May 31, 2024

The Town of Collingwood
Box 157, 97 Hurontario Street
Collingwood, ON
L9Y 3Z5

Attn: Wendy Martin

RE: Geotechnical Test Pit Investigation
Wilson Sheffield Park – 31 Dey Drive, Collingwood, ON
Project No. 2403781

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1. INTRODUCTION & SCOPE OF WORK

It is proposed to construct a new park at 31 Dey Street in Collingwood, colloquially to be known as “Wilson Sheffield Park”. A site location plan is provided as Figure 1. The park will contain a washroom building, retaining walls, tennis/pickleball/basketball courts, parking lot, playground and walkways. It is understood that Wilson Sheffield Park is in the late design stages and geotechnical design support is required.

The property is approximately 100 metres long (north to south) and 130 metres wide (east to west). The property is bounded by Dey Drive to the west, existing single family residential properties to the south, a storm water management pond to the east and Admiral Collingwood Elementary School to the north. Currently the property is vacant and flat lying with minimal vegetation.

To facilitate the geotechnical recommendations, on May 2, 2024 a representative of our technical staff visited the site to observe the existing soil and groundwater conditions within five test pit excavations, advanced using an excavator available on-site, to provide geotechnical design advice in support of the proposed park construction. The location of the excavated test pits were located throughout the site, and the approximate test pit locations are provided in Figure 2.

GEI conducted visual examinations, and tactile probing to determine the compactness/consistency of the soils at a depth of approximately 1.2 m below existing ground surface within the test pits (when safe to enter), to evaluate the bearing capacity of the native site soils. Dynamic Cone Penetration Test (DCPT) was conducted in select test pits to obtain information used for foundation design (for the washroom building and retaining walls). GEI surveyed the test pits using a GPS survey to determine the geodetic elevation of the test pits.

2. SITE AND TEST PIT OBSERVATIONS

A detailed breakdown of the results of each test pit is provided in the table below. Photographs of each test pit are also enclosed.

	Test Pit #1	Test Pit #2	Test Pit #3	Test Pit #4	Test Pit #5
GPS Coordinates	N: 4926093 E: 563406	N: 4926060 E: 563459	N: 4926044 E: 563415	N: 4926108 E: 563445	N: 4926123 E: 563486
Geodetic Elevation	194.53 m	195.01 m	194.46 m	194.79 m	193.97 m
Stratigraphy Encountered	0.0m to 1.2m – EARTH FILL: Sand, trace to some silt, trace to some gravel, cobbles, inferred compact, brown, moist 1.2m to 1.5m – EARTH FILL: Silt, some sand, some gravel, cobbles, inferred compact to dense, reddish brown, moist 1.5m to 2.8m – NATIVE: Sand, trace to some silt, inferred compact, brown, moist	0.0m to 0.5m – EARTH FILL: Sand, trace to some gravel, trace silt, cobbles, inferred compact, brown, moist 0.5m to 1.1m – EARTH FILL: Clayey silt, some sand, trace gravel with deleterious materials (wood logs and organics), inferred loose, grey, moist to very moist 1.1m to 1.7m – EARTH FILL: Sandy silt, trace to some gravel, inferred compact, brown, moist 1.7m to 2.4m – NATIVE: Sand, trace to some silt, inferred compact, brown, moist	0.0m to 1.2m – EARTH FILL: Sand and gravel, trace to some silt (becoming silty with depth) with cobbles and boulders, inferred dense to compact, brown, moist to wet 1.2m to 1.8m - NATIVE: Sand, trace to some silt, inferred compact, brown, moist	0.0m to 1.0m – EARTH FILL: Sand trace to some silt, inferred compact, brown, moist 1.0m to 2.3m – EARTH FILL: Clay, trace sand, inferred firm to stiff, grey, moist 2.3m to 2.7m – NATIVE: Sand, trace to some silt, inferred compact, brown, moist	0.0m to 0.05m – Topsoil, rootlets 0.05m to 0.8m – EARTH FILL: Sand and gravel, trace silt with cobbles and boulders, inferred compact, brown, moist 0.8m to 1.4m – EARTH FILL: Silt, some clay, some sand trace gravel with organic inclusions, inferred loose to compact, grey, moist 1.4m to 2.0m – NATIVE: Sand, trace to some silt, inferred compact, brown, moist
Groundwater and Caving Conditions	No ground water or caving was noted within the test pit.	Seepage was noted 0.8 metres below existing grade. Slight caving was observed.	Seepage was noted 1.0 metres below existing grade. No caving was observed.	No ground water or caving was noted within the test pit	No ground water or caving was noted within the test pit

The stratigraphic descriptions were based on visual and tactile observations. No particle size distributions were conducted as part of the scope of work. Inferred consistency or relative density of the soil strata was determined based on tactile probing.

A Dynamic Cone Penetration Test (DCPT) was conducted within Test Pit 1 at 1.2 metres and Test Pit 5 at 1.8 metres. The purpose of the DCP Tests was to confirm that the DCPT readings within the native soils and earth fill were generally consistent. The results of the DCP Tests are enclosed.

As no groundwater was observed, it is inferred that the prevailing groundwater table is deeper than 2.8 metres below existing grade. Groundwater levels are expected to fluctuate seasonally and vary in response to prevailing climate conditions.

3. FOUNDATION DESIGN CONSIDERATIONS

Topsoil and earth fill are not suitable to support new foundations or retaining walls. Foundations at this site may be constructed as conventional shallow spread and strip footing foundations that bear on the competent undisturbed and compact native sand that was encountered between 1.2 to 2.3 metres below existing grade. In areas of retaining walls with structural loads (i.e. retaining walls more than 1 metre in height), either the base of the retaining wall needs to be extended down to the native soil, or the earth fill need to be sub-excavated and replaced with engineered fill. Based on the observations within the test pits and the results of the DCP testing, foundations may be designed using a geotechnical reaction at SLS of 100 kPa, for an estimated settlement of 25 mm or less. The maximum factored geotechnical resistance at ULS is 150 kPa.

Regardless of loading considerations, the minimum strip footing widths to be used shall be dictated as per the Ontario Building Code. Footings stepped from one level to another must be at a slope not exceeding 7 vertical to 10 horizontal.

Foundations exposed to ambient air temperature throughout the year must be provided with a minimum of 1.2 metres of earth cover for frost protection. Where earth cover is less than 1.2 m, additional equivalent insulation is required. A 25 mm thick extruded polystyrene insulation board is equivalent to 300 mm of soil cover. The insulation should extend a minimum distance of 1.2 m from the foundation wall, placed a minimum of 0.3 m below grade and sloped away from the foundation at a minimum 2% gradient to provide adequate drainage. Insulation should also be installed vertically up exterior foundation walls above the horizontal insulation. The insulation boards should have staggered joints and be fastened to the foundation wall.

Prior to pouring concrete for the footings, the footing subgrade must be cleaned of deleterious materials, softened, disturbed, or caved materials, and any standing water. During the excavation and construction of the footings GEI should be retained to inspect the founding base to ensure the subgrade has been properly prepared and that the integrity of the founding soil has been maintained.

4. FLOOR SLABS

Existing proof-rolled and inspected earth fill is suitable to support lightly loaded slab on grades (e.g. for the washroom building, concrete pathways, etc.). The exposed subgrade must be proof-rolled and inspected by the geotechnical engineer. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of deleterious/organic material, they must be locally sub-excavated and backfilled with approved imported granular material and compacted to a minimum of 95% Standard Proctor maximum dry density (SPmdd).

It is necessary that the floor slabs must be provided with a capillary moisture barrier and drainage layer. This is made by placing the concrete slab on a minimum 200 mm layer of 19 mm clear stone (OPSS.MUNI 1004) compacted by vibration to a dense state. The clear stone and subgrade must be separated by a geotextile such as Terrafix 270R (or approved equivalent) to prevent the migration of fines into the clear stone layer which could result in loss of support for the slab. Alternatively, Granular A (OPSS.MUNI 1010) compacted to 100% SPmdd can be utilized without filter cloth.

It is noted that the granular base recommendations above also apply in the case where a concrete surfaced pathway/trail is being constructed.

For the planned slab-on-grade structures, perimeter and under-slab drainage at the foundation level is not required, provided that the underside of concrete slab is at least 200 mm above the prevailing grade of the site and the surrounding surfaces slope away from the building at a gradient of at least 2% to promote surface water run-off and to reduce groundwater infiltration adjacent to foundations.

5. EARTH PRESSURES

Retaining walls must be designed to resist unbalanced lateral earth pressures imparted from the weight of adjacent soils. Lateral earth pressures are calculated using the following equation:

$$\boldsymbol{P} = \boldsymbol{K}[\boldsymbol{\gamma h} + \boldsymbol{q}]$$

where, **P** = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below surface in metres
γ = the bulk unit weight of soil, (kN/m^3)
q = surcharge loading (kPa)

The above equation assumes that a drainage system is present which prevents the build up of any hydrostatic pressure behind the structure subjected to the unbalanced lateral earth pressures. If this is not the case, the equation must be revised to also incorporate the submerged unit weight of the soil multiplied by the earth pressure coefficient, in addition to the water pressure itself.

The values for use in the design of structures subjected to unbalanced lateral earth pressures at this site are as follows:

Soil Type	γ - Bulk Unit Weight (kN/m^3)	φ - Friction Angle (degrees)	Earth Pressure Coefficient (dimensionless)		
			K_a - Active	K_o – At-Rest	K_p - Passive
Granular 'B' (OPSS 1010)	21.0	32	0.31	0.47	3.25
Existing Earth Fill	20.0	28	0.36	0.53	2.73

The calculation of the earth pressure coefficients is based on Rankine theory, which provides a conservative estimate as no friction between the soil and the structure is accounted for. The earth pressure coefficients provided above are only applicable for flat ground surfaces beyond the structure and must be increased for sloping ground surfaces.

6. EXCAVATIONS & TEMPORARY GROUNDWATER CONTROL

Excavations must be carried out in accordance with the Occupational Health and Safety Act, Ontario Regulation 213/91 (as amended), Construction Projects, Part III - Excavations, Section 222 through 242.

Where workers must enter a trench or excavation the soil must be suitably sloped and/or braced in accordance with the OHSA. These regulations designate four (4) broad classifications of soils to stipulate appropriate measures for excavation safety. For this site, the earth fill above the ground water table is classified as a Type 3 soil, which requires excavation sidewalls to be constructed no steeper than 1 horizontal to 1 vertical from the base of the excavation, assuming the groundwater is controlled.

The excavations will typically be above the prevailing groundwater table and only limited seepage is expected. Conventional sump pumping should suffice to control the anticipated groundwater seepage. It is recommended to carry out the work during the dry time of the year when the ground water table is lowest, to mitigate groundwater control measures. Also reducing the size of the excavation that is open at any one time will aid in reducing groundwater control requirements.

7. PAVEMENT DESIGN

As grades are not expected to change much, pavement subgrade is expected to comprise of the existing earth fill. The pavement subgrade must be inspected and approved by the geotechnical engineer at the time of construction. The exposed pavement subgrade should be compacted to a minimum of 95% SPmdd. If any soft or weak subgrade areas are identified, or if there are areas containing excessive amounts of moisture or deleterious/organic material, they must be locally sub-excavated and backfilled with approved clean earth fill or imported granular material and compacted to a minimum of 95% SPmdd.

Control of surface water is an important factor in achieving a good pavement life. The need for adequate subgrade drainage cannot be over-emphasized. The subgrade must be free of depressions and sloped (at a minimum grade of 2 percent) to provide effective drainage toward subgrade drains. Grading adjacent to pavement areas should be designed to ensure that water is not allowed to pond adjacent to the outside edges of the pavement.

For the surfaces to drain properly, it is recommended that provisions be made for water to drain out of the surface soil. Perimeter subdrains should be installed at 500 mm below the surface of all hard surfaces as detailed in OPSD 216. The subdrains should be connected to a frost-free outlet such as catchbasin or maintenance structure.

The industry pavement design methods are based on a design life of 15 to 20 years for typical weather conditions depending on actual traffic volumes. The following pavement thickness designs are provided on the above noted considerations.

Pavement Layer	Min. Compaction Requirement	Min. Component Thickness		
		Parking/Drive Areas	Asphalt Trail/Pathway	Granular Trail/Pathway
Surface Course Asphaltic Concrete: HL3 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)	92% MRD (OPSS.MUNI 310)	40 mm	50 mm	N/A
Binder Course Asphaltic Concrete: HL8 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)		50 mm	N/A	N/A
Base Course: Granular A (OPSS.MUNI 1010)	100% SPmdd (OPSS.MUNI 501)	150 mm	200 mm	300 mm*
Subbase Course: Granular B Type I (OPSS.MUNI 1010)		300 mm	N/A	N/A

*Upper 100 mm can consist of limestone screenings as a surface treatment.

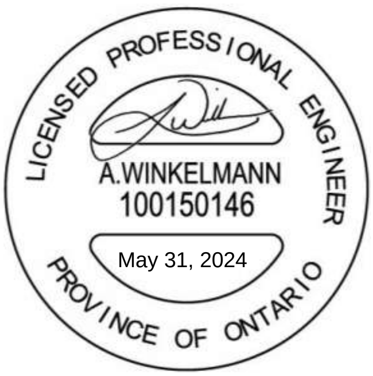
The granular materials should be placed in lifts 200 mm thick or less and be compacted to a minimum of 100% SPmdd for both granular base and subbase. Asphalt materials should be rolled and compacted as per OPSS 310. The granular and asphalt pavement materials and their placement should conform to OPSS 310, 501, 1010 and 1150.

It is recommended that regular testing and inspection be conducted during the pavement construction to confirm subgrade soil and granular material quality, thickness, and adequate compaction.

8. CONCLUSION

We trust this information is sufficient for your present purposes. Should you have any questions concerning the above, or can be of any further assistance, please do not hesitate to contact the undersigned.

Yours truly,
GEI Consultants



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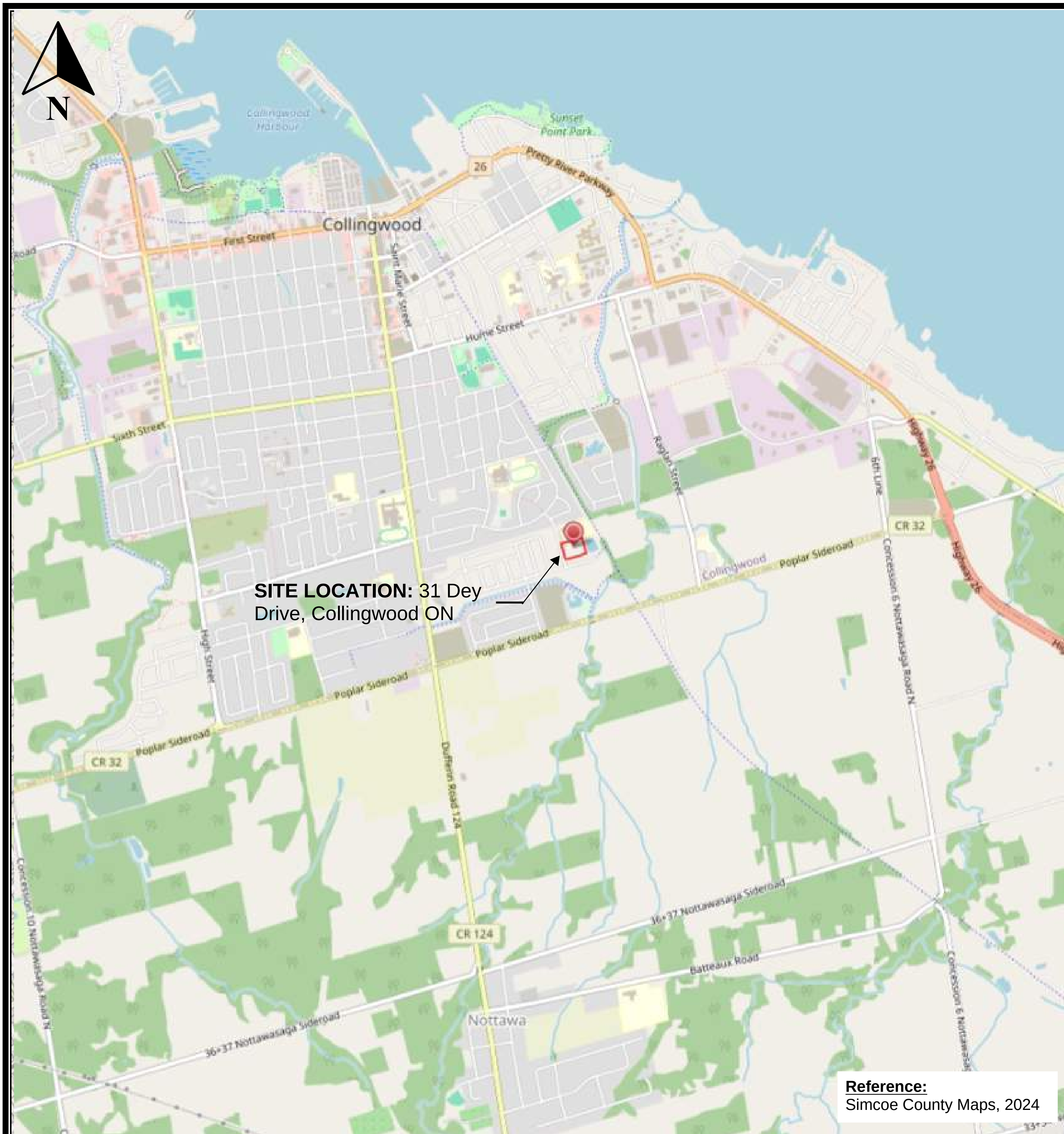
Enclosures (3)

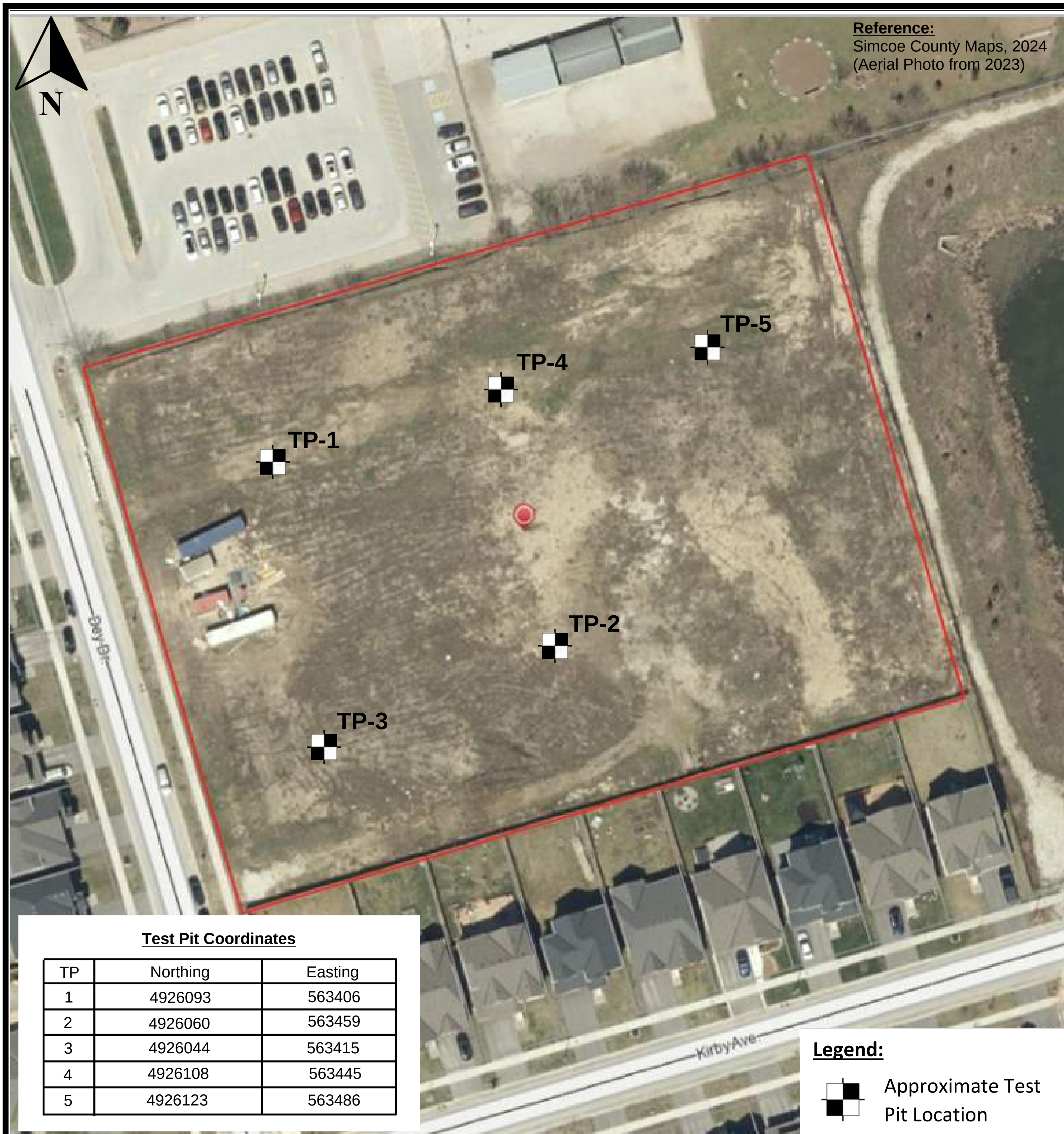
Site Location Plan, Test Pit Location Plan
Site Photographs
Dynamic Cone Penetration Test Results

ENCLOSURE 1

Site Location Plan, Test Pit Location Plan



GEI Consultants	Client: Town of Collingwood	Scale: N.T.S
		Date: May 2024
	Project: 31 Dey Drive, Collingwood ON	Drawn By: S.B.
		Project No: 2403781
647 Welham Rd, Unit 14, Barrie, ON, L4N 0B7 *P: (705) 719-7994*	Title: SITE LOCATION PLAN	FIGURE 1



Test Pit Coordinates

TP	Northing	Easting
1	4926093	563406
2	4926060	563459
3	4926044	563415
4	4926108	563445
5	4926123	563486

GEI Consultants

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	Date: May 2024
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Title: TEST PIT LOCATION PLAN	FIGURE 2

ENCLOSURE 2

Site Photographs

PHOTOGRAPH 1

(GEI 2024)

Description:
Detailed view of Test Pit #1

PHOTOGRAPH 2

(GEI 2024)

Description:
Detailed view of Test Pit #2

PHOTOGRAPH 3

(GEI 2024)

Description:
Detailed view of
Test Pit #3

PHOTOGRAPH 4

(GEI 2024)

Description:
Detailed view of
Test Pit #4

PHOTOGRAPH 5

(GEI 2024)

Description:
Detailed view of Test Pit #5

ENCLOSURE 3

Dynamic Cone Penetration Test Results

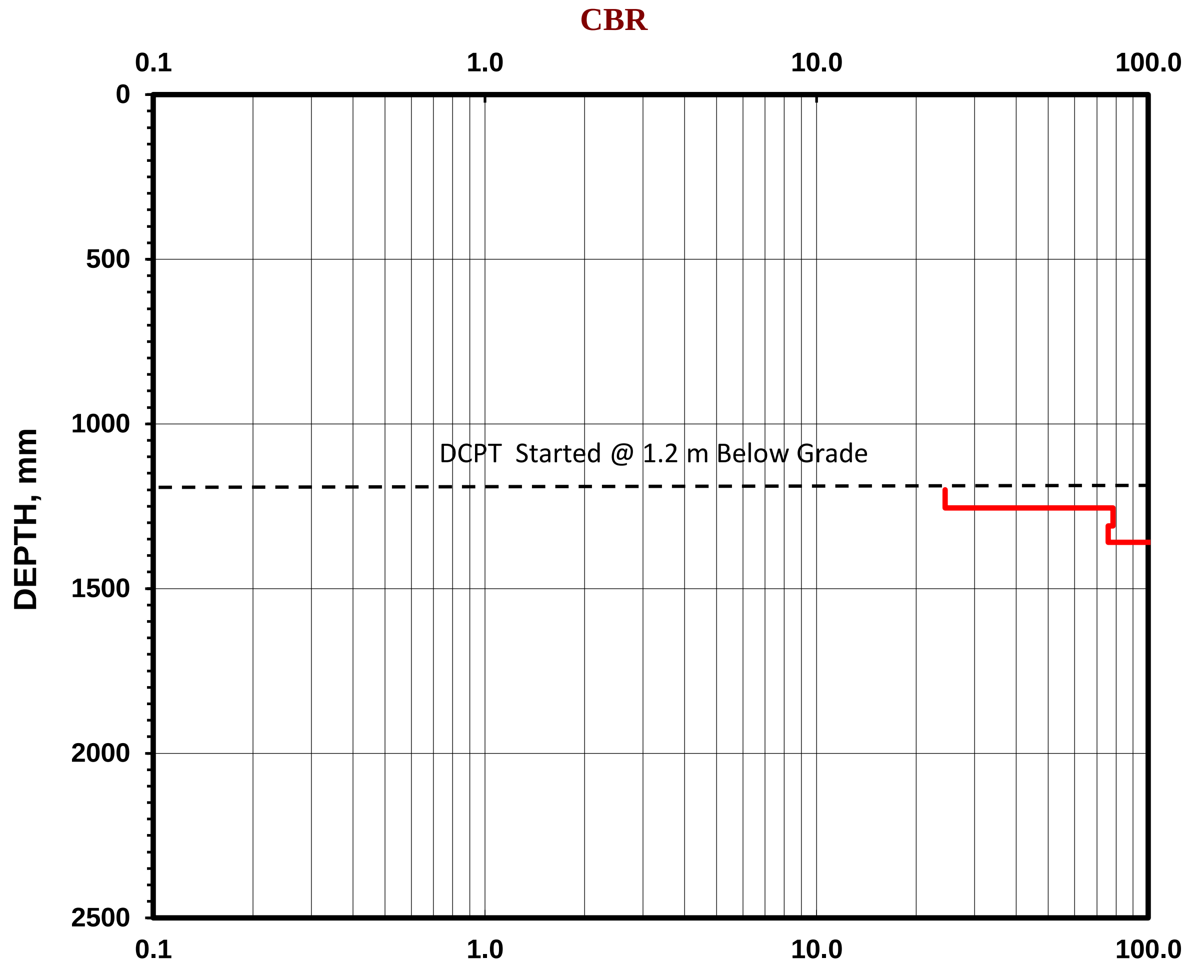
DCP TEST DATA

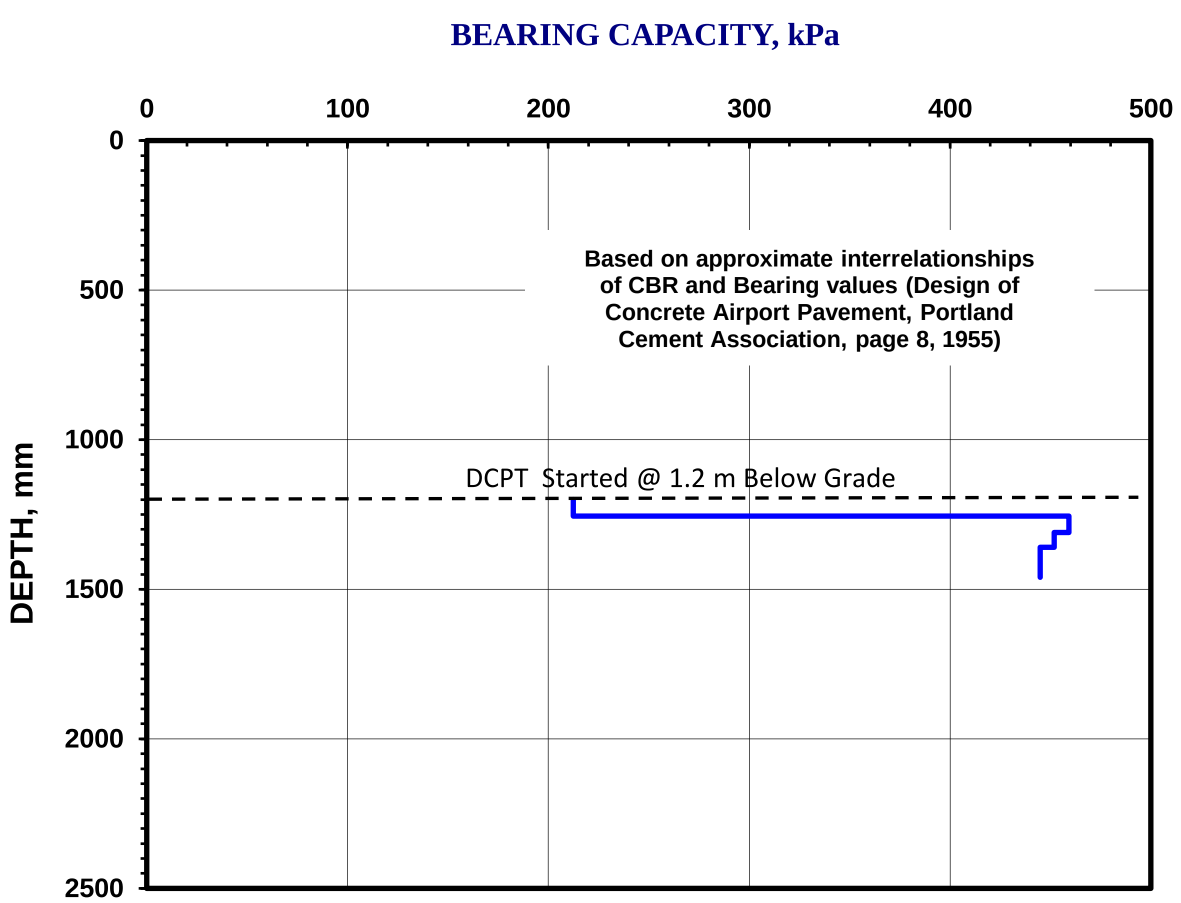
Project: *Wilson Sheffield Park* **Date:** *2-May-24*
Location: **TP1** **Soil Types(s):** **Silt Fill**

Hammer
- ○ 10.1 lbs.
- ◉ 17.6 lbs.
- ○ Both hammers used

Soil Type
- ○ CH
- ○ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	1200	1
6	1255	1
17	1310	1
15	1360	1
30	1410	1
30	1460	1





DCP TEST DATA

Project: *Wilson Sheffield Park* **Date:** *2-May-24*
Location: **TP5** **Soil Type(s):** **Sand**

Hammer
- ◯ 10.1 lbs.
- ◉ 17.6 lbs.
- ◯ Both hammers used

Soil Type
- ◯ CH
- ◯ CL
- ◉ All other soils

No. of Blows	Accumulative Penetration (mm)	Type of Hammer
0	1800	1
2	1860	1
3	1910	1
4	1960	1
5	2010	1
6	2060	1
7	2110	1
8	2160	1
8	2215	1
9	2265	1
7	2320	1
6	2370	1
6	2420	1
7	2470	1
6	2530	1