse | Fine | Coarse | Medium | Fine | Silt | Clay |
| ○ | 0.0 | 0.0 | 1.0 | 0.0 | 0.4 | 14.7 | 72.9 | 11.0 |
| | | | | | | | | |
| | | | | | | | | |

| | LL | PL | $D_{85}$ | $D_{60}$ | $D_{50}$ | $D_{30}$ | $D_{15}$ | $D_{10}$ | $C_c$ | $C_u$ |
|---|---|---|---|---|---|---|---|---|---|---|
| ○ | | | 0.0991 | 0.0457 | 0.0279 | 0.0135 | 0.0044 | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

| Material Description | USCS | AASHTO |
|---|---|---|
| ○ Silt, some sand, trace clay, trace gravel | | |

**Project No.** 44148A **Client:** Parkin Architects Limited

**Project:** Proposed Helicopter Hangar, 350 Garfield Wright Boulevard, East Gwillimbury, Ontario

○ **Source:** BH9 SS3 **Depth:** 7.5' to 9' **Sample No.:** R5065

**Remarks:**
○Date of Sampling,
July 26, 2024

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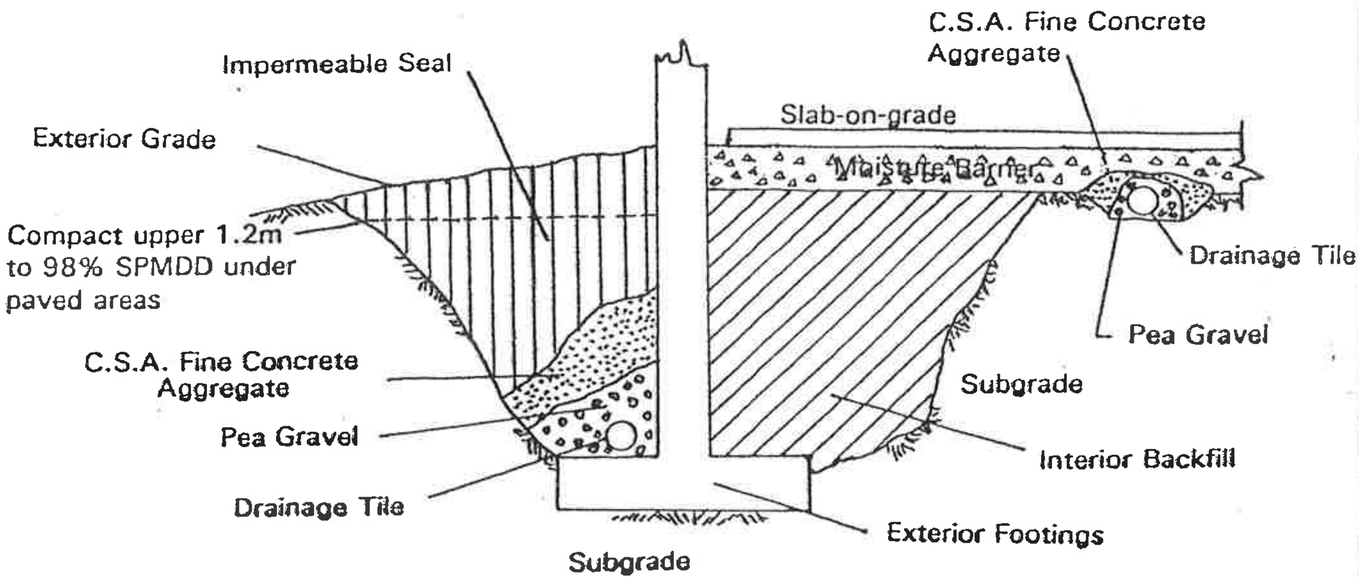
**Figure** 27




NOTES:

1. Drainage tile to consist of 10cm (4") diameter weeping tile or equivalent perforated pipe leading to a positive sump or outlet. Invert to be minimum of 15cm (6") below underside of floor slab.
2. Pea gravel 15cm (6") top and sides of drain. If drain is not on footing, place 10cm (4") of pea gravel below drain. 20mm (3/4") stone is an alternative, provided it is covered by an approved geotextile.
3. C.S.A. fine concrete aggregate to act as filter material. Minimum 30cm (12") top and side of tile drain. This may be replaced by an approved porous plastic membrane as indicated in 2.
4. Impermeable backfill seal-compacted clay, clay silt or equivalent. If original soil is free-draining, seal may be omitted.
5. The interior fill may be any clean, non organic soil which may be compacted to at least 98% Standard Proctor density in this confined space.
6. Do not use heavy compaction equipment within 0.5m (18") of the wall. Do not fill or compact within 1.8m (6') of wall unless the fill is placed on both sides simultaneously.
7. Moisture barrier to be at least 20cm (8") of compacted Granular "A" fill or equivalent free-draining material to be approved by our geotechnical staff.
8. The moisture barrier is to be compacted to 98% Standard Proctor maximum dry density.
9. Slab-on-grade should not be structurally connected to the wall or the footing.
10. Exterior grade to slope away from wall.
11. Underfloor drain invert to be at least 300mm (1') below the underside of floor slab. Tile placed in parallel rows 6-8m (20'- 25') centres one way.
12. Do not connect the underfloor drains to perimeter drains.
13. If the 20mm (3/4") stone requires surface blinding, use 6mm (1/4") stone chips.

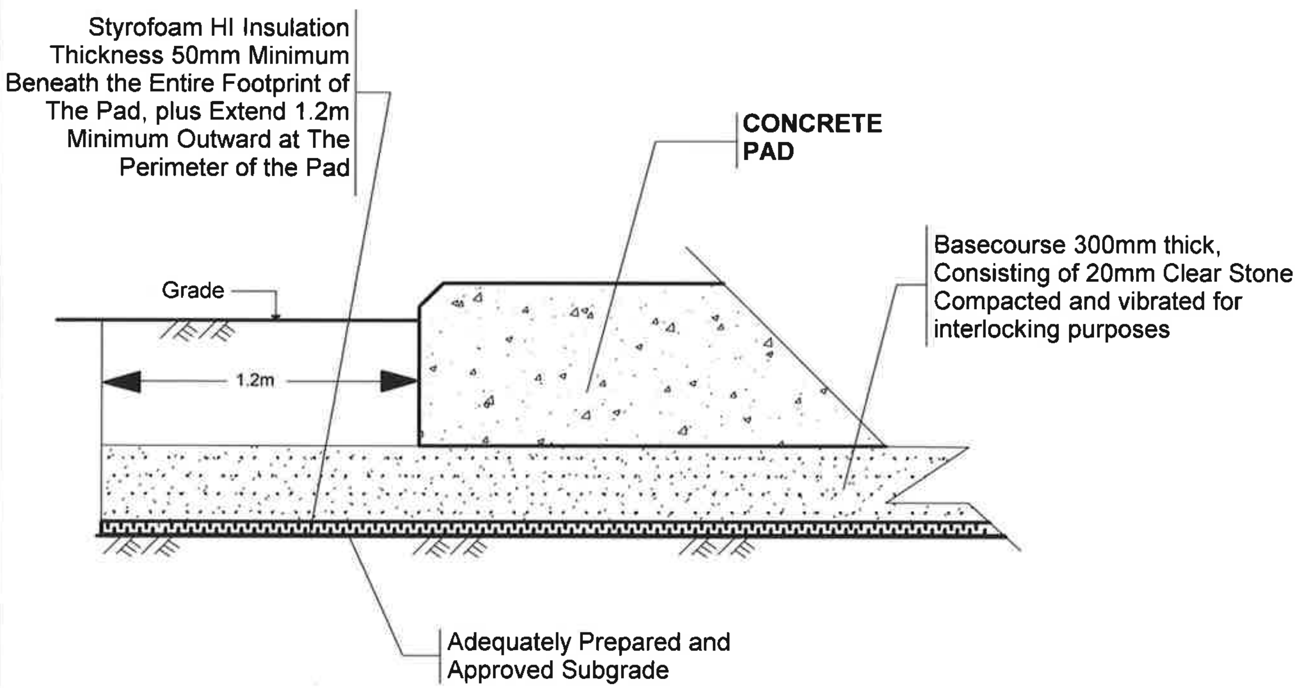
**DRAINAGE AND BACKFILL RECOMMENDATIONS**

Not to Scale

| | Name | Date | PATRIOT ENGINEERING LTD. Consulting Engineers | |
|---|---|---|---|---|
| Drawn By | | | | |
| Checked By | | | Project : 44148A | Figure: 28 |
| Revisions | | | | |
| Scale | | | | |

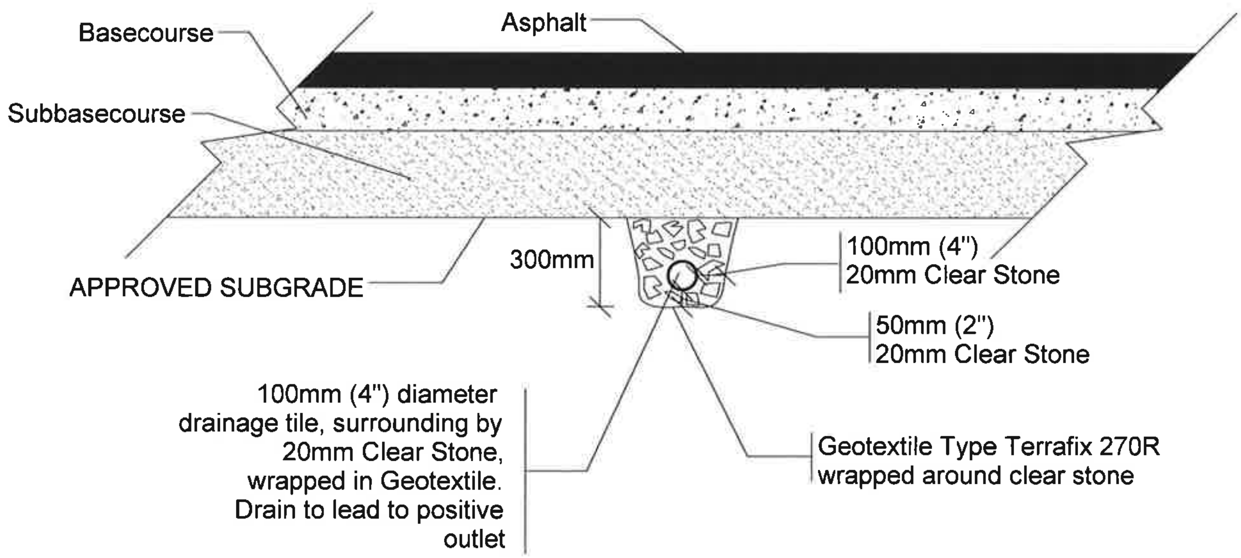
**SCHEMATIC DETAIL FOR EXTERIOR CONCRETE PAD**

1. A minimum of 0.3m (1ft) of exterior soil cover is required.
2. Good site grading is to be provided to prevent ponded water at pad base, otherwise adequately filtered perimeter drainage will be required.
3. Insulation should have at least two overlapping layers, have tight splices, glue should be used on any vertical surfaces and spot glue on the horizontal surfaces.
4. Provide a continuous Styrofoam HI insulation pad beneath the entire footprint of the pad, plus it must extend outward a minimum of 1.2m from the edge of the pad at the sides, as shown in the diagram below.
5. Basecourse to be at least 300mm thick consisting of 20mm (3/4 inch) clear stone compacted and vibrated for interlocking purposes.
6. The drawings must be reviewed with accompanying text.
7. Diagram provided below is for guidance only. In all cases, manufacturers' specifications must be followed for installing insulation.




| | | | | | |
|---|---|---|---|---|---|
| Drawn By | Name | Date | | **PATRIOT ENGINEERING LTD.** Consulting Engineers | |
| Checked By | | | | Project: 44148A | Figure: 29 |
| Revisions | | | | | |
| Scale | N.T.S. | | | | |

# TYPICAL SUBDRAIN DETAIL




| | | |
|---|---|---|
| Drawn By | Name | Date |
| Checked By | | |
| Revisions | | |
| Scale | N.T.S. | |

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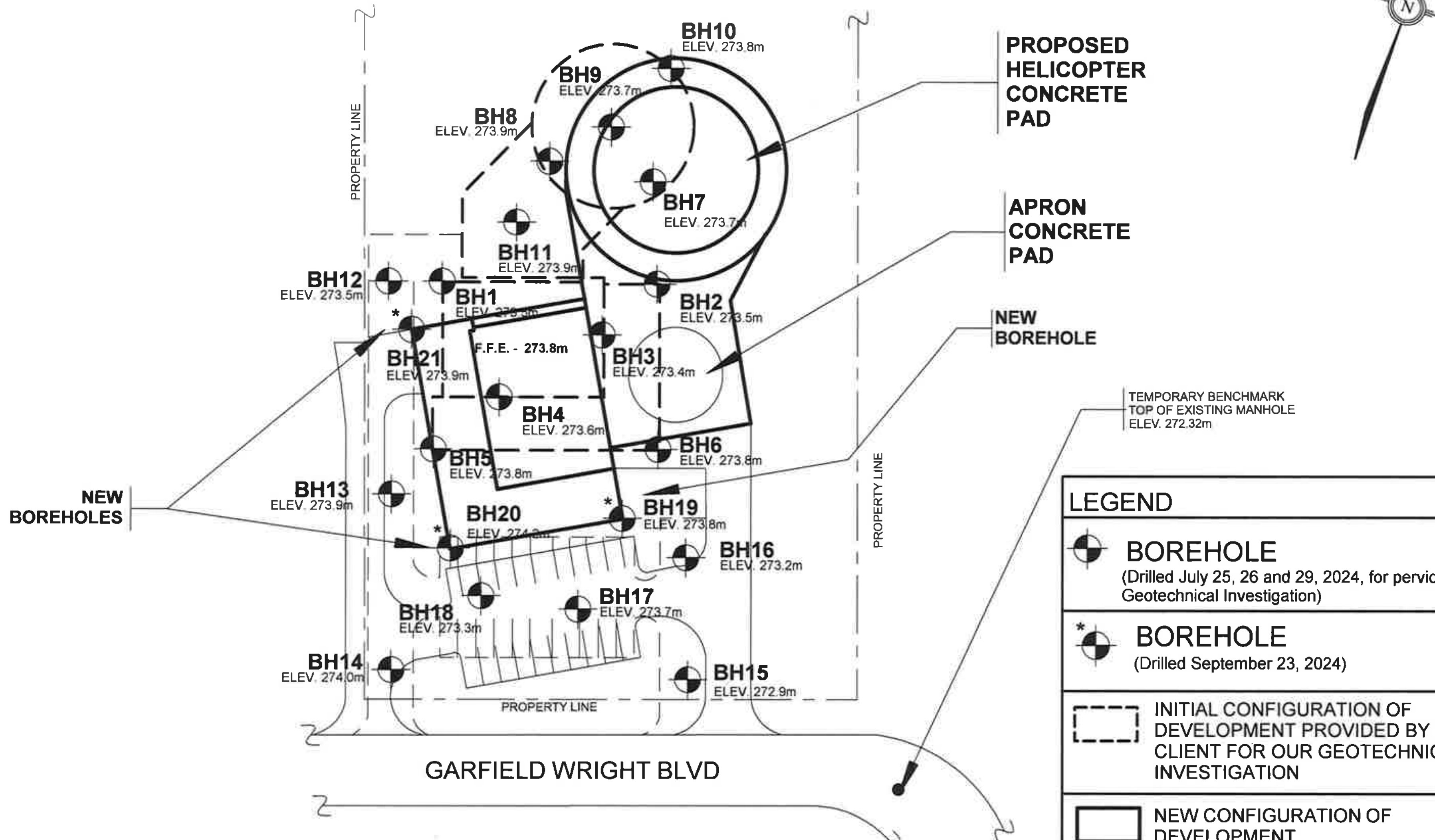
| | |
|---|---|
| Project: 44148A | Figure: 30 |

# APPENDIX A

## FOOTPRINTS OF ORIGINAL DEVELOPMENT AND NEW DEVELOPMENT
## PROPOSED HELICOPTER HANGAR
## 350 GARFIELD WRIGHT BOULEVARD
## EAST GWILLIMBURY, ONTARIO

## FIGURE 1: PARTIAL SITE PLAN SHOWING THE APPROXIMATE BOREHOLE LOCATIONS
**PROPOSED HELICOPTER HANGAR**
**350 GARFIELD WRIGHT BOULEVARD, EAST GWILLIMBURY, ONTARIO**




**LEGEND**

| Symbol | Description |
|---|---|
| Borehole symbol | BOREHOLE (Drilled July 25, 26 and 29, 2024, for pervious Geotechnical Investigation) |
| * Borehole symbol | BOREHOLE (Drilled September 23, 2024) |
| Dashed box | INITIAL CONFIGURATION OF DEVELOPMENT PROVIDED BY THE CLIENT FOR OUR GEOTECHNICAL INVESTIGATION |
| Solid box | NEW CONFIGURATION OF DEVELOPMENT |

REFERENCE:

PARTIAL SITE PLAN INFORMATION ADAPTED FROM OVERALL SITE PLAN DRAWING NO. A-002, PREPARED BY PARKIN ARCHITECTS LIMITED, DATED APRIL 15, 2024, AS WELL AS THE REVISED DRAWING SUBMITTED TO US ON AUGUST 31, 2024 BY PARKIN ARCHITECTS LIMITED.

| | Name | Date |
|---|---|---|
| Drawn By | M.A. | Sept '24 |
| Checked By | L.G. | Sept '24 |
| Revisions | | |
| Scale | Reduced From Original | |

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Project: 44148A | Figure: A1

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# EXPLANATION OF TERMS

1. SAMPLING PROCEDURES

| | | | |
|---|---|---|---|
| AS | Auger Sample | GS | Grab Sample |
| SS | Split Spoon | ST | Shelby Tube |

2. PENETRATION RESISTANCE

Standard Penetration Resistance 'N'

The number of blows that are required to advance a standard split spoon sampler 0.3 m into the subsurface soil, that is driven by means of a 63.5 kg hammer falling freely for a distance of 0.76 m.

Dynamic Penetration Resistance:

The number of blows that are required to advance a 51 mm diameter, 60 degree cone, fitted to the end of drill rods, 0.3m into subsurface soil. The driving energy is 475 J per blow.

3. DESCRIPTION OF SOIL

The description of the soil is based on visual examination of the samples obtained and laboratory testing. Each layer is described according to the following classification and terminology:

| Classification* | Particle Size |
|---|---|
| Clay | less than 0.002 mm |
| Silt | from 0.002 to 0.075 mm |
| Sand | from 0.075 to 4.75 mm |
| Gravel | from 4.75 to 75 mm |
| Cobbles | from 75 to 200 mm |
| Boulders | larger than 200 mm |

* Unified Soil Classification System (ASTM D2487-75).

| Terminology | Proportion |
|---|---|
| Trace, or occasional | Less than 10% |
| Some | 10 to 20% |
| Adjective (e.g. silty or sandy) | 20 to 35% |
| And (e.g. sand and gravel) | 35 to 50% |

The relative density of the cohesionless soils and the consistency of cohesive soils are defined below:

| Cohesionless Soils | | Cohesive Soils | | |
|---|---|---|---|---|
| Relative Density | Penetration Resistance "N" Blows/0.3 m or Blows/foot | Consistency | Underdrained Shear Strength** | |
| | | | kPa | psf |
| Very loose | 0 to 4 | Very soft | 0 to 12 | 0 to 250 |
| Loose | 4 to 10 | Soft | 12 to 25 | 250 to 500 |
| Compact | 10 to 30 | Firm | 25 to 50 | 500 to 1000 |
| Dense | 30 to 50 | Stiff | 50 to 100 | 1000 to 2000 |
| Very dense | over 50 | Very Stiff | 100 to 200 | 2000 to 4000 |
| | | Hard | over 200 | over 4000 |

** The compressive strength obtained from the quick (Q) triaxial test is equal to twice the shear strength of the clay tested.

80 Nashdene Road, Unit 62, Toronto, Ontario M1V 5E4 Tel. 416-293-7716 Fax. 416-293-6722