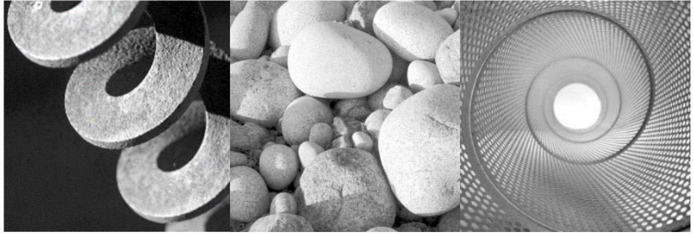


GEI Consultants

Consulting
Engineers and
Scientists

Geotechnical Report

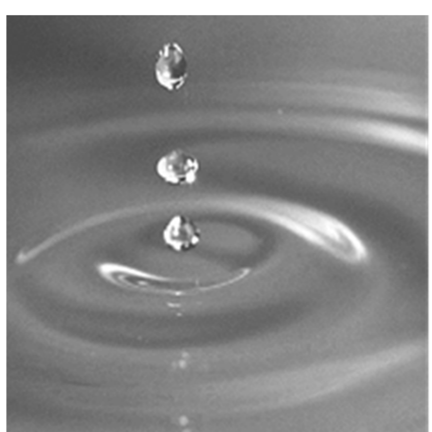
Vessel Residential

446 Hopmeadow Street
Simsbury, Connecticut

Submitted to:
Vessel Technologies, Inc.
46 West 55th Street
New York, NY 10019

Submitted by:
GEI Consultants, Inc.
455 Winding Brook Drive, Suite 201
Glastonbury, CT 06033
860-368-5300

February 24, 2023
Project No. 2203416



Thomas Rezzani, E.I.T.
Geotechnical Professional

Matthew Glunt, P.E.
Senior Geotechnical Engineer

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Figures

Appendices

1. Introduction

1.1 Project Summary

We understand that the proposed development at 446 Hopmeadow Street will consist of a structure containing eighty (80) prefabricated residential units stacked across three floors. Appurtenant site features include parking areas, access drives, and storm water management basin(s).

This report was prepared to address foundation and site preparation recommendations for the proposed construction.

1.2 Scope of Services

Our scope of work included the following tasks:

- Engaged a subcontractor to drill three (3) test borings on the property to depths of 22 feet each.
- Observed soil samples recovered from the test borings and prepared test boring logs.
- Engaged a subcontractor to perform five (5) test pits to depths of 6.2 feet to 9.8 feet each.
- Installation of two (2) temporary monitoring wells to depths of 8 feet each.
- Conducted infiltration testing within the temporary wells and three (3) test pits.
- Engaged a testing laboratory to perform three (3) grain-size analyses on soil samples to verify visual classification and evaluate subsurface conditions regarding infiltration capacity.
- Developed recommendations for site preparation, pavement sections, excavation, backfill, seismic design, lateral wall pressures, foundation design, infiltration rate, and construction considerations.
- Prepared this *Geotechnical Report.*

1.3 Authorization

Our work was performed in general accordance with our proposal dated June 30, 2022, and the resulting Standard Professional Services agreement, with supplemental work in accordance with our proposal dated February 7, 2023.

2. Site and Project Description

2.1 Site Description and History

The property slated for development is an approximate 1.95-acre parcel known by Town records as 446 Hopmeadow Street in Simsbury, Connecticut. The site is bounded by Hopmeadow Street (Route 202) to the west, the Farmington River and wooded land to the east, and residential property to the north and south.

The west side of the site is occupied with a one-story residential dwelling. The remaining extents of the property consist of paved drives, maintained grass, or wooded areas.
Based on provided site plans, total topographic relief is on the order of 16 feet, sloping downward to the north and east.

2.2 Proposed Construction

Our current understanding of the project is based on the information provided to GEI as shown on drawing "GD-1" dated 12/16/2022, as detailed below, and information provided in support of other Vessel facilities in development.

We understand that the project involves construction of a four-story residential building consisting of stacked prefabricated units with a footprint of 14,063-sf and a finished-floor elevation (FFE) of 95.0. We also understand that the structure will likely be founded on a series of grade beams supporting load bearing walls and an elevated cold-formed metal panel floor. We expect cuts and fills of up to about 5 feet will be required to meet final grades. A retaining wall up to 4 feet in height is shown north of the parking area.

Plans provided to GEI show tenant parking sited to the north of the building and continuing west to a new entrance from Hopmeadow Street. Though we understand these are subject to change during final design, current plans show stormwater basins on the west and east sides of the building, a drywell within the western basin, and subsurface detention chambers to the north beneath the tenant parking lot.

3. Exploration Procedures

3.1 Test Borings

The boring locations were laid out on the site from the provided conceptual plan using handheld GPS. Borings were located in accessible areas within the proposed building footprint. Approximate boring locations relative to the property boundary and conceptual site plan are shown on Figure 1.

Three (3) soil test borings (B-1 through B-3) were performed at the site on September 14, 2022, by New England Boring Contractors, under subcontract to GEI. The appropriate one-call utility location service (Call Before You Dig) was contacted prior to our arrival. All borings were advanced to depths of 22 feet using hollow-stem augering techniques and a track-mounted drilling rig. Boring logs are attached in Appendix A.

Standard Penetration Testing (SPT) and split-spoon sampling were performed continuously through the upper 8 feet of the borings and at 5-foot intervals thereafter using a 140-pound automatic hammer. Representative samples of the soils obtained by the sampler were classified by the on-site GEI engineer. The samples were placed in appropriately identified sealed glass jars and transported to our office for laboratory assignment. Borings were backfilled with drill cuttings upon completion.

3.2 Test Pits

Five (5) test pits were dug at the site on February 8, 2023, using an excavator to depths of 6.2 feet to 9.8 feet each. Each test pit was logged and photographed by a representative of GEI. The approximate test pit locations relative to the site plan are shown on Figure 1.

The test pit logs are attached in Appendix A.

3.3 In-place Permeability Testing

In-situ hydraulic conductivity was measured using a Guelph-model permeameter within three (3) of the test pits. Constant-head test procedures generally followed ASTM D5126 and manufacturer recommendations.

Estimations of in-place permeability from the test measurements are provided in Appendix D.

3.4 Monitoring Well Installation and Testing

Two (2) temporary PVC wells (MW-1 and MW-2) were installed within areas designated for stormwater management basins. Well installation logs are attached in Appendix A for reference.

Falling-head infiltration measurements were conducted within the wells, the results of which are attached in Appendix D.

3.5 Laboratory Testing

Laboratory testing was conducted on representative soil samples to confirm field identification of the soils and establish engineering characteristics for design. Tests performed by GeoTesting Express, under subcontract to GEI, included the following:

- Three (3) grain-size analysis with standard sieve set (ASTM D6913)
- Three (3) moisture content analyses (ASTM D2216)

Results of the laboratory testing program are included in Appendix B.

4. Subsurface Conditions

4.1 Geologic Setting

Based on observations and published mapping, the eastern portion site appears to lie on an area underlain by interbedded alluvial silts and clays. Stratified sand and gravel deposits appear to be more prevalent on the upland site areas to the west.

4.2 Subsurface Conditions

The generalized subsurface conditions at the site are described below, in order of increasing depth. The subsurface conditions between boring locations may differ. The nature and extent of variations between the sampling points will not become evident until construction.

Topsoil – Topsoil thickness at the boring and test pit locations was measured as about 7 to 10 inches.

Sand – Native sands were encountered near the ground surface on the western upland area of the site. These soils were observed in test pit TP-5 beneath the topsoil and continuing to a depth of 5.3 feet. Recovered samples were generally classified as silty sand or sand with silt, containing about 10 to 25 percent silt fines. Though no samples were obtained at well MW-1, drill cuttings observed during installation were generally consistent with these characteristics.

Alluvial Silts and Clays – Thinly layered deposits of fine-grained clays and silts were observed beneath the topsoil or sand layer and continuing to termination depth of the borings. Samples were generally noted as having 90 to 95 percent non-plastic to low-plasticity cohesive fines. Thin sand seams were also common within this stratum. Evident of recently deposited alluvial soils, minor to moderate proportions of organic fibers were noted in borings B-2 and B-3 to depths of up to 8 feet below current grade.

Below the near-surface soils, Standard Penetration Test (SPT) N-values typically ranged between 9 to 15 blows/foot, indicating stiff conditions, softening to between 4 and 9 blows/foot below groundwater.

4.3 Groundwater Conditions

Free groundwater was not encountered in the test borings conducted in November 2022. Groundwater intrusion was noted in each recent test pit at depths varying from 3.9 to 7.7 feet. Based on our observations during the investigation, water below the site appears to be predominantly contained within intermittent, thin sand seams within the overall alluvial formation. This is consistent with observations of groundwater not encountered within test borings at the time of drilling and slow water intrusion within open test excavations.

Groundwater levels are subject to seasonal and weather-related variations. Groundwater measurements made at different times and different locations may be significantly different than the measurements taken as part of this investigation.

5. Design Recommendations

5.1 General Suitability

The fine-grained clays and silts encountered beneath the primary development area are suitable for this scale of development, so long as they properly handled and addressed during construction, as discussed further below. The primary issue associated with these soils will be subgrade softening and general workability if they are allowed to become wet, as well as long-term susceptibility to frost heave and drainage issues. These soils also can be expected to exhibit poor long term drainage characteristics.

5.2 Foundation Design

The proposed structure may be supported on shallow foundations bearing on a subgrade consisting of fine-grained natural soils or compacted structural fill. We caution that these soils will be highly susceptible to moisture disturbance, so protection of exposed subgrades will be critical.

As shown on conceptual plans, we recommend that proposed grade beams bear on a minimum 6-inch working pad of crushed stone wrapped on the sides by a geotextile fabric, placed over a soil subgrade, soon after exposure, prepared in accordance with Section 6.1. This will serve to protect subgrades and improve expediency of foundation construction. Crushed Stone meeting the specifications in Appendix E may be considered non-frost susceptible. We recommend that all footing subgrades be evaluated by a GEI representative prior to concrete placement.

The maximum allowable bearing pressures for the design of footings are:

Table 1: Allowable Bearing Pressure

Bearing Stratum	Net Allowable Bearing Pressure
Crushed Stone over Clay or Structural Fill	2,500 lb/ft^2

Minimum individual column footing and wall footing widths should be at least 36 and 18 inches, respectively. Exterior footings should bear at least 3½ feet below the adjacent exterior grade for frost protection. Interior footings should be founded at least 18 inches below the bottom of the floor slab. The tops of all footings should be at least 6 inches below the bottom of the overlying floor slab.

5.3 Settlement

We understand structure loads on the 18-inch-wide grade beams will be on the order of 3.5 kips/ft. Assuming the design and construction recommendations herein are followed, we estimate total settlement of the building will be less than 1 inch, and differential settlement will be less than ½ inch. We expect nearly all expected settlements will occur during construction or soon after.

5.4 Seismic Design

The 2022 edition of the Connecticut Building Code document mirrors the 2021 International Building Code, with exception of the revisions and supplemental information provided by state building officials.

Based on the criteria of Building Code Section 1613.3.2 and the SPT N-values measured on site, we recommend the use of Site Class D for seismic design. The Site Class was used in conjunction with the seismic hazard (S_S, S_1) for this location to determine spectral design values, as follows:

Table 2: Seismic Design Values

2022 Connecticut Building Code	
S_S	0.177 g
S_1	0.054 g
S_{DS}	0.189 g
S_{D1}	0.087 g
PGA_M	0.150 g
Seismic Design Category (Risk Category I, II, or III)	B

We calculated the spectral response parameters for the site using general procedures outlined in Building Code Section 1613.3. Peak ground acceleration (PGA_M) is adjusted for Site Class effects, per ASCE 7-10 Section 11.8.3.

The soils below the foundation level at this site are not considered susceptible to liquefaction.

5.5 Lateral Earth Pressures

All earth retaining structures should be designed using the earth pressures shown in Table 3. Note that no factor of safety has been applied to these values. Below-grade walls that are restrained from movement should be designed for at-rest earth pressures. Retaining walls free to rotate at the top should be designed for active earth pressures. In addition to the lateral loads exerted by the soil against the walls, allowance should be included for lateral stresses imposed by any temporary or long-term surcharge loads, such as cars or trucks adjacent to the walls or adjacent footing loads.

We caution that natural soils underlying most of the site can be considered poor-draining and must be replaced behind any retaining walls used on the project to, at minimum, within the active zone behind the wall and replaced with granular Structural Fill.

Table 3: Wall Design Parameters

Material	Total Unit Weight (γ, pcf)	Friction Angle (Φ)	Cohesion (c)	At-Rest Earth Pressure Coeff (K_o)	Active Earth Pressure Coeff, (K_a)	Passive Earth Pressure Coeff, (K_p)
Structural Fill	125	34º	0	0.44	0.28	3.00

We recommend limiting the passive pressure coefficient to 3.00 as shown above, due to the relatively high movement required to fully engage passive resistance. The minimum factors of safety for sliding and overturning under static loads should be 1.5 and 2.0, respectively. An allowable coefficient of friction of 0.40 between the grade beam and crushed stone over granular bearing soil may be assumed.

The recommended wall design parameters do not consider the development of hydrostatic pressure behind the walls. As such, positive wall drainage must be provided for all earth retaining structures. These drainage systems can be constructed of open-graded washed stone isolated from the soil backfill with a geosynthetic filter fabric and drained by perforated pipe, or several wall drainage products made specifically for this application. Where backfill soils are not drained using an appropriately designed drainage system, the lateral soil pressure on proposed retaining walls must consider hydrostatic forces and submerged soil unit weight.

The earth pressures given in Table 3 assume placement and compaction of the backfill in accordance with recommendations elsewhere in this report. Compact backfill directly behind walls with light, hand-operated compactors. Heavy compactors and grading equipment should not be allowed to operate within 10 feet of the walls during backfilling to avoid developing excessive temporary or long-term lateral soil pressures.

5.6 Pavement Design

Native fine-grained soils similar to those encountered on the site are considered to be highly susceptible to frost heave and drainage issues. To mitigate this risk, we recommend including a relatively free-draining subbase course under the stone base and pavement section, as noted below. Pavement subgrades should be prepared in accordance with Section 6.1.

The tenant parking area may be designed with light-duty pavements, while those areas expected to receive repeated truck traffic, such as dumpster pads, should be designed as a rigid pavement section. We recommend the following pavement sections for these areas:

Light-Duty Parking Area

3.0 inches bituminous concrete

- 1.5 inches wearing course (CTDOT Form 818 Class 2 or Superpave HMA S0.375)
- 1.5 inches binder course (CTDOT Form 818 Class 1 or Superpave HMA S0.5)

6.0 inches of processed aggregate base (CTDOT Form 818 M05.01)
6.0 inches of compacted gravel subbase (CTDOT Form 818 M.02.06, Grading B)

Heavy-Duty Rigid Concrete Section

6.0 inches of 4,000-psi jointed concrete (CTDOT M.03.01 Portland Cement)
6.0 inches of processed aggregate base (CTDOT Form 818 M05.01)
6.0 inches of compacted gravel subbase (CTDOT Form 818 M.02.06, Grading B)

Recommended pavement sections are based on AASHTO Guide for Design of Pavement Structures (1993) and ACI 330R. Pavement materials should conform with and be placed in accordance with the *Connecticut Department of Transportation (CTDOT) Standard Specifications for Road, Bridges, and Incidental Construction (Form 818), 2020.*

CTDOT Standard Specifications (form 818) allow for the use of recycled materials as Processed Aggregate Base under M.05.01. If recycled base is to be considered under pavement sections, we recommend that it be compliant with requirements of M.05.01-2 and that the material be tested for LA Abrasion. Subject to the results of this testing, recycled base may be suitable for use on this project.

Rigid pavement sections should be designed and constructed in accordance with appropriate American Concrete Institute (ACI) recommendations and with the applicable specifications of the CTDOT Standard Specifications. An adequate number of smooth steel dowels should be provided at all control and construction joints. All dowels should be coated and lubricated and affixed with metal or plastic caps. The size and spacing of dowels should conform to recommendations in ACI 330R. All joints should also be sealed with a flexible fuel resistant sealer to minimize surface water infiltration into the prepared base.

According to AASHTO design guidelines, the recommended pavement sections shown above are suitable for a 20-year design life. However, pavement maintenance such as sealing of cracks and localized patching due to normal weathering should be expected within the first 5 to 10 years of life.

5.7 Subsurface Drainage Design

It is our understanding that stormwater will likely be managed using a combination of detention basins and chambers. Based on preliminary site plans provided to us, up to two detention basins will be constructed to the east and/or west of the building, with detention chambers constructed below the north tenant parking area.

Based on the results of this investigation, the proposed east basin and north detention chambers would be founded primarily in poorly-draining clays and silts. The west basin would be founded in moderately well-draining sands.

Hydraulic conductivities at the monitoring well locations (MW-1 and MW-2) were estimated using downhole falling-head field measurements and published equations for borehole permeability. The investigation also included in-place permeability testing within three of the test pits. These results are attached in Appendix D.

Based on the characteristics of soil formations present below the site, we believe the permeameter testing conducted within test pits would be more representative of long-term performance of proposed stormwater features, and therefore was the primary data source for the recommendations given below.

For the west basin, we recommend assuming an infiltration rate of **20.0 inches/hour** for stormwater system design. For the east basin, we recommend assuming a minimal infiltration rate of less than **0.1 inches/hour**. For the stormwater chambers below the tenant parking lot, a field measured infiltration rate of **0.5 inches/hour** should be assumed.

Per CT DEEP regulations, a factor of safety of 2.0 must be applied to these values for design.

5.8 Site Slopes

We recommend that all cut and fill slopes on the project be constructed at grades no steeper than 2H:1V. Suitable erosion protection should be established as quickly as possible following construction of slopes.

6. Construction Considerations

6.1 Subgrade Preparation

6.1.1 General

To prepare the site for grading operations, topsoil, organic matter, and other deleterious material should be stripped from the building and site improvement areas. Soft, wet, loose, or otherwise un-suitable soils should be removed and replaced, or potentially re-compacted in-place.

We caution that most existing in-place soils will be very sensitive to disturbance from construction equipment, especially during or immediately following periods of inclement weather. Conditions could temporarily become excessively muddy and unstable during these times.

6.1.2 Demolition

All existing structures should be removed in their entirety from within the building footprint and the area backfilled with compacted Structural Fill to finished grade. Where existing structures fall at least 10 feet from the exterior line of building footings, below-grade portions of these structures may remain in place. However, where this occurs below new pavements, below-grade structural features should be cut off at least 2 feet below the pavement base course, to reduce the potential for a hard spot developing.

Existing utilities to remain in use should be rerouted around the proposed building footprint. If not removed, any pipes over 3 inches in diameter should be filled with flowable fill or grout. Otherwise, these pipes may serve as conduits for subsurface erosion resulting in formation of voids below foundations or floor slabs. Where existing utilities are left in place and plugged in the building footprint, it may be necessary to undercut poorly compacted backfill to provide adequate support for footings or slabs.

6.1.3 Pavements

Following the required stripping, excavation to rough grade, and before placing new fill to achieve design grades, the resulting subgrade should be firm, stable, and unyielding. Stabilization, where required, may consist of removing unsuitable material and replacement with compacted structural fill, or where unsuitable soils are relatively thin, drying and compacting in place.

Fine-grained soil subgrades (silt and clay) should be protected with the subbase course soon after exposure, particularly if inclement weather is forecast. Stone compaction should be conducted using small rollers without vibratory action. Use of large rollers or vibratory action is likely to soften the subgrade and necessitate re-placement of the stone. Excavation and compaction within these soils should not be performed during inclement weather.

Coarse-grained sand and gravelly subgrades, if/where encountered on the upland western portions of the site, should be proof-rolled with at least four (4) passes of a minimum 10-ton vibratory roller in open areas, or a 1-ton vibratory roller or large plate compactor, such as Wacker DPU4545 or equivalent, in trenches.

6.1.4 Foundations

Footings should bear on a subgrade consisting of native fine-grained soils or compacted structural fill. Bearing surfaces should be free of standing water, frost, and loose soil before placement of reinforcing steel and concrete.

Final excavation to foundation subgrade should be conducted with a smooth-edged bucket to reduce soil disturbance. As shown on conceptual plans, we recommend that the grade beams bear on a minimum 6-inch working pad of crushed stone wrapped on the sides by a geotextile fabric, placed over an approved soil subgrade. This will serve to protect subgrades and improve expediency of foundation construction. Crushed Stone meeting the specifications in Appendix E may be considered non-frost susceptible.

6.2 Excavation and Dewatering

Excavations can be accomplished with conventional earthmoving equipment. Excavations should be sloped or shored in accordance with the local, state, and federal regulations, including Occupational Safety and Health Agency (OSHA 29 CFR Part 1926) excavation trench safety standards.

Based on the investigation results, groundwater intrusion should be expected within deeper excavations. Dewatering for foundation and utility construction could likely be accomplished with filtered sumps and pumps located outside the footing or trench excavations.

6.3 Freezing Conditions

The native soils that will form the subgrades for grade slabs, footings, and pavements can be expected to have a moderate to high susceptibility to frost.

All subgrades should be free of frost before placement of concrete. Frost-susceptible soils that have frozen should be removed and replaced with compacted Structural Fill. The footing and the soil adjacent to the footing should be insulated until they are backfilled. Soil placed as fill should be free of frost, as should the ground on which it is placed.

If slabs-on-grade or footings are built and left exposed during the winter, precautions should be taken to prevent freezing of the underlying soil.

6.4 Backfilling and Compaction

Recommended specifications for gradation and compaction of backfill soils are provided in the attached recommended Material Specifications (Appendix C).

The natural fine-grained, brown clays and silts referenced in Section 5.1 are not suitable for re-use as Structural Fill on the project due to their high fines content. These soils, where excavated, should be “wasted” on non-structural areas of the project or removed from the site.

Though data is limited at this time, suitable granular soils might be obtained from upland areas of the site, including, potentially, the western stormwater basin shown on concept plans. If native sands and gravels are encountered and excavated as part of earthwork activities they can possibly be re-used on site as Structural Fill or Ordinary Fill, provided they do not contain oversize, organic, or otherwise deleterious material and can meet the appropriate compaction requirements.

Fill imported from off site should meet the attached gradation requirements. Fill placed within the building limits, within a 3-foot-wide zone outside foundation walls, under pavements, and behind retaining walls should meet the compaction requirements for Structural Fill. Backfill placed in non-structural areas should meet the compaction requirements for Ordinary Fill. Proposed borrow materials that fall slightly outside of these specifications may also be suitable for use, subject to review and approval by GEI.

7. Closure

7.1 Follow-on Services

We recommend that GEI be kept on the project through the final design and construction phases for the following services:

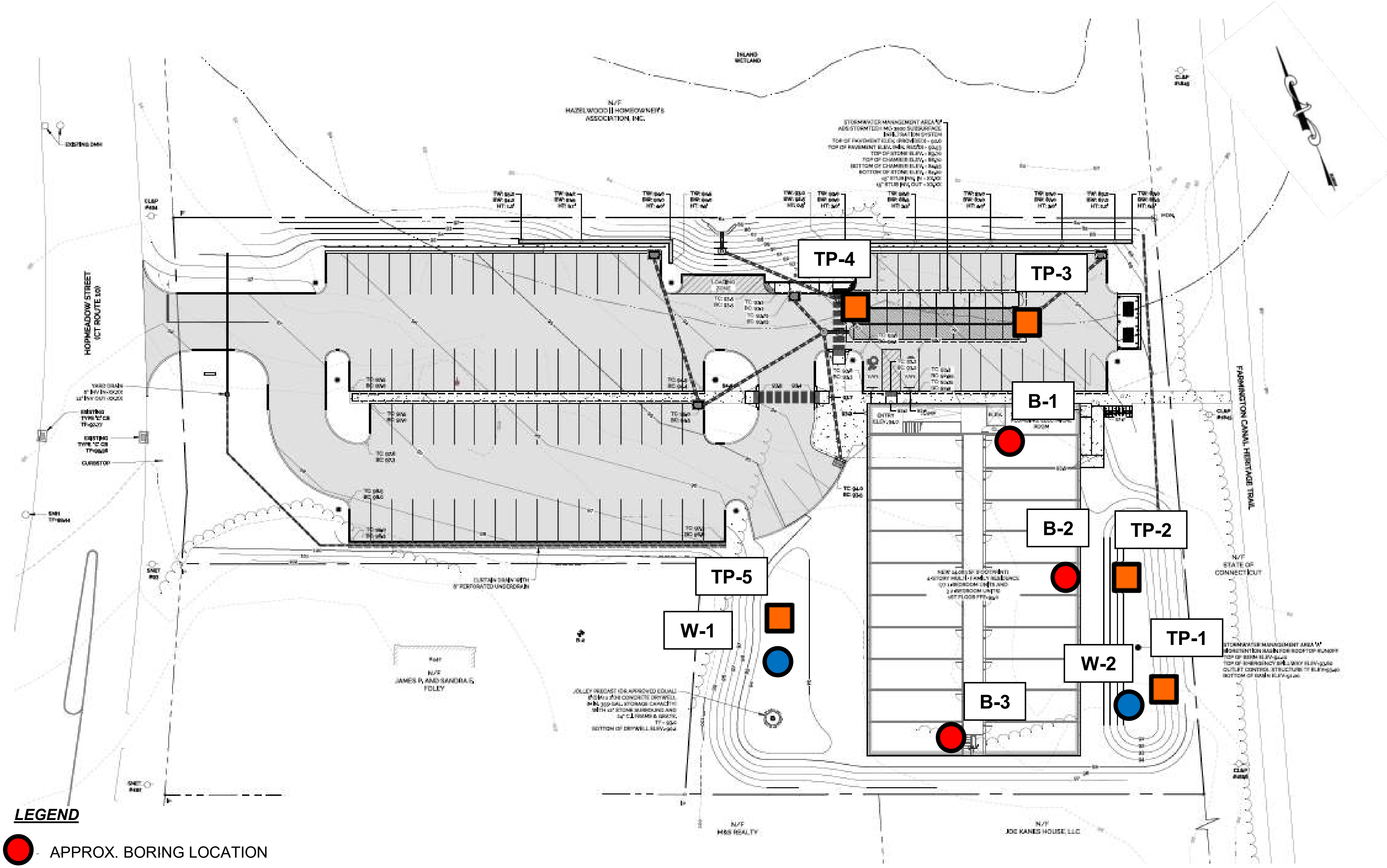
- Review geotechnical-related contractor submittals and assist in developing responses to questions from the contractor (i.e. RFI's).
- Provide periodic site visits during construction to view subgrades and consult on geotechnical-related issues that occur.

7.2 Limitations

This report was prepared for the use of the project team, exclusively. Our recommendations are based on the project information provided to us at the time of this report and may require modification if there are any changes in the nature, design, or location of the proposed building. We cannot accept responsibility for designs based on our recommendations unless we are engaged to review the final plans and specifications to determine whether any changes in the project affect the validity of our recommendations, and whether our recommendations have been properly implemented in the design.

Our professional services for this project have been performed in accordance with generally accepted engineering practices. No warranty, expressed or implied, is made.

Figures



LEGEND

- APPROX. BORING LOCATION
- APPROX. WELL LOCATION
- APPROX. TEST PIT LOCATION

SOURCE:

GRADING & DRAINAGE PLAN "GD-1" (H+H ENGINEERING ASSOC., 11/28/22)

GEI Consultants

TEST LOCATION PLAN
446 HOPMEADOW STREET
SIMSBURY, CT

GEI PROJECT NO: **2203416**

FIGURE NO. 1

Appendix A

Boring, Monitoring Well, and Test Pit Logs

BORING INFORMATION

LOCATION: See Boring Location Plan.

GROUND SURFACE EL. (ft): 93

VERTICAL DATUM:

TOTAL DEPTH (ft): 22.0

LOGGED BY: B. Akereyeni & R. Perryman

DATE START/END: 9/14/2022 - 9/14/2022

DRILLING COMPANY: New England Boring

DRILLER NAME: Anthony McKernan

RIG TYPE: Diedrich D-50 ATV

BORING B-1

DRILLING INFORMATION

HAMMER TYPE: Automatic

AUGER I.D./O.D.: 4.25 inch / NA

CASING I.D./O.D.: NA/ NA

DRILL ROD O.D.: NM

CORE BARREL TYPE: N/A

CORE BARREL I.D./O.D. NA / NA

DRILLING METHOD: Hollow Stem Auger

WATER LEVEL DEPTHS (ft): 9/14/2022 Not encountered

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/15	2-2-2-3		CLAY	S1A (0-10"): CLAYEY SAND WITH GRAVEL (SC); ~60% F sand, ~25% NP fines, ~15% F-C gravel, frequent organic fibers, brown, damp. TOPSOIL S1B (10-15"): LEAN CLAY (CL); ~95% NP-LP fines, ~5% F sand, brown, damp.
90		S2	2 to 4	24/14	5-6-5-7			S2: LEAN CLAY WITH SAND (CL); 92.2% LP fines, 7.5% F-M sand, 0.3% F gravel, brown, moisture=32.3%.
	5	S3	4 to 6	24/24	5-6-7-7			S3: Similar to S1B .
		S4	6 to 8	24/17	6-7-8-9			S4: Similar to S1B, layer of silt and F-C sand from 2"-6", moist
	10	S5	10 to 12	24/15	5-5-5-12			S5: SANDY LEAN CLAY (CL); ~70% NP-MP fines, ~30% v. F sand, wet at 5".
80	15	S6	15 to 17	24/19	3-4-3-3			S6: Similar to S1B, wet.
	20	S7	20 to 22	24/20	2-2-2-4			S7: Similar to S1B, wet.
70								End of boring at 22'. Planned Extent. Backfilled with drill cuttings

NOTES:

PROJECT NAME: Vessel - Simsbury

CITY/STATE: Simsbury, Connecticut

GEI PROJECT NUMBER: 2203416

GEI Consultants

BORING INFORMATION

LOCATION: See Boring Location Plan.

GROUND SURFACE EL. (ft): 94 **DATE START/END:** 9/14/2022 - 9/14/2022

VERTICAL DATUM: **DRILLING COMPANY:** New England Boring

TOTAL DEPTH (ft): 22.0 **DRILLER NAME:** Anthony McKernan

LOGGED BY: B. Akereyeni & R. Perryman **RIG TYPE:** Diedrich D-50 ATV

BORING B-2

DRILLING INFORMATION

HAMMER TYPE: Automatic **CASING I.D./O.D.:** NA/ NA **CORE BARREL TYPE:** N/A

AUGER I.D./O.D.: 4.25 inch / NA **DRILL ROD O.D.:** NM **CORE BARREL I.D./O.D.** NA / NA

DRILLING METHOD: Hollow Stem Auger

WATER LEVEL DEPTHS (ft): 9/14/2022 Not encountered

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
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Sv = Pocket Torvane Shear Strength
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PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample No.	Sample Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD	Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		S1	0 to 2	24/19	1-1-1-1		CLAY	S1A (0-9"): CLAYEY SAND (SC); ~60% F-C sand, ~35% NP fines, ~5% F-C gravel, organic fibers, dark brown, damp. TOPSOIL S1B (9-19"): LEAN CLAY WITH SAND (CL); ~85% NP-LP fines, ~10% F sand, ~5% F-C gravel, brown, damp.
		S2	2 to 4	24/17	3-5-6-6			S2: LEAN CLAY (CL); ~90% NP-LP fines, ~10% F-sand, lauer of F-M sand at 8-10", brown, damp.
90								
	5	S3	4 to 6	24/22	5-4-5-6			S3: LEAN CLAY (CL); 94.9% fines, 5.1% F sand, brown, moist.
		S4	6 to 8	24/15	6-7-6-7			S4: Similar to S3, few organic fibers.
	10	S5	10 to 12	24/20	3-4-4-5			S5: Similar to S3, with red.
80								
	15	S6	15 to 17	24/24	2-2-2-2			S6: Similar to S3, reddish brown, wet.
	20	S7	20 to 22	24/22	3-2-3-4			S7: Similar to S3, layer of silt and F sand at top 0-2".
								End of boring at 22'. Planned Extent. Backfilled with drill cuttings

NOTES:

PROJECT NAME: Vessel - Simsbury

CITY/STATE: Simsbury, Connecticut

GEI PROJECT NUMBER: 2203416

GEI Consultants

BORING INFORMATION		BORING B-3
LOCATION: See Boring Location Plan.		PAGE 1 of 1
GROUND SURFACE EL. (ft): 97	DATE START/END: 9/14/2022 - 9/14/2022	
VERTICAL DATUM:	DRILLING COMPANY: New England Boring	
TOTAL DEPTH (ft): 22.0	DRILLER NAME: Anthony McKernan	
LOGGED BY: B. Akereyeni & R. Perryman	RIG TYPE: Diedrich D-50 ATV	

DRILLING INFORMATION

HAMMER TYPE: Automatic **CASING I.D./O.D.:** NA/ NA **CORE BARREL TYPE:** N/A

AUGER I.D./O.D.: 4.25 inch / NA **DRILL ROD O.D.:** NM **CORE BARREL I.D./O.D.** NA / NA

DRILLING METHOD: Hollow Stem Auger

WATER LEVEL DEPTHS (ft): 9/14/2022 Not encountered

ABBREVIATIONS:
Pen. = Penetration Length
Rec. = Recovery Length
RQD = Rock Quality Designation = Length of Sound Cores>4 in / Pen.,%
WOR = Weight of Rods
WOH = Weight of Hammer
S = Split Spoon Sample
C = Core Sample
U = Undisturbed Sample
SC = Sonic Core
DP = Direct Push Sample
HSA = Hollow-Stem Auger
Qp = Pocket Penetrometer Strength
Sv = Pocket Torvane Shear Strength
LL = Liquid Limit
PI = Plasticity Index
PID = Photoionization Detector
I.D./O.D. = Inside Diameter/Outside Diameter
NA, NM = Not Applicable, Not Measured
Blows per 6 in.: 140-lb hammer falling 30 inches to drive a 2-inch-O.D. split spoon sampler.

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
		S1	0 to 2	24/14	1-1-1-2		CLAY	S1A (0-9"): CLAYEY SAND (SC); ~60% F-M sand, ~30% NP fines, ~10% F-C gravel, organic fibers, dark brown, damp. S1B (9-14"): LEAN CLAY (CL); ~90% NP-LP fines, ~10% F sand, organic fibers, brown, damp.
		S2	2 to 4	24/13	1-4-5-7			S2: Similar to S1B, layer of F-M sand and F-C gravel at 10-13"
	5	S3	4 to 6	24/10	4-4-5-6			S3: LEAN CLAY WITH SAND (CL); 94.0% fines, 6.0% F sand, with organic fibers, brown, moist.
90		S4	6 to 8	24/18	5-7-7-7			S4: Similar to S3, with organic fibers, wet at 6".
	10	S5	10 to 12	24/6	4-5-6-7			S5: Similar to S3, absent fibers, wet.
	15	S6	15 to 17	24/17	4-5-5-6			S6: Similar to S3, gray seam of NP fines 0-4".
80								
	20	S7	20 to 22	24	3-5-4-5			S7: Similar to S5, saturated, gray layer at 0-5".
								End of boring at 22'. Planned Extent. Backfilled with drill cuttings

NOTES:

PROJECT NAME: Vessel - Simsbury
CITY/STATE: Simsbury, Connecticut
GEI PROJECT NUMBER: 2203416

GEI Consultants

Vessel - Simsbury
446 Hopmeadow Street, Simsbury, CT
Vessel Technologies
GEI Project No. 2203416
Test Pit Results
GS Elev: 94.0 FT
Equipment: Mini-Excavator

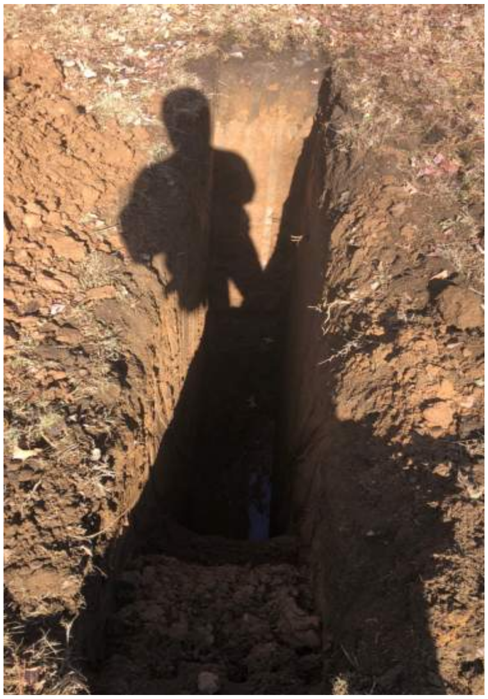
ID	Depth	Description
TP-1	0' - 0.9'	SILTY SAND (SM); ~ 60% F-M sand, ~ 40% NP fines, frequent to few organic fibers, brown, dry. TOPSOIL
	0.9' - 3.7'	SANDY SILT (ML); ~ 70% LP fines, ~30% F-sand, brown, moist.
	3.7' - 8.6'	SILT (MH); ~ 95% MP fines, ~ 5% F-sand, brown, moist.
Notes:		Test pit dimensions: ~2'x9'x8.6' deep. No soil mottling observed. Groundwater intrusion observed at 3.9' during excavation (perched seam). Groundwater observed in adjacent well at 2.9' BGS. Backfilled with excavated material, generally in reverse order, tamped in lifts.


Vessel -Simsbury
446 Hopmeadow Street, Simsbury, CT
Vessel Technologies
GEI Project No. 2203416
Test Pit Results
GS Elev: 93.0 FT
Equipment: Mini-Excavator

ID	Depth	Description
TP-2	0 - 0.8'	SILTY SAND (SM); ~60% F-M sand, ~35% NP fines, ~5% F-gravel, some organic fibers, brown, dry. TOPSOIL
	0.8' - 3.3'	SANDY SILT (ML); ~70% LP fines, ~30% F-sand, yellowish-brown, moist.
	3.3' - 6.2'	SILT (MH); ~90% MP fines, ~10% F-sand, yellowish brown to gray, moist to wet.
Notes:		Test pit dimensions: ~2'x9'x6.2' deep. No soil mottling observed. Infiltration test performed at 2.5'. GW intrusion at 6.0'. Sidewall caved at 3.4'. Backfilled with excavated material, generally in reverse order, tamped in lifts.

Vessel - Simsbury
446 Hopmeadow Street, Simsbury, CT
Vessel Technologies
GEI Project No. 2203416
Test Pit Results
GS Elev: 89.0 FT
Equipment: Mini-Excavator

ID	Depth	Description
TP-3	0' - 0.7'	SILTY SAND (SM); ~60% F-M sand, ~35% NP fines, ~5% F-gravel, few organic fibers, dark-brown to black staining, dry. TOPSOIL
	0.7' - 5'	SILT WITH SAND (ML-MH); ~90% LP-MP fines, ~10% F-sand (thinly bedded), brown, sand at interfaces, moist.
	5' - 7.4'	SILTY CLAY (MH-CH); ~90% LP-MP fines, ~10% F-sand (thinly bedded), reddish-brown, sand at interfaces, moist.
Notes:		Test pit dimensions: ~2'x9'x7.4' deep. No soil mottling observed. Infiltration test performed at 5.0'. Groundwater intrusion at 7.0'. Backfilled with excavated material, generally in reverse order, tamped in lifts.



Vessel - Simsbury
446 Hopmeadow Street, Simsbury, CT
Vessel Technologies
GEI Project No. 2203416
Test Pit Results
GS Elev: 90.0 FT
Equipment: Mini-Excavator

ID	Depth	Description
TP-4	0' - 0.8'	SILTY SAND (SM); ~65% F-sand, ~35% NP fines, roots and organic fibers, brown, dry. TOPSOIL
	0.8' - 4.5'	SILT (ML); ~95% LP fines, ~5% F-sand, with gravel to 2.0 ft., brown, moist.
	4.5' - 9.8'	CLAYEY SILT (CL-ML); ~95% LP-MP fines, ~5% F-sand (thin seams), reddish-brown, moist to damp.
Notes:		Test pit dimensions: ~4'x9'x9.8' deep. No soil mottling observed. Groundwater intrusion observed at 7.7'. Backfilled with excavated material, generally in reverse order, tamped in lifts.

Vessel - Simsbury
446 Hopmeadow Street, Simsbury, CT
Vessel Technologies
GEI Project No. 2203416
Test Pit Results
GS Elev: 99.0 FT
Equipment: Mini-Excavator

ID	Depth	Description
TP-5	0' - 0.7'	SILTY SAND (SM); ~70% F-M sand, ~30% NP fines, some organic fibers, roots, yellowish brown, dry. TOPSOIL
	0.7' - 2.7'	SILTY SAND (SM); ~70% F-sand, ~25% NP -LP fines, ~5% F-C gravel, few fine roots, dry to moist.
	2.7' - 5.3'	NARROWLY GRADED SAND WITH SILT (SP-SM); ~90% F-M sand, ~10% NP fines, brown, dry to moist.
	5.3' - 9.6'	SILT (ML); ~95% NP-LP fines, ~5% F-sand, brown, moist.
Notes:		Test pit dimensions: ~4'x9'x9.6' deep. No soil mottling observed. Inflitration test performed at 5.5'. Minor GW intrusion (perched seam) at 5.0'. Backfilled with excavated material, generally in reverse order, tamped in lifts.

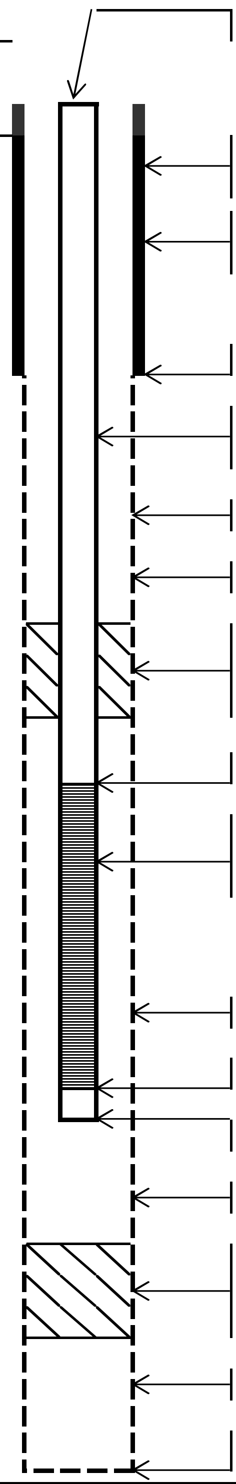
Monitoring Well Installation Log

MW-1

Project	Vessel Residential Simsbury	**GEI Proj. No.**	2203416
City / Town	466 Hopmeadow Street, Simbury	**Location**	West of Proposed Building
Client	Vessel Technologies		
Contractor	New England Boring Contractors		
Driller	A. McKernan	**GEI Rep.**	B. Akereyeni & R. Perryman
		Install Date	9/14/2022

Survey Datum: N/A

Ground Elevation: 98.5



Length of Riser Pipe above Ground	1.9 ft
Type of Seal around Surface Casing	No Seal
Type of Surface Casing	N/A
Surface Casing ID	No Casing
ID and OD of Riser Pipe	2-inch ID/ 2 3/8-inch OD
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	No. 2 Sand
Diameter of Borehole	4.25 in.
Depth Top of Seal	N/A
Type of Seal	N/A
Depth Bottom of Seal	N/A
Depth Top of Screened Section	2.75 ft BGS
Type of Screen	Sch. 40 PVC
Description of Screen Openings	0.010 in. slots
ID and OD of Screened Section	2-inch ID
Type of Filter Material	No. 2 Sand
Depth Bottom of Screened Section	7.75 ft
Depth Bottom of Silt Trap	8.0 ft
Depth Bottom of Filter Material	N/A
Depth Top of Seal	N/A
Type of Seal	N/A
Depth Bottom of Seal	N/A
Type of Backfill below Filter Material	N/A
Bottom of Borehole	8.0 ft

Date	Time	Distance to GW below ground surface
9/14/2022	-	Not Encountered
2/8/2023	9:00:00 AM	2.9 FT

Notes: No survey information available at time of well installation.

GEI Consultants

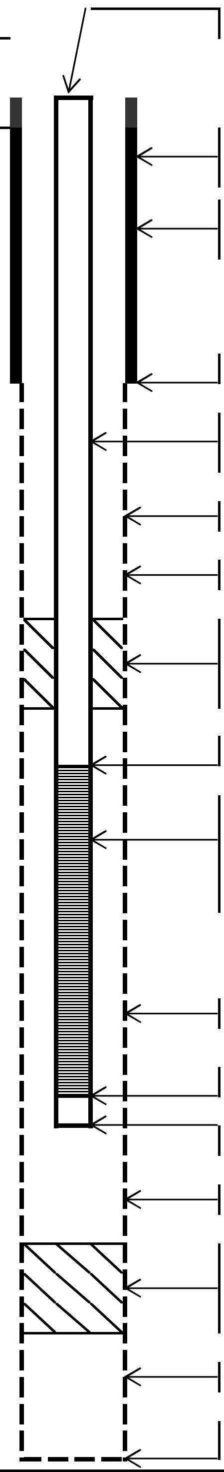
Monitoring Well Installation Log

MW-2

Project	Vessel Residential Simsbury	**GEI Proj. No.**	2203416
City / Town	466 Hopmeadow Street, Simbury	**Location**	East of Proposed Building
Client	Vessel Technologies		
Contractor	New England Boring Contractors		
Driller	A. McKernan **GEI Rep.** B. Akereyeni & R. Perryman	**Install Date**	9/14/2022

Survey Datum: N/A

Ground Elevation: 96.0



Length of Riser Pipe above Ground	1.9 ft
Type of Seal around Surface Casing	No Seal
Type of Surface Casing	N/A
Surface Casing ID	No Casing
ID and OD of Riser Pipe	2-inch ID/ 2 3/8-inch OD
Type of Riser Pipe	PVC
Type of Backfill around Riser Pipe	No. 2 Sand
Diameter of Borehole	4.25 in.
Depth Top of Seal	N/A
Type of Seal	N/A
Depth Bottom of Seal	N/A
Depth Top of Screened Section	2.75 ft BGS
Type of Screen	Sch. 40 PVC
Description of Screen Openings	0.010 in. slots
ID and OD of Screened Section	2-inch ID
Type of Filter Material	No. 2 Sand
Depth Bottom of Screened Section	7.75 ft
Depth Bottom of Silt Trap	8.0 ft
Depth Bottom of Filter Material	N/A
Depth Top of Seal	N/A
Type of Seal	N/A
Depth Bottom of Seal	N/A
Type of Backfill below Filter Material	N/A
Bottom of Borehole	8.0 ft

Date	Time	Distance to GW below ground surface
9/14/2022	-	Not Encountered
2/8/2023	9:00 AM	Not Encountered

Notes: No survey information available at time of well installation.

GEI Consultants

Appendix B

Laboratory Test Results

Client:	GEI Consultants, Inc.			
Project:	Vessel Simsbury			
Location:	Simsbury, CT		Project No:	GTX-316175
Boring ID: ---		Sample Type: ---	Tested By:	ckg
Sample ID: ---		Test Date: 10/04/22	Checked By:	bfs
Depth : ---		Test Id: 687812		

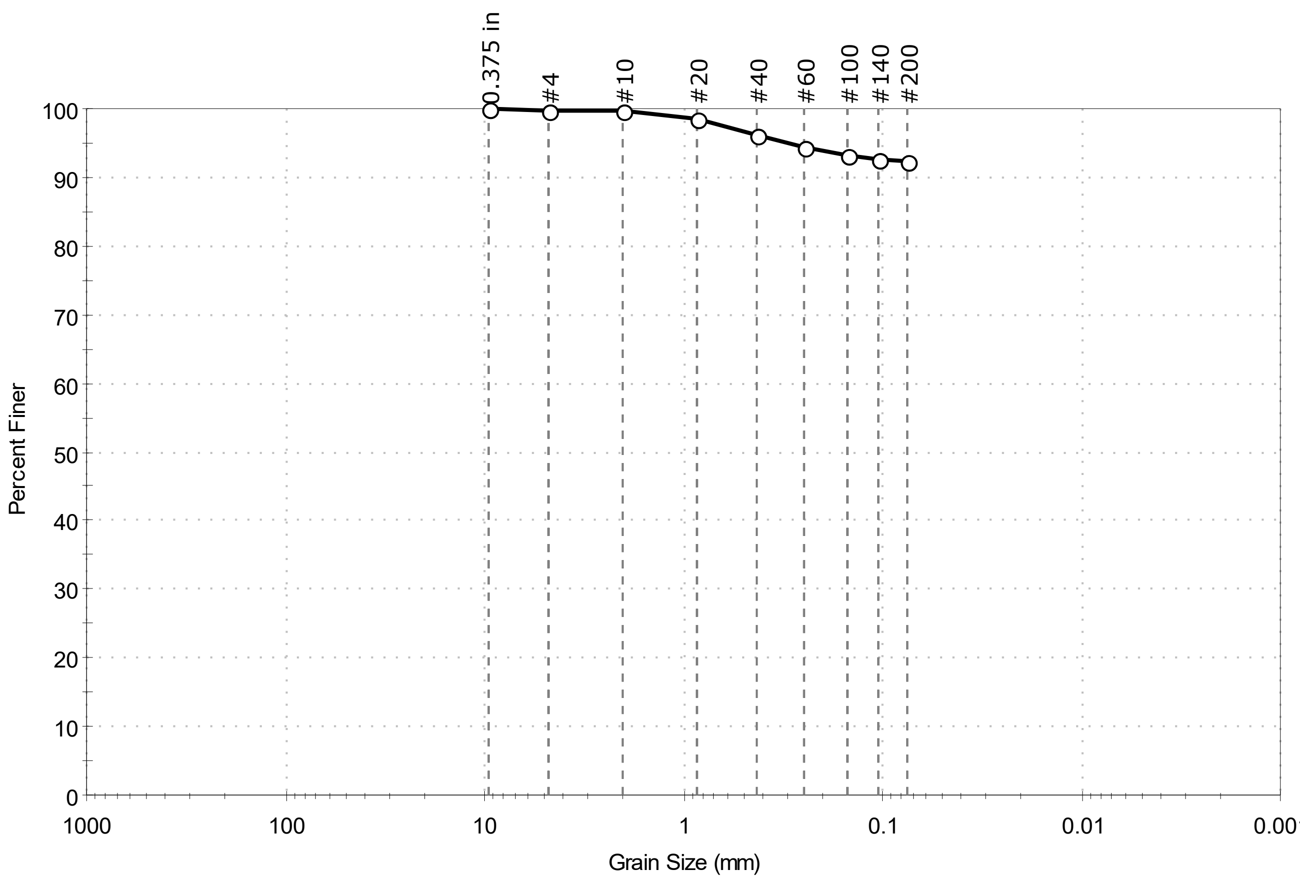
Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
B1	S2	2-4	Moist, brown clay	32.3
B2	S3	4-6	Moist, brown clay	32.9
B3	S4	6-8	Moist, brown clay	33.2

Notes: Temperature of Drying : 110º Celsius

Client:	GEI Consultants, Inc.				
Project:	Vessel Simsbury				
Location:	Simsbury, CT			Project No:	GTX-316175
Boring ID:	B1	Sample Type:	bag	Tested By:	ckg
Sample ID:	S2	Test Date:	10/05/22	Checked By:	bfs
Depth :	2-4	Test Id:	687807		
Test Comment:	---				
Visual Description:	Moist, brown clay				
Sample Comment:	---				

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.3	7.5	92.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	100		
#10	2.00	100		
#20	0.85	98		
#40	0.42	96		
#60	0.25	94		
#100	0.15	93		
#140	0.11	93		
#200	0.075	92		

Coefficients

D_{85} =N/A D_{30} =N/A

D_{60} =N/A D_{15} =N/A

D_{50} =N/A D_{10} =N/A

C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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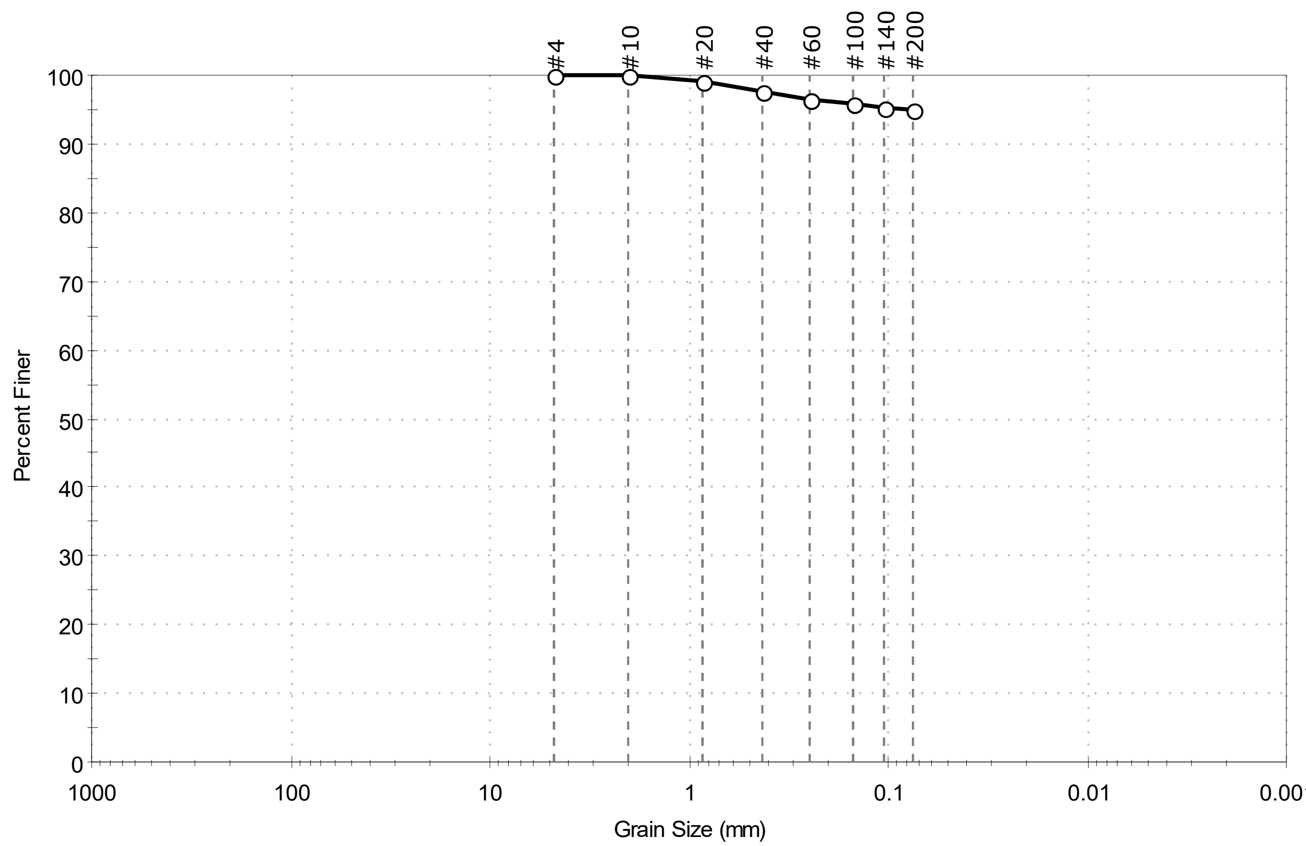
Client:	GEI Consultants, Inc.
Project:	Vessel Simsbury
Location:	Simsbury, CT
Project No:	GTX-316175
Boring ID:	B2
Sample ID:	S3
Depth :	4-6
Sample Type:	bag
Test Date:	10/05/22
Test Id:	687808
Tested By:	ckg
Checked By:	bfs
Test Comment:	---
Visual Description:	Moist, brown clay
Sample Comment:	---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	5.1	94.9

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#60	0.25	97		
#100	0.15	96		
#140	0.11	95		
#200	0.075	95		

Coefficients

D_{85} =N/A
D_{30} =N/A
D_{60} =N/A
D_{15} =N/A
D_{50} =N/A
D_{10} =N/A
C_u =N/A
C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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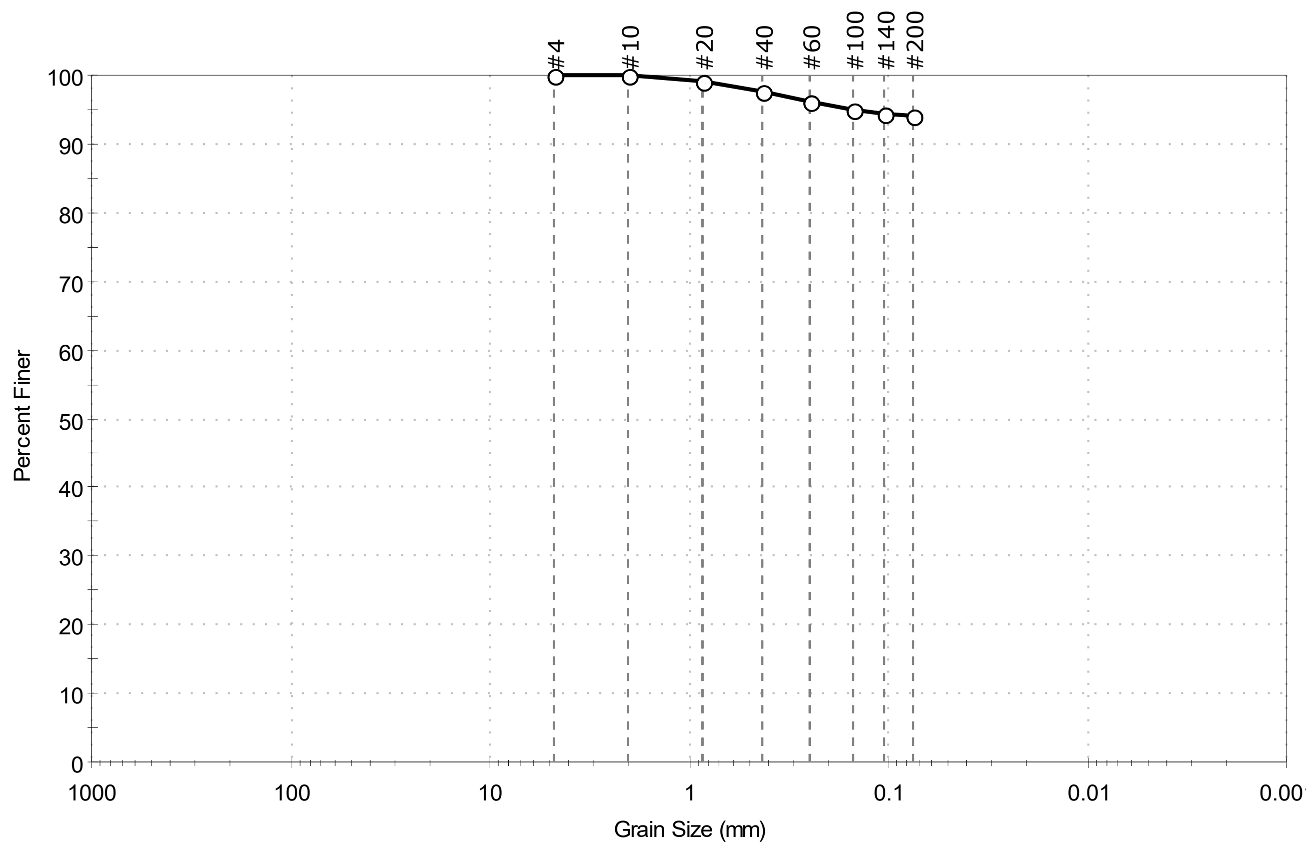
Client:	GEI Consultants, Inc.				
Project:	Vessel Simsbury				
Location:	Simsbury, CT			Project No:	GTX-316175
Boring ID:	B3	Sample Type:	bag	Tested By:	ckg
Sample ID:	S4	Test Date:	10/05/22	Checked By:	bfs
Depth :	6-8	Test Id:	687809		

Test Comment: ---
Visual Description: Moist, brown clay
Sample Comment: ---

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	6.0	94.0

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#60	0.25	96		
#100	0.15	95		
#140	0.11	95		
#200	0.075	94		

Coefficients

D_{85} =N/A D_{30} =N/A
D_{60} =N/A D_{15} =N/A
D_{50} =N/A D_{10} =N/A
C_u =N/A C_c =N/A

Classification

ASTM N/A

AASHTO Silty Soils (A-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

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Appendix C

Recommended Material Specifications

Recommended Material Specifications
Vessel – 446 Hopmeadow Street
Simsbury, CT

The natural fine-grained, brown clays and silts referenced in the Geotechnical Report are not suitable for re-use as Structural Fill on the project due to their high fines content. These soils, where excavated, should be wasted on non-structural areas of the project or removed from the site.

Though data is limited at this time, suitable granular soils might be obtained from upland areas of the site, including, potentially, the western stormwater basin shown on concept plans. If native sands and gravels are encountered and excavated as part of earthwork activities they can possibly be re-used on site as Structural Fill or Ordinary Fill, provided they do not contain oversize, organic, or otherwise deleterious material and can meet the appropriate compaction requirements.

Fill imported from off site should meet the attached gradation requirements. Fill placed within the building limits, within a 3-foot-wide zone outside foundation walls, under pavements, and behind retaining walls should meet the compaction requirements for Structural Fill. Backfill placed in non-structural areas should meet the compaction requirements for Ordinary Fill. Proposed borrow materials that fall slightly outside of these specifications may also be suitable for use, subject to review and approval by GEI.

Structural Fill

Imported Structural Fill should consist of hard, durable sand and gravel. It should be free of clay, organic matter, surface coatings, and other deleterious materials. Soil finer than the No. 200 sieve (the "fines") should be non-plastic. Structural Fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
3 inches	100
1 - ½ inch	55 – 100
No. 4	35 – 85
No. 16	20 – 65
No. 50	5 – 40
No. 200 (fines)	0 – 10

Structural Fill should be compacted in maximum 12-inch-thick, loose lifts to at least 95 percent of the maximum dry density determined in accordance with ASTM D1557 (Modified AASHTO Compaction). The moisture content should be held to within +/- 3 percent of optimum moisture content (as determined by ASTM D1557).

Ordinary Fill

Ordinary fill should consist of hard, durable sand and gravel, free of clay, organic matter, surface coatings, and other deleterious materials. Soil finer than the No. 200 sieve (the "fines") should be nonplastic. Ordinary Fill shall meet the following gradation requirements:

Sieve Size	Percent Passing by Weight
6 inches	100
3 inches	80 – 100
No. 4	20 – 100
No. 200 (fines)	0 – 20

Ordinary fill should be compacted in maximum 12-inch-thick, loose lifts to at least 92 percent of the maximum dry density determined in accordance with ASTM D1557 (Modified AASHTO Compaction). The moisture content should be held to within +/- 3 percent of optimum moisture content (as determined by ASTM D1557).

Crushed Stone

Crushed Stone should consist of a ¾-inch size durable crushed rock or durable crushed gravel stone and shall conform to the requirements of the ConnDOT Form 818, Section M.01.01, No. 6. Crushed stone should be compacted with at least four passes of a vibratory compactor.

Geotextile Fabric

Geotextile fabric should be a non-woven fabric, consisting of Mirafi 140N or an approved equal product.

Appendix D

Infiltration Testing Results

GEI Consultants, Inc.
GEI Proj # 2203416- 1.1
Guelph Permeameter Testing
Test Date 2/8/2023

Field Data TP-2

Reservoir Combined
Unit Set 6"
Depth of Test 2 FT
Depth to GW ~6'
GEI Rep. Tom Rezzani

Soil Type SANDY CLAY (CL); ~70% LP fines, ~30% F-sand, yellowish-brown, moist.

Water Level in Well **5 cm** *

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.1667		1.0		
0.333	0.17	1.1	0.1	0.6000
0.500	0.17	1.1	0.0	0.0000
0.667	0.17	1.1	0.0	0.0000
0.833	0.17	1.1	0.0	0.0000
1.000	0.17	1.2	0.1	0.6000
1.167	0.17	1.2	0.0	0.0000
1.333	0.17	1.2	0.0	0.0000
1.500	0.17	1.2	0.0	0.0000
1.667	0.17	1.2	0.0	0.0000
1.833	0.17	1.2	0.0	0.0000
2.000	0.17	1.2	0.0	0.0000
2.167	0.17	1.2	0.0	0.0000
2.333	0.17	1.2	0.0	0.0000
	Steady Rate of Change, R_1 (cm/min)			**0.09**

Water Level in Well **10 cm**

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.1667		5.5		
0.333	0.17	5.3	-0.2	-1.2000
0.500	0.17	5.5	0.2	1.2000
0.667	0.17	5.5	0	0.0000
0.833	0.17	5.5	0	0.0000
1.000	0.17	5.5	0	0.0000
1.167	0.17	5.5	0	0.0000
1.333	0.17	5.6	0.1	0.6000
1.500	0.17	5.6	0	0.0000
1.667	0.17	5.6	0	0.0000
1.833	0.17	5.6	0	0.0000
2.000	0.17	5.6	0	0.0000
2.167	0.17	5.6	0	0.0000
2.333	0.17	5.6	0	0.0000
2.500	0.17	5.7	0.1	0.6000
2.667	0.17	5.7	0	0.0000
2.833	0.17	5.7	0	0.0000
3.000	0.17	5.7	0	0.0000
3.167	0.17	5.7	0	0.0000
3.333	0.17	5.7	0	0.0000
3.500	0.17	5.7	0	0.0000
3.667	0.17	5.7	0	0.0000
3.833	0.17	5.7	0	0.0000
4.000	0.17	5.7	0	0.0000
4.167	0.17	5.7	0	0.0000
4.333	0.17	5.8	0.1	0.6000
4.500	0.17	5.8	0	0.0000
4.667	0.17	5.8	0	0.0000
4.833	0.17	5.8	0	0.0000
5.000	0.17	5.8	0	0.0000
5.167	0.17	5.8	0	0.0000
5.333	0.17	5.8	0	0.0000
5.500	0.17	5.8	0	0.0000
5.667	0.17	5.8	0	0.0000
5.833	0.17	5.8	0	0.0000
6.000	0.17	5.9	0.1	0.6000
	Steady Rate of Change, R2 (cm/min)			**0.07**

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GEI Proj # 2203416- 1.1 **Check by:** M. Glunt **Date:** 2/13/2023
Guelph Permeameter Testing - TP-2

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	**0.09**	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.768		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.0542	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	9.376E-05	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	7.813E-04	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	0.07	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.234		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	0.04	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	4.168E-05	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	3.473E-04	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**6.772E-05**	cm/sec
			0.1	in/hour

GEI Consultants, Inc.
GEI Proj # 2203416- 1.1
Guelph Permeameter Testing
Test Date 2/8/2023

Field Data TP-3

Reservoir Combined
Unit Set 6"
Depth of Test 4.5 FT
Depth to GW ~7'
GEI Rep. Tom Rezzani
Soil Type SILT (ML-MH); ~90% LP-MP fines, ~10% F-sand (thinly bedded), brown,moist.

Water Level in Well **8 cm** *

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.2500		14.6		
0.500	0.25	14.6	0.0	0.00
0.750	0.25	14.7	0.1	0.40
1.000	0.25	14.7	0.0	0.00
1.250	0.25	14.9	0.2	0.80
1.500	0.25	15.1	0.2	0.80
1.750	0.25	15.2	0.1	0.40
2.000	0.25	15.4	0.2	0.80
2.250	0.25	15.5	0.1	0.40
2.500	0.25	15.7	0.2	0.80
2.750	0.25	16.0	0.3	1.20
3.000	0.25	16.1	0.1	0.40
3.250	0.25	16.2	0.1	0.40
3.500	0.25	16.4	0.2	0.80
3.750	0.25	16.5	0.1	0.40
4.000	0.25	16.7	0.2	0.80
4.250	0.25	16.8	0.1	0.40
4.500	0.25	16.9	0.1	0.40
4.750	0.25	17.1	0.2	0.80
5.000	0.25	17.3	0.2	0.80
5.250	0.25	17.5	0.2	0.80
5.500	0.25	17.6	0.1	0.40
5.750	0.25	17.7	0.1	0.40
6.000	0.25	18.1	0.4	1.60
	Steady Rate of Change, R_1 (cm/min)			**0.61**

Water Level in Well **12.7 cm**

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.2500		21.1		
0.500	0.25	21.4	0.3	1.20
0.750	0.25	21.7	0.3	1.20
1.000	0.25	21.9	0.2	0.80
1.250	0.25	22.1	0.2	0.80
1.500	0.25	22.2	0.1	0.40
1.750	0.25	22.4	0.2	0.80
2.000	0.25	22.6	0.2	0.80
2.250	0.25	22.9	0.3	1.20
2.500	0.25	23.0	0.1	0.40
2.750	0.25	23.2	0.2	0.80
3.000	0.25	23.4	0.2	0.80
3.250	0.25	23.5	0.1	0.40
3.500	0.25	23.7	0.2	0.80
3.750	0.25	23.9	0.2	0.80
4.000	0.25	24.2	0.3	1.20
4.250	0.25	24.3	0.1	0.40
4.500	0.25	24.5	0.2	0.80
4.750	0.25	24.7	0.2	0.80
5.000	0.25	24.9	0.2	0.80
5.250	0.25	25.1	0.2	0.80
	Steady Rate of Change, R2 (cm/min)			**0.80**

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GEI Proj # 2203416- 1.1 **Check by:** M. Glunt **Date:** 2/13/2023
Guelph Permeameter Testing - TP-3

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	8	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	**0.61**	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	1.063		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.3573	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	4.440E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	3.700E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	12.7	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	3		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	0.80	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α^*	-	0.12	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.442		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	0.47	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	3.925E-04	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	3.271E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**4.183E-04**	cm/sec
			0.6	in/hour

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GEI Proj # 2203416- 1.1
Guelph Permeameter Testing
Test Date 2/8/2023

Field Data TP-5

Reservoir Combined
Unit Set 6"
Depth of Test 5 FT
Depth to GW ~6'
GEI Rep. Tom Rezzani
Soil Type NARROWLY GRADED SAND WITH SILT (SP-SM); ~90% F-M sand, ~10% NP fines, brown, dry to moist.

Water Level in Well 5 cm *

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.1667		1.0		
0.333	0.17	1.6	0.6	3.60
0.500	0.17	1.9	0.3	1.80
0.667	0.17	2.0	0.1	0.60
0.833	0.17	2.2	0.2	1.20
1.000	0.17	2.3	0.1	0.60
1.167	0.17	2.5	0.2	1.20
1.333	0.17	2.6	0.1	0.60
1.500	0.17	2.9	0.3	1.80
1.667	0.17	3.1	0.2	1.20
1.833	0.17	3.2	0.1	0.60
2.000	0.17	3.3	0.1	0.60
2.167	0.17	3.6	0.3	1.80
2.333	0.17	3.7	0.1	0.60
2.500	0.17	3.8	0.1	0.60
2.667	0.17	3.9	0.1	0.60
2.833	0.17	4.1	0.2	1.20
3.000	0.17	4.3	0.2	1.20
3.167	0.17	4.4	0.1	0.60
3.333	0.17	4.5	0.1	0.60
3.500	0.17	4.7	0.2	1.20
3.667	0.17	5.0	0.3	1.80
3.833	0.17	5.0	0.0	0.00
4.000	0.17	5.2	0.2	1.20
4.167	0.17	5.3	0.1	0.60
4.333	0.17	5.4	0.1	0.60
4.500	0.17	5.6	0.2	1.20
4.667	0.17	5.7	0.1	0.60
4.833	0.17	5.8	0.1	0.60
5.000	0.17	6.0	0.2	1.20
	Steady Rate of Change, R_1 (cm/min)			**0.89**

Water Level in Well 10 cm

Time (min)	Time Change (min)	Water Level in Res. (cm)	Change in Res. Water Level (cm)	Rate of Change (cm/min)
0.1667		11.5		
0.333	0.17	11.7	0.2	1.20
0.500	0.17	12.3	0.6	3.60
0.667	0.17	13.0	0.7	4.20
0.833	0.17	13.3	0.3	1.80
1.000	0.17	13.7	0.4	2.40
1.167	0.17	14.1	0.4	2.40
1.333	0.17	14.5	0.4	2.40
1.500	0.17	15.1	0.6	3.60
1.667	0.17	15.6	0.5	3.00
1.833	0.17	15.9	0.3	1.80
2.000	0.17	16.2	0.3	1.80
2.167	0.17	16.6	0.4	2.40
2.333	0.17	17.0	0.4	2.40
2.500	0.17	17.5	0.5	3.00
2.667	0.17	17.9	0.4	2.40
2.833	0.17	18.1	0.2	1.20
3.000	0.17	18.6	0.5	3.00
3.167	0.17	19.0	0.4	2.40
3.333	0.17	19.4	0.4	2.40
3.500	0.17	19.7	0.3	1.80
3.667	0.17	20.0	0.3	1.80
3.833	0.17	20.5	0.5	3.00
4.000	0.17	20.9	0.4	2.40
4.167	0.17	21.2	0.3	1.80
4.333	0.17	21.5	0.3	1.80
4.500	0.17	21.9	0.4	2.40
4.667	0.17	22.2	0.3	1.80
4.833	0.17	22.6	0.4	2.40
5.000	0.17	23.0	0.4	2.40
	Steady Rate of Change, R2 (cm/min)			**2.26**

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Guelph Permeameter Testing - TP-5		

Single Head Method - Test 1

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_1	-	5	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_1	-	**0.89**	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_1	-	0.768		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_1	-	0.5199	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	1.483E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	4.120E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Single Head Method - Test 2

Test Data and Information

• Reservoir		-	Combined		
• Reservoir Cross-Sectional Area		-	35.22	cm^2	(Provided on Permeameter)
• Water Head Height	H_2	-	10	cm	
• Borehole Radius	a	-	3.2	cm	Assumed slightly larger than 3cm rad. hand auger
• Soil Texture-Structure Category		-	4		(Table 2)
• Steady State Rate of Water Level Change	R_2	-	2.26	cm/min	(Obtained during testing)

Test Calculations and Results

• Microscopic Capillary Length Factor	α*	-	0.36	cm^{-1}	(Table 2: Based on Soil Texture-Structure Category)
• Shape Factor	C_2	-	1.234		(Table 2: Based on Soil Texture-Structure Category)
• Volumetric Flow Rate	Q_2	-	1.32	cm^3/sec	(Table 3: One Head, Combined Reservoir)
• Soil Saturated Hydraulic Conductivity	K_{fs}	-	1.940E-03	cm/sec	(Table 3: One Head, Combined Reservoir)
• Soil Matrix Flux Potential	Φ_m	-	5.390E-03	cm^2/sec	(Table 3: One Head, Combined Reservoir)

Test Averages

• Soil Saturated Hydraulic Conductivity	K_{fs}	-	**1.712E-03**	cm/sec
			2.4	in/hour

Table 2

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_2/a}{2.081 + 0.121\left(H_2/a\right)}\right)^{0.672}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091\left(H_1/a\right)}\right)^{0.683}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091\left(H_2/a\right)}\right)^{0.683}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093\left(H_1/a\right)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093\left(H_2/a\right)}\right)^{0.754}$

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is microscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Table 3

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{a^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)a^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi\left(2H_1 H_2 (H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_2 = \frac{H_1 C_2}{\pi\left(2H_1 H_2 (H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $K_{fs} = G_2 Q_2 - G_1 Q_1$ $G_3 = \frac{(2H_2^2 + a^2 C_2)C_1}{2\pi\left(2H_1 H_2 (H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $G_4 = \frac{(2H_1^2 + a^2 C_1)C_2}{2\pi\left(2H_1 H_2 (H_2 - H_1) + a^2(H_1 C_2 - H_2 C_1)\right)}$ $\Phi_m = G_3 Q_1 - G_4 Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm²/s), a^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm) , H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

446 Hopmeadow Street
Simsbury, CT
Soil Permeability Calculations
Well MW-1

WELL CALCULATIONS

$$k'_v = \frac{d^2(\frac{\pi}{11}\frac{k'_v}{k_v}\frac{D}{m} + L)}{D^2(t_2 - t_1)} \ln\frac{H_1}{H_2}$$

("Soil in casing in uniform soil," Lambe and Whitman, 1969.)

Diameter, sand pack	8.26	D (cm)
Diam., PVC riser	5.08	d (cm)
Length, slotted PVC	152	L (cm)
k'_v/k_v	1	*Assumed*

Test 1

Height H (cm)	Time t (seconds)	Vertical Perm. k'_v (cm/sec)	Vertical Perm. k'_v (in/hr)**
15	5		
302	20	1.16E+01	16471.02

***After initial pre-soak, well completely drained within 20 seconds of filling*

446 Hopmeadow Street
Simsbury, CT
Soil Permeability Calculations
Well MW-2

GEI Consultants

WELL CALCULATIONS

$$k'_v = \frac{d^2(\frac{\pi}{11}\frac{k'_v}{k_v}\frac{D}{m} + L)}{D^2(t_2 - t_1)} \ln\frac{H_1}{H_2}$$

("Soil in casing in uniform soil," Lambe and Whitman, 1969.)

Diameter, sand pack	8.26	D (cm)
Diam., PVC riser	5.08	d (cm)
Length, slotted PVC	152	L (cm)
k'_v/k_v	1	*Assumed*

Test 1

Height H (cm)	Time t (seconds)	Vertical Perm. k'_v (cm/sec)	Vertical Perm. k'_v (in/hr)
146	60		
147	120	6.06E-03	8.59
148	180	2.01E-03	2.85
148	240	6.01E-03	8.52
150	300	1.19E-02	16.89
152	360	1.37E-02	19.44
152	420	0.00E+00	0.00
153	480	5.82E-03	8.25
154	540	5.79E-03	8.20
155	600	5.75E-03	8.15
156	660	7.62E-03	10.80
157	720	3.79E-03	5.37
158	780	3.77E-03	5.35
158	840	5.63E-03	7.98
159	900	3.74E-03	5.29
160	960	5.58E-03	7.90
161	1020	3.70E-03	5.24
162	1080	5.52E-03	7.83
162	1140	1.83E-03	2.60
162	1200	3.66E-03	5.18
164	1260	7.28E-03	10.31
165	1320	5.42E-03	7.68
		AVERAGE	6.4