GEI Consultants Canada

Geotechnical Investigation and Report

Proposed Residential Development

Pine Valley Estates, 9332 County Road 93, Midland, ON

Submitted to:
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Acronyms and Abbreviations

AMSL	Above Mean Sea Level
ASTM	ASTM International (testing standards)
BH	Borehole
BH/MW	Borehole / Monitoring Well
cm	centimeters
EASR	Environmental Activity and Sector Registry
Elev.	Elevation
FOS	Factor of Safety
GEI	GEI Consultants Canada Ltd.
GPS	Global Positioning System
ha	Hectare
HL3	Asphalt mix designation (OPSS 1150)
HL8	Asphalt mix designation (OPSS 1150)
kg	Kilogram
kPa	Kilopascal
L	Litres
m	Metres
m/s	Metres per second
mm	Millimetres
m^2	Square metres
MECP	Ministry of Environment, Conservation and Parks
MRD	Maximum Relative Density
N value	Standard Penetration Test “N” value
N60	Energy-corrected Standard Penetration Test blow count
NAD 83	North American Datum 1983
NBCC	National Building Code of Canada
OBC	Ontario Building Code
OD	Outside Diameter
OHSA	Occupational Health and Safety Act
OPSD	Ontario Provincial Standard Drawings
OPSS	Ontario Provincial Standard Specifications
OPSS.MUNI	Ontario Provincial Standard Specifications (Municipal)
O.Reg.	Ontario Regulation
PG	Performance Grade (asphalt cement designation)
PVC	Polyvinyl Chloride
PTTW	Permit to Take Water
SLS	Serviceability Limit State
SPmdd	Standard Proctor maximum dry density
SPT	Standard Penetration Test
SS	Split Spoon (sampler)
Su	Undrained shear strength
SWM	Stormwater Management

ULS	Ultimate Limit State
UTM	Universal Transverse Mercator
Vs30	Time-average shear-wave velocity in top 30 m
µm	micrometer

It is noted that all elevations in this report are metric/geodetic and expressed in m. All measurements are also in metric and expressed in mm, m or km.

1. Introduction

GEI was retained by the Pine Valley Estates Ltd. (Client) to complete a subsurface investigation and geotechnical report, for the proposed residential development to be located at the property of 9332 County Road 93 in Midland, Ontario. A site location plan is enclosed as Figure 1.

The property is approximately 27.64 ha with approximately 16.91 ha of the area to be developed in the eastern half. The developable area is approximately 440 m long east to west and 400 m wide north to south. The property is surrounded by vacant and forested lands to the north, south and west with commercial properties and Lanigan Drive to the east. The property is currently undeveloped and forested with one section in the southern section of the developable area recently cleared of trees. The site is relatively flat with only a few metres of topographical relief across the site. An aerial image of the site is provided in Figure 2A.

The Client has given GEI the following updated drawing to review:

- “Site Plan, Pine Valley Estates, 9332 County Road 93, Midland, Ontario, Project No. 16142 “, Prepared by Orchard Design Studio Inc., dated January 16, 2026.

Based on the drawing provided, three (3) 6-storey apartment buildings will be located in southeast corner of the property with high density parking lots surrounding them. Some underground levels are begin considered. Stacked townhomes and internal roadways will occupy the rest of the site linking to a main road/roundabout which will connect to existing roadways towards County Road 93. A 1.8 ha stormwater management facility is proposed in the northeast corner of the site. Parklands of varying sizes will be located throughout the site. It is understood that the development would be connected to existing municipal services. The latest concept plan for the development is provided in Figure 2B.

The purpose of the geotechnical investigation was to assess the subsurface soil conditions at the site, and based on this information, provide geotechnical engineering recommendations in support of the proposed design. This report summarizes borehole findings, provides design geotechnical engineering recommendations regarding site earthworks and engineered fill, available bearing capacities for foundations, floor slabs, earth pressures and drainage for basements, site servicing installation/connections, SWM pond, and pavement design. Considerations for constructability such as soil excavation, compaction, on-site backfill suitability and temporary groundwater control are also provided.

A hydrogeological investigation and report have been requested and are provided under a separate report.

A year-long groundwater monitoring program has been requested, and a separate letter report will be provided at the conclusion of the monitoring.

It is noted that the recommendations provided in this report must be considered preliminary in nature due to the current uncertainty of the design for the project at the time of this report. Key geotechnical considerations are discussed to help guide preliminary design. As the design progresses further geotechnical review and input will likely be required, which might necessitate the need for additional investigation and analysis.

2. Procedures and Methodology

Prior to the commencement of drilling activities, the borehole locations were staked in the field by GEI. Ground surface elevations of the boreholes and horizontal coordinates (referencing NAD 83 geodetic datum) were surveyed by GEI with a Topcon FC – 5000 GPS Survey unit.

Underground utilities including natural gas, electrical, telephone, water, etc. were marked out by public and private utility locating companies, prior to drilling.

The fieldwork for the drilling program was carried out between March 23 and March 30, 2026. Boreholes 1, 3, 9, 14 and 15 were drilled 12.6 to 24.8 m below existing grade (Elev. 218.9 to 233.9) in an attempt to capture the deep groundwater table. Boreholes 2, 4 to 8, and 11 to 13 were drilled 6.6 m below existing grade (Elev. 237.2 to 240.2) across the remainder of the site. Borehole logs are provided in Appendix A and the borehole locations are shown on Figures 2A and 2B.

Table 2-1 presents a summary of borehole locations and ground surface elevations.

Table 2-1. Borehole Horizontal Coordinates and Ground Surface Elevations

Borehole ID	Elevation (m AMSL)	Borehole Easting (UTM Zone 17)	Borehole Northing (UTM Zone 17)
1	244.8	585311	4954451
2	244.4	585509	4954551
3	243.8	585689	4954692
4	244.7	585438	4954423
5	244.6	585611	4954536
6	246.4	585433	4954299
7	246.6	585564	4954413
8	243.8	585728	4954520
9	245.9	585686	4954449
10	246.8	585489	4954231
11	245.3	585589	4954285
12	244.8	585761	4954419
13	246.0	585734	4954314
14	246.5	585587	4954228
15	245.5	585800	4954344

The boreholes were advanced by a drilling subcontractor retained and supervised by GEI using a track-mounted drill rig, solid or hollow stem augers, and standard soil sampling equipment. Sampling was conducted using a 51 mm OD SS sampler. N values were recorded for the sampled intervals as the number of blows required to drive an SS sampler 305 mm into the soil using a 63.5 kg drop hammer falling 750 mm, in accordance with ASTM D1586. In each borehole, soil sampling was conducted at 0.75 m intervals to 3.0 m depth, then at 1.5 m intervals thereafter.

Monitoring wells were installed in Borehole 1, 3, 9, 14 and 15 by GEI to facilitate long-term groundwater monitoring, each consisting of a 50 mm diameter PVC pipe with a 3.0 m long screen and protective casing. Monitoring well construction is shown on the borehole logs in Appendix A. Boreholes without wells were backfilled in accordance with O.Reg. 903.

The GEI field staff examined, and classified characteristics of the soils encountered in the boreholes, including the presence of fill materials, groundwater observations during and upon completion of drilling, recorded observations of borehole construction, and processed the recovered samples. All recovered soil samples were logged in the field, carefully packaged, and transported to GEI's laboratory for more detailed examination and classification.

In GEI's laboratory, the samples were classified based on their visual and textural characteristics. All samples were submitted for moisture content determination in accordance with ASTM D2216. Ten (10) representative samples of the subgrade soils were selected and submitted to our laboratory for grain size analysis. Grain size results are provided in Figures B1 to B3 in Appendix B.

GEI is currently monitoring groundwater levels monthly for one year and when completed, the results will be provided in a separate letter.

3. Subsurface Conditions

3.1. General Overview

The detailed soil profiles encountered in the boreholes are indicated in the attached borehole logs in Appendix A. The geotechnical laboratory results are included in Appendix B. The borehole locations are shown on Figures 2A and 2B.

It should be noted that the conditions indicated on the borehole logs are for specific locations only and can vary between and beyond the locations. It should be noted that the soil boundaries indicated on the borehole logs are inferred from non-continuous sampling and observations during drilling. The boundaries are intended to reflect approximate transition zones and should not be interpreted as exact planes of geological change.

In addition, the descriptions provided in the borehole logs are inferred from a variety of factors, including visual observations of the soil samples retrieved, measurements prior to and after drilling, and the drilling process itself (speed of drilling, shaking/grinding of the augers, etc.) and laboratory testing. The passage of time may also result in changes in conditions to exist at locations where sampling was conducted.

3.2. Stratigraphy

3.2.1. Topsoil

A topsoil layer was at the ground surface in all boreholes. Topsoil thickness measurements are provided below. Topsoil thicknesses may vary between boreholes and in other areas of the site.

Table 3.1. Topsoil Thicknesses

Borehole No.	Topsoil Thickness (mm)
1	50
2	75
3	75
4	75
5	75
6	50
7	75
8	75
9	75
10	50
11	50
12	50
13	150
14	50
15	150

3.2.2. Silty Fine Sand

Underlying the topsoil in all boreholes, except Borehole 3, a layer of silty fine sand was encountered and was penetrated at 0.8 to 3.0 m depth (Elev. 240.7 to 246.0). Trace organics were noted in some samples in the upper 200 to 300 mm of the layer. The layer was moist to wet with moisture contents ranging from 5 to 31%. N values in the soil ranged from 4 to 10, revealing very loose to loose soil.

3.2.3. Silt and Sand / Sand and Silt

Underlying the surficial silty fine sand in Boreholes 2, 4, 7, 8, 10, 11, 12, 13, 14, and 15, an upper silt and sand (locally sand and silt) layer was encountered and extended to 4.6 to 10.7 m depth (Elev. 234.9 to 241.4), typically the depth of the 6.6 m boreholes, locally penetrated within deeper boreholes. Three (3) samples of the material were submitted for grain size analysis, and the results are provided in Figure B1 in Appendix B. The soil was typically moist and locally wet with moisture contents of 3 to 25 %. The N values were 5 to 62, indicating loose to very dense conditions, but typically compact.

Intermittent/secondary sand and silt to silt and sand layers were encountered in some boreholes other than directly below the silty fine sand as follows:

- In Borehole 1 from 4.6 m to 6.1 m depth (Elev. 238.7 to 240.2) and from 9.1 to 15.2 m depth (Elev. 229.6 to 234.1). The soil was moist with moisture contents of 5 to 8 %. The soil was compact to very dense with N values of 22 to 49.
- Borehole 3 from 6.1 to 9.1 m depth (Elev. 234.6 to 237.7). The soil was moist to wet with moisture contents of 10 to 22%, with depth. The N values were 16 (compact) and 46 (dense).
- A silt and sand layer was encountered in Boreholes 5 and 6, below a silt unit to the 6.6 m depth of exploration (Elev. 238.0 and 239.8). The soil was moist to wet with depth and moisture contents varied from 4 to 20%. The N values in the soil were 25 to 38 and the soil was compact to dense.
- Below the sand in Borehole 9 the sand and silt extended from 4.6 to the 12.6 m depth of exploration (Elev. 233.2 to 241.3). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B1 in Appendix B. The soil was moist with moisture contents of 4 to 10% and local wet seams showed moisture contents of 16 to 18%. The soil was dense (N values of 32 to 43).

3.2.4. Silt

Underlying the surficial silty fine sand in Boreholes 5 and 6, an upper silt unit was encountered and extended to 3.0 and 4.6 m depth (Elev. 241.6 and 241.8), respectively. One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B2 in Appendix B. Some sand and trace clay were noted. Moisture contents were 21 to 29% (moist to wet). The N values ranged from 4 to 11 blows, showing the material was loose to compact.

Basal silt units were underlying the silt and sand/sand and silt layer in Boreholes 12 and 13 and extended to the 6.6 m depth of exploration (Elev. 238.3 to 239.5). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B2 in Appendix B. The soil was moist and moisture contents were 7 to 20%. The N values were 29 to 50 blows, indicating compact to dense conditions.

A deep silt layer was encountered in Borehole 15 from 15.2 to the 17.2 m depth of exploration (Elev. 228.3 to 230.3). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B2 in Appendix B. Some sand and trace clay were indicated. The soil was wet with moisture contents of 15 to 21%. The N value was 57 blows, indicating very dense soil.

3.2.5. Sand

Underlying the surficial silty fine sand in Boreholes 1 and 9, and underlying the topsoil in Borehole 3, an upper sand deposit was encountered and extended to 4.6 to 6.1 m depth (Elev. 237.7 to 241.3). Trace to some silt was noted in the deposit. Trace organics were noted in the upper 200 mm of the sand layer in Borehole 3. The soil was moist with moisture contents of 5 to 9 %. The N values ranged from 4 to 21 blows, indicating loose to compact conditions, typically loose.

A second sand layer was encountered in Borehole 1 from 6.1 to 10.7 m depth (Elev. 235.7 to 234.1) and a third sand layer was also encountered in Borehole 1 from 15.2 to the 21.8 m depth of exploration (Elev. 223.0 to 229.6). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B3 in Appendix B. The soil layers were moist with moisture contents of 1 to 3%. The N values ranged from 37 to greater than 100, showing dense to very dense conditions.

A deeper sand deposit was encountered in Borehole 3 from 9.1 to the 24.8 m depth of exploration (Elev. 218.9 to 234.6). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B3 in Appendix B. Some silt and trace gravel were revealed in the sample. The soil was moist with moisture contents of 6% or less. Locally at the base of the borehole the soil was wet and the moisture was 14%. Dense to very dense soil was indicated with N values of 44 to greater than 50.

Underlying the silt and sand layer in Borehole 14, a basal sand deposit was encountered and extended to the 12.6 m depth of exploration (Elev. 233.9). One (1) sample of the material was submitted for grain size analysis, and the results are provided in Figure B3 in Appendix B. The soil was moist with moisture contents of 2 to 3%, locally very moist at the base of the unit with a moisture content of 9%. The N values ranged from 38 to 68 blows, indicating dense to very dense conditions.

Borehole 15 also had a deeper sand layer from 10.7 to 15.2 m depth (Elev. 230.3 to 234.9). The soil was moist with moisture contents of 3%. The N values were 44 and 70, showing dense to very dense conditions.

3.3. Groundwater

Unstabilized groundwater level measurements and cave measurements were taken upon the completion of drilling of each borehole as shown on the borehole logs in Appendix A. These measurements were taken to provide a rough estimate of the possible excavation and temporary groundwater control constructability considerations that may arise. Five (5) boreholes were outfitted with a monitoring well with 50 mm diameter pipe and 3.0 m long screen. Monitoring well configuration and groundwater observations are noted on the borehole logs in Appendix A and summarized in the table below.

Table 3.2. Groundwater Levels

Borehole	Cave Depth / Elev.	Unstabilized Groundwater Level Depth / Elev.	Groundwater Table, April 17, 2026 Depth / Elev.
1	Open	No Water	Dry
2	Open	No Water	N/A
3	Open	No Water	Dry
4	Open	No Water	N/A
5	Open	No Water	N/A
6	Open	No Water	N/A
7	Open	No Water	N/A
8	Open	No Water	N/A
9	Open	No Water	Dry
10	Open	No Water	N/A
11	Open	No Water	N/A
12	Open	No Water	N/A
13	Open	No Water	N/A
14	Open	No Water	Dry
15	Open	No Water	Dry

The stabilized groundwater levels were below the installed depth of the wells, to date. Perched water can also be expected in the finer soil layers as shown by the wet conditions and the high moisture contents.

The native sand layers are permeable and will allow for the free flow of water. The native silty fine sand, sand and silt, and silt layers are semi-permeable and allow for some free flow of ground water when wet.

Groundwater levels are expected to show seasonal fluctuations and vary in response to prevailing climate conditions.

GEI is currently monitoring groundwater levels monthly for one year and when completed, the results will be provided in a separate letter.

4. Engineering Design Parameter & Analysis

The property is approximately 27.64 ha with approximately 16.91 ha of the area to be developed in the eastern half. The developable area is approximately 440 m long east to west and 400 m wide north to south. The property is surrounded by vacant and forested lands to the north, south and west with commercial properties and Lanigan Drive to the east. The property is currently undeveloped and forested with one section in the southern section of the developable area recently cleared of trees. The site is relatively flat with only a few metres of topographical relief across the site. An aerial image of the site is provided in Figure 2A.

The Client has given GEI the following updated drawing to review:

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Based on the drawing provided, three (3) 6-storey apartment buildings will be located in southeast corner of the property with high density parking lots surrounding them. Some underground levels are begin considered. Stacked townhomes and internal roadways will occupy the rest of the site linking to a main road/roundabout which will connect to existing roadways towards County Road 93. A 1.8 ha stormwater management facility is proposed in the northeast corner of the site. Parklands of varying sizes will be located throughout the site. It is understood that the development would be connected to existing municipal services. The latest concept plan for the development is provided in Figure 2B.

It is noted that the recommendations provided in this report must be considered preliminary in nature due to the current uncertainty of the design for the project at the time of this report. Key geotechnical considerations are discussed to help guide preliminary design. As the design progresses further geotechnical review and input will likely be required, which might necessitate the need for additional investigation and analysis.

4.1. Site Grading

Grading plans were not available for review at the time of this report. However, it is speculated that some site grading may be required to accommodate the project. When grading is established, GEI should review the drawings for further geotechnical requirements.

The topsoil and upper silty fine sand with organics (upper 100 to 300 mm) are unsuitable to support building foundations or other structures. As such, removal of this soil from under the building and other structures will eliminate constructability/settlement.

Further, the upper soil layers typically are weak (upper 3 m) and are only able to provide a limited bearing resistance (on the order of 50 to 80 kPa at SLS). Removal of this weak soil may also be considered depending on the building configuration and bearing resistance requirements. Inclusion of basements may aid with this site condition. This can be reviewed as the design evolves.

In paved or landscaped areas, the topsoil should be stripped and the underlying soil with organics (typically 100 to 300 mm) should also be stripped. The underlying native material can be used to support pavement structures.

The exposed subgrade surface in all areas should be thoroughly compacted and then engineered placement can commence to the desired grade.

It is envisioned that all earthworks be carried out first, then housing/building and servicing construction would take place.

4.1.1. Engineered Fill

GEI defines “engineered fill” as material that will support foundations, and which is placed and compacted in a specified and controlled manner under full-time supervision of geotechnical engineering staff.

Engineered fill may be required to raise grades in areas with structures. In building areas, the full depth of topsoil and soil with organics or other unsuitable soil must be fully removed down to competent, undisturbed native soil, as shown in the table below, separating the materials during excavation. As noted earlier in the report, the removal of the upper loose native soil material, about 3 m (typically can support only about 50 to 80 kPa) may be considered based on the building configuration and bearing resistance requirements (depth to remove this loose soil provided in brackets). The soil below about 3 m will typically support bearing resistances of about 150 to 250 kPa. Inclusion of basements may aid with this condition. This can reviewed as the design evolves.

Table 4.1. Depth of Sub-excavation at Borehole Locations for Structures – Raising Grades

Borehole	Depth / Elev.
1	0.3 / 244.5 (3.0 / 241.8)
2	0.8 / 243.6 (6.0 / 238.4)
3	0.3 / 243.5
4	0.8 / 243.9 (3.0 / 241.7)
5	0.4 / 244.2 (2.3 / 242.3)
6	0.3 / 246.1 (4.6 / 241.8)
7	0.5 / 246.1 (4.6 / 242.0)
8	0.3 / 243.5 (3.0 / 240.7)
9	0.3 / 245.6 (3.0 / 242.9)
10	0.3 / 246.5 (4.6 / 242.2)
11	0.2 / 245.1 (4.6 / 240.7)
12	0.3 / 244.5 (3.0 / 241.8)
13	0.3 / 245.7 (4.6 / 241.4)
14	0.3 / 246.2 (3.0 / 243.5)
15	0.2 / 245.3 (4.6 / 240.9)

In paved or landscaped areas, the topsoil and underlying material with organics shall be stripped. In general, the remaining inorganic soil can be left in place in pavement and landscaped areas.

The exposed subgrade soil in all areas must be proof-rolled and inspected by the geotechnical engineer to ensure all unsuitable material is removed from the engineered fill footprint. Any unsuitable areas must be further sub-excavated to an approved subgrade. The subgrade soil shall be proof-rolled to a targeted 100% SPmdd, in building areas (minimum 98% SPmdd) and 95% SPmdd in servicing and road areas.

Once the subgrade is approved, engineered fill can be placed. Engineered fill must be placed under the full-time supervision of a geotechnical engineer as required in the Ontario Building Code. The engineered fill may consist of excavated on-site inorganic soils (native sand) provided they have been moisture conditioned to a moisture content within 2% of optimum moisture content and do not contain organics, topsoil or deleterious material. The maximum cobble or boulder size should not exceed half of the loose lift thickness (i.e., all particles with a diameter greater than 100 mm should be removed). Existing site fill containing organics can be utilized in landscaped areas. It is recommended that if imported soil is required, it consisted of OPSS.MUNI 1010 Granular B or Select Subgrade Material (SSM) and first be utilized in building areas with suitable site soil used in non-building areas. Imported soil from other sites may also be possible and is subject to geotechnical and excess soil (environmental) review of the source site prior to import.

Engineered fill must be placed in loose lifts of 200 mm or less and compacted to a targeted 100% SPmdd in building areas (minimum 98% SPmdd) and 95% SPmdd in servicing or pavement areas. A minimum of 98% SPmdd is recommended for all fill placed at the site, based on the large scale of the site. That way, if site plans change in the future, the compaction specifications are already met, and additional engineered fill placement would not be required.

Localized wet subgrade areas may occur in low lying areas, uneven areas that allow ponded rain or other water to accumulate. Where wet areas are present and cannot be remediated through sub-excavation/allowed to dry, the first lift of engineered fill shall consist of 400 mm of Granular B Type II (OPSS.MUNI 1010). This will help to bridge the weaker subgrade and improve the ability to achieve the compaction specifications for subsequent engineered fill lifts. Additional lifts of Granular B Type II (OPSS.MUNI 1010) (200 mm to 400 mm thick) may be required for stability. Geogrid and/or geotextile may also be an alternative prior to engineered fill placement, to be determined on site during construction. Lastly, in wet areas direct compaction on the wet soil may lead to a larger issue. The situation should be reviewed at the time of construction for use of the alternatives noted above.

The engineered fill must extend a minimum of 1 m out from all sides of the foundations and extend at a 1 horizontal to 1 vertical slope (1H:1V) down to the exposed subgrade. A typical detail for engineered fill pad dimensioning is included in Appendix C.

4.2. Foundation Design

4.2.1. Foundations on Native Soil

Grading Plans were not available for review at the time of this report. It is speculated that some site grading may be required to accommodate the project. When grading is established, GEI should review the drawings for further geotechnical requirements.

Based on the above, the foundation elevations have not been established. The following is provided for preliminary planning purposes. As noted earlier, the upper loose soil only has a limited bearing resistance. Inclusion of basement levels may aid in reducing engineered fill requirements or larger footings.

Any foundations at this site founded on the upper typically loose soil layers above the depth/Elev. given in brackets in Table 4-1 can be designed for net geotechnical bearing resistances at SLS of about 50 to 100 kPa and factored bearing resistances at ULS of 75 to 150 kPa. The more competent soil layers below the depth/Elev. provided in brackets in Table 4.1 can be designed for net geotechnical bearing resistances at SLS of about 150 to 300 kPa and factored bearing resistances at ULS of 225 to 450 kPa.

Final footing elevations must be reviewed by geotechnical personnel from GEI to confirm bearing capacity values. The final site configuration must also be reviewed by GEI to assess the potential for footings to be founded on different soil subgrades, and to assess the potential for differential settlement. It is recommended that all foundations for each individual building / structure be set on the same soil subgrade wherever possible, to reduce the potential for differential settlement.

4.2.2. Foundations on Engineered Fill

For any foundations at this site that are constructed as conventional shallow spread and strip footings that bear on engineered fill, constructed as discussed in Section 4.1.1. can be designed using utilizing the values for the underlying native soil to a maximum of 150 kPa at SLS and 225 kPa at ULS.

It is recommended that nominal reinforcing steel for stiffening of the foundation walls made on engineered fill be provided to help mitigate minor cracking due to minor differential settlement. The reinforcing steel in the poured concrete foundation walls may consist of 2-15M bars continuous at the top of the foundation wall, and 2-15M bars continuous at the bottom of the foundation walls. Typically, these bars are placed 100 to 200 mm from the top or bottom of the foundation wall, respectively. The reinforcing steel should extend a minimum of 3 m past any transition zones between engineered fill and native soil. A typical reinforcing steel detail for foundation walls placed on engineered fill is provided within Appendix C. The recommended nominal reinforcing steel should not be considered a structural design. The need for different or additional reinforcement should be reviewed by a structural engineer to ensure the original structural design intent of the structure is maintained.

4.2.3. Foundation Alternatives

Due to the typical loose soil for the upper 3 m, Rapid Impact Compaction (RIC) may be an alternative to prepare the entire site without the requirement for excavation and reworking the soil. The soil is typically siltier than desired for this method. However, a contractor who performs this service should be consulted to confirm the potential effectiveness of this method.

Where vibration is a concern, helical piles may be considered to penetrate the loose soil layer for some structures. If being considered a contractor who specializes in this installation should be consulted.

4.2.4. General Foundation Considerations

All footings exposed to ambient air temperature throughout the year must be provided with a minimum of 1.2 m of earth cover or equivalent insulation for frost protection (25 mm of polystyrene insulation is equivalent to 300 mm of soil cover). The minimum strip and spread footing widths to be used shall be dictated as per the Ontario Building Code, regardless of loading considerations. Footings stepped from one level to another must be at a slope not exceeding 7V:10H.

The foundation design parameters provided above are predicated on the assumption that the foundation subgrade surface is undisturbed, and that all deleterious, topsoil, softened, disturbed, organic, and caved material is removed. The foundation excavation must be done in such a way that groundwater is controlled to prevent any disturbance to the foundation base. Temporary groundwater control during construction is discussed in Section 5.2.

The foundation subgrade must be reviewed by the geotechnical engineer prior to concrete placement to ensure the foundation design parameters provided are applicable, and to provide remedial recommendations if necessary. If the foundation excavation will be open for a prolonged period of time, the foundation subgrade should be protected with a skim coat of lean mix concrete (applied immediately after inspection by the geotechnical engineer), to ensure that no deterioration will occur due to weather effects.

4.3. Floor Slabs

The floor slabs can be constructed at this site on the engineered fill or possibly native soil, depending on the grading.

The exposed top of the engineered fill or native soil must be proof-rolled and inspected by the geotechnical engineer, prior to the placement of an aggregate base. 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 soil from the site or imported granular material and compacted to a minimum of 98% SPmdd within 2% optimum moisture content.

All building 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 upper 50 mm of clear stone can be replaced with 19 mm crusher run limestone for a working surface. The clear stone and subgrade must be separated by a filter cloth layer 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.

4.4. Earth Pressure Design Parameters

Any buildings with basement 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:

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

where, **P** = the horizontal pressure at depth, **h** (m)
K = the earth pressure coefficient (dimensionless)
h = depth below ground surface (m)
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 buildup 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 in the upper 3 to 5 m at this site are as follows.

Table 4.2. Earth Pressure Values

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.MUNI 1010)	21.0	32	0.31	0.47	3.25
Compact to Very Dense Native Soils Below About 3 m Depth	20.0	30	0.33	0.50	3.0

Soil Type	**γ - Bulk Unit Weight (kN/m³)**	**ϕ - Friction Angle (degrees)**	**Earth Pressure Coefficient (dimensionless)**		
			K_a - Active	**K_o – At-Rest**	**K_p - Passive**
Loose Native Soil Above 3 m depth	20.0	28	0.36	0.53	2.77

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 applicable for flat ground surfaces beyond the structure and must be revised for sloping ground surfaces.

The earth pressure coefficients referenced within the above table are a function of the friction angle of the adjacent soil, and both the degree and direction of movement of the structure subjected to unbalanced lateral earth pressures. For structures that are restrained at the top (such as basement walls), the at-rest earth pressure coefficient will apply. For structures that allow for 0.1 to 1% of movement away from the soil (such as unrestrained retaining walls), the full active earth pressure coefficient will apply. For structures that allow for 1 to 10% of movement into the soil, the full passive earth pressure coefficient will apply. The percentage movement is based on the height of the structure.

Other types of structures such as shoring walls with multiple rows of tiebacks and soil nail walls are subject to different loading conditions and must be analyzed separately.

4.5. Drainage

For the proposed buildings where basements are created, all basement foundation walls must be provided with damp-proofing provisions in conformance to the Ontario Building Code. Backfill along the foundation wall must consist of Granular ‘B’ Type 1 (OPSS.MUNI 1010) for a minimum lateral distance of 600 mm out from the foundation wall. Alternatively, if a filtered cellular drainage media is provided adjacent to the foundation wall, the backfill may consist of common earth fill.

GEI recommends maintaining a minimum 0.5 to 1.0 m separation from the seasonal high groundwater table to the basement slabs to reduce long-term risk of basements flooding, based on our experience with other municipalities and general industry standards. Considering the general absence of groundwater at this site, currently there appears to be no real restriction for basement levels due to groundwater.

For buildings with basements, a perimeter drainage system must be installed that will remove any water that infiltrates into the building backfill, to ensure that any water does not infiltrate into the basement. The perimeter drains must consist of minimum 100 mm diameter perforated pipes wrapped in filter socks, sufficiently covered on all sides by 19 mm clear stone. Perimeter drains should be directed to the sump underneath the basement floor in solid pipes so as not to surcharge the underfloor drainage layer with water or a frost free outlet. Underfloor drains are not considered necessary at this site, at this time. A typical basement drainage detail is included in Appendix C.

4.6. Site Servicing

It is assumed that the development will be serviced with municipal water, sanitary and storm sewers. Inverts were assumed to extend as deep as 3 to 5 m below existing grade for purposes of this report.

4.6.1. Bedding

The type of material and depth of granular bedding below the pipe will, to some extent, depend on the method of construction used by the contractor. Pipe bedding for flexible pipes should follow the requirements in OPSD 802.010 or applicable municipal standards. Pipe bedding for rigid pipes should follow the requirements in OPSD 802.030 to 802.032 or applicable municipal standards.

A subgrade consisting of the native soils at the site will provide adequate support for pipes with the bedding requirements as laid out in the above referenced OPS drawings. Where disturbance of the trench base has occurred from groundwater seepage, construction traffic, etc., or if in-situ fill is present at the invert level, the material should be sub-excavated and replaced with suitably compacted granular bedding. If weak zones are encountered, additional bedding materials and differing construction practices may be required and should be determined during construction. Any zones of peat or organic soil should be sub-excavated and replaced with approved earth fill or imported granular material compacted to 95% SPmdd. Details on temporary groundwater control are provided in Section 5.2.

Regardless of whether flexible or rigid pipes are implemented, granular bedding and cover material should consist of a well graded, free draining material, such as Granular “A” (OPSS.MUNI 1010). All granular bedding must be compacted to a minimum of 95% SPmdd.

4.6.2. Backfill

Excavated native cohesionless soils free from organics and deleterious materials may be re-used as backfill in trenches, provided the soil is moisture conditioned so that the moisture content is within 2% of optimum. Additional soil compaction details are provided in Section 5.3. The backfill should be compacted to a minimum of 95% SPmdd. In confined areas the layer thickness will have to be reduced to utilize smaller compaction equipment efficiently or by using granular material instead of locally sourced fill. Any backfill that is frozen contains a high percentage of organic material (topsoil, peat, etc.) or moisture or has otherwise unsuitable deleterious inclusion should not be used as backfill. The maximum cobble or boulder size should not exceed half of the loose lift thickness (i.e., all particles with a diameter greater than 100 mm should be removed).

Where trenches are within the traveled portions of proposed/existing roadway or paved areas, backfill within the frost penetration depth of 1.2 m should consist of native, non-organic, excavated material consistent with the soils surrounding the trench in the upper 1.2 m. If this technique is not undertaken, then frequent problems arise with yearly differential frost heave movements between the trench backfill and the adjacent native soil. This would occur, for example, if imported granular material is used to backfill trenches which is less susceptible to frost effects compared to the native soils on site. Alternatively, if different soil is used as the backfill due to issues with achieving compaction, a frost taper of 10H:1V can be implemented to help mitigate the potential for differential settlement and frost heave.

4.7. Pavement Design

The proposed development will consist of a main roadway/roundabout connecting to existing roadways and internal roadways. High density parking lots will surround the proposed 6-storey apartments.

4.7.1. Subgrade Preparation

In general, at this stage of the project the pavement subgrade is expected to consist of the near surface soils comprising silty fine sand, sand, and silt and sand which is considered to have a generally moderate frost susceptibility.

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 inorganics site soil compacted to a minimum of 95% SPmdd. If subgrade areas are extremely wet, they should not be compacted, as this may lead to further disturbance. The wet subgrade should be evaluated by geotechnical personnel to establish methodology for remediation.

The long-term performance of the pavement structure is highly dependent upon the subgrade support conditions. Stringent construction control procedures must be maintained to ensure that uniform subgrade moisture and density conditions are achieved as much as possible when fill is placed, and the subgrade is not disturbed or weakened after it is exposed.

4.7.2. Drainage

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.

Continuous pavement subdrains should be provided along the edges of the pavement and drained into respective catch basins to facilitate drainage of the subgrade and the granular materials. The subdrain invert should be maintained at least 0.3 m below subgrade level. To minimize the problems of differential movement between the pavement and catch basins/manhole due to frost action, the backfill around the structures should consist of free-draining OPSS Granular B. Typical pavement drainage details are provided in Appendix C.

4.7.3. Pavement Structure

There are two (2) different types of pavements that need to be designed for:

- Light Duty: Includes driveways and parking lots which will not see frequent heavy traffic loads such as buses, delivery, or fire trucks, etc. and will mostly service small vehicles such as cars or pickup trucks; and
- Heavey Duty: Includes driveways and parking lots which are designated for busses and fire truck routes, or will see frequent heavy traffic loads such as delivery or garbage trucks, etc.

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 and anticipating the subgrade will comprise of a moderate frost susceptible soil. The pavement design will need to be reviewed once the grading/subgrade has been established.

Table 4.3. Pavement Design

Pavement Layer	**Compaction Requirement**	**Min. Component Thickness (mm)**	
		Light Duty	**Heavy Duty**
Surface Course Asphaltic Concrete: HL3 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)	92% MRD (OPSS.MUNI 310)	40 mm	40 mm
Binder Course Asphaltic Concrete: HL8 (OPSS 1150) with PG 58-28 Asphalt Cement (OPSS.MUNI 1101)		50 mm	80 mm
Base Course: Granular A (OPSS.MUNI 1010)	100% SPmdd (OPSS. MUNI 501)	150 mm	150 mm
Subbase Course: Granular B Type I (OPSS.MUNI 1010)		350 mm	500 mm

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. The granular and asphalt pavement materials and their placement should conform to OPSS 310, 501, 1010 and 1150.

If the pavement construction occurs in wet, winter or inclement weather, it may be necessary to provide additional subgrade support for heavy construction traffic by increasing the thickness of the granular subbase, base or both. Further, traffic areas for construction equipment may experience unstable subgrade conditions. These areas may be stabilized utilizing additional thickness of granular materials or the use of geogrid. Further, if subgrade areas are wet, direct compaction will only serve to intensify the disturbance and is not recommended. The area should be reviewed by Geotechnical personnel to develop a strategy with the above noted or other alternatives.

It should be noted that in addition to adherence of the above pavement design recommendations, a close control on the pavement construction process will also be required in order to obtain the desired pavement life. Therefore, it is recommended that regular inspection and testing should be conducted during the pavement construction to confirm material quality, thickness, and to ensure adequate compaction.

Smooth transitions are required in all areas where the new pavement meets the existing asphalt surface. Asphalt joints shall follow OPSS.MUNI 310. Frost tapers of 10H:1V should be implemented between areas of differing pavement thickness and tie-in areas to existing pavement. Longitudinal asphalt joints should be milled into the existing asphalt a minimum 0.5 m for each lift. Transvers joint shall be milled into the existing asphalt a minimum 0.5 m for each lift. Successive joints should be staggered.

4.8. SWM Pond Design

Concept plans for the SWM pond have not been provided at the time of this report. General recommendations provided below are preliminary and must be reviewed and updated once additional design information becomes available.

Boreholes 3 and 5 were drilled in the area of the SWM pond. Below the topsoil, sand or silty fine sand was revealed to 1.5 to 6.1 m depth (loose to compact soil). Silt and sand and silt units were below the sand/silty fine sand to 6.6 or 9.1 m depth (typically compact to dense soil). Underlying the sand and silt in Borehole 3 a major sand deposit was revealed to the 24.8 m depth of the borehole (dense to very dense soil). Groundwater was not present upon completion in both boreholes or in the well installed in Borehole 3.

4.8.1. General Construction Considerations

General excavation and temporary groundwater control construction considerations are provided with Section 5.0 of this report and generally would apply.

The steepest recommended pond slope inclination is 4H:1V and should follow the design guidelines of the local municipality. Steeper slopes below the permanent pool level will need to be reviewed on a case by case basis.

It is recommended that any piping or trenching in the area of the pond (within 50 m) should be provided with seepage cut-off collars (clay plugs, concrete plugs, or other barriers) to protect against water seepage through the pipe bedding and backfill.

Pond berms above grade will have to be constructed as engineered fill, as described earlier in this report, and compacted to minimum 95% SPmdd. The material for the berm may vary depending on liner requirements and any “dam” requirements.

4.8.2. Pond Slope Surface Treatment

The final slope surface and all bare or exposed areas (where applicable) should be provided with suitable vegetation cover or erosion protection. The sloped surface should be provided with a layer of topsoil (minimum 100 mm thick) and should be hydro-seeded with a grass mixture and mulch. If seeded, during the first 2 to 3 years, the surface cover of topsoil and seeding may require periodic maintenance until the vegetation becomes well established. It is recommended that erosion netting/erosion control blankets be staked on the slope surface for erosion protection (including the inside slope above the water level).

4.8.3. Liner Considerations

Depending on the type of pond that is planned, a liner may be required if a permanent pool is proposed. The liner should be placed along the entire pond bottom and extend a minimum of 1.0 m above the permanent pool elevation. The liner may consist of a natural soil material (such as clay), a synthetic membrane liner (such as a High-Density Polyethylene, Geo-synthetic Clay Liner, or PVC), a concrete liner, or a combination thereof. Details can be provided when the design has progressed.

If natural soil is being considered, the liner must be constructed of low permeability materials (clayey soil) and be a minimum 1.0 m thick in order to perform adequately and to provide liner bulk permeability on the order of 10^{-9} m/s or lower. The grain size distribution of the clay liner material must conform to the following:

- No particle greater than 100 mm dimension;
- Not greater than 15 percent of the material larger than 4.75 mm (No. 4 sieve);
- Minimum of 35 percent of the material finer than 0.075 mm (i.e., passing No. 200 sieve);
- Minimum 15 percent finer than 0.002 mm (clay size); and
- Not greater than 2% organic content, with no visible roots or topsoil.

There is no material at the site that is considered acceptable for use as liner material.

The liner system must be designed to withstand uplift pressure due to hydrostatic head at the base of the liner for the worse-case condition when the pond is emptied for cleaning and maintenance activities. Uplift pressure can be assessed and reviewed when design details are established.

5. Constructability Considerations

5.1. Excavations

At this time, excavations for the project site are anticipated to extend to about 3.0 to 5.0 m below existing grade to account for the buildings, trenches for site servicing and the SWM pond. Below the surficial topsoil, excavations will encounter the silty fine sand, sand and silt, and locally upper sand or silt layers. Harder digging can be expected in the dense to very dense soil.

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. If more than one soil type is encountered in an excavation, the most conservative soil type must be followed for sloping the sidewalls of the excavation. Excavations for the site should be completed considering a Type 3 soil geometry, 1H:1V from the base of the excavation, assuming the groundwater is controlled as noted in the sext section.

Excavation sidewalls will need to be continuously reviewed for evidence of instability and ground water seepage, particularly following periods of heavy rain or thawing. When required, remedial action must be taken to ensure the continued stability of excavation slopes and the safety of the workers.

Minimum support system requirements for steeper excavations are stipulated in Sections 235 through 238 and 241 of the OHSA and include provisions for timbering, shoring and moveable trench boxes. To reduce the potential for instability of the trench excavations, materials excavated from the service trenches and/or other fill materials, or heavy equipment should not be placed near the crest of the trench excavations.

It is important to note that soils encountered in the construction excavations may vary significantly across the site. Our soil classifications are based solely on the materials encountered in the boreholes advanced on site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, we recommend that GEI be contacted immediately to evaluate the conditions encountered.

5.2. Temporary Construction Groundwater Control

As noted above, excavation is envisioned to extend to about 3.0 to 5.0 m below existing grade for the project.

The stabilized groundwater levels were below the installed depth of the wells, to date. Perched water can also be expected in the finer soil layers as shown by the wet conditions and the high moisture contents.

Based on the measurements to date, conventional sump pumping should suffice to control groundwater seepage for excavations that extend to 5.0 m depth. Locally greater pumping may be required where perched water is encountered.

The exact scenario where certain groundwater control techniques will work are directly correlated to how coarse/fine the native soils are in an excavation, and both the lateral and vertical extent of the wet cohesionless deposits. If the groundwater table is not controlled during construction, the base of the excavations will be unstable, leading to difficulties in excavating and placement of pipes, footings or engineered fill, and providing safety for the workers.

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.

Due to new guidance recently provided by the MECP (ERO number 019-6853, last updated May 27, 2025), water taking for construction purposes are only required to be registered on the EASR system, even if water taking rates are expected to exceed 400,000 L/day (per previous MECP guidance). If water taking for any purpose other than or in addition to construction dewatering occurs, a PTTW from the MECP may be necessary. Registry on the EASR system is likely not required for this site based on excavation as described above. Reference is made to our hydrogeological report for further details.

5.3. Compaction Specifications

SPmdd is the specification to indicate the degree to which soil or aggregate is compacted. To achieve the specified SPmdd as indicated in this report, all soils or aggregates must be placed in lift thicknesses no greater than 200 mm. If this is not the case, only the upper portion of the lift will be adequately compacted, and the lower portion of the lift has a high probability of not meeting compaction specifications. In addition, industry standard equipment used to determine the degree of compaction consists of nuclear densometers. These devices have an inherent limitation in that they cannot test beyond 300 mm in depth, and so the degree of compaction beyond this depth cannot be quantitatively determined.

Along with lift thickness, ensuring that the soil or aggregate is within 2% of its optimum moisture content ensures that the specified compaction can be reached. If the soil or aggregate is too dry/wet, it is either very difficult or impossible to reach the specified compaction. This is especially true for when higher compaction specifications such as 98% and 100% SPmdd are required.

Moisture can be increased by adding water and mixing the soil prior to re-use, blending the soil with wetter material, or by importing soil to the site that is at optimum and can be readily compacted.

Moisture can be reduced by tilling or spreading out the soil to dry or blending it with drier material. In-situ moisture contents can change based on the season and local groundwater levels and can also change for stockpiled material due to precipitation. Zones of the fine-grained soil with very high moisture contents may find moisture conditioning to be difficult to accomplish in short periods and will require adjustments to scheduling to accommodate.

In addition to the above compaction specifications, in any areas where compacted fill will be placed over the exposed native soil subgrade, any loose, soft, wet, organic or unstable areas should be sub-excavated, and backfilled with clean earth fill or Granular ‘B’ (OPSS.MUNI 1010) compacted to a minimum of 95% SPmdd. This recommendation applies to site servicing and pavement subgrades. Where structures/ buildings require upfilling beneath the structure the fill should be compacted to 100% SPmdd.

5.4. Quality Verification Services

On-site quality verification services are an integral part of the geotechnical design function, and for foundations, engineered fill and retaining walls are required under the Ontario Building Code. Quality verification services are used to confirm that construction is being conducted in general conformance with the requirements as outlined in the drawings, reports and specifications prepared for the proposed development.

- GEI can provide all the on-site quality verification services outlined below:
    - The subgrade for shallow foundations for the proposed buildings will need to be field reviewed by the geotechnical engineer;
    - Installation of retaining structures over 1.0 m high and related backfilling operations must be field reviewed on a continuous basis by the geotechnical engineer as required in the OBC;
    - Full-time monitoring, testing and inspection of engineered fill placement is required by the geotechnical engineer per the OBC;
    - Part-time monitoring of the subgrade support capabilities, material quality, lift thickness, moisture content, degree of compaction, etc. is recommended for the following areas to ensure the recommendations within this report are followed and they perform adequately in the long-term:
        - Slab-on-grade;
        - Pavement structure (granular and asphalt); and
        - Pipe bedding and cover.
- Testing of the concrete (compressive strength, slump, air content, etc.) and testing of the asphalt (asphalt content and gradation) are recommended to ensure that the quality of the materials being brought to site meet the requirements of the project.

5.5. Site Work

The soils found at this site will become weakened when subjected to traffic, particularly when wet. If there is site work conducted during periods of wet weather, then it can be expected that the subgrade will be disturbed unless an adequate granular working surface is provided to protect the integrity of the subgrade soils from construction traffic. Subgrade preparation works cannot be adequately accomplished during wet weather, and the project must be scheduled accordingly. The disturbance caused by the traffic can result in the removal of disturbed soil and use of granular fill material for site restoration or underfloor fill that is not intrinsic to the project requirements.

The most severe loading conditions on the subgrade may occur during construction. Consequently, special provisions such as end dumping and forward spreading of earth and aggregate fills, restricted construction lanes, and half-loads during paving and other work may be required, especially if construction is conducted during unfavourable weather.

If construction proceeds during freezing weather conditions, adequate temporary frost protection for the founding subgrade and concrete must be provided. The soil at this site is susceptible to frost damage. Consideration must be given to frost effects, such as heave or softening, on exposed soil surfaces in the context of this project development.

6. Limitations and Conclusions

6.1. Limitations

The recommendations and comments provided are necessarily on-going as new information of underground conditions becomes available. More specific information with respect to the conditions between samples, or the lateral and vertical extent of materials may become apparent during excavation operations. The interpretation of the borehole information must, therefore, be validated during excavation operations. Consequently, conditions not observed during this investigation may become apparent. Should this occur, GEI should be contacted to assess the situation and additional testing and reporting may be required.

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

The comments given in this report are intended only for the guidance of the design engineers. The number of boreholes required to determine the localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc. could be greater than has been carried out for design purposes. Contractors bidding on or undertaking the works should, in this light, decide on their own investigations, as well as 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.

This report was authorized by, and prepared by GEI for, the account of Pine Valley Estates Ltd. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. GEI accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project.

6.2. Conclusions

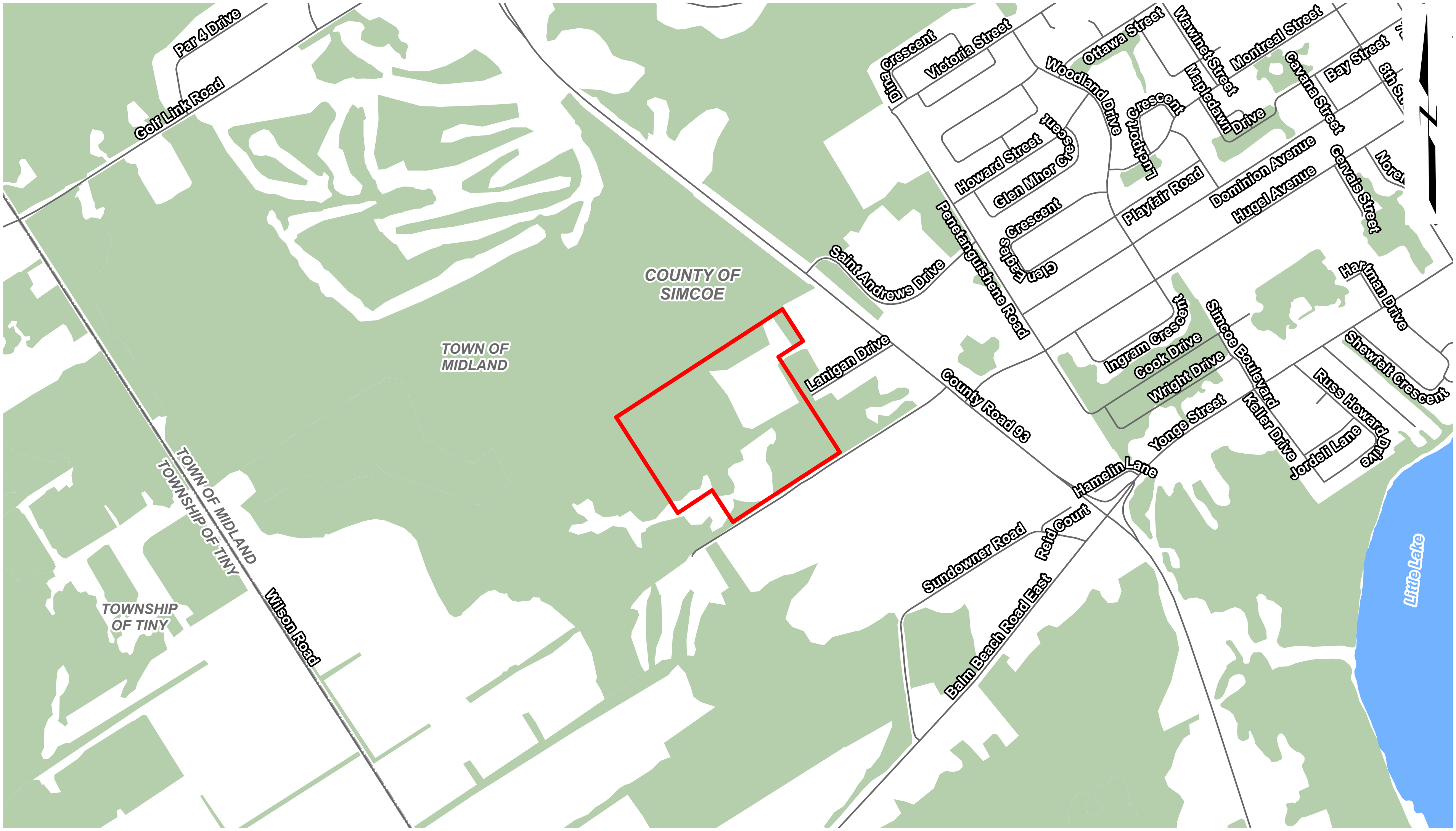
It is recognized that municipal/regional governing bodies, in their capacity as the planning and building authority under Provincial statues, will make use of and rely upon this report, cognizant of the limitations thereof, both as are expressed and implied.

We trust this report is complete within our terms of reference, and the information presented is sufficient for your present purposes. If you have any questions, or when we may be of further assistance, please do not hesitate to contact our office.

Figures

Site Location Plan

Borehole Location Plans



🟥 Subject Lands

▭ Municipal Boundary, Lower/Single Tier

🟦 Waterbody

🟩 Wooded Area

Reference(s):

1. Coordinate System: NAD 1983 CSRS UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2026.

0 170 340

Metres

Geotechnical Investigation
9332 County Road 93
Midland, Ontario

Pine Valley Estates Ltd.

GEI Consultants Canada

SITE LOCATION PLAN

Project 2506478

April 2026

Fig. 1

\\bos-pzcc-1\Data_Storage\Working\PINE VALLEY ESTATES LTD\2506478 Proposed Pine Valley Estates Development 9332 County Rd 93 Midland ON\05_GIS\APRX\2026-03_Geotech\2026-03_Geotech.aprx

🟥 Subject Lands

● Borehole Location

⊕ Borehole/Monitoring Well Location

Reference(s):
1. Coordinate System: NAD 1983 CSRS UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2026.
3. Orthoimagery © First Base Solutions, 2026. Imagery taken in 2025.

0 40 80
Metres

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Midland, Ontario

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Project 2506478

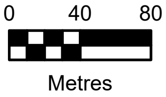
BOREHOLE LOCATION
PLAN (AERIAL)

April 2026

Fig. 2A

\\bos-pzcc-1\Data_Storage\Working\PINE VALLEY ESTATES LTD\2506478 Proposed Pine Valley Estates Development 9332 County Rd 93 Midland ON\05_GIS\APRX\2026-03_Geotech\2026-03_Geotech.aprx

Reference(s):
1. Coordinate System: NAD 1983 CSRS UTM Zone 17N.
2. Base features produced under license with the Ontario Ministry of Natural Resources and Forestry © King's Printer for Ontario, 2026.



Geotechnical Investigation
9332 County Road 93
Midland, Ontario

Pine Valley Estates Ltd.

GEI Consultants Canada

BOREHOLE LOCATION PLAN (CONCEPT)

Project 2506478

April 2026

Fig. 2B

\\bos-pzcc-1\Data_Storage\Working\PINE VALLEY ESTATES LTD\2506478 Proposed Pine Valley Estates Development 9332 County Rd 93 Midland ON\05_GIS\APRX\2026-03_Geotech\2026-03_Geotech.aprx

Appendix A Borehole Logs

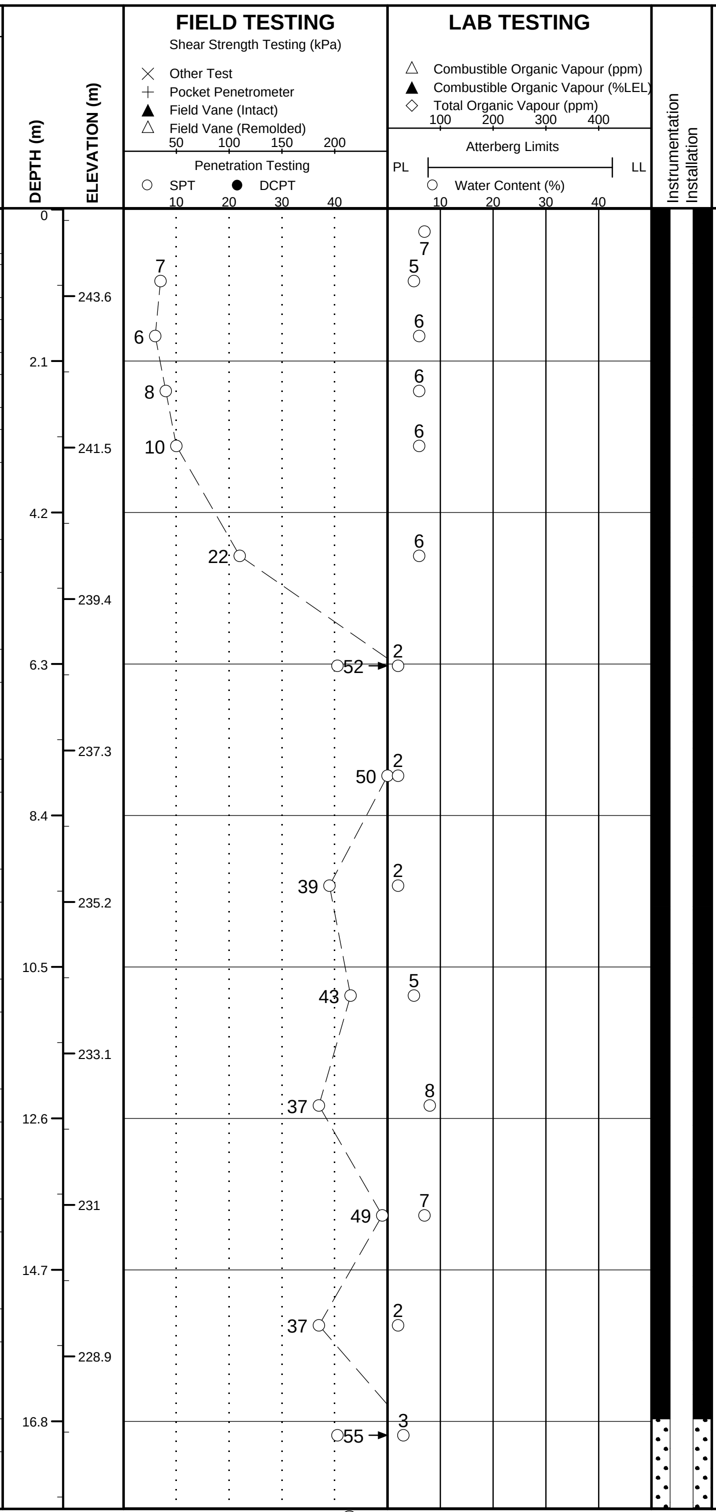
RECORD OF BOREHOLE No. 01

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Hollow Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954451**
Easting: **585311**
Date Started: **Mar 25/26**
Date Completed: **Mar 26/26**

LITHOLOGY PROFILE / SOIL SAMPLING

		DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value
0.0	244.8	TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist	AS	1		
			SS	2	100	7
1.5	243.3	SAND: Trace to some silt, loose, brown, moist	SS	3	100	6
			SS	4	100	8
			SS	5	100	10
4.6	240.2	SAND AND SILT: Trace clay, compact, greyish brown, moist	SS	6	100	22
6.1	238.7	SAND: Trace to some silt, very dense to dense, greyish brown, moist	SS	7	100	52
			SS	8	100	50
			SS	9	100	39
10.7	234.1	SILT AND SAND: Trace clay, dense, brown, moist	SS	10	100	43
			SS	11	100	37
			SS	12	100	49
15.2	229.6	SAND: Trace silt, trace gravel, dense to very dense, brown, moist	SS	13	100	37
			SS	14	100	55



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Groundwater Elevation:

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Scale **1 :105**

RECORD OF BOREHOLE No. 01

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Hollow Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954451**
Easting: **585311**
Date Started: **Mar 25/26**
Date Completed: **Mar 26/26**

FIELD TESTING
Shear Strength Testing (kPa)
× Other Test
+ Pocket Penetrometer
▲ Field Vane (Intact)
△ Field Vane (Remolded)
50 100 150 200
Penetration Testing
○ SPT ● DCPT
10 20 30 40

LAB TESTING
△ Combustible Organic Vapour (ppm)
▲ Combustible Organic Vapour (%LEL)
◇ Total Organic Vapour (ppm)
100 200 300 400
Atterberg Limits
PL LL
○ Water Content (%)
10 20 30 40

LITHOLOGY PROFILE		SOIL SAMPLING						FIELD TESTING	LAB TESTING	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)				GR	SA	SI	CL
	SAND con't						226.8							
		SS	15	100	90			○90 →	1 ○					
						18.9								
		SS	16	65	100+		224.7	○100+ →	1 ○		4	92	4	0
						21								
	21.8 223.0	SS	17	20	100+			○100+ →	3 ○					
	Borehole Terminated at 21.8 m													

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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Cave depth after auger removal: Open
Groundwater Elevation:

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Scale: **1 :105**

RECORD OF BOREHOLE No. 02

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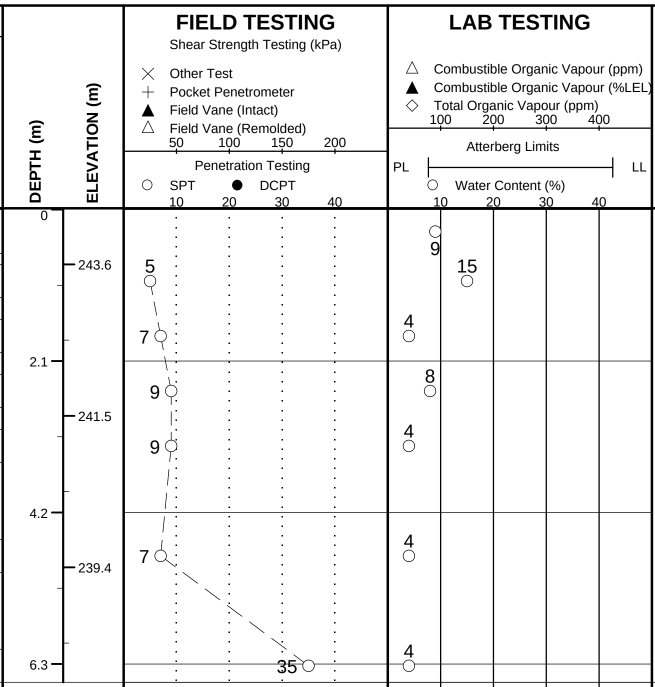
Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954551**
Easting: **585509**
Date Started: **Mar 30/26**
Date Completed: **Mar 30/26**

Depth (m)	Elevation (m)	Description
0.0	244.4	TOPSOIL: 75 mm SILTY FINE SAND: Trace organics rootlets, loose, brown, moist
0.8	243.6	SAND AND SILT: Trace clay, loose to dense, brown, moist
6.6	237.8	Borehole Terminated at 6.6 m

Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
AS	1			9				
SS	2	100	5	15	0	49	48	3
SS	3	100	7	4				
SS	4	100	9	8				
SS	5	100	9	4				
SS	6	100	7	4				
SS	7	100	35	4				



Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Groundwater depth encountered on completion of drilling: Dry

Cave depth after auger removal: Open

Groundwater depth observed on:

Groundwater Elevation:

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Scale **1 :105**

RECORD OF BOREHOLE No. 03

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

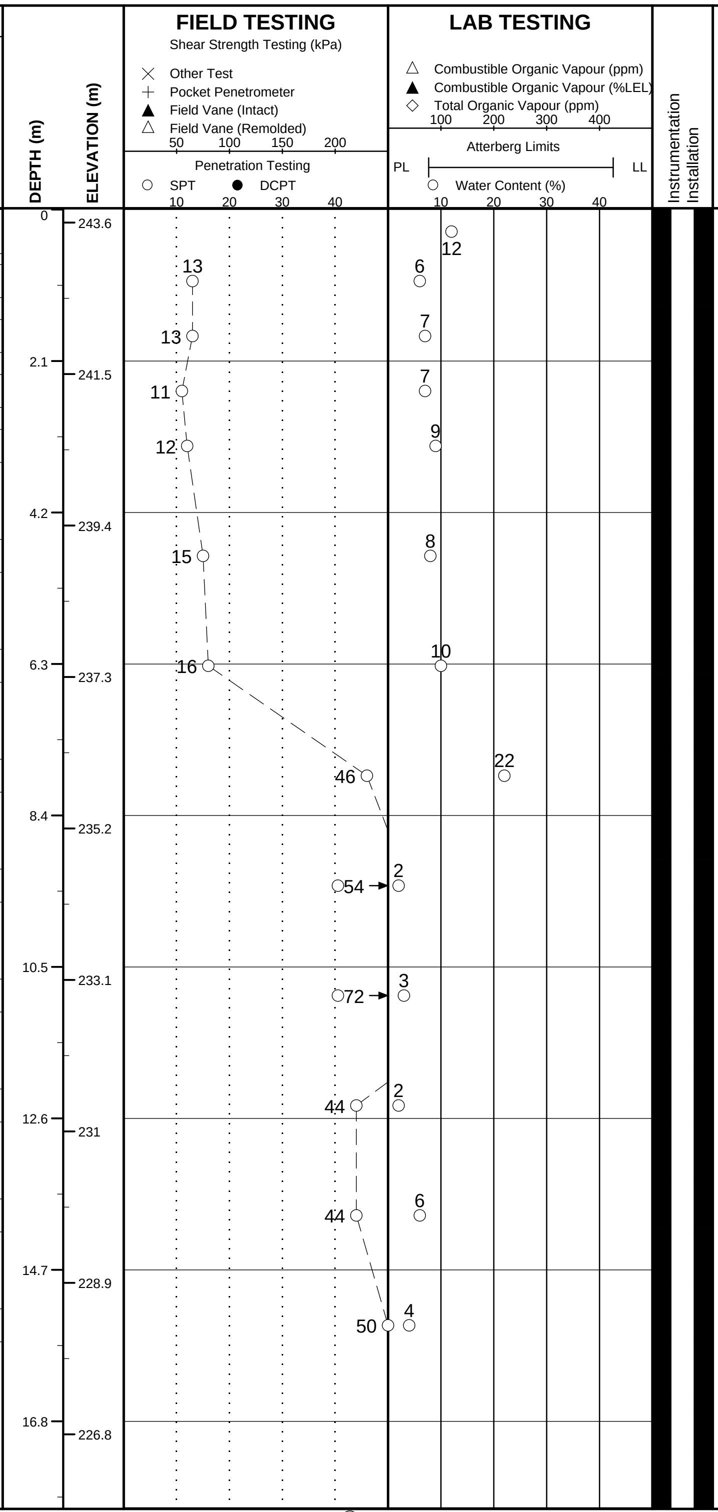
Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954692**
Easting: **585689**
Date Started: **Mar 26/26**
Date Completed: **Mar 30/26**

LITHOLOGY PROFILE

Depth (m)	Elevation (m)	DESCRIPTION
0.0	243.8	TOPSOIL: 75 mm SAND: Some silt, trace organics upper 200 mm, compact, brown, moist
6.1	237.7	SAND AND SILT: Trace clay, compact to dense, brown, moist to wet
9.1	234.6	SAND: Trace to some silt, dense to very dense, brown, moist

SOIL SAMPLING

Sample Type	Sample Number	Recovery (%)	SPT "N" Value
AS	1		
SS	2	100	13
SS	3	100	13
SS	4	100	11
SS	5	100	12
SS	6	100	15
SS	7	100	16
SS	8	100	46
SS	9	100	54
SS	10	100	72
SS	11	100	44
SS	12	100	44
SS	13	100	50



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Groundwater Elevation:

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Scale **1 :105**

RECORD OF BOREHOLE No. 03

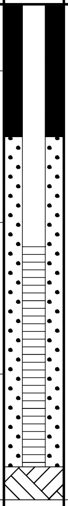
Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:
Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954692**
Easting: **585689**
Date Started: **Mar 26/26**
Date Completed: **Mar 30/26**

FIELD TESTING – Shear Strength Testing (kPa): × Other Test; + Pocket Penetrometer; ▲ Field Vane (Intact); △ Field Vane (Remolded); 50 100 150 200. Penetration Testing: ○ SPT ● DCPT; 10 20 30 40

LAB TESTING – △ Combustible Organic Vapour (ppm); ▲ Combustible Organic Vapour (%LEL); ◇ Total Organic Vapour (ppm); 100 200 300 400. Atterberg Limits: PL ├──┤ LL. ○ Water Content (%); 10 20 30 40

LITHOLOGY PROFILE – DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	Penetration Testing	Water Content (%)	GR	SA	SI	CL
SAND con't	SS	14	100	51			○51 →	2				
					18.9	224.7						
					21	222.6						
	SS	15	100	79			○79 →	2				
					23.1	220.5						
- - - Wet - - - 24.8 218.9	SS	16	100	75			○75 →	14	1	85	14	0
Borehole Terminated at 24.8 m												

Instrumentation Installation



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Groundwater depth encountered on completion of drilling: Dry
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Cave depth after auger removal: Open
Groundwater Elevation:

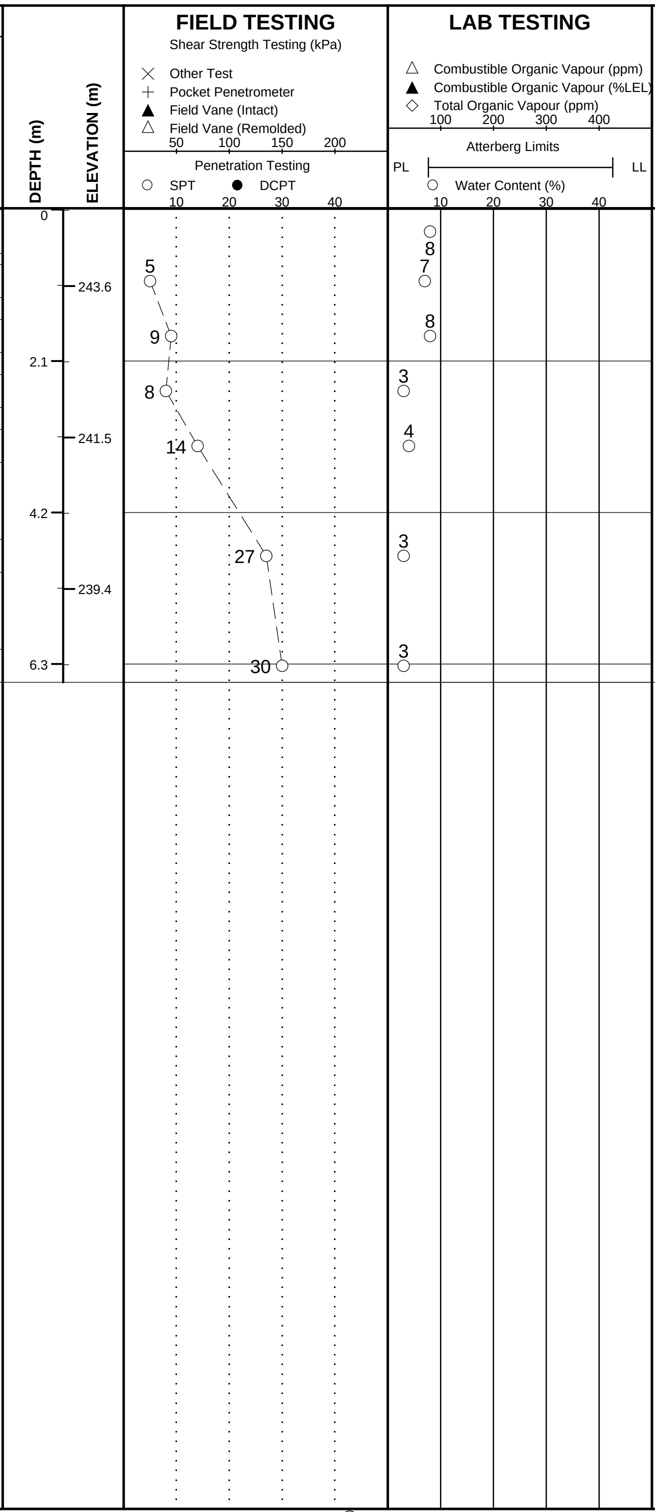
Scale: **1 :105**

RECORD OF BOREHOLE No. 04

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954423**
Easting: **585438**
Date Started: **Mar 25/26**
Date Completed: **Mar 25/26**

LITHOLOGY PROFILE		SOIL SAMPLING				Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value		GR	SA	SI	CL
	0.0 244.7									
	TOPSOIL: 75 mm SILTY FINE SAND: Loose, brown, moist 0.8 243.9	AS	1							
	SILT AND SAND: Trace clay, loose to compact, brown, moist	SS	2	100	5					
		SS	3	100	9					
		SS	4	100	8					
		SS	5	100	14					
		SS	6	100	27					
	6.6 238.1	SS	7	100	30					
	Borehole Terminated at 6.6 m									



Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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RECORD OF BOREHOLE No. 05

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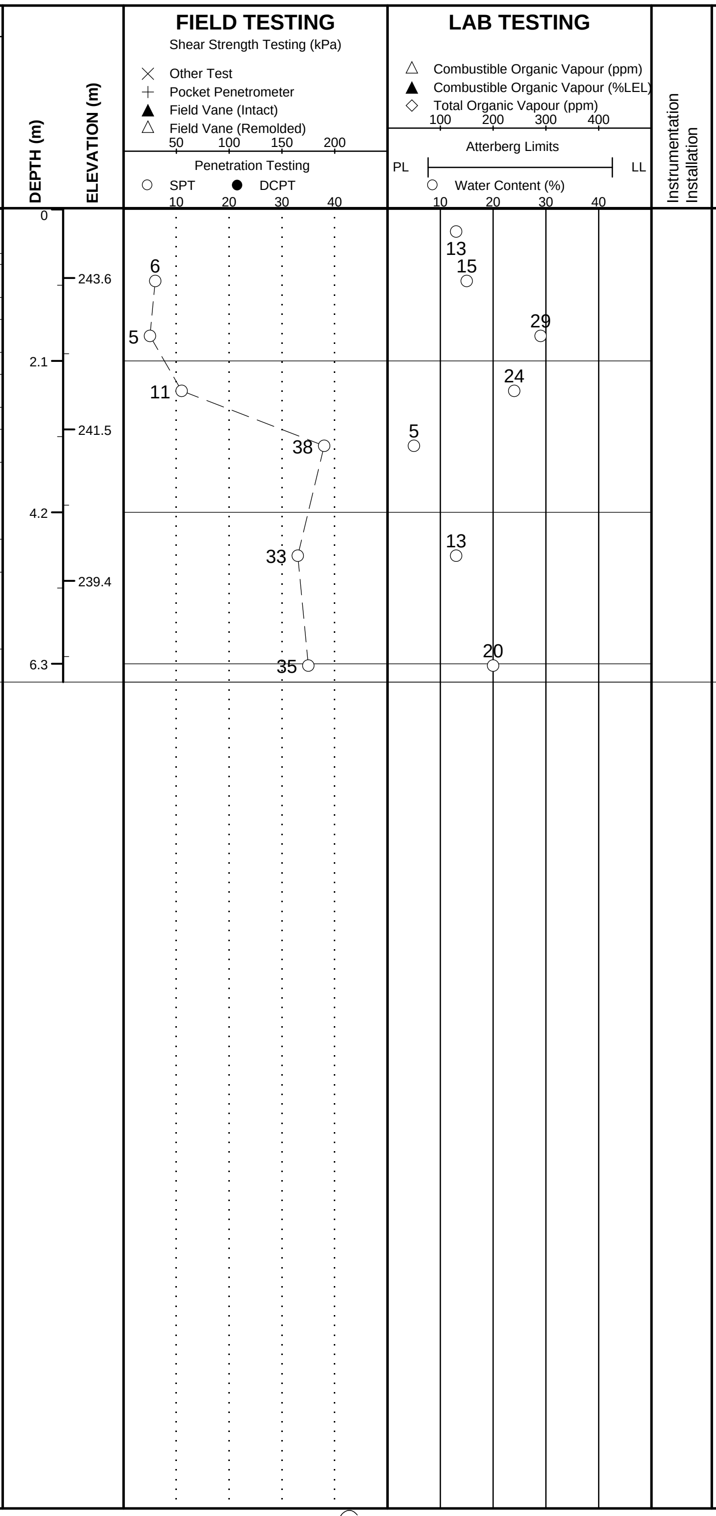
Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954536**
Easting: **585611**
Date Started: **Mar 23/26**
Date Completed: **Mar 23/26**

LITHOLOGY PROFILE		SOIL SAMPLING				COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Depth / Elevation	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	GR	SA	SI	CL
0.0 / 244.6	TOPSOIL: 75 mm SILTY FINE SAND: Trace organics upper 300 mm, loose, brown, moist to wet	AS	1						
		SS	2	100	6				
1.5 / 243.0	SILT: Some sand, trace clay, loose to compact, brown, wet to moist	SS	3	100	5				
		SS	4	100	11	0	14	80	5
3.0 / 241.5	SAND AND SILT: Trace clay, dense, brown, moist to wet	SS	5	100	38				
		SS	6	100	33				
6.6 / 238.0		SS	7	100	35				
	Borehole Terminated at 6.6 m								



Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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RECORD OF BOREHOLE No. 06

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

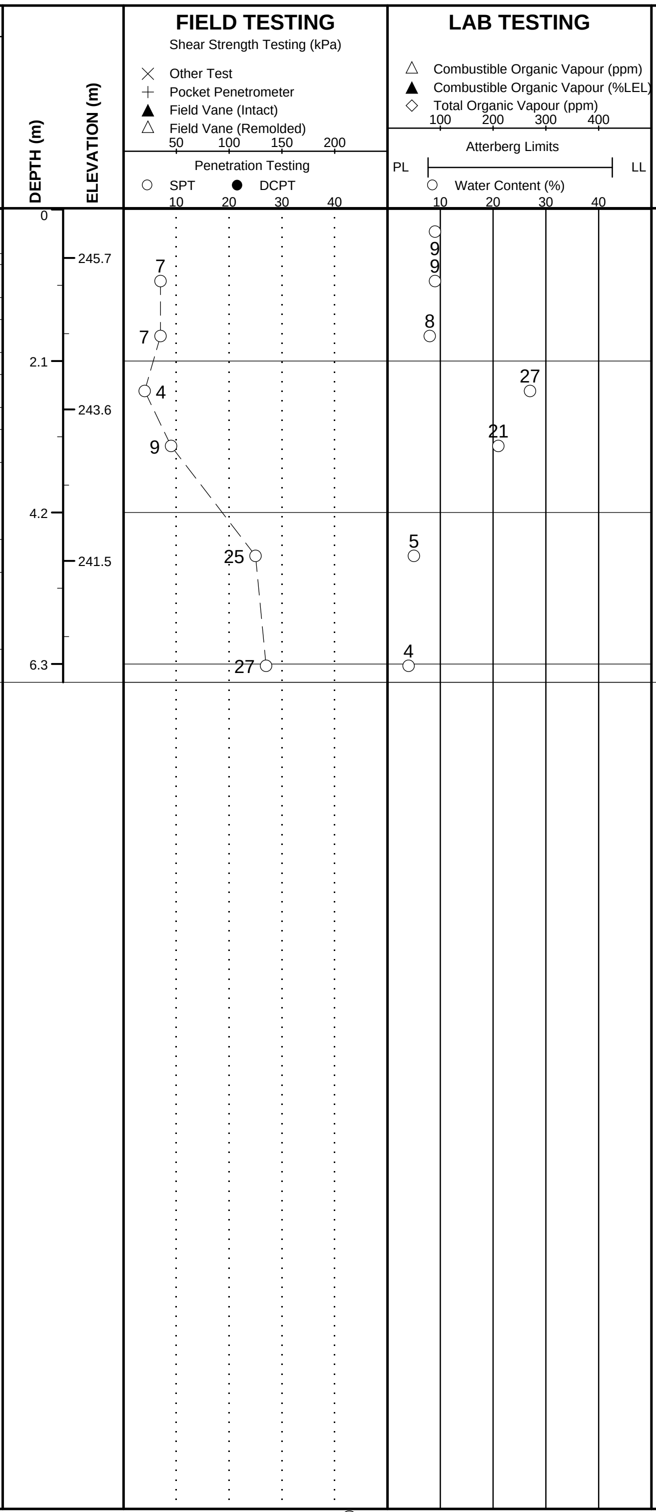
Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954299**
Easting: **585433**
Date Started: **Mar 25/26**
Date Completed: **Mar 25/26**

LITHOLOGY PROFILE

Depth (m)	Elevation (m)	DESCRIPTION
0.0	246.4	TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist
2.3	244.1	SILT: Some sand, trace clay, loose, brown, moist to wet
4.6	241.8	SILT AND SAND: Trace clay, compact, brown, moist
6.6	239.8	Borehole Terminated at 6.6 m

SOIL SAMPLING

Sample Type	Sample Number	Recovery (%)	SPT "N" Value
AS	1		
SS	2	100	7
SS	3	100	7
SS	4	100	4
SS	5	100	9
SS	6	100	25
SS	7	100	27



Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

Groundwater depth encountered on completion of drilling: Dry

Cave depth after auger removal: Open

Groundwater depth observed on:

Groundwater Elevation:

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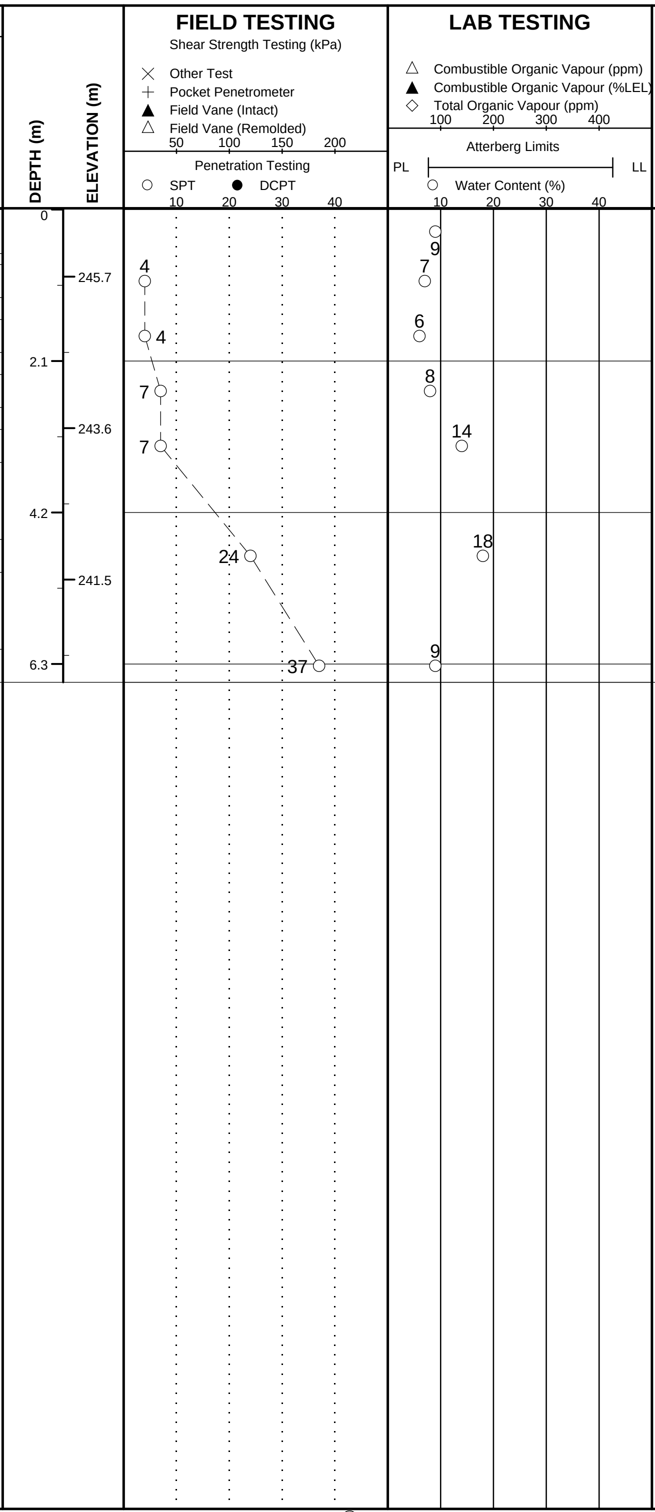
RECORD OF BOREHOLE No. 07

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954413**
Easting: **585564**
Date Started: **Mar 25/26**
Date Completed: **Mar 25/26**

LITHOLOGY PROFILE		SOIL SAMPLING							COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Depth (m) / Elevation (m)	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	Instrumentation Installation		GR	SA	SI	CL
0.0 / 246.6	TOPSOIL: 75 mm SILTY FINE SAND: Loose, brown, moist	AS	1			9						
		SS	2	100	4	7						
		SS	3	100	4	6						
		SS	4	100	7	8						
3.0 / 243.6	SILT AND SAND: Trace clay, loose to dense, brown, moist	SS	5	100	7	14						
		SS	6	100	24	18			0	35	57	8
		SS	7	100	37	9						
6.6 / 240.1	Borehole Terminated at 6.6 m											



☰ Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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RECORD OF BOREHOLE No. 08

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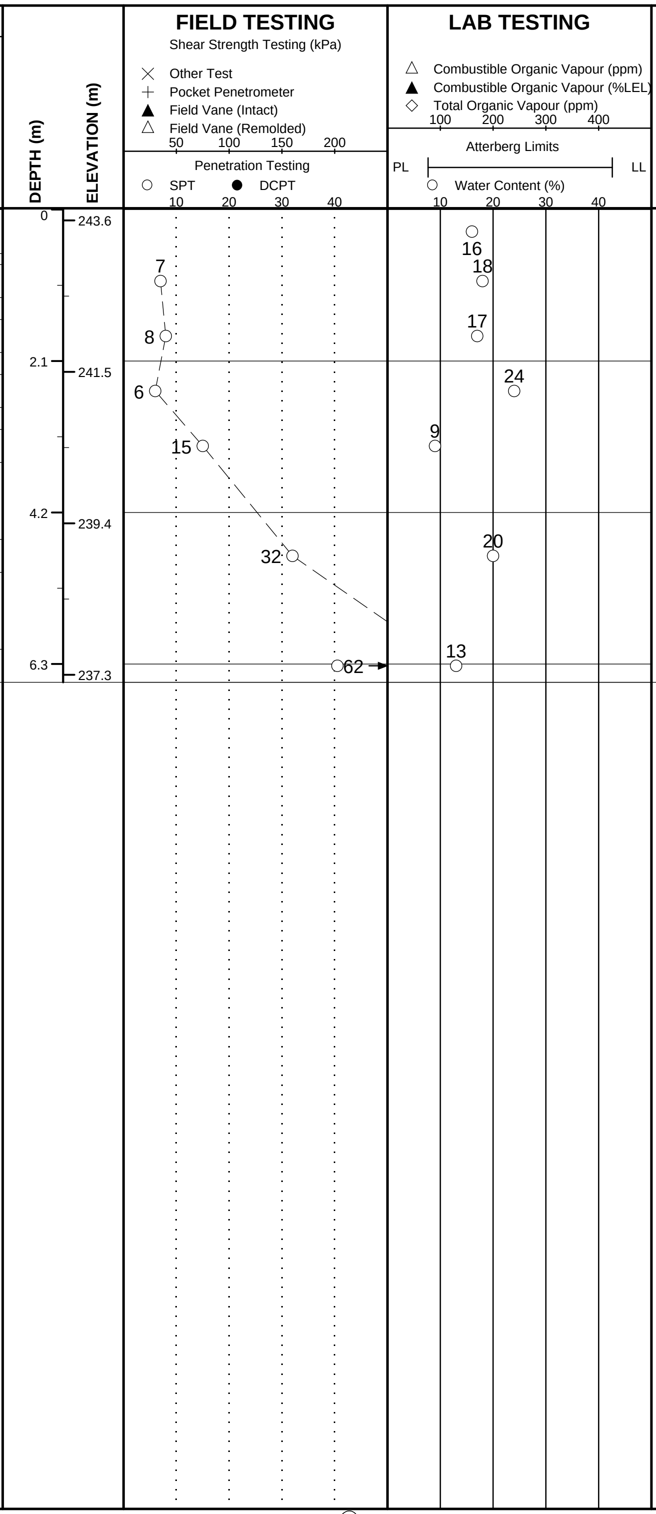
Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954520**
Easting: **585728**
Date Started: **Mar 23/26**
Date Completed: **Mar 23/26**

LITHOLOGY PROFILE		SOIL SAMPLING			
Depth / Elevation	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value
0.0 / 243.8	TOPSOIL: 75 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist to very moist	AS	1		
		SS	2	100	7
		SS	3	100	8
		SS	4	100	6
3.0 / 240.7	SAND AND SILT: Trace clay, compact to very dense, brown to grey/brown, moist to wet	SS	5	100	15
		SS	6	100	32
6.6 / 237.2		SS	7	100	62
	Borehole Terminated at 6.6 m				



Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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Scale **1 :105**

RECORD OF BOREHOLE No. 09

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Hollow Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954449**
Easting: **585686**
Date Started: **Mar 25/26**
Date Completed: **Mar 25/26**

LITHOLOGY PROFILE

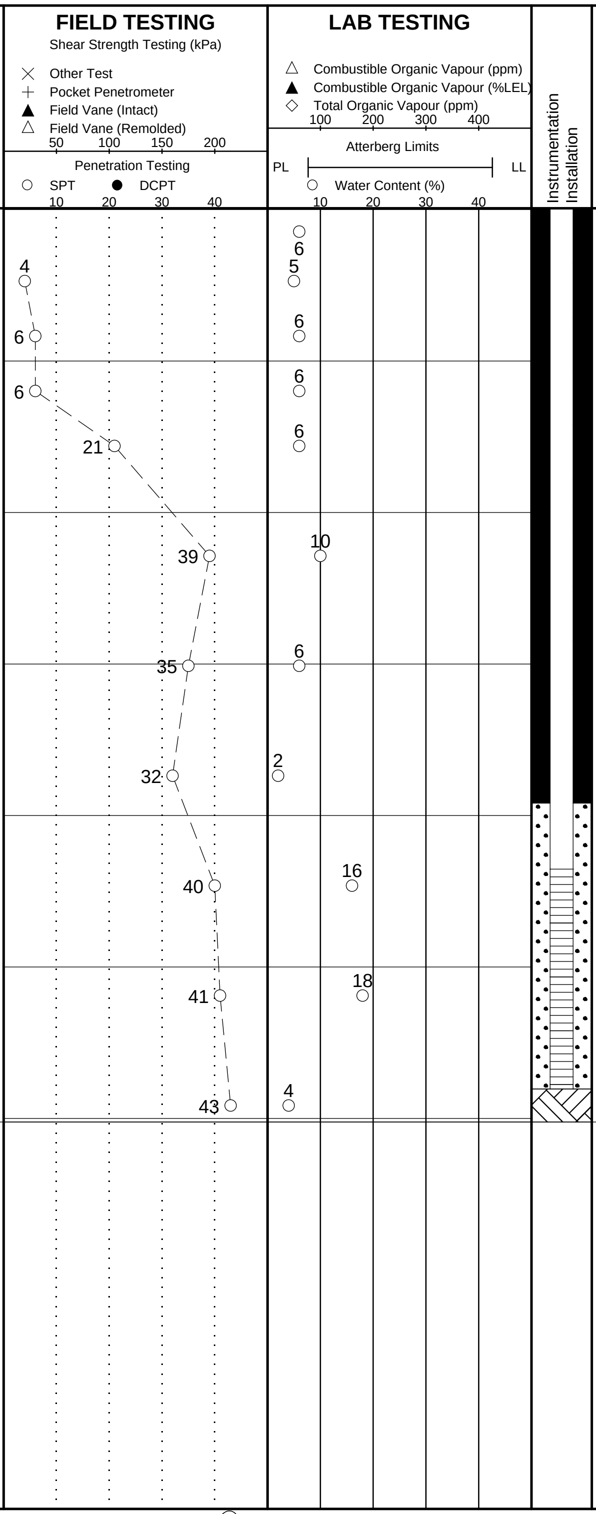
Depth (m)	Elevation (m)	DESCRIPTION
0.0	245.9	TOPSOIL: 75 mm SILTY FINE SAND: Trace organics, upper 200 mm, loose, brown, moist
0.8	245.1	SAND: Some silt, loose to compact, brown, moist
4.6	241.3	SAND AND SILT: Trace clay, dense, brown, moist - - - Sand seams - - - - - - Wet seams - - - - - - Wet seams - - -
12.6	233.2	Borehole Terminated at 12.6 m

SOIL SAMPLING

Sample Type	Sample Number	Recovery (%)	SPT "N" Value	GR	SA	SI	CL
AS	1						
SS	2	100	4				
SS	3	100	6				
SS	4	100	6				
SS	5	100	21				
SS	6	100	39				
SS	7	100	35				
SS	8	100	32				
SS	9	100	40	0	50	44	6
SS	10	100	41				
SS	11	100	43				

DEPTH (m)	ELEVATION (m)
0	245.7
2.1	243.6
4.2	241.5
6.3	239.4
8.4	237.3
10.5	235.2
12.6	

COMMENTS & GRAIN SIZE DISTRIBUTION (%)



Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Groundwater Elevation:

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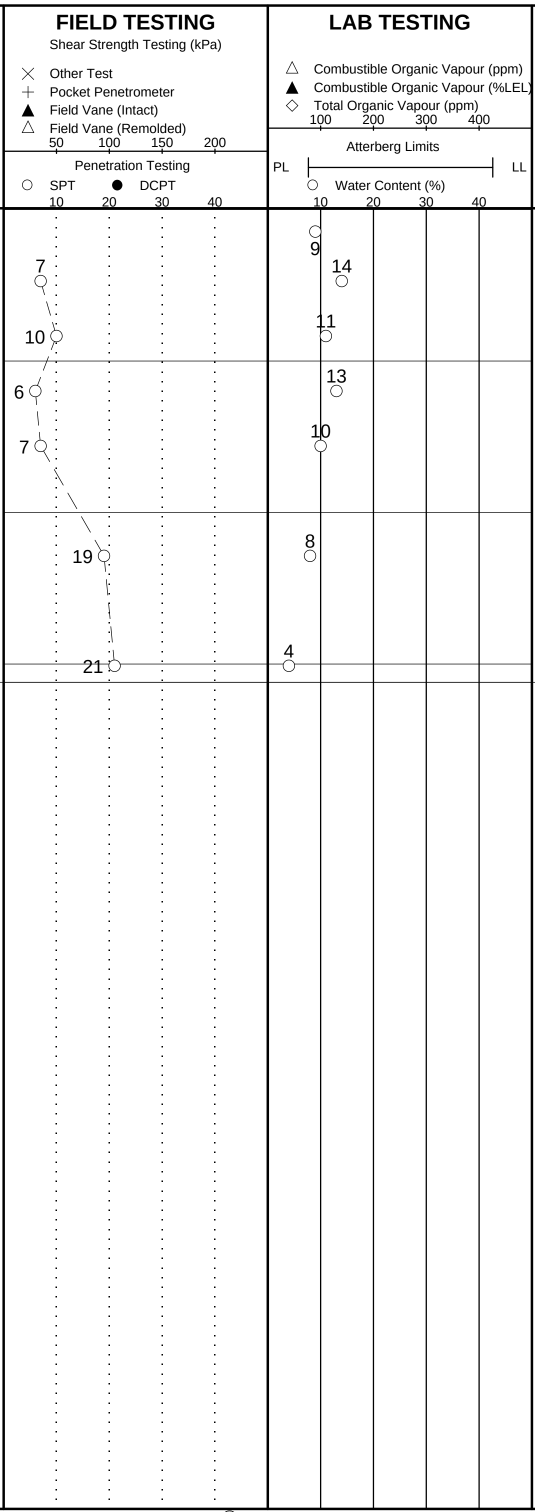
RECORD OF BOREHOLE No. 10

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954231**
Easting: **585489**
Date Started: **Mar 24/26**
Date Completed: **Mar 24/26**

LITHOLOGY PROFILE		SOIL SAMPLING					
Depth / Elev.	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)
0.0 / 246.8	TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist	AS	1			0	
0.8 / 246.0	SAND AND SILT: Trace clay, loose to compact, brown, moist	SS	2	100	7		245.7
		SS	3	100	10	2.1	
		SS	4	100	6		
		SS	5	100	7		243.6
		SS	6	100	19	4.2	241.5
6.6 / 240.2		SS	7	100	21	6.3	
	Borehole Terminated at 6.6 m						



Instrumentation Installation

COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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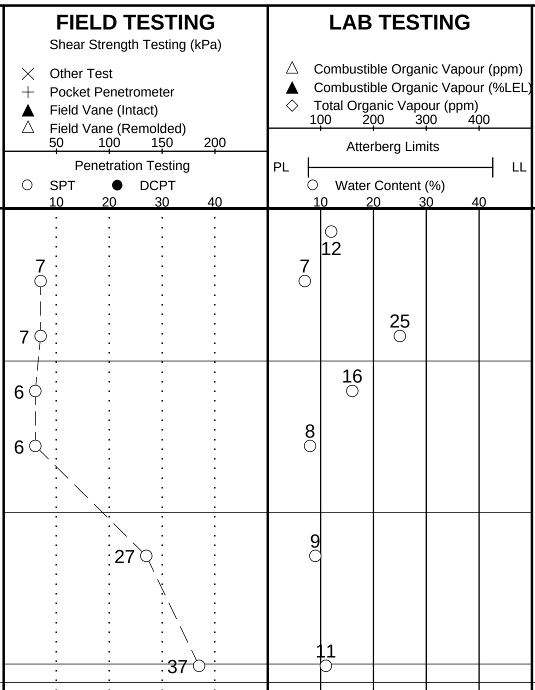
RECORD OF BOREHOLE No. 11

GEI Consultants

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954285**
Easting: **585589**
Date Started: **Mar 25/26**
Date Completed: **Mar 25/26**

LITHOLOGY PROFILE		SOIL SAMPLING									
Lithology Plot	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	DEPTH (m)	ELEVATION (m)	FIELD TESTING: Penetration Testing SPT	LAB TESTING: Water Content (%)	Instrumentation Installation	COMMENTS & GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
	0.0 245.3 TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 100 mm, loose, brown, moist 0.8 244.5	AS	1			0			12		
	SILT AND SAND: Trace clay, loose to dense, brown, moist - - - Wet seams - - -	SS	2	100	7			7	7		
		SS	3	100	7		243.6	7	25		
		SS	4	100	6	2.1		6	16		
		SS	5	100	6		241.5	6	8		
		SS	6	100	27	4.2		27	9		
	6.6 238.7	SS	7	100	37	6.3	239.4	37	11		
	Borehole Terminated at 6.6 m										



Groundwater depth encountered on completion of drilling: Dry

Cave depth after auger removal: Open

Groundwater depth observed on:

Groundwater Elevation:

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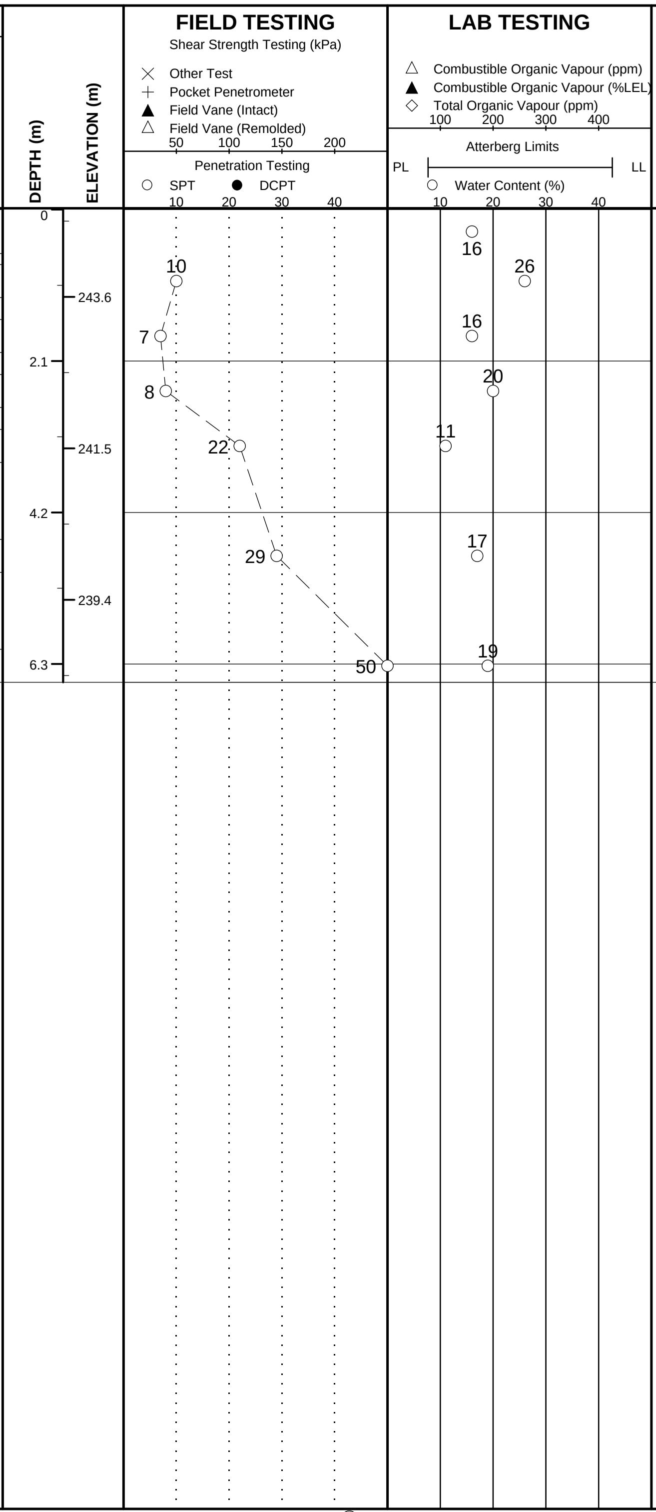
Scale **1 :105**

RECORD OF BOREHOLE No. 12

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954419**
Easting: **585761**
Date Started: **Mar 23/26**
Date Completed: **Mar 23/26**

Depth (m)	Elevation (m)	Description	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
0.0	244.8	TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist	AS	1			16				
			SS	2	100	10	26				
1.5	243.3	SILT AND SAND: Trace clay, loose to compact, brown to greyish brown, moist	SS	3	100	7	16				
			SS	4	100	8	20				
			SS	5	100	22	11				
4.6	240.2	SILT: Trace clay, trace sand, compact to dense, greyish brown, moist	SS	6	100	29	17	0	2	91	7
			SS	7	100	50	19				
6.6	238.3	Borehole Terminated at 6.6 m									



Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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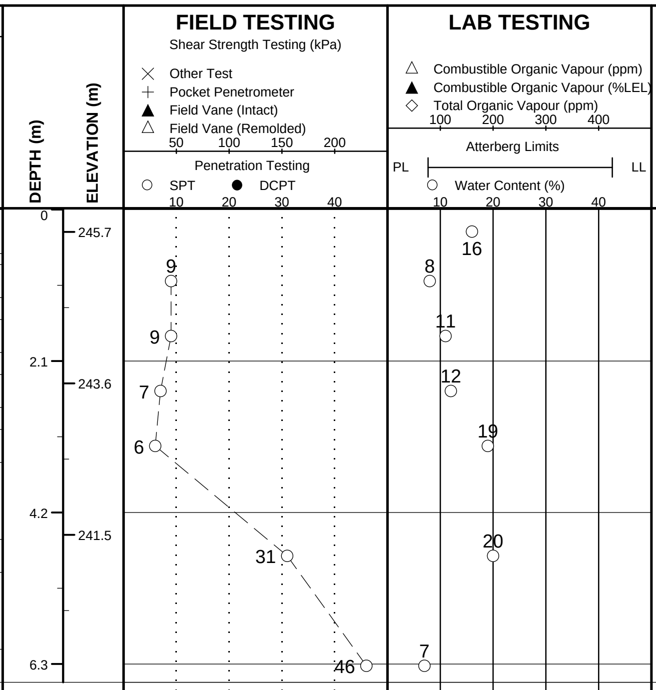
Scale **1 :105**

RECORD OF BOREHOLE No. 13

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Solid Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954314**
Easting: **585734**
Date Started: **Mar 24/26**
Date Completed: **Mar 24/26**

LITHOLOGY PROFILE		SOIL SAMPLING				LAB TESTING	COMMENTS & GRAIN SIZE DISTRIBUTION (%)			
Depth / Elevation	DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	Water Content (%)	GR	SA	SI	CL
0.0 / 246.0	TOPSOIL: 150 mm	AS	1			16				
0.2 / 245.9	SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist									
0.8 / 245.2	SAND AND SILT: Trace clay, loose, brown, moist	SS	2	100	9	8	0	52	44	4
		SS	3	100	9	11				
		SS	4	100	7	12				
		SS	5	100	6	19				
4.6 / 241.4	SILT: Trace sand, trace clay, dense, brown, moist	SS	6	100	31	20				
		SS	7	100	46	7				
6.6 / 239.5	Borehole Terminated at 6.6 m									



Instrumentation Installation

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on:
Groundwater Elevation:

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Page: **1 of 1**

RECORD OF BOREHOLE No. 14

Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

Drilling Method: **Hollow Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954228**
Easting: **585587**
Date Started: **Mar 24/26**
Date Completed: **Mar 24/26**

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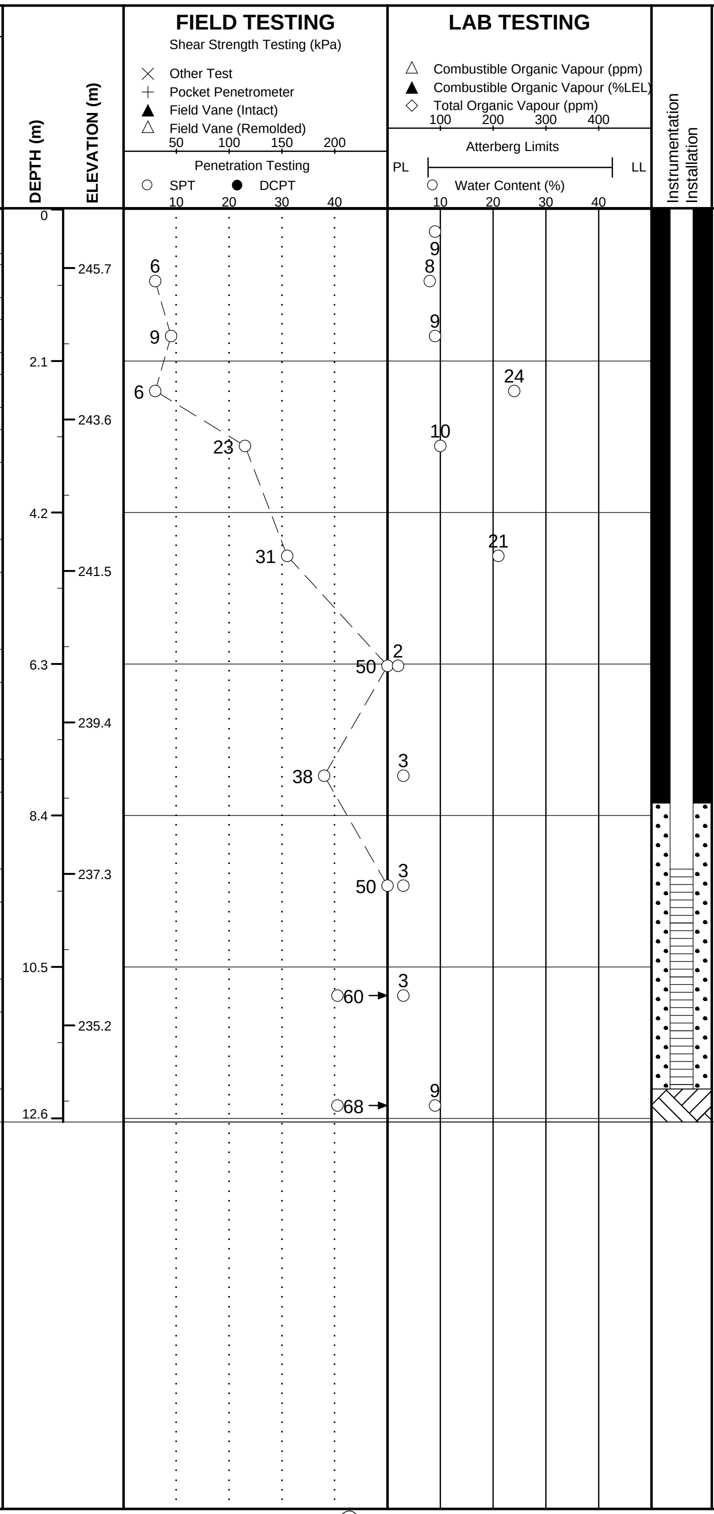
Depth (m) / Elevation (m)	LITHOLOGY PROFILE – DESCRIPTION	Sample Type	Sample Number	Recovery (%)	SPT "N" Value	GR	SA	SI	CL
0.0 / 246.5	TOPSOIL: 50 mm SILTY FINE SAND: Trace organics upper 200 mm, loose, brown, moist	AS	1						
0.8 / 245.7	SILT AND SAND: Trace clay, loose to dense, brown, moist	SS	2	100	6				
		SS	3	100	9				
	- - - Wet seams - - -	SS	4	100	6				
		SS	5	100	23				
	- - - Wet seams - - -	SS	6	100	31				
6.1 / 240.4	SAND: Some silt, dense to very dense, greyish brown, moist	SS	7	100	50				
		SS	8	100	38				
		SS	9	100	50				
		SS	10	100	60	0	85	15	0
12.6 / 233.9	- - - Very moist - - -	SS	11	100	68				
	Borehole Terminated at 12.6 m								



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Groundwater Elevation:

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Scale **1 :105**

RECORD OF BOREHOLE No. 15

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Project Number: **2506478**
Project Client: **Pine Valley Estates**
Project Name: **Residential Development 9332 Cty Road 93**
Project Location: **9332 County Rd 93, Midland, ON**
Drilling Location: **See Borehole Location Plan**
Local Benchmark:

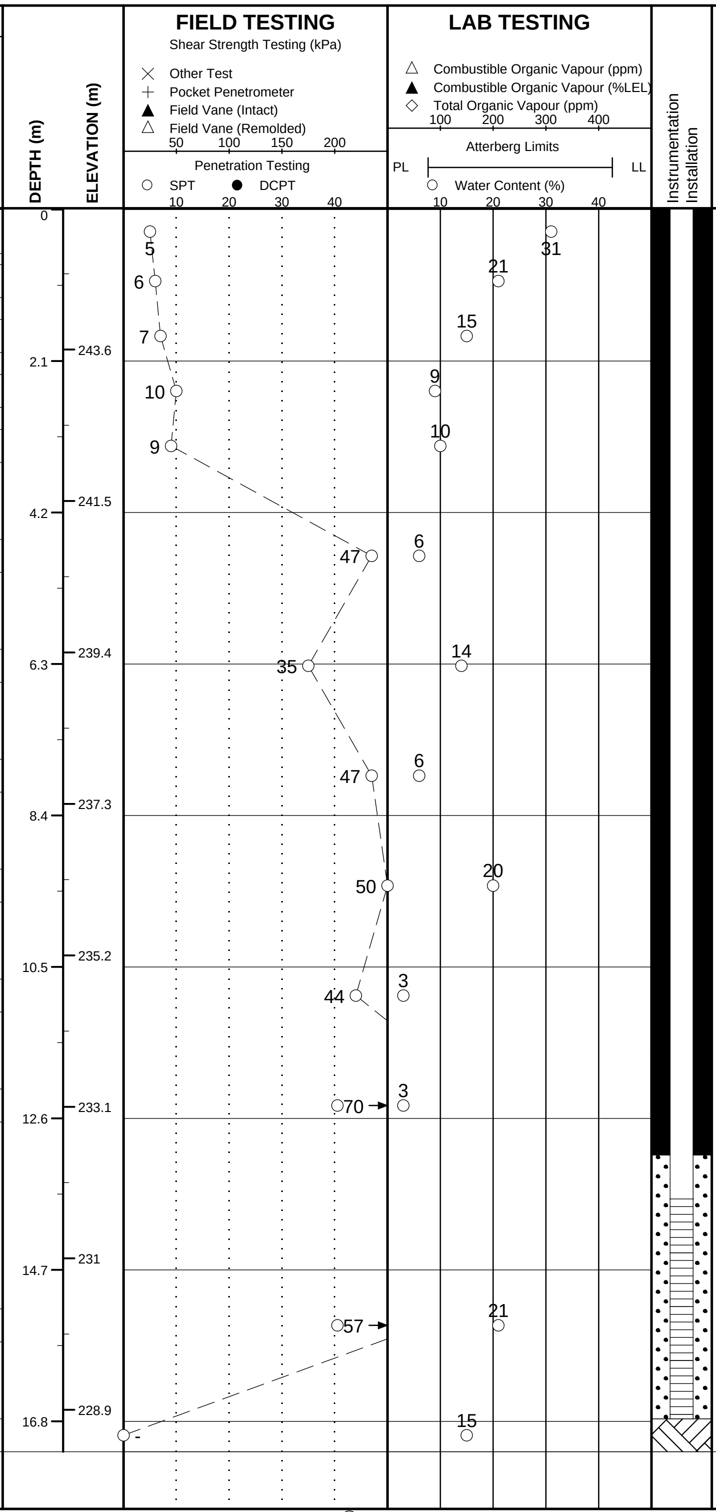
Drilling Method: **Hollow Stem Augers**
Drilling Machine: **Track Mount**
Logged By: **BH**
Reviewed By: **MH**
Northing: **4954344**
Easting: **585800**
Date Started: **Mar 23/26**
Date Completed: **Mar 23/26**

LITHOLOGY PROFILE

Depth	Elevation	DESCRIPTION
0.0	245.5	
0.2	245.4	TOPSOIL: 150 mm
		SILTY FINE SAND: Trace organics/ rootlets upper 100 mm, loose, brown, moist
1.5	244.0	SAND AND SILT: Trace clay, loose to dense, brown, moist
		- - - Greyish brown - - -
		- - - Wet seams - - -
10.7	234.9	SAND: Trace to some silt, dense to very dense, brown, moist
15.2	230.3	SILT: Some sand, trace clay, very dense, greyish brown, wet
17.2	228.3	Borehole Terminated at 17.2 m

SOIL SAMPLING

Sample Type	Sample Number	Recovery (%)	SPT "N" Value
AS	1	100	5
SS	2	100	6
SS	3	100	7
SS	4	100	10
SS	5	100	9
SS	6	100	47
SS	7	100	35
SS	8	100	47
SS	9	100	50
SS	10	100	44
SS	11	100	70
SS	12	100	57
AS	13	-	-



COMMENTS & GRAIN SIZE DISTRIBUTION (%)

GR	SA	SI	CL
0	13	81	6

First Water Strike SS12

Groundwater depth encountered on completion of drilling: Dry
Cave depth after auger removal: Open
Groundwater depth observed on: Apr 17/26 at depth of: Dry
Groundwater Elevation:

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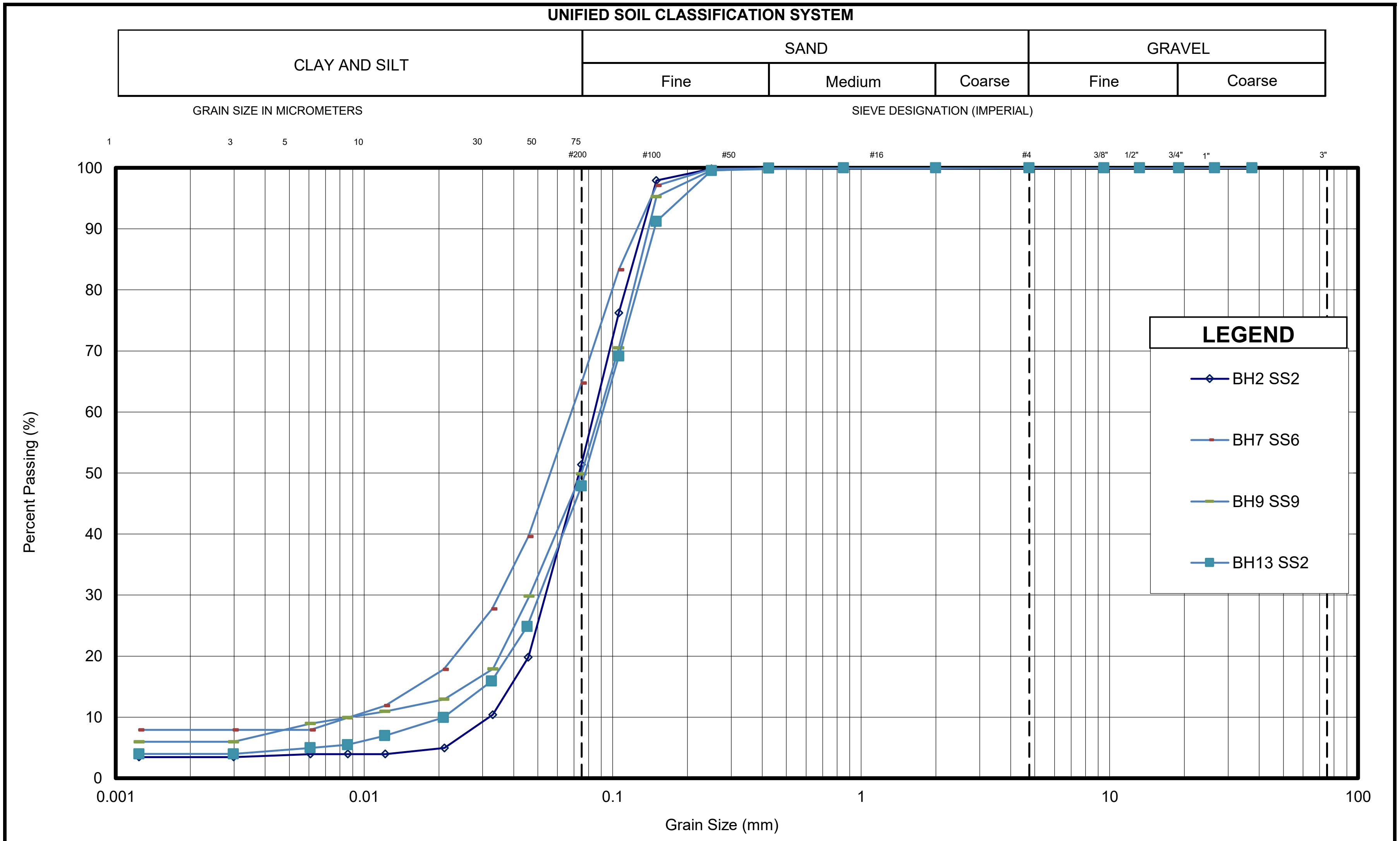
Appendix B Geotechnical Laboratory Data



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH2 SS2	SAND AND SILT, Trace Clay	0	49	48	3	0.032	0.054	0.085	2.7	1.1
BH7 SS6	SILT AND SAND, Trace Clay	0	35	57	8	0.009	0.035	0.068	7.8	2.0
BH9 SS9	SAND AND SILT, Trace Clay	0	50	44	6	0.009	0.046	0.089	10.2	2.8
BH13 SS2	SAND AND SILT, Trace Clay	0	52	44	4	0.021	0.051	0.091	4.4	1.4

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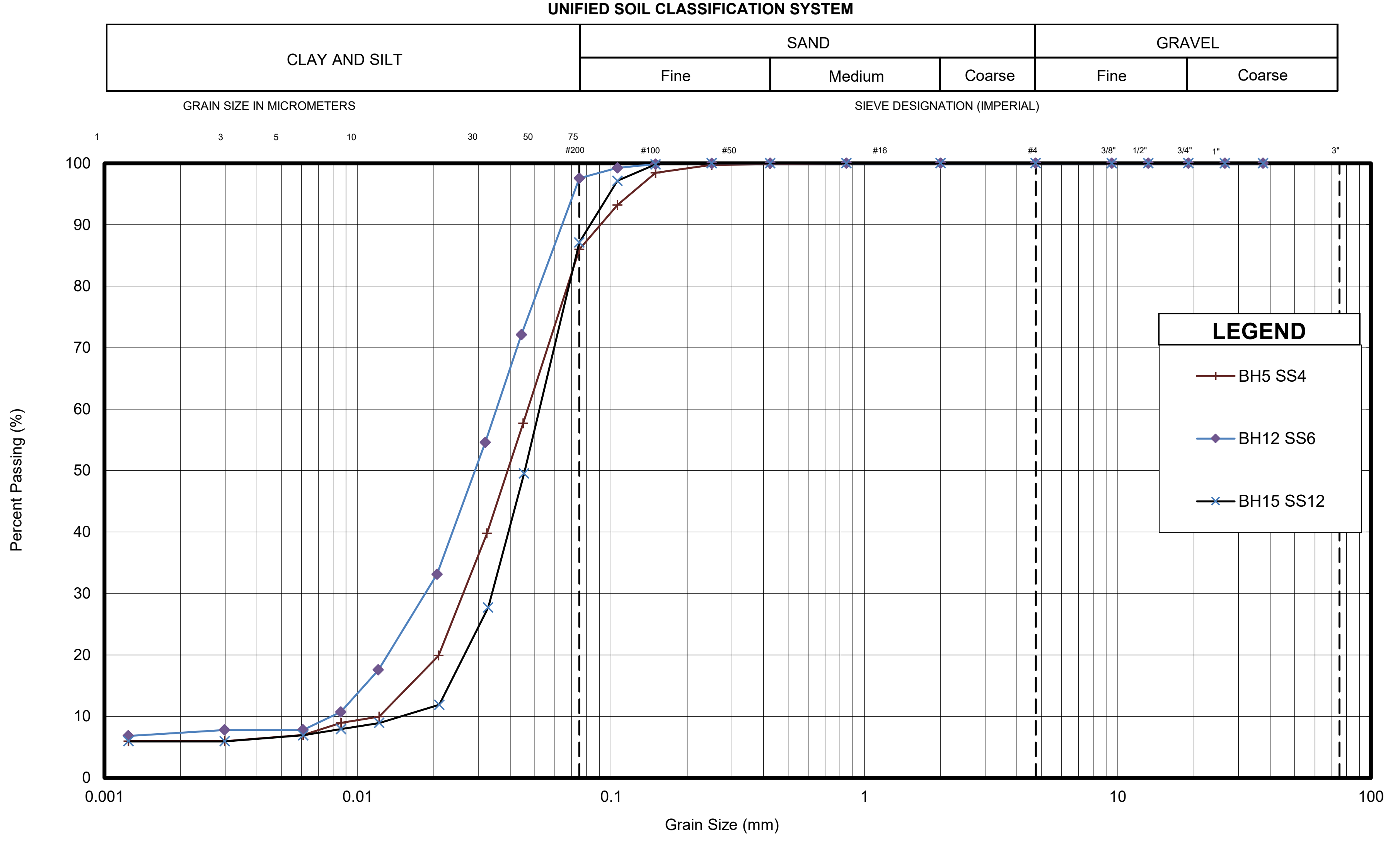
GRAIN SIZE DISTRIBUTION - Pine Valley Estates Development

SAND AND SILT

FIGURE No.	B1
REF. No.	2506478
DATE	April 2026



Sample	Description	Gr.	Sa.	Si.	Cl.	D_{10}	D_{30}	D_{60}	C_u	C_c
BH5 SS4	SILT, Some Sand, Trace Clay	0	14	80	5	0.012	0.026	0.047	3.9	1.2
BH12 SS6	SILT, Trace Clay, Trace Sand	0	2	91	7	0.008	0.018	0.035	4.5	1.2
BH15 SS12	SILT, Some Sand, Trace Clay	0	13	81	6	0.015	0.034	0.052	3.5	1.5

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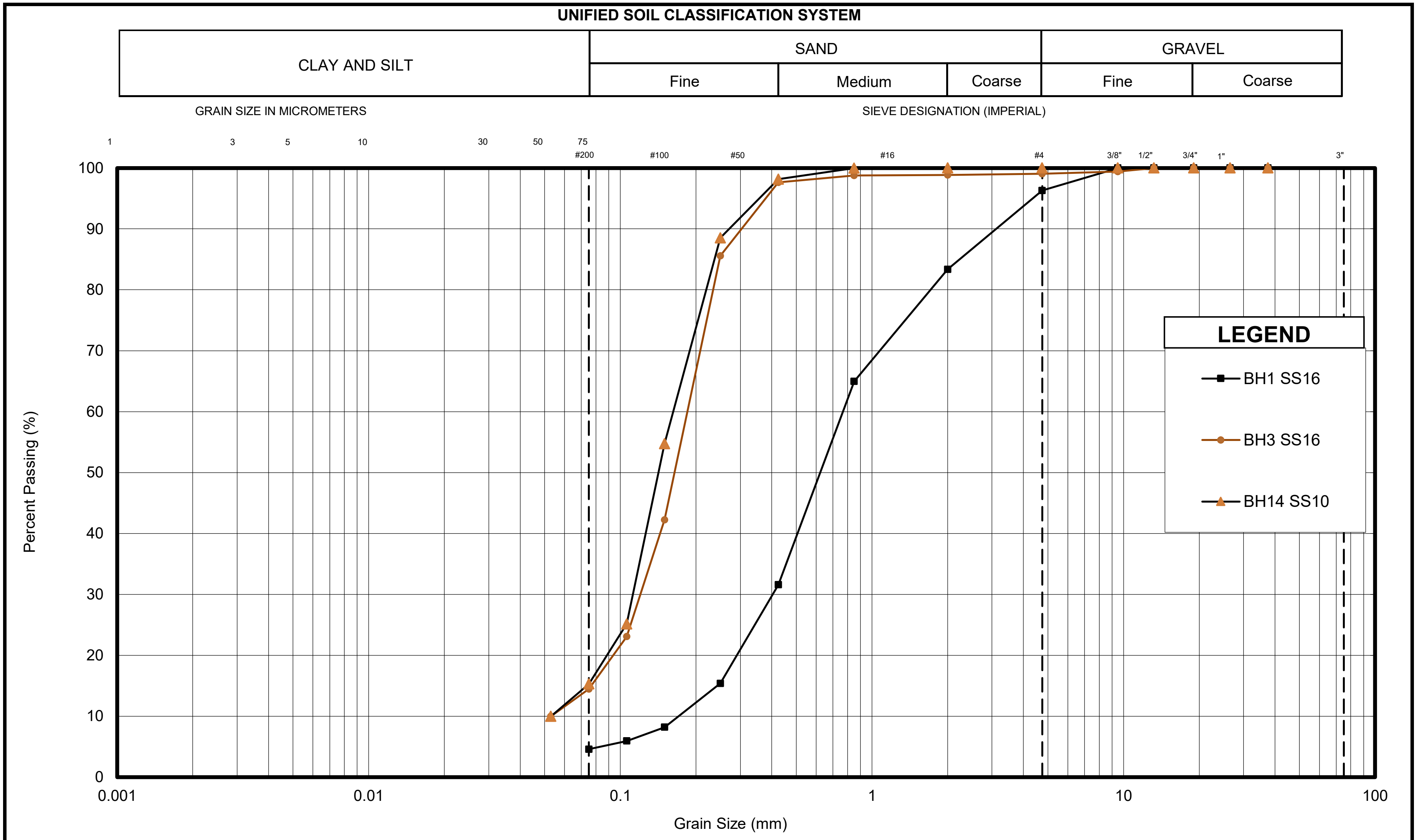
GRAIN SIZE DISTRIBUTION - Pine Valley Estates Development

SILT

FIGURE No. B2
REF. No. 2506478
DATE April 2026



Sample	**Description**	**Gr.**	**Sa.**	**Si.**	**Cl.**	**D_{10}**	**D_{30}**	**D_{60}**	**C_u**	**C_c**
BH1 SS16	SAND, Trace Gravel, Trace Silt	4	92	4	-	0.170	0.404	0.767	4.5	1.3
BH3 SS16	SAND, Some Silt, Trace Gravel	1	85	14	-	0.053	0.120	0.185	3.5	1.5
BH14 SS10	SAND, Some Silt	0	85	15	-	0.053	0.112	0.162	3.1	1.5

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GRAIN SIZE DISTRIBUTION - Pine Valley Estates Development

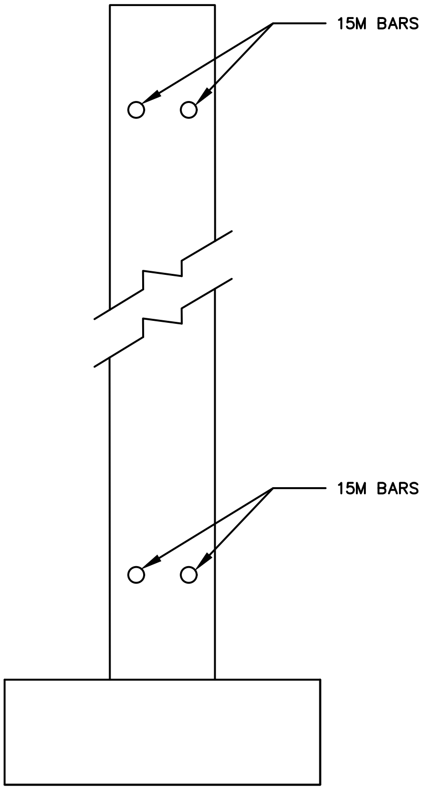
SAND

FIGURE No. B3

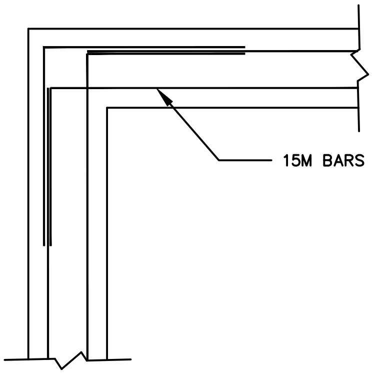
REF. No. 2506478

DATE April 2026

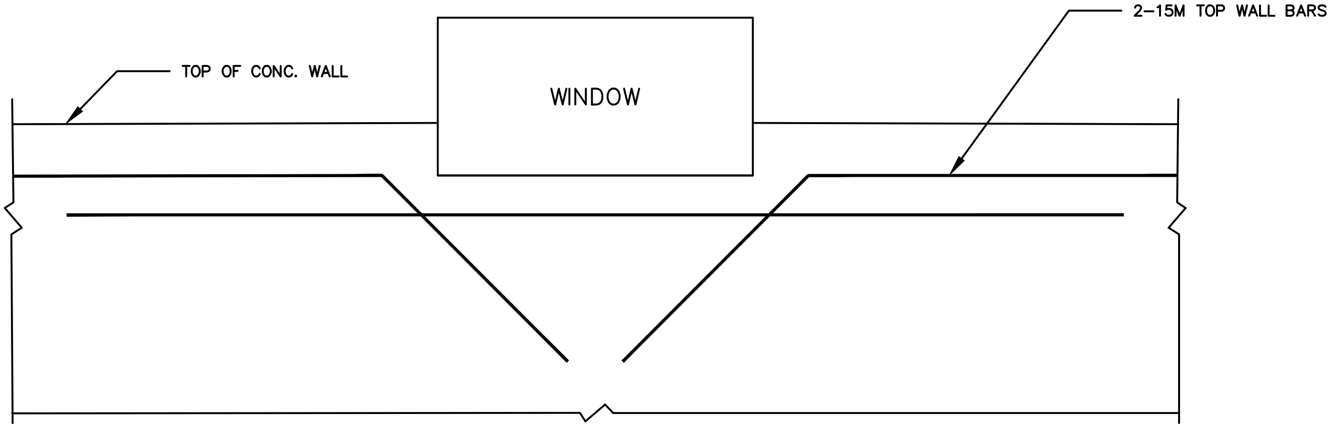
Appendix C Typical Details



TYPICAL REINFORCED WALL



TYPICAL SPLICING AT CORNERS



TYPICAL WINDOW REINFORCING

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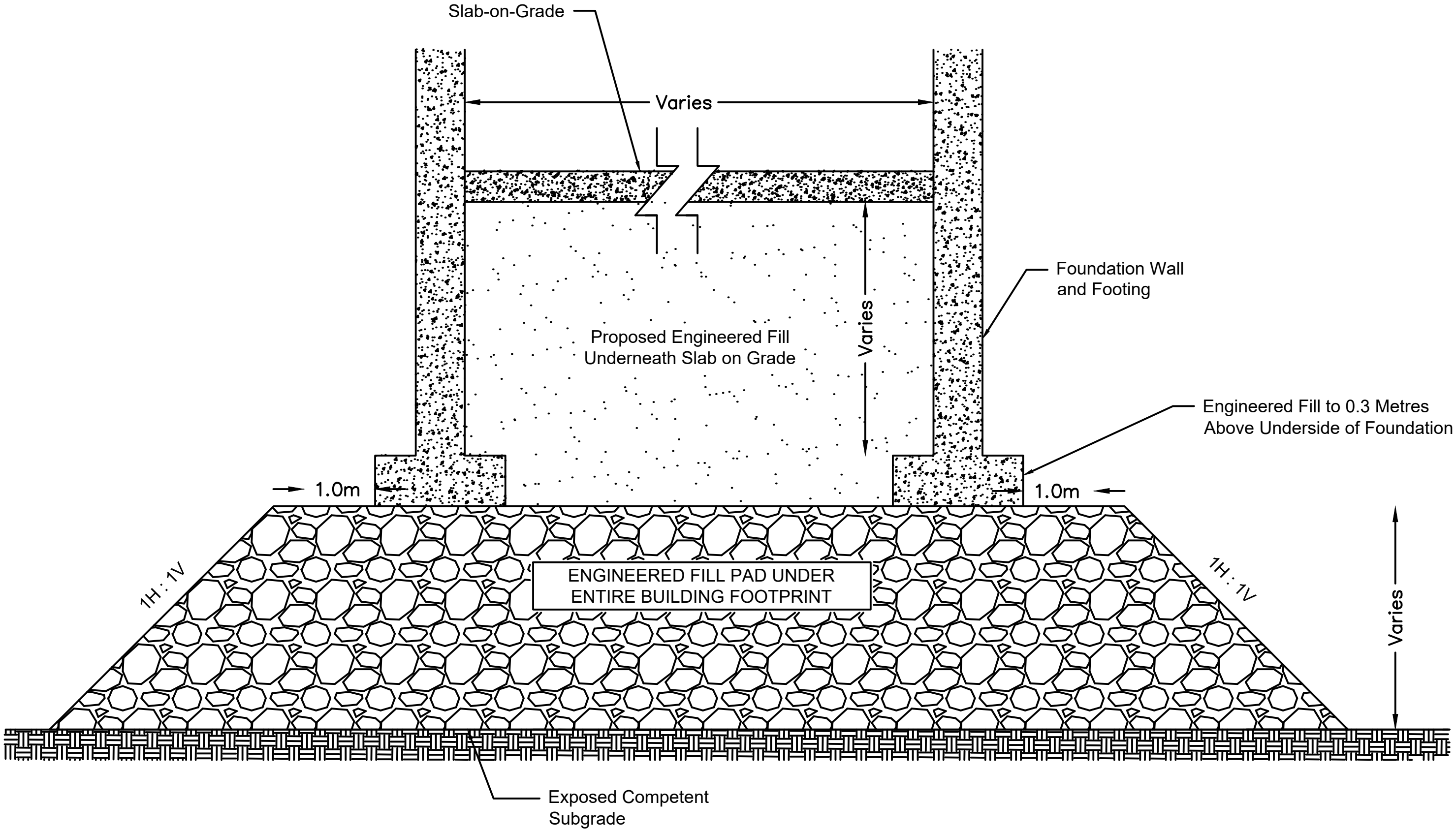
FOUNDATION WALL REINFORCING ON ENGINEERED FILL TYPICAL DETAIL

Notes:

1. Engineered Fill compacted to 100% Standard Proctor Maximum Dry Density (SPMDD) and inspected under the full time supervision of GEI.
2. Engineered fill must be placed in loose lifts of 200 mm or less and then compacted as noted above.
3. Interior engineered fill compacted to 98% SPMDD.



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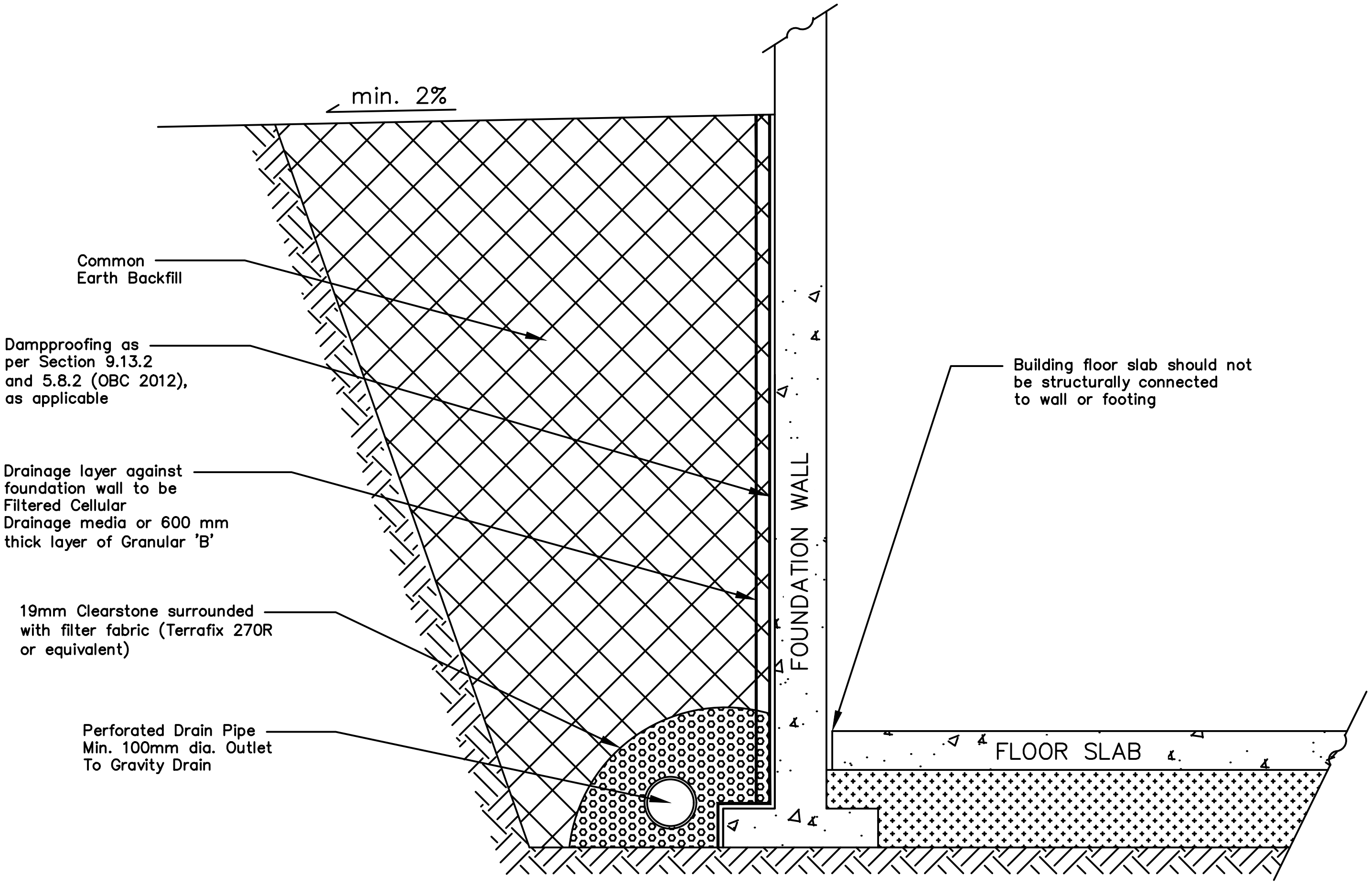
142 Commerce Park Dr, Unit O, Barrie, ON, L4N 8W8

ENGINEERED FILL PAD DIMENSIONING TYPICAL DETAIL



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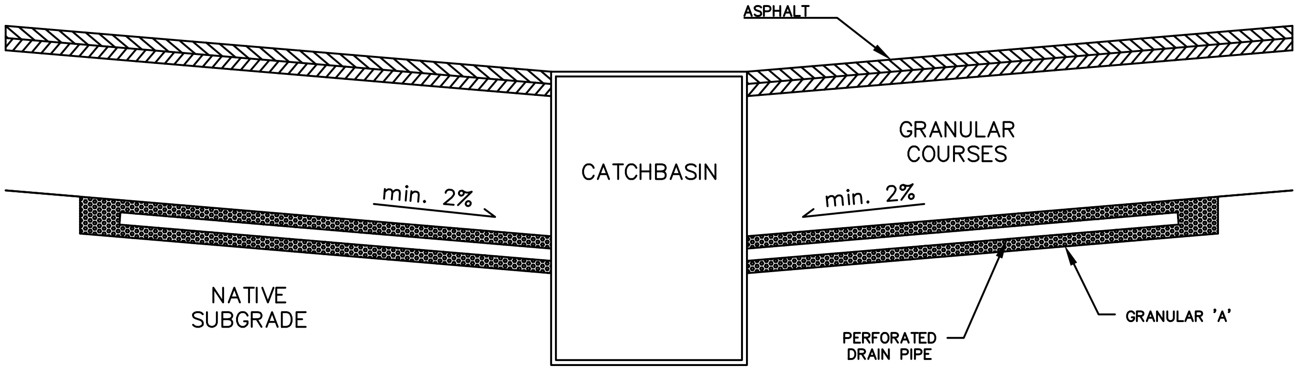
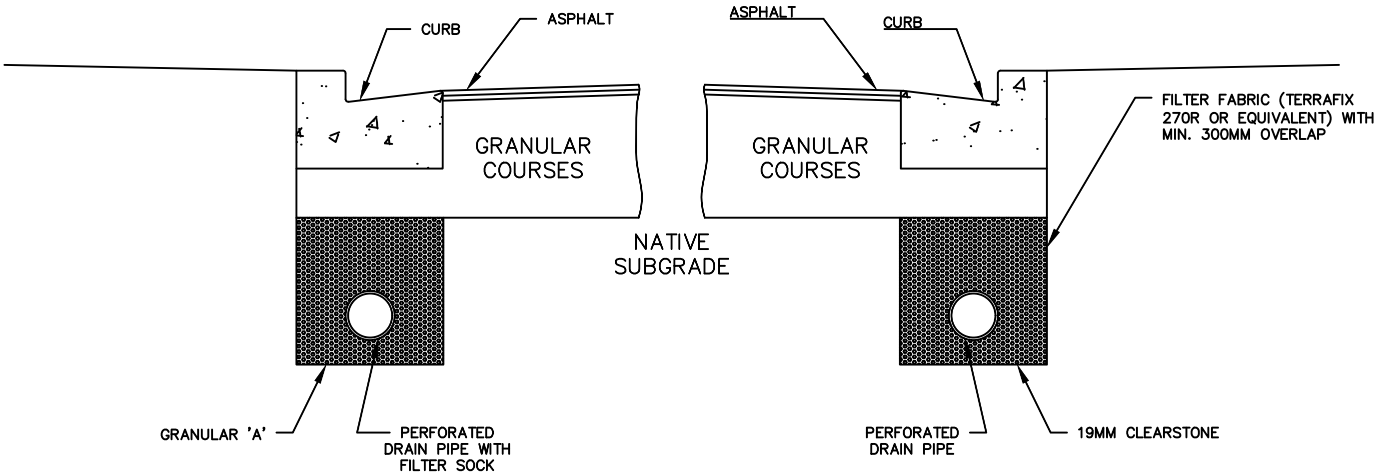
BASEMENT FOUNDATION WALL TYPICAL DETAIL

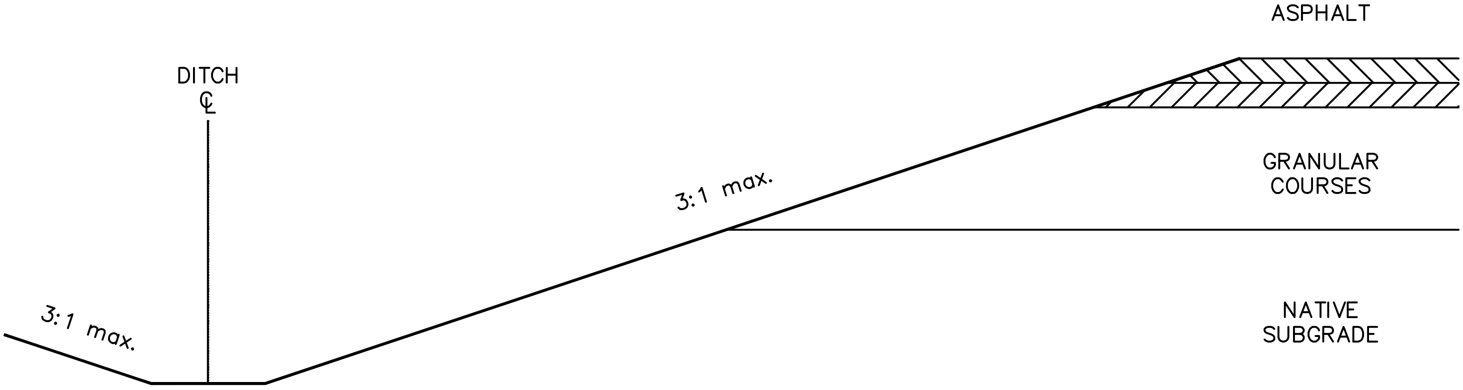




Unwrapped Trench

Wrapped Trench

Urban Cross Sections



Rural Cross Section

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PAVEMENT DRAINAGE ALTERNATIVES
TYPICAL DETAILS