McPHAIL
ASSOCIATES, LLC

FOUNDATION ENGINEERING REPORT

WALDEN SQUARE APARTMENTS

21 WALDEN SQUARE ROAD

CAMBRIDGE, MASSACHUSETTS

MAY 27, 2021

Prepared For:

Winn Companies
One Washington Mall, Suite 500
Boston, MA 02108

2269 Massachusetts Avenue
Cambridge, MA 02140
www.mcphailgeo.com
(617) 868-1420

PROJECT NO. 7160.2.T1

May 27, 2021

Winn Companies
One Washington Mall, Suite 500
Boston, MA 02108

Attention: Mr. Matthew Robayna

Reference: Walden Square Apartments; Cambridge, Massachusetts
Foundation Engineering Report

This report documents the results of our subsurface exploration and foundation design study for the proposed Walden Square Apartments project to be located at 21 Walden Square Road in Cambridge, Massachusetts. Refer to the Project Location Plan, **Figure 1**, for the general site location.

This report was prepared in accordance with our proposal dated March 16, 2021 and the subsequent authorization of Winn Companies. These services are subject to the limitations contained in **Appendix A**.

Purpose and Scope

The purposes of the subsurface exploration program and foundation design study are to assess the subsurface soil and groundwater conditions at the site as they relate to foundation design, and based on these conditions, to provide safe and economic foundation design recommendations for the proposed building.

Foundation design includes foundation support of the proposed building and its lowest-level slabs, lateral earth pressures on foundation walls, and seismic design considerations in accordance with the provisions of the Ninth Edition of the Massachusetts State Building Code (The Code). Foundation construction considerations relating to geotechnical aspects of the proposed construction are also presented herein.

Available Information

Information available to McPhail Associates, LLC (McPhail) included the following:

- A report entitled “Phase I Initial Site Investigation, Walden Square Apartments, 21 Walden Square Road, Cambridge, Massachusetts” dated March 1997 and prepared by Green Environmental, Inc. The logs of two (2) borings, MW-1 and MW-2, where contained in this report.
- A report entitled “Phase I Environmental Site Assessment Update, Walden Square Apartments, 102-104 Sherman Street, Cambridge, Massachusetts” dated June 2018 and prepared by Loureiro Engineering Associates, Inc. (Loureiro).
- A drawing entitled “Existing Conditions Plan of Land” dated February 25, 2021 prepared by Vanasse Hangen Brustlin, Inc. (VHB).

- A drawing entitled “Overall Site Plan” dated March 11, 2021 prepared by VHB.
- A Soil Management Plan (SMP) dated March 2021 and prepared by Loureiro.
- A Project Health and Safety Plan (HASP) dated March 24, 2021 and prepared by Loureiro.

Existing Conditions and Site Background

The site of proposed development is located within the existing Cambridge Housing Authority (CHA) Walden Square Apartments (WSA) complex, which is located east of Sherman Street, west of Raymond Street and occupies an approximate 7.324-acre plan area. The site generally contains six (6) multi-unit, concrete residential buildings varying in height from 3 to 9 stories. The existing buildings are surrounded by bituminous concrete paved driveways and parking areas, with landscaped margins. The site of the proposed building generally consists of at-grade bituminous concrete paved roadways, drive aisles and parking areas with grassed and landscaped margins. Ground surface across the site of the proposed building slopes up gradually from west to east from about Elevation +23 to Elevation +30 across an approximate 450-foot horizontal distance. Elevations cited herein are in feet and are referenced to the Cambridge City Base datum.

Historically, the brick making industry was active in the northwest area of Cambridge through the early to mid-1900s. Based on our review of historic USGS topographical maps, it appears that clay pits were present either on or in the vicinity of the site. As part of this process, clay was mined from open pits which were later filled when the industry abandoned the operation.

The site is currently listed with the Massachusetts Department of Environmental Protection (DEP) as a listed Disposal Site with Release Tracking Number (RTN) 3-0001656. An Activity and Use Limitation (AUL) was recorded for the site which states that the site formerly consisted of a clay pit that was filled in with fill materials (usually consisting of debris and excess soil from construction sites), industrial refuse, and ash and cinders from incinerators located proximal to the site. It is understood that the AUL requires that a Soil Management Plan be “prepared by a Licensed Site Professional (LSP) and implemented prior to the commencement of any activity which is likely to disturb potentially contaminated soil located at greater than 3 feet below surface grade.” Furthermore, it is understood that a HASP is required if any soil below a depth of three feet is to be disturbed or excavated.

Proposed Development

It is understood that the proposed development includes the construction of a new, 7-story building which is planned to occupy a footprint of approximately 26,000 square feet. The ground floor of the building will contain open-air parking, a residential lobby, and mechanical and trash rooms. Floors 2 through 7 will contain residential units. At this time, it is understood that the proposed building will not contain any below-grade space.

Levels 1 and 2 will consist of post-tensioned concrete slabs with concrete columns and Levels 3 through 7 will be timber framed. Based on information provided to us by the Project Structural Engineer, Odeh Engineers, Inc., the approximate anticipated column loads, including dead load and live load, for interior and exterior columns are about 750 and 400 kips, respectively.

Subsurface Explorations by McPhail

McPhail completed the following scope of subsurface explorations at the site:

- Four (4) soil borings, MA-1 through MA-4, completed in March 2021.
- Five (5) cone penetration tests (CPTs) on March 17, 2021.

The locations of the borings and CPTs are indicated on the attached Subsurface Exploration Plan, **Figure 2**. The boring logs and data from the CPT exploration program are contained in **Appendix B** and **Appendix C**, respectively. Furthermore, the logs of two (2) borings, MW-1 and MW-2, performed by others are contained in **Appendix D** and the locations are indicated on **Figure 2**.

The recent borings were performed utilizing a truck-mounted drill-rig and advanced using hollow-stem augers and/or HW casing. Standard 2-inch outside diameter (O.D.) split-spoon samples and standard penetration tests (SPT) were performed in accordance with the standard procedures in ASTM D1586 and were generally obtained continuously or at minimum 5-foot intervals of depth.

Borings MA-1 and MA-2 were terminated within the bedrock that underlies the site at depths of 85 and 78 feet below ground surface, respectively. Two (2) five-foot, NX-sized cores of bedrock were obtained from borings MA-1 and MA-2 each. Borings MA-3(OW) and MA-4 were performed in the vicinity of a proposed stormwater infiltration system and were terminated in the fill at depths of 17 and 10 feet below ground surface, respectively. A groundwater observation well was installed in completed boring MA-3(OW) and recorded groundwater levels from this well and existing monitoring well MW-2 are indicated on the groundwater monitoring reports contained in **Appendix E**.

The CPTs were advanced using an integrated electronic piezocone penetrometer and advanced with the direct push method using a 25-ton CPT rig. Using a compression model cone penetrometer with tip and sleeve areas of 15 cm^2 and 225 cm^2, respectively, readings of tip resistance, sleeve friction, and dynamic pore pressure were recorded at approximate 1-inch intervals in accordance with the procedures described in ASTM D5778-12.

Seismic cone penetration tests (SCPT), which includes shear wave velocity testing, were performed within SCPT-03C. Shear waves were generated using an impact hammer mounted to the rig striking a beam that was coupled to the ground surface by applying downward force from the rig. The resulting seismic waves were recorded by a horizontally active geophone mounted approximately 8 inches above the cone tip. Shear wave velocity tests were conducted at approximate 5-foot intervals. These procedures are in general accordance with current ASTM 5778 and ASTM D7400 standards.

The CPTs and SCPT21-03C were advanced to depths ranging from about 58 feet to 61 feet below the ground surface and were terminated in the glacial till deposit. SCPT21-03, SCPT21-03A and SCPT21-03B encountered shallow refusals at depths of approximately 2 feet below the existing ground surface.

The explorations were observed by a McPhail field representative who performed field layout, prepared boring logs, obtained and visually classified soil samples from the borings, monitored groundwater conditions in the open boreholes and groundwater observation wells, and determined the required exploration depth based upon the actual subsurface conditions encountered.

Field locations of the borings and CPTs were determined by taping from existing site features indicated on the above-referenced existing conditions plan. Additionally, the existing ground surface elevation at each exploration location was determined by a level survey performed by our field staff utilizing vertical control information indicated on the existing conditions plan. Lastly, the borings and CPTs were performed under the provisions of the above-referenced SMP and HASP prepared by Loureiro.

Laboratory Testing

At the completion of the recent field work, soil samples were returned to our laboratory for more detailed classification, analysis and testing. The laboratory testing consisted of sieve analyses to determine the gradations and confirm the visual classifications of the fill material and natural alluvial deposit. Laboratory test procedures were in general accordance with applicable ASTM Standards. Results of the fill and alluvial deposit sieve analyses appear on **Figure 3** and **Figure 4**, respectively, following the text of this report.

Subsurface Conditions

A detailed description of the subsurface conditions encountered in the explorations is documented on the logs contained in the Appendices as described above. Based on the explorations performed at the site, the following is a description of the generalized subsurface conditions across the site encountered from ground surface downward.

Generalized Subsurface Strata	***Depth to Top of Strata (Feet)***	***Approximate Thickness (Feet)***
Fill	Under Surface Treatments	7 to 32
Alluvial Deposit	7	Not Encountered to 6
Marine Clay	13 to 32	26 to 50
Glacial Till	58 to 63	3 to 13
Bedrock	66 to 73	Not Applicable

The following are generalized descriptions of the subsurface strata that were encountered:

- **Fill** – Very loose to very dense, gray to brown, gravelly sand with some silt to well-graded mixture of silt, sand and gravel, also containing brick, wood, ash and cinders. Grain size distributions of samples of the fill are presented on the enclosed **Figure 3**. The fill within the eastern portion of the proposed building footprint was observed to vary from about 5 to 10 feet in thickness. Within the western portion of the proposed building, the fill was observed to vary from about 17 to 32 feet in thickness, which likely indicates the presence of former clay pits. It should be noted that in addition to the deleterious material observed within the fill deposit, larger debris could be present in areas where the former clay pits were filled in.

- **Alluvial Deposit** – Within boring MA-2, a 6-foot thick natural alluvial deposit was encountered underlying the fill at a depth of 7 feet. The alluvium consists of compact to very dense, light brown to gray, inorganic silt and fine sand. A grain size distribution of a sample of the alluvium is presented on the enclosed **Figure 4**. Although it cannot be definitively confirmed, the logs of CPT21-04 and 05, SCPT-03C and previous boring MW-1 suggest that the alluvial deposit may be present at these locations.

- **Marine Clay Deposit** – Firm to soft, gray silty clay varying to clay with some silt, also containing occasional fine sand partings. The clay deposit is moderately compressible.

- **Glacial Till Deposit** – Dense to very dense, gray, well-graded mixture of silt, sand and gravel, also containing clay, cobbles and boulders. Borings MA-1 and MA-2 penetrated the glacial till deposit where it was observed to be 13 and 3 feet thick, respectively. The CPTs and SCPT21-03C were terminated within what is assumed to be the glacial till deposit at depths of approximately 58 to 61 feet below the existing ground surface.

- **Bedrock** – Bedrock was encountered in borings MA-1 and MA-2 at depths of 73 and 66 feet below ground surface, respectively. Two NX-size rock cores were obtained from each of these borings. Descriptions of the rock cores are contained on the recent boring logs contained in **Appendix B**. Based on information obtained from the rock core samples, the bedrock deposit was observed to generally consist of a hard, slightly weathered to fresh, slightly fractured to sound, fine-grained, gray, Cambridge Argillite. The rock core recoveries of the recent bedrock samples ranged from 80 to 100 percent and the Rock Quality Designations (RQD) ranged from 62 to 72 percent, respectively.

- **Groundwater** – Groundwater was observed within the completed borings at depths of about 8 feet below ground surface. The groundwater level within the observation well installed in MA-3(OW) ranged from 8.4 to 8.7 feet below ground surface. Additionally, the groundwater level within previous monitoring well MW-2 was observed to be at a depth of 7.5 feet on May 24, 2021. Groundwater monitoring reports are contained in **Appendix E**. Monitoring well MW-1 was unable to be located. Pore pressure measurements collected during the CPTs indicated a groundwater surface (referenced as the “Assumed Phreatic Surface” in the Cone Penetration Test Summary Table contained in **Appendix C**) ranging from about 5 to 7.4 feet below the existing ground surface. It is anticipated that future groundwater levels across the site may vary from those reported herein due to factors such as normal seasonal changes, periods of heavy precipitation, and alterations of existing drainage patterns.

Foundation Design Recommendations

In summary, foundation support for the proposed building is recommended to be provided by spread footing foundations bearing on rigid inclusions, a type of ground improvement element, in conjunction with slab-on-grade construction. The rigid inclusions are recommended to be installed through the fill, alluvial, and/or marine clay deposits and be supported in the underlying glacial till deposit. The required plan area of proposed footings is recommended to be proportioned utilizing a maximum allowable design bearing pressure of 8.0 kips per square-foot (ksf). Note that the thickness of the proposed footings may need to be increased beyond standard design requirements to account for a high concentration of stresses acting on the bottom of the proposed footings from the RI elements.

Several other types of shallow, intermediate and deep foundations were considered for support of the proposed structure, including: 1) conventional footings bearing on the natural alluvial deposit and on aggregate piers in the vicinity of the former clay pits, 2) conventional footings bearing on rigid inclusions installed to a uniform depth of about 35 feet below ground surface, 3) driven precast prestressed concrete piles bearing in the glacial till or bedrock, and 4) drilled-in mini-piles bearing in the glacial till and/or bedrock. Options 1 and 2 were ruled out because of concerns regarding the total and/or differential settlement of the structure and because a lower bearing capacity would have required the footings to be larger. Option 3, the precast prestressed concrete piles, may have a similar cost to the selected deep RI option, however, the added cost for pile caps and grade beams may make this option less economically viable, and this approach would also involve noise and vibration impacts to abutters during pile installation. Lastly, Option 4, drilled mini-piles, is technically feasible and would have minimal noise and vibration impacts, however, it is not considered to be an economical option.

Specific foundation design recommendations for rigid inclusions, design requirements for the lowest level slab, and general foundation design recommendations are outlined below.

Rigid Inclusions

Rigid inclusions are constructed by driving or vibrating a hollow mandrel to the design depth and vertically ramming lifts of concrete using a specially designed tamper head and high-energy impact densification equipment to create a compacted concrete base. If required, the mandrel can be raised and lowered several times, vertically ramming lifts of concrete to create an expanded base. The rigid inclusion elements are typically installed in a grid pattern and are used in conjunction with an engineered granular pad (also referred to as a load transfer platform) to produce an intermediate foundation system for support of foundation loads. The type and thickness of the engineered pad is dependent on the design bearing pressure and is designed by the rigid inclusion design-build consultant. The design-build consultant should check that the structural design of the footings (i.e., one-way shear, two-way shear, moment, etc.) based on the footing dimensions and reinforcement as shown on the Contract Drawings prepared by the project structural engineer are adequate to resist the concentrated forces from the rigid inclusions acting on the bottom of the footings.

Since ground improvement techniques are provided by a design-build consultant, detailed design calculations should be submitted to the Architect and design team for review prior to the beginning of construction. A detailed explanation of the design parameters for capacity and settlement calculations should be included in the design submittal. The design submittal should also include a testing program to demonstrate the capacity of the elements. All calculations and drawings should be prepared and sealed by a Professional Engineer who is licensed in the Commonwealth of Massachusetts and retained by the Contractor who is to perform the work.

The following general criteria should be utilized in the design of rigid inclusions:

- Rigid inclusions should extend at least to the surface of the natural inorganic glacial till deposit.
- Estimated long-term settlement for footings should be less than 1-inch.
- Estimated long-term differential settlement of adjacent footings should be less than 1/2-inch.
- A minimum of one (1) modulus load test should be performed on a rigid inclusion to 150 percent of the maximum design stress to confirm the design parameters. The modulus load test set-up should include installation of a tell-tale to measure the movement at the tip of the element.

The design-build consultant will determine the layout of the rigid inclusions beneath the footings based on structural loads provided by the Project Structural Engineer. The rigid inclusion design calculations and layout submittal should be reviewed by McPhail and the Project Structural Engineer.

Slab Recommendations

We recommend that the lowest level slabs within the ground level non-parking areas such as the mechanical rooms and residential lobbies be designed as conventional soil-supported slabs-on-grade. In consideration of the presence of the former clay pits that have been backfilled with uncontrolled fill, it is recommended that a ground improvement technique, such as rigid inclusions or aggregate piers (APs), be utilized to minimize the potential for slab settlement. The slabs-on-grade should be underlain by a polyethylene vapor barrier spread over a minimum 6-inch thickness of ¾-inch crushed stone, which is underlain by filter fabric, such as Mirafi 140N or equivalent.

Based on information provided to us, it is understood that the proposed lowest level slabs will be located at or above the proposed exterior finished grades, therefore, perimeter and underslab foundation drainage are not considered necessary. All pits and depressions extending below the ground floor slab (i.e., elevator pits, etc.) should be provided with properly tied continuous waterstops in all construction joints and cementitious waterproofing to protect against groundwater intrusion.

Preparation of the subgrade for support of the at-grade, open air parking areas should include the removal of any existing surface treatments and proofrolling of the existing fill subgrade below the depth of the required base and subbase courses with at least four (4) passes of a 10-ton vibratory drum roller. All soft or compressible areas detected by the proofrolling should be excavated and replaced with a compacted, off-site gravel borrow.

General Foundation Recommendations

All foundations should be designed in accordance with the Code. Perimeter foundations and foundations below unheated areas (such as the open air parking areas) should be provided with a minimum 4-foot thickness of soil cover as frost protection. Foundations at heated interior locations should be located such that the top of the foundation concrete is a minimum of 6 inches below the underside of the lowest level slab.

Recommended minimum footing widths for continuous and isolated spread footings are 30 and 36 inches, respectively. All foundations should be located such that they are below a theoretical line drawn upward and outward at a 2 to 1 (horizontal to vertical) slope from the bottom exterior edge of all adjacent footings, structures and utilities, except within the areas where ground improvement is installed as indicated above.

Lateral forces can be transmitted from the structure to the soil by passive pressure on the below-grade walls, footings, and pile caps utilizing an equivalent fluid density of 120 pounds per cubic-foot providing that these structural elements are designed to resist these pressures. Lateral forces can also be considered to be transmitted from the structure to the soil by friction on the base of proposed footings using a frictional coefficient of 0.4, to which a factor of safety of 1.5 should be applied.

Below-grade foundation walls receiving lateral support at the top and bottom (i.e., restrained walls) should be designed for a lateral earth pressure corresponding to an equivalent fluid density of 60 pounds per cubic-foot. Similarly, drained cantilevered retaining walls, (i.e., receiving no lateral support at the top) should be designed for a lateral earth pressure corresponding to an equivalent fluid density of 40 pounds per cubic-foot. To these values must be added the pressures attributable to earthquake forces per Section 1610.2 of the Code.

Seismic Design Considerations

For the purposes of determining parameters for structural seismic design, including the use of the SCPT data, this site is a Site Class D as defined in Chapter 20 of American Society of Civil Engineers (ASCE) Standard 7-10 “Minimum Design Loads for Buildings and Other Structures”. Further, the bearing stratum on the proposed site is not considered to be subject to liquefaction during an earthquake based on the criterion of Section 1806.4 of the Code.

Foundation Construction Considerations

The primary construction considerations include removal of foundation remains of previous structures, vibrations associated with installation of the rigid inclusions, footing bearing surface preparation, construction dewatering, on-site soil reuse and off-site reuse and/or removal of excess excavated soil.

Removal of Foundation Remains of Previous Structures

The above-referenced Phase I ESA prepared by Loureiro documents that former structures and clay pits were likely present on-site. As such, the remains of the former structures, as well as miscellaneous debris used to backfill the clay pits, will likely be encountered during the excavation process and during the installation of ground improvement elements. These foundation remains most likely consist of concrete and brick walls, footings, slabs, mass concrete, cobble stone pavers, granite blocks, wood piles, and/or pile caps. Below grade obstructions which are observed to be non-deleterious (i.e., wood or other material which could decompose over time) may remain in-place where they don’t conflict with proposed structures provided that they are removed to 24 inches beneath the proposed finished grade or utility elevations.

Given these types of potential obstructions within the existing fill deposit, it is recommended that an allowance be included for pre-augering at RI locations and/or excavation to remove obstructions. If substantial foundation remains are encountered, bulk pre-excavation may be required to remove obstructions prior to the RI installation. Excavations performed to remove obstructions should be backfilled with the excavated soil after all oversized material and foundation remains have been removed. Soil used as backfill should be placed in approximate 1-foot thick lifts and thoroughly tamped with the excavator bucket. Organic material, if encountered within the pre-excavation, should not be reused as backfill.

Vibration Monitoring

It is not anticipated that ground vibrations caused by the RI installation will cause damage to nearby structures, however, the magnitude of vibrations may be of sufficient magnitude to cause cosmetic cracking of adjacent structures and annoyance to building occupants. Due to the proximity of the adjacent buildings, it is recommended that the Owner or Contractor perform a preconstruction survey of the adjacent buildings before the start of construction. This information would be useful in documenting previously existing problems with regard to responding to third-party claims.

It is recommended that the maximum allowable peak particle velocity (i.e., vibration level) adjacent to the above-grade existing buildings be limited to 2.0 inches-per-second (ips) above a frequency of 40 Hz, 1.5 ips between 30 Hz and 40 Hz, 1.0 ips between 20 Hz and 30 Hz, and 0.5 ips below 20 Hz. These criteria are intended to reduce the probability of structural damage to the adjacent structures to within generally acceptable levels. It is recommended that vibration monitoring with seismographs be performed by McPhail during the RI installation.

Preparation of Footing Bearing Surfaces

All footing bearing surfaces should be excavated with a backhoe bucket which has either a smooth, toothless cutting edge, or a steel plate welded across the teeth to maintain the excavated bearing stratum in an undisturbed condition. Further, it is recommended that as soon as footing bearing surfaces are exposed, they be immediately covered with a 6-inch thickness of 3/4-inch crushed stone to prevent disturbance of the footing subgrade during subsequent forming operations. Note that footings that bear on rigid inclusions may require more than 6 inches of crushed stone beneath them depending on the submitted design.

Construction Dewatering

Based on the soil and groundwater conditions encountered in the subsurface explorations, groundwater may be encountered during construction of the elevator pits and/or and utility installation. It is anticipated that groundwater can generally be controlled using conventional sumping in combination with strategic use of trenches. It is recommended that all pumped water be recharged on-site to avoid the necessity of obtaining the required permits to perform off-site discharge.

On-site Soil Reuse and Off-Site Removal of Excess Excavated Soil

It is anticipated that portions of the excavated fill may be reused on-site as structural fill within the building footprint, to raise the grade below paved areas and as ordinary fill outside the building footprint provided that the fill is maintained in a dry condition and can be properly compacted. Therefore, it is recommended that stockpiles of excavated soil intended for reuse be protected against increases in moisture content by securely covering the stockpiles at all times when they are not in use. The placement and compaction of fill should be completed during relatively dry and non-freezing conditions. It is recommended that all debris, brick and concrete, and all cobbles measured 4 inches or greater should be culled out prior to the placement of on-site fill. If, due to any of the above conditions, the excavated material is unsuitable for reuse, an off-site fill should be used. The off-site fill should consist of an off-site well-graded, natural sand and gravel containing less than 8 percent passing the No. 200 sieve.

It is currently anticipated that excess soil will be generated from the proposed construction which will require off-site removal. Details regarding the off-site removal of soils will be presented in the Soil Management Plan to be prepared by Loureiro.

Final Comments

McPhail has been retained to provide design assistance during the design phase of this project. The purpose of this involvement is to review the structural foundation drawings and foundation notes for conformance with the recommendations presented herein and to prepare the earthwork and ground improvement specification sections for inclusion into the Contract Documents for construction.

It is recommended that McPhail be retained to observe the installation of rigid inclusions, preparation of footing and slab subgrades, placement and compaction of fill material, and to perform vibration monitoring during rigid inclusion installation. Our involvement during the construction phase of the work should minimize costly delays due to unanticipated field problems since our field engineer would be under the direct supervision of our project manager who was responsible for the subsurface exploration program and foundation design recommendations documented herein.

We trust that the above is sufficient for your present requirements. Should you have any questions concerning the recommendations presented herein, please do not hesitate to call us.

Very truly yours,

McPHAIL ASSOCIATES, LLC

John A Erikson

John A. Erikson, P.E.

Jonathan W Patch

Jonathan W. Patch, P.E.

\\McPhail-fs2\McPhail\Working Documents\Reports\7160_WaldenSquareAptsCambridge_FER_052721.docx
JWP/jae

FIGURE 1

McPHAIL ASSOCIATES, LLC
Geotechnical and
Geoenvironmental Engineers
2269 Massachusetts Avenue
Cambridge, MA 02140
617/868-1420
617/868-1423 (Fax)
www.mcphailgeo.com

N

SCALE 1:25,000

PROJECT LOCATION PLAN

WALDEN SQUARE APARTMENTS

CAMBRIDGE MASSACHUSETTS

LEGEND

- — APPROXIMATE LOCATION OF BORING PERFORMED BY SEABOARD DRILLING FROM MARCH 24-26 AND MARCH 30, 2021 FOR McPHAIL ASSOCIATES, LLC
- — APPROXIMATE LOCATION OF CONE PENETRATION TEST (CPT) OR SEISMIC CONE PENETRATION TEST (SCPT) PERFORMED BY CONETEC ON MARCH 17, 2021 FOR McPHAIL ASSOCIATES, LLC
- — APPROXIMATE LOCATION OF BORING PERFORMED IN 1997 BY OTHERS

(OW) — INDICATES OBSERVATION WELL INSTALLED WITHIN COMPLETED BOREHOLE

REFERENCE: THIS PLAN WAS PREPARED FROM A 40-SCALE DRAWING ENTITLED, "EXISTING CONDITIONS PLAN OF LAND" DATED FEBRUARY 25, 2021 PREPARED BY VHB AND A 40-SCALE DRAWING ENTITLED, "OVERALL SITE PLAN" DATED MARCH 11, 2021 PREPARED BY VHB

GRAPHIC SCALE

20 0 20 40 80

McPHAIL
ASSOCIATES, LLC
Geotechnical and
Geoenvironmental Engineers
2269 Massachusetts Avenue
Cambridge, MA 02140
617/868-1420
617/868-1423 (Fax)
www.mcphailgeo.com

WALDEN SQUARE APARTMENTS

CAMBRIDGE MASSACHUSETTS

SUBSURFACE EXPLORATION PLAN

FOR

WINN COMPANIES

BY

McPHAIL ASSOCIATES, LLC

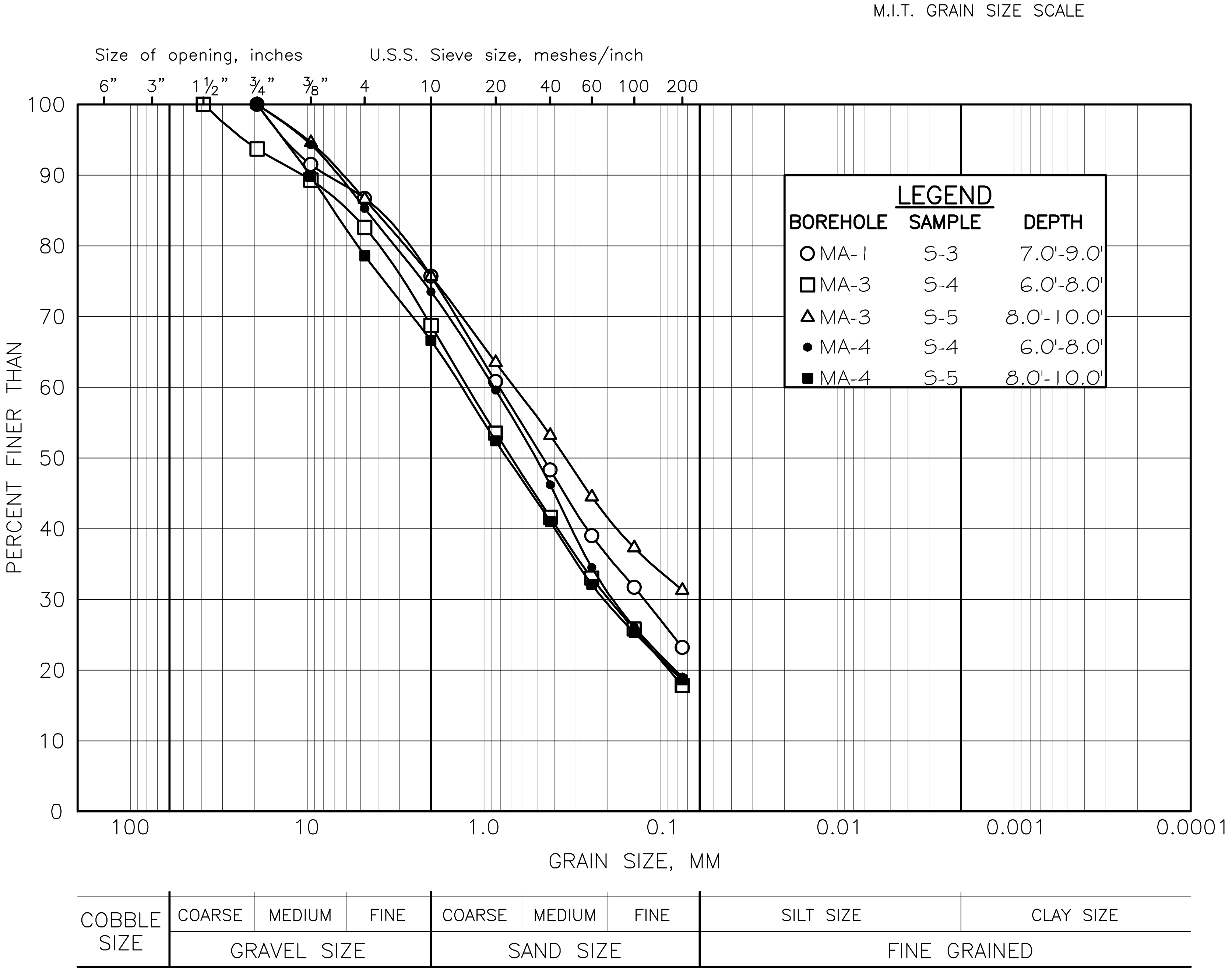
Date: MAY 2021
Dwn: M.B.S.
Chkd: J.W.P.
Scale: 1" = 20'
Project No: 7160
FIGURE 2

FILE NAME: N:\Acad\JOBS\7160\7160-F02.dwg

FILE NAME: \\mcphail-fs2\mcphail\Acad\JOBS\7160\7160-F03_Sieve.dwg

PROJECT No. 7160

McPHAIL ASSOCIATES, LLC



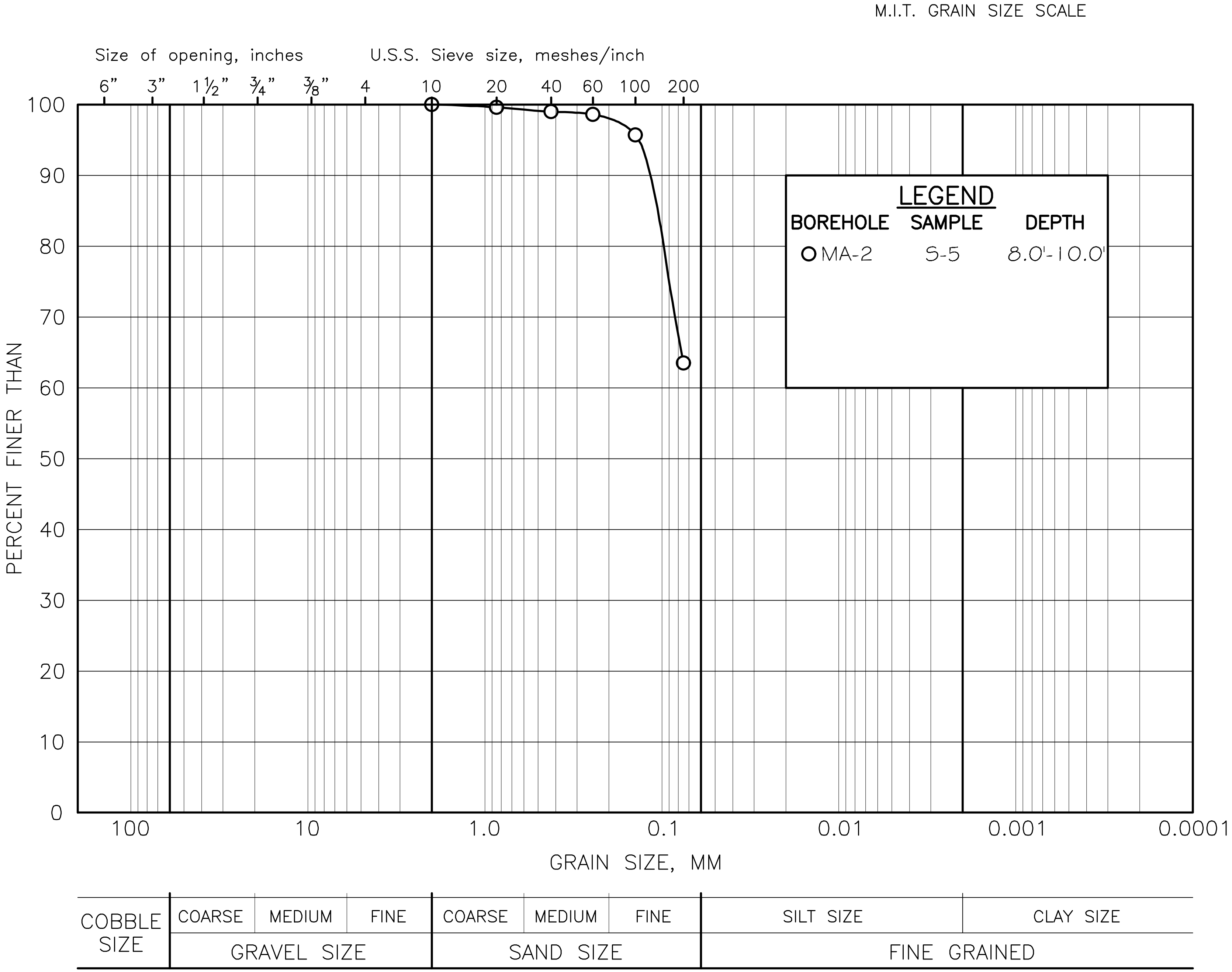
GRAIN SIZE DISTRIBUTION
FILL

FIGURE 3

FILE NAME: \\mcphail-fs2\mcphail\Acad\JOBS\7160\7160-F04_Sieve.dwg

PROJECT No. 7160

McPHAIL ASSOCIATES, LLC



GRAIN SIZE DISTRIBUTION
ALLUVIUM

FIGURE 4

APPENDIX A:

LIMITATIONS

LIMITATIONS

This report has been prepared on behalf of and for the exclusive use of Winn Companies for specific application to the proposed building to be located at 21 Walden Square Road in Cambridge, Massachusetts in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, expressed or implied, is made.

In the event that any changes in nature or design of the proposed construction are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by McPhail Associates, LLC.

The analyses and recommendations presented in this report are based upon the data obtained from the subsurface explorations performed at the approximate locations indicated on the enclosed plan. If variations in the nature and extent of subsurface conditions between the widely spaced explorations become evident during the course of construction, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

APPENDIX B:

BORING LOGS PREPARED BY MCPHAIL ASSOCIATES, LLC

Project:	Walden Square Apartments	**Job #:**	7160.2.T1
Location:		**Date Started:**	3-26-21
City/State:	Cambridge, MA	**Date Finished:**	3-30-21

Boring No.
MA-1

Contractor:	Seaboard Drilling	**Casing Type:**	4"
Driller/Helper:	Mike/ Ben	**Casing Hammer (lbs)/Drop (in):**	300lb/24in
Logged By/Reviewed By:	JDM	**Sampler Size/Type:**	2' Split Spoon
Surface Elevation (ft):	24.1	**Sampler Hammer (lbs)/Drop (in):**	140lb/30in

Groundwater Observations

Date	Depth	Elev.	Notes

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" Min/ft	Sample Description and Boring Notes
			0.5 / 23.6	ASPHALT						
1	23				136	S1	24/16	0.5-2.5	98 38 98 100/4"	Very dense, black, SILT and SAND and GRAVEL, w/ brick. (Fill)
2	22									
3	21									
4	20									
5	19				9	S2	24/8	5.0-7.0	4 4 5 4	Loose, black, SAND, some gravel and silt, w/ brick. (Fill)
6	18									
7	17				6	S3	24/6	7.0-9.0	3 3 3 2	Loose, black, SAND, some gravel and silt. (Fill)
8	16									
9	15			FILL						
10	14				13	S4	24/2	10.0-12.0	5 6 7 7	Stiff, gray, SILTY CLAY, w/ brick. (Fill)
11	13									
12	12									
13	11									
14	10									
15	9				13	S5	24/8	15.0-17.0	6 6 7 6	Stiff, gray, SILTY CLAY, some gravel, w/ brick and wood. (Fill)
16	8		17.0 / 7.1							
17	7									
18	6									
19	5									
20	4			MARINE CLAY	4	S6	24/24	20.0-22.0	2 2 2 2	Soft to firm, gray, CLAY, some silt. (Marine Clay)
21	3									
22	2									

GRANULAR SOILS

BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS

BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project: Walden Square Apartments
Location:
City/State: Cambridge, MA

Job #: 7160.2.T1
Date Started: 3-26-21
Date Finished: 3-30-21

Boring No.

MA-1

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 24.1

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes
					N-Value RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" Min/ft	
24	0	▨								
25	-1				2	S7	24/18	25.0-27.0	5 1 1 2	Soft, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
26	-2									
27	-3									
28	-4									
29	-5									
30	-6				2	S8	24/24	30.0-32.0	WoH/12" 3 2	Soft, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
31	-7									
32	-8									
33	-9									
34	-10			MARINE CLAY						
35	-11				10	S9	24/24	35.0-37.0	3 5 5 6	Stiff, gray, CLAY, some silt. (Marine Clay)
36	-12									
37	-13									
38	-14									
39	-15									
40	-16				8	S10	24/24	40.0-42.0	5 4 4 7	Firm to stiff, gray, SILTY CLAY, w/ occasional fine sand partings. (Marine Clay)
41	-17									
42	-18									
43	-19									
44	-20									
45	-21									Soft to firm, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Walden Square Apartments	**Job #:**	7160.2.T1	Boring No.
Location:		**Date Started:**	3-26-21	**MA-1**
City/State:	Cambridge, MA	**Date Finished:**	3-30-21	

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 24.1

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" / Min/ft	Sample Description and Boring Notes
					4	S11	24/24	45.0-47.0	4 2 2 8	
47	-23									
48	-24									
49	-25									
50	-26				2	S12	24/12	50.0-52.0	2 1 1 2	Soft, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
51	-27									
52	-28									
53	-29			MARINE CLAY						
54	-30									
55	-31				2	S13	24/24	55.0-57.0	WoH/12" 3 2	Soft, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
56	-32									
57	-33									
58	-34									
59	-35		60.0 / -35.9							
60	-36				76	S14	24/6	60.0-62.0	24 34 42 54	Very dense, gray, SAND and SILT and GRAVEL. (Glacial Till)
61	-37									
62	-38									
63	-39									
64	-40			GLACIAL TILL						
65	-41				39	S15	24/2	65.0-67.0	38 23 16 16	Dense, gray, GRAVEL, some sand and silt. (Glacial Till)
66	-42									
67	-43									
68	-44									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project: Walden Square Apartments
Location:
City/State: Cambridge, MA

Job #: 7160.2.T1
Date Started: 3-26-21
Date Finished: 3-30-21

Boring No.

MA-1

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 24.1

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
70	-46			GLACIAL TILL	128	S16	24/6	70.0-72.0	35 52 76 64	Very dense, gray, SAND and SILT and GRAVEL. (Glacial Till)
71	-47									
72	-48									
73	-49		73.0 / -48.9	WEATHERED BEDROCK						
74	-50									
75	-51		75.0 / -50.9	BEDROCK	RQD: 38/60 % RQD: 63%	RC1	60/Rec: 50/60 % Rec: 83%	75.0-80.0		Hard, slightly weathered to fresh, slightly fractured to sound, gray, fine grained CAMBRIDGE ARGILLITE, with close to moderately closefractures, tight joints, low angle bedding, and calcite fillings. Time intervals (min.): 9 - 12 - 10 - 6 - 6.
76	-52									
77	-53									
78	-54									
79	-55									
80	-56				RQD: 40/60 % RQD: 66%	RC2	60/Rec: 60/60 % Rec: 100%	80.0-85.0		Hard, slightly weathered to fresh, slightly fractured to sound, gray, fine grained CAMBRIDGE ARGILLITE, with close to moderately close fractures, tight joints, low angle bedding, and calcite fillings. Time intervals (min.): 5.5 - 5 - 6 - 6 - 6.
81	-57									
82	-58									
83	-59									
84	-60									
85	-61		85.0 / -60.9	Bottom of borehole 85 feet below ground surface.						
86	-62									
87	-63									
88	-64									
89	-65									
90	-66									
91	-67									

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project: Walden Square Apartments
Location:
City/State: Cambridge, MA

Job #: 7160.2.T1
Date Started: 3-24-21
Date Finished: 3-24-21

Boring No.
MA-2

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 27.4

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes
3-24-21	8	19.4	

Depth (ft): 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22

Elev. (ft): 27, 26, 25, 24, 23, 22, 21, 20, 19, 18, 17, 16, 15, 14, 13, 12, 11, 10, 9, 8, 7, 6, 5

Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" / Min/ft	Sample Description and Boring Notes
0.5 / 26.9	ASPHALT						
	FILL	171/11"	S1	18/3	0.5-2.0	71 100/5"	Very dense, brown, SAND and GRAVEL, trace silt. (Fill)
		61	S2	24/12	2.0-4.0	41 41 20 39	Very dense, brown, SAND and GRAVEL, trace silt, w/ brick. (Fill)
		177/7"	S3	24/6	4.0-6.0	77 100/1"	Very dense, brown, SAND and GRAVEL, trace silt, w/ brick. (Fill)
7.0 / 20.4		18	S4	12/8	6.0-7.0	11 7	Compact, brown, SAND and GRAVEL, some silt, w/ brick. (Fill)
	ALLUVIUM DEPOSIT	34	S4A	12/8	7.0-8.0	18 16	Dense, light brown to gray, SILT, trace fine sand. (Alluvium)
		60	S5	24/12	8.0-10.0	16 18 42 39	Very dense, light brown, SILT, trace fine sand. (Alluvium)
		26	S6	24/12	10.0-12.0	13 14 12 16	Compact, light brown to gray, SILT, trace fine SAND. (Alluvium)
13.0 / 14.4							
	MARINE CLAY	5	S7	24/24	15.0-17.0	2 2 3 3	Firm, gray, SILTY CLAY, w/ occasional fine sand partings. (Marine Clay)
		2	S8	24/24	20.0-22.0	1 1 1 2	Very soft to soft, gray, SILTY CLAY, w/ occasional fine sand partings. (Marine Clay)

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

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2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project: Walden Square Apartments
Location:
City/State: Cambridge, MA

Job #: 7160.2.T1
Date Started: 3-24-21
Date Finished: 3-24-21

Boring No.
MA-2

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 27.4

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes
3-24-21	8	19.4	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
	4	▨		MARINE CLAY						
24	3	▨								
25	2	▨			5	S9	24/24	25.0-27.0	2 2 3 4	Firm, gray, SILTY CLAY, w/ occasional fine sand partings. (Marine Clay)
26	1	▨								
27	0	▨								
28	-1	▨								
29	-2	▨								
30	-3	▨			11	S10	24/8	30.0-32.0	2 5 6 8	Stiff, gray, CLAY, some gravel and silt. (Marine Clay)
31	-4	▨								
32	-5	▨								
33	-6	▨								
34	-7	▨								
35	-8	▨			11	S11	24/24	35.0-37.0	6 5 6 5	Stiff, gray, CLAY, some silt. (Marine Clay)
36	-9	▨								
37	-10	▨								
38	-11	▨								
39	-12	▨								
40	-13	▨			7	S12	24/24	40.0-42.0	2 3 4 4	Firm, gray, SILTY CLAY, w/ occasional fine sand partings. (Marine Clay)
41	-14	▨								
42	-15	▨								
43	-16	▨								
44	-17	▨								
45	-18	▨								Firm, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project: Walden Square Apartments
Location:
City/State: Cambridge, MA

Job #: 7160.2.T1
Date Started: 3-24-21
Date Finished: 3-24-21

Boring No.
MA-2

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 27.4

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes
3-24-21	8	19.4	

Depth (ft): 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68

Elev. (ft): -19 -20 -21 -22 -23 -24 -25 -26 -27 -28 -29 -30 -31 -32 -33 -34 -35 -36 -37 -38 -39 -40 -41

Symbol	Depth/EL to Strata Change (ft)	Stratum
▨	63.0 / -35.6	MARINE CLAY
▨	66.0 / -38.6	GLACIAL TILL
▨		BEDROCK

Sample N-Value / RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" / Min/ft	Sample Description and Boring Notes
6	S13	24/24	45.0-47.0	3 3 3 7	
4	S14	24/24	50.0-52.0	2 1 3 3	Soft to firm, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
13	S15	24/24	55.0-57.0	4 6 7 3	Stiff, gray, CLAY, some silt, w/ occasional fine sand partings. (Marine Clay)
16	S16	24/18	60.0-62.0	2 7 9 9	Very stiff, gray, CLAY, some sand and gravel and silt. (Marine Clay) Transition to Glacial Till
158/10"	S17	24/2	65.0-67.0	58 100/4"	Very dense, gray, GRAVEL, some sand and silt. (Glacial Till) Split spoon refusal on suspected bedrock. Roller Bit into rock to 68' to confirm.

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Walden Square Apartments	**Job #:**	7160.2.T1
Location:		**Date Started:**	3-24-21
City/State:	Cambridge, MA	**Date Finished:**	3-24-21

Boring No.
MA-2

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 27.4

Casing Type: 4"
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations			
Date	Depth	Elev.	Notes
3-24-21	8	19.4	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value / RQD	Sample No.	Sample Pen. /Rec. (in)	Sample Depth (ft)	Sample Blows/6" / Min/ft	Sample Description and Boring Notes
70 71 72	-42 -43 -44 -45	▨		BEDROCK	RQD: 43/60 % RQD: 72%	RC1	60/Rec: 50/60 % Rec: 83%	68.0-73.0		Hard, slightly weathered to fresh, slightly fractured to sound, gray, fine grained CAMBRIDGE ARGILLITE, with close fractures, tight joints, high angle bedding, and calcite fillings. Time intervals (min.): 8.5 - 6.5 - 5 - 6 - 5.5.
73 74 75 76 77	-46 -47 -48 -49 -50	▨	78.0 / -50.6		RQD: 37/60 % RQD: 62%	RC2	60/Rec: 48/60 % Rec: 80%	73.0-78.0		Hard, slightly weathered to fresh, slightly fractured to sound, gray, fine grained CAMBRIDGE ARGILLITE, with close fractures, tight joints, high angle bedding, and calcite fillings. Time intervals (min.): 10 - 4.5 - 4.5 - 5 - 8. Core barrel jammed several times during first foot of second run.
78 79 80 81 82 83 84 85 86 87 88 89 90 91	-51 -52 -53 -54 -55 -56 -57 -58 -59 -60 -61 -62 -63 -64			Bottom of borehole 78 feet below ground surface.						

GRANULAR SOILS	
BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS	
BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Walden Square Apartments	**Job #:**	7160.2.T1
Location:		**Date Started:**	3-24-21
City/State:	Cambridge, MA	**Date Finished:**	3-25-21

Boring No.

MA-3 (OW)

Contractor:	Seaboard Drilling	**Casing Type:**	HSA
Driller/Helper:	Mike/ Ben	**Casing Hammer (lbs)/Drop (in):**	300lb/24in
Logged By/Reviewed By:	JDM	**Sampler Size/Type:**	2' Split Spoon
Surface Elevation (ft):	25.2	**Sampler Hammer (lbs)/Drop (in):**	140lb/30in

Groundwater Observations

Date	Depth	Elev.	Notes
3-24-21	8.52	16.7	
3-25-21	8.52	16.7	
3-26-21	8.40	16.8	
3-30-21	8.70	16.5	

Depth (ft)	Elev. (ft)	Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample					Sample Description and Boring Notes
					N-Value RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" Min/ft	
	25		0.5 / 24.7	ASPHALT						
1	24	▨			40	S1	24/10	0.5-2.5	19 17 23 30	Dense, gray, SILTY SAND, trace gravel and clay, w/ brick. (Fill)
2	23	▨								
3	22	▨			100/3"	S2	18/2	2.5-4.0	100/3"	Very dense, gray-brown, SAND and GRAVEL, some silt, w/ brick. (Fill)
4	21	▨			21	S3	24/14	4.0-6.0	9 11 10 14	Compact, gray-brown, SAND, some gravel, trace silt, to gray, SILTY CLAY, some gravel, w/ ash&cinders. (Fill)
5	20	▨								
6	19	▨			31	S4	24/8	6.0-8.0	18 16 15 13	Dense, gray-brown, GRAVELLY SAND, some silt, w/ ash&cinders. (Fill)
7	18	▨								
8	17	▨			5	S5	24/10	8.0-10.0	4 2 3 4	Loose, gray-brown to brown, GRAVELLY SILTY SAND, trace clay, w/ ash&cinders and wood. (Fill)
9	16	▨		FILL						
10	15	▨			8	S6	24/8	10.0-12.0	2 3 5 6	Loose, gray, SILTY SAND, some gravel, trace clay, w/ ash&cinders. (Fill)
11	14	▨								
12	13	▨								
13	12	▨								
14	11	▨								
15	10	▨			3	S7	24/8	15.0-17.0	1 1 2 1	Very loose, gray, SAND, some gravel, w/ ash&cinders. (Fill)
16	9	▨	17.0 / 8.2							
17	8			Bottom of borehole 17 feet below ground surface.						
18	7									
19	6									
20	5									
21	4									
22	3									

GRANULAR SOILS

BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS

BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer. Well installed at 15'. 10' screen, 5' riser.

Weather:

McPHAIL ASSOCIATES, LLC

McPHAIL ASSOCIATES, LLC
2269 MASSACHUSETTS AVENUE
CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

Project:	Walden Square Apartments	**Job #:**	7160.2.T1	Boring No.
Location:		**Date Started:**	3-24-21	**MA-4**
City/State:	Cambridge, MA	**Date Finished:**	3-24-21	

Contractor: Seaboard Drilling
Driller/Helper: Mike/ Ben
Logged By/Reviewed By: JDM
Surface Elevation (ft): 24.0
Casing Type: HSA
Casing Hammer (lbs)/Drop (in): 300lb/24in
Sampler Size/Type: 2' Split Spoon
Sampler Hammer (lbs)/Drop (in): 140lb/30in

Groundwater Observations

Date	Depth	Elev.	Notes
3-24-21	8	16.0	

Depth (ft)	Elev. (ft)
1	23
2	22
3	21
4	20
5	19
6	18
7	17
8	16
9	15
10	14
11	13
12	12
13	11
14	10
15	9
16	8
17	7
18	6
19	5
20	4
21	3
22	2

Symbol	Depth/EL to Strata Change (ft)	Stratum	Sample N-Value RQD	No.	Pen. /Rec. (in)	Depth (ft)	Blows/6" Min/ft	Sample Description and Boring Notes
	0.5 / 23.5	ASPHALT						
▨		FILL	46	S1	24/3	0.5-2.5	37 26 20 17	Dense, gray, SAND and GRAVEL, some silt. (Fill)
▨			26	S2	18/8	2.5-4.0	12 14 12	Compact, brown, SILTY SAND, some gravel and clay, w/ brick. (Fill)
▨			13	S3	24/6	4.0-6.0	11 7 6 5	Compact, gray-brown, SILTY SAND, some gravel, w/ ash&cinders. (Fill)
▨			10	S4	24/8	6.0-8.0	7 5 5 6	Loose to compact, gray-brown, GRAVELLY SILTY SAND, w/ ash&cinders. (Fill)
▨	10.0 / 14.0		8	S5	24/10	8.0-10.0	7 4 4 5	Loose, gray-brown, GRAVELLY SILTY SAND, w/ ash&cinders. (Fill)
		Bottom of borehole 10 feet below ground surface.						

GRANULAR SOILS

BLOWS/FT.	DENSITY
0-4	V.LOOSE
4-10	LOOSE
10-30	COMPACT
30-50	DENSE
>50	V.DENSE

COHESIVE SOILS

BLOWS/FT.	CONSISTENCY
<2	V.SOFT
2-4	SOFT
4-8	FIRM
8-15	STIFF
15-30	V.STIFF
>30	HARD

SOIL COMPONENT

DESCRIPTIVE TERM	PROPORTION OF TOTAL
"TRACE"	0-10%
"SOME"	10-20%
"ADJECTIVE" (eg SANDY, SILTY)	20-35%
"AND"	35-50%

SOIL CONTAINING THREE COMPONENTS EACH OF WHICH COMPRISE AT LEAST 25% OF THE TOTAL ARE CLASSIFIED AS "A WELL-GRADED MIXTURE OF"

Notes:
Safety Hammer

Weather:

McPHAIL ASSOCIATES, LLC
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CAMBRIDGE, MA 02140
TEL: 617-868-1420
FAX: 617-868-1423

APPENDIX C:

CPT DATA PREPARED BY CONETEC INC.

PRESENTATION OF SITE INVESTIGATION RESULTS

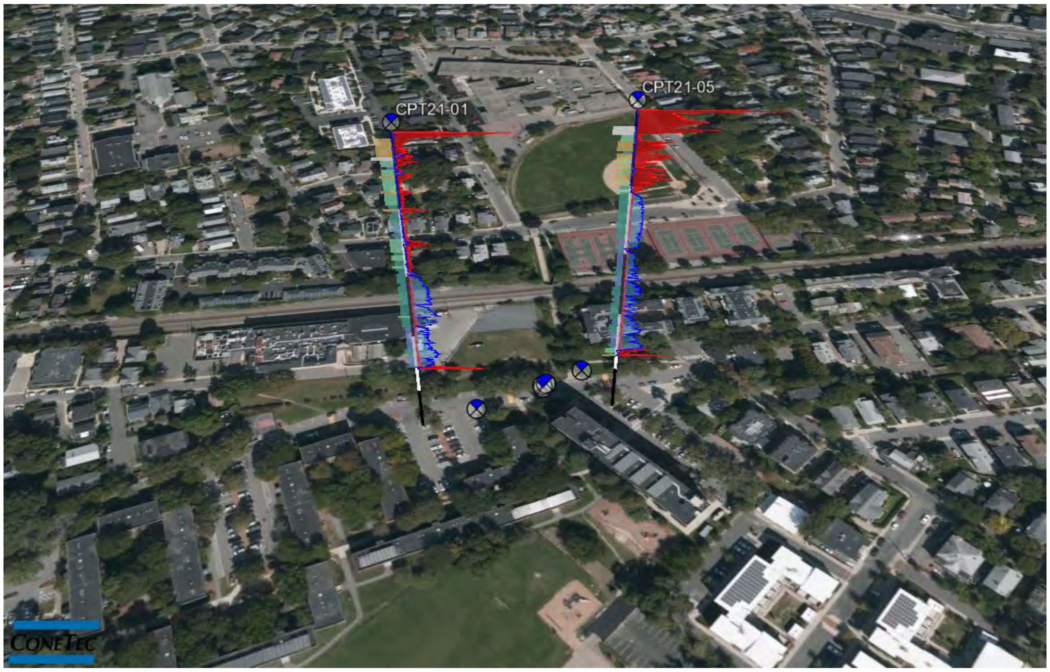
Walden Square Apartments
Cambridge, Massachusetts

Prepared for:

McPhail Associates

ConeTec Job No: 21-53-22085

Project Start Date: 17-Mar-2021
Project End Date: 17-Mar-2021
Report Date: 5-Apr-2021



Prepared by:

ConeTec Inc.
436 Commerce Lane, Unit C
West Berlin, NJ 08091

Tel: (856) 767-8600
Toll Free: (800) 504-1116

Email: conetecNJ@conetec.com
www.conetec.com
www.conetecdataservices.com

Introduction

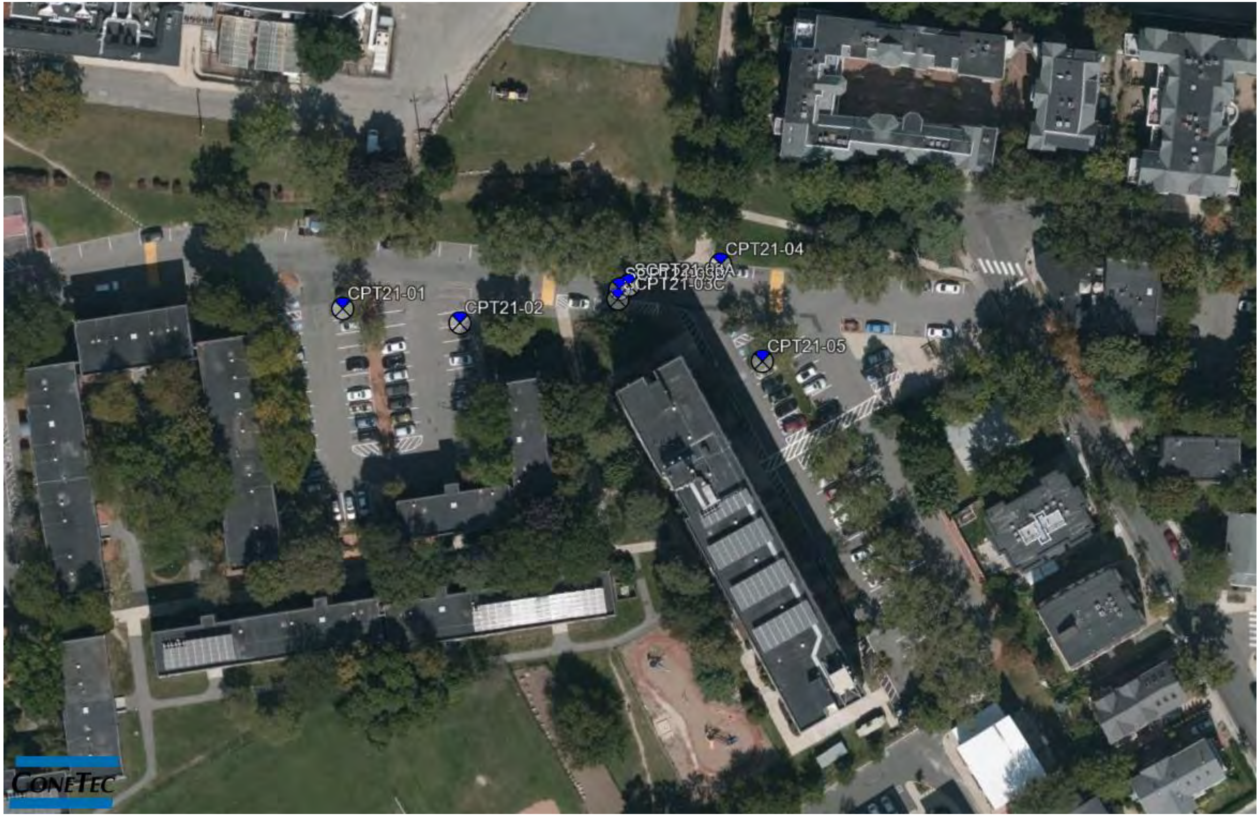
The enclosed report presents the results of a piezocone penetration testing (CPTu or CPT) and seismic piezocone penetration testing (SCPTu or SCPT) program carried out for the Walden Square Apartments located in Cambridge, Massachusetts. The site investigation program was conducted by ConeTec Inc. (ConeTec), under contract to McPhail Associates of Cambridge, Massachusetts.

A total of 4 cone penetration tests and 4 seismic cone penetration tests were completed at 5 locations (SCPT21-03 was attempted four times due to shallow refusal). The CPT and SCPT program was performed to evaluate the subsurface soil conditions. CPT and SCPT sounding locations were selected and numbered under supervision of McPhail Associates personnel (Tom Cormican).

Project Information

Project	
Client	McPhail Associates
Project	Walden Square Apartments, Cambridge, MA
ConeTec project number	21-53-22085

A map from CESIUM including the CPT and SCPT test locations is presented below.



Rig Description	Deployment System	Test Type
CPT Truck Rig	25 ton truck mounted (twin cylinders)	CPT and SCPT

Coordinates		
Test Type	Collection Method	EPSG Number
CPT and SCPT	GPS (GlobalSat MR-350)	32619 (WGS 84 / UTM North)

Cone Penetration Test (CPT)	
Depth reference	Ground surface at the time of the investigation.
Tip and sleeve data offset	0.1 meter. This has been accounted for in the CPT data files.
Pore pressure dissipation (PPD) tests	Three pore pressure dissipation tests were completed primarily to determine the phreatic surface and consolidation characteristics.
Additional plots	Advanced, Seismic and Soil Behavior Type (SBT) scatter plots are included in the data release package.

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
597:T1500F15U35	597	15	225	1500	15	35
Cone 597 was used for each sounding.						

Calculated Geotechnical Parameters Tables	
Additional information	The Normalized Soil Behavior Type Chart based on Q_{tn} (SBT Qtn) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPT parameters have been generated and are provided in Excel format files in the release folder. The CPT parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behavior type zones and the assumed equilibrium pore pressure profile. Soils were classified as either drained or undrained based on the Q_{tn} Normalized Soil Behavior Type Chart (Robertson, 2009). Calculations for both drained and undrained parameters were included for materials that classified as silt mixtures (zone 4).

Limitations

This report has been prepared for the exclusive use of McPhail Associates (Client) for the project titled “Walden Square Apartments, Cambridge, MA”. The report’s contents may not be relied upon by any other party without the express written permission of ConeTec. ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum 16 bit resolution down hole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 mm diameter over a length of 32 mm with tapered leading and trailing edges) located at a distance of 585 mm above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is 6 mm thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meet or exceed those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

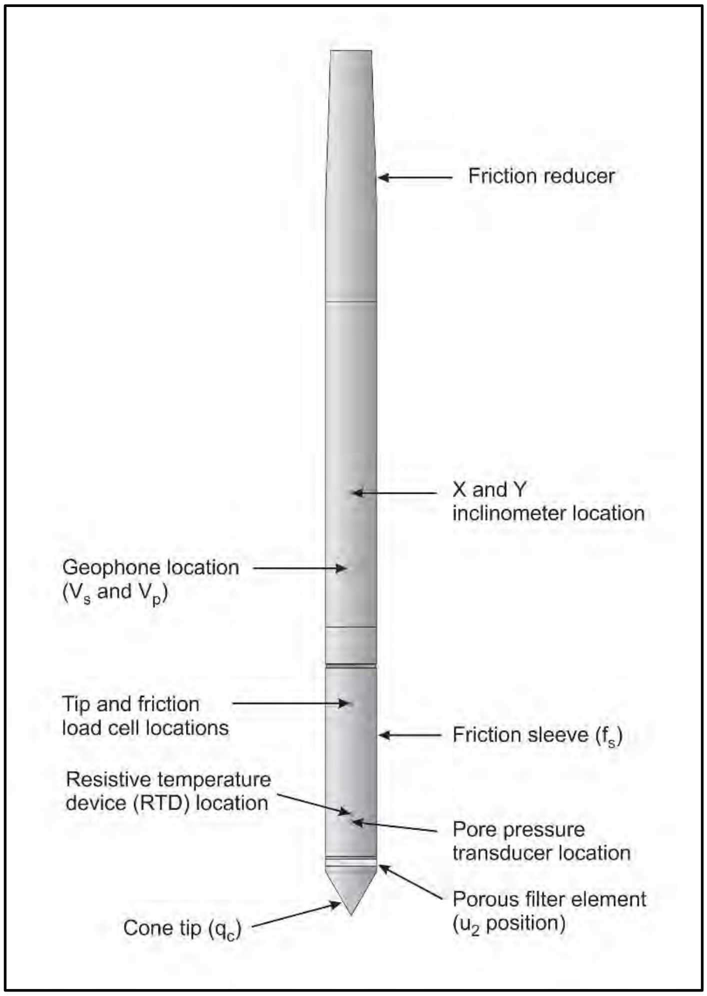


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal interface box and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 cm; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPT operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with either glycerin or silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of 2 cm/s, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson et al. (1986) and Robertson (1990, 2009). It should be noted that it is not always possible to accurately identify a soil behavior type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al. (1986):

$$q_t = q_c + (1-a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (Rf) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of files with calculated geotechnical parameters were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the methods used is also included in the data release folder.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

References

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM, West Conshohocken, US.

Lunne, T., Robertson, P.K. and Powell, J. J. M., 1997, “Cone Penetration Testing in Geotechnical Practice”, Blackie Academic and Professional.

Mayne, P.W., 2013, “Evaluating yield stress of soils from laboratory consolidation and in-situ cone penetration tests”, Sound Geotechnical Research to Practice (Holtz Volume) GSP 230, ASCE, Reston/VA: 406-420.

Mayne, P.W. and Peuchen, J., 2012, “Unit weight trends with cone resistance in soft to firm clays”, Geotechnical and Geophysical Site Characterization *4,* Vol. 1 (Proc. ISC-4, Pernambuco), CRC Press, London: 903-910.

Mayne, P.W., 2014, “Interpretation of geotechnical parameters from seismic piezocone tests”, CPT’14 Keynote Address, Las Vegas, NV, May 2014.

Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, “Use of Piezometer Cone Data”, Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.

Robertson, P.K., 1990, “Soil Classification Using the Cone Penetration Test”, Canadian Geotechnical Journal, Volume 27: 151-158.

Robertson, P.K., 2009, “Interpretation of cone penetration tests – a unified approach”, Canadian Geotechnical Journal, Volume 46: 1337-1355.

Shear wave velocity (Vs) testing is performed in conjunction with the piezocone penetration test (SCPTu) in order to collect interval velocities. For some projects seismic compression wave velocity (Vp) testing is also performed.

ConeTec's piezocone penetrometers are manufactured with one horizontally active geophone (28 hertz) and one vertically active geophone (28 hertz). Both geophones are rigidly mounted in the body of the cone penetrometer, 0.2 meters behind the cone tip. The vertically mounted geophone is more sensitive to compression waves.

Shear waves are typically generated by using an impact hammer horizontally striking a beam that is held in place by a normal load. In some instances an auger source or an imbedded impulsive source maybe used for both shear waves and compression waves. The hammer and beam act as a contact trigger that initiates the recording of the seismic wave traces. For impulsive devices an accelerometer trigger may be used. The traces are recorded in the memory of the cone using a fast analog to digital converter. The seismic trace is then transmitted digitally uphole to a Windows based computer through a signal interface box for recording and analysis. An illustration of the shear wave testing configuration is presented in Figure SCPTu-1.

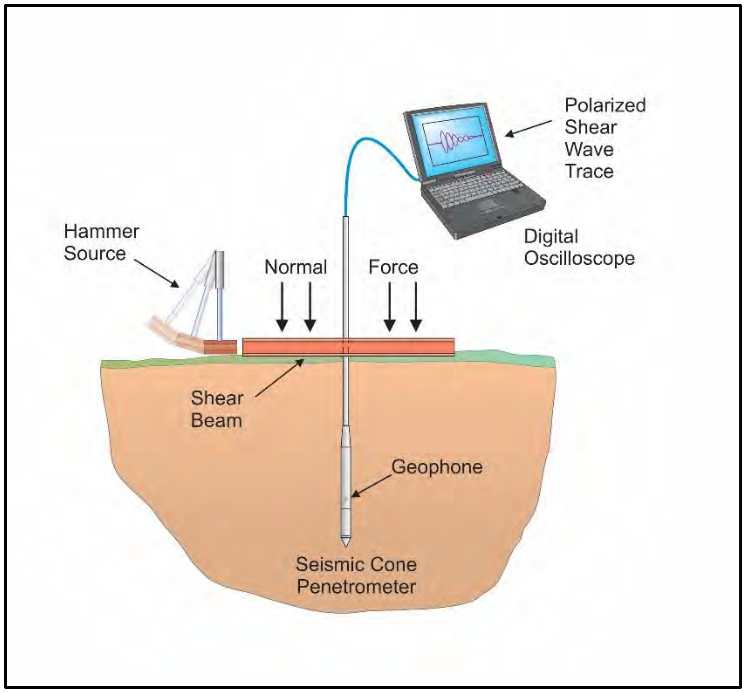


Figure SCPTu-1. Illustration of the SCPTu system

All testing is performed in accordance to ConeTec's SCPTu operating procedures which are in general accordance with the current ASTM 5778 and ASTM D7400 standards.

Prior to the start of a SCPTu sounding, the procedures described in the Cone Penetration Test section are followed. In addition, the active axis of the geophone is aligned parallel to the beam (or source) and the horizontal offset between the cone and the source is measured and recorded.

Prior to recording seismic waves at each test depth, cone penetration is stopped and the rods are decoupled from the rig to avoid transmission of rig energy down the rods. Typically, five wave traces for each orientation are recorded for quality control purposes and uncertainty analysis. After reviewing wave traces for consistency the cone is pushed to the next test depth (typically one meter intervals or as requested by the client). Figure SCPTu-2 presents an illustration of a SCPTu test.

For additional information on seismic cone penetration testing refer to Robertson et. al. (1986).

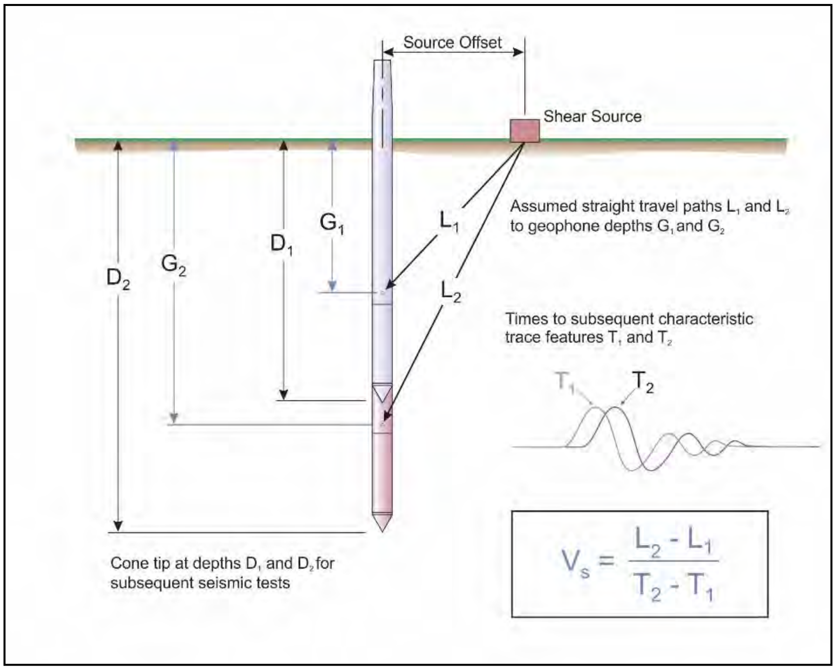


Figure SCPTu-2. Illustration of a seismic cone penetration test

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.

The average shear wave velocity to a depth of 100 feet (30 meters) ($\bar{v}_s$) has been calculated and provided for all applicable soundings using the following equation presented in ASCE (2010).

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}}$$

where: $\bar{v}_s$ = average shear wave velocity ft/s (m/s)

d_i = the thickness of any layer between 0 and 100 ft (30 m)

v_{si} = the shear wave velocity in ft/s (m/s)

$\sum_{i=1}^{n} d_i$ = 100 ft (30 m)

Average shear wave velocity, $\bar{v}_s$ is also referenced to V_{s100} or V_{s30}.

The layer travel times refers to the travel times propagating in the vertical direction, not the measured travel times from an offset source.

Tabular results and SCPTu plots are presented in the relevant appendix.

References

American Society of Civil Engineers (ASCE), 2010, “Minimum Design Loads for Buildings and Other Structures”, Standard ASCE/SEI 7-10, American Society of Civil Engineers, ISBN 978-0-7844-1085-1, Reston, Virginia.

ASTM D5778-12, 2012, "Standard Test Method for Performing Electronic Friction Cone and Piezocone Penetration Testing of Soils", ASTM, West Conshohocken, US.

ASTM D7400-14, 2014, "Standard Test Methods for Downhole Seismic Testing", ASTM, West Conshohocken, US.

Robertson, P.K., Campanella, R.G., Gillespie D and Rice, A., 1986, “Seismic CPT to Measure In-Situ Shear Wave Velocity”, Journal of Geotechnical Engineering ASCE, Vol. 112, No. 8: 791-803.

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

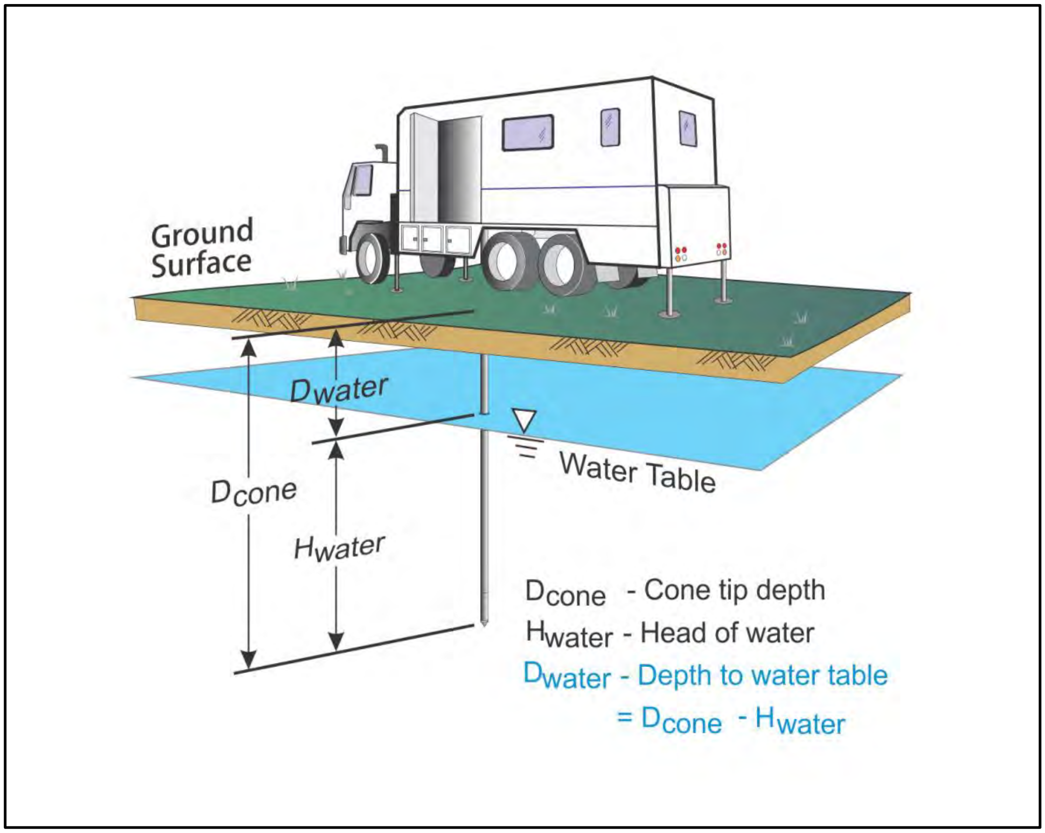


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

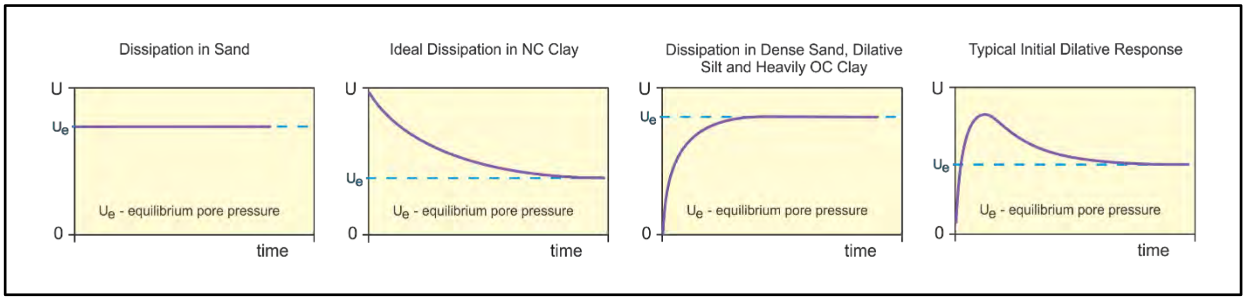


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve in Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:

T* is the dimensionless time factor (Table Time Factor)

a is the radius of the cone

I_r is the rigidity index

t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby (1991))

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby (1991)), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

References

Burns, S.E. and Mayne, P.W., 1998, "Monotonic and dilatory pore pressure decay during piezocone tests", Canadian Geotechnical Journal 26 (4): 1063-1073.

Burns, S.E. and Mayne, P.W., 2002, "Analytical cavity expansion-critical state model cone dissipation in fine-grained soils", Soils & Foundations, Vol. 42(2): 131-137.

Jones, G.A. and Van Zyl, D.J.A., 1981, "The piezometer probe: a useful investigation tool", Proceedings, 10th International Conference on Soil Mechanics and Foundation Engineering, Vol. 3, Stockholm: 489-495.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, "Estimating coefficient of consolidation from piezocone tests", Canadian Geotechnical Journal, 29(4): 551-557.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, "An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils", Canadian Geotechnical Journal, 36(2): 369-381.

Teh, C.I., and Houlsby, G.T., 1991, "An analytical study of the cone penetration test in clay", Geotechnique, 41(1): 17-34.

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Advanced Cone Penetration Test Plots with Ic, Su(Nkt), Phi and N1(60)Ic
- Seismic Cone Penetration Test Plots
- Seismic Cone Penetration Test Shear Wave (Vs) Traces
- Seismic Cone Penetration Test Tabular Results
- Soil Behavior Type (SBT) Scatter Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

Job No: 21-53-22085
Client: McPhail Associates
Project: Walden Square Apartments, Cambridge, MA
Start Date: 17-Mar-2021
End Date: 17-Mar-2021

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[1] (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Northing[2] (m)	Easting[2] (m)	Refer to Notation Number
CPT21-01	21-53-22085_CP01	17-Mar-2021	597:T1500F15U35	7.4	58.73		4695221	324649	
CPT21-02	21-53-22085_CP02	17-Mar-2021	597:T1500F15U35	5.3	59.96		4695215	324672	
SCPT21-03	21-53-22085_SP03	17-Mar-2021	597:T1500F15U35		1.97		4695218	324706	4
SCPT21-03A	21-53-22085_SP03A	17-Mar-2021	597:T1500F15U35		1.97		4695218	324706	4
SCPT21-03B	21-53-22085_SP03B	17-Mar-2021	597:T1500F15U35		2.05		4695217	324704	4
SCPT21-03C	21-53-22085_SP03C	17-Mar-2021	597:T1500F15U35	5.0	60.04	11	4695215	324703	3
CPT21-04	21-53-22085_CP04	17-Mar-2021	597:T1500F15U35	5.0	57.74		4695219	324724	3
CPT21-05	21-53-22085_CP05	17-Mar-2021	597:T1500F15U35	7.0	61.43		4695199	324730	3
Totals	8 soundings				303.88	11			

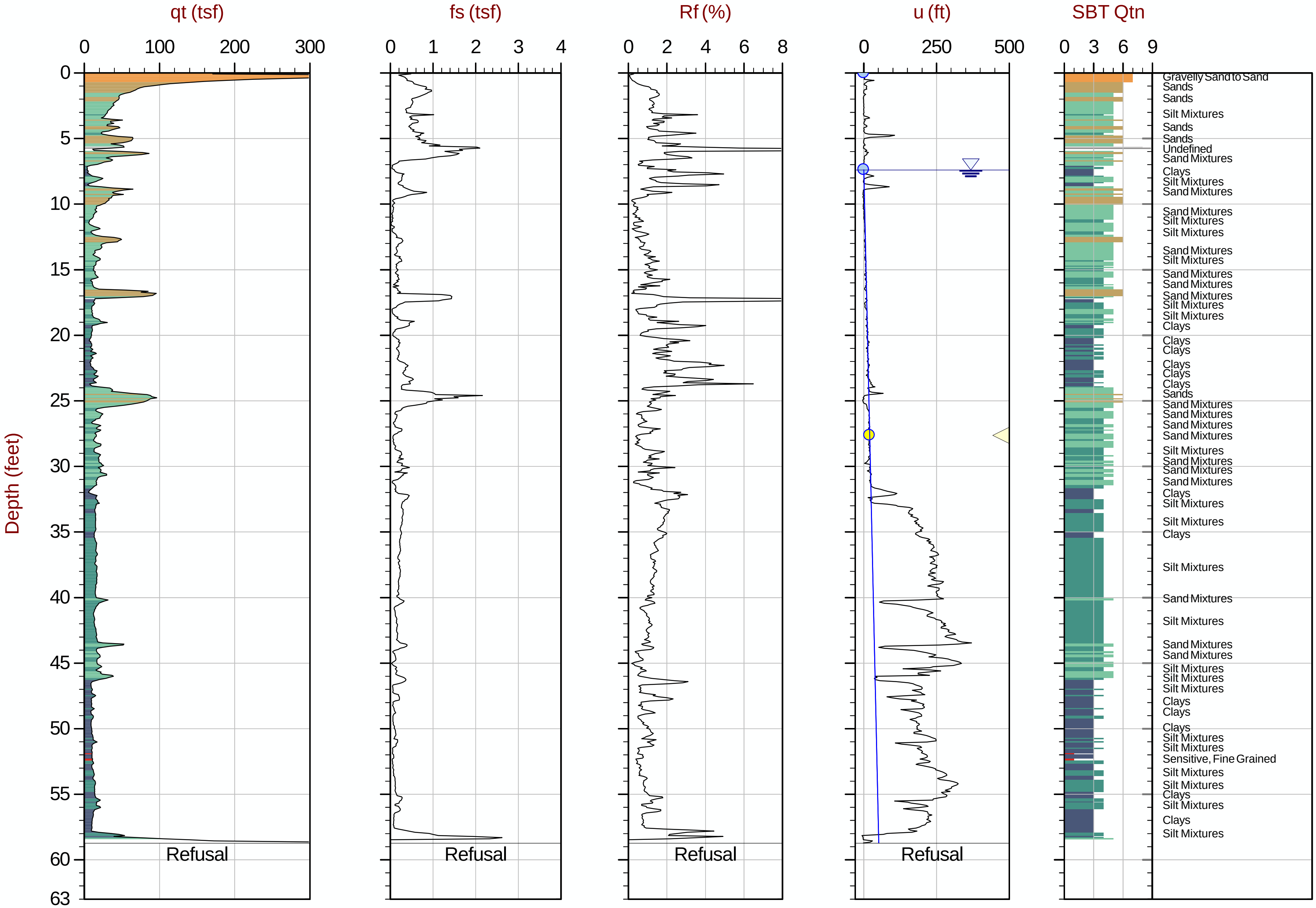
1. The assumed phreatic surface was based on pore pressure dissipation tests. Hydrostatic data were used for the calculated parameters.
2. Coordinates were acquired using a MR-350 GlobalSat GPS Receiver in datum: WGS84 / UTM Zone 19 North.
3. The assumed phreatic surface was estimated from the dynamic pore pressure data.
4. No phreatic surface detected.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 09:00
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-01
Cone: EC597



Max Depth: 17.900 m / 58.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP01.COR
Unit Wt: SBTQtn (PKR2009)

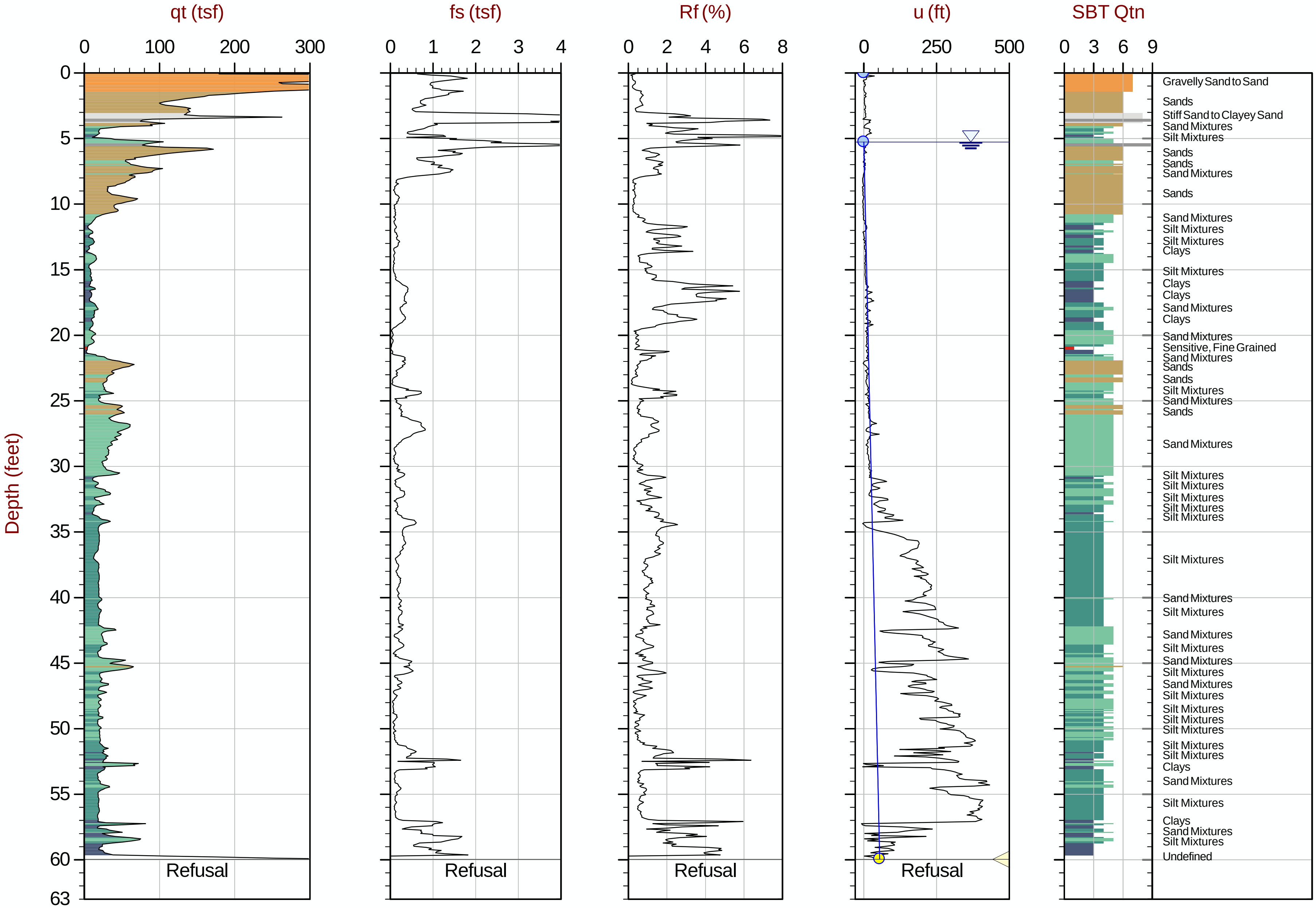
SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695221m E: 324649m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 07:31
Site: Walden Square Apartments, Cambridge, MA
Sounding: CPT21-02
Cone: EC597



Max Depth: 18.275 m / 59.96 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695215m E: 324672m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

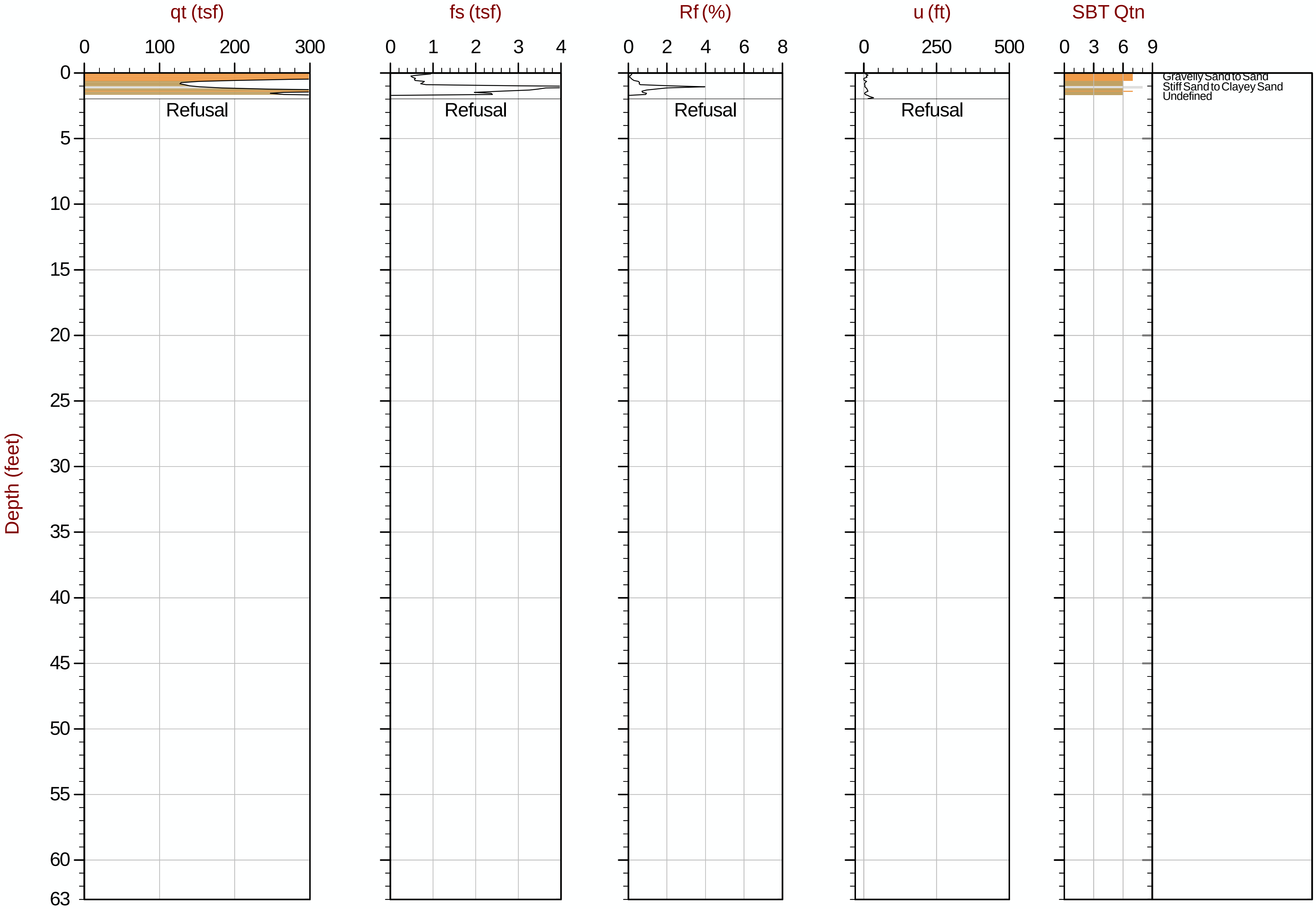
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 11:54
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03
Cone: EC597



Max Depth: 0.600 m / 1.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03.COR
Unit Wt: SBTQtn (PKR2009)

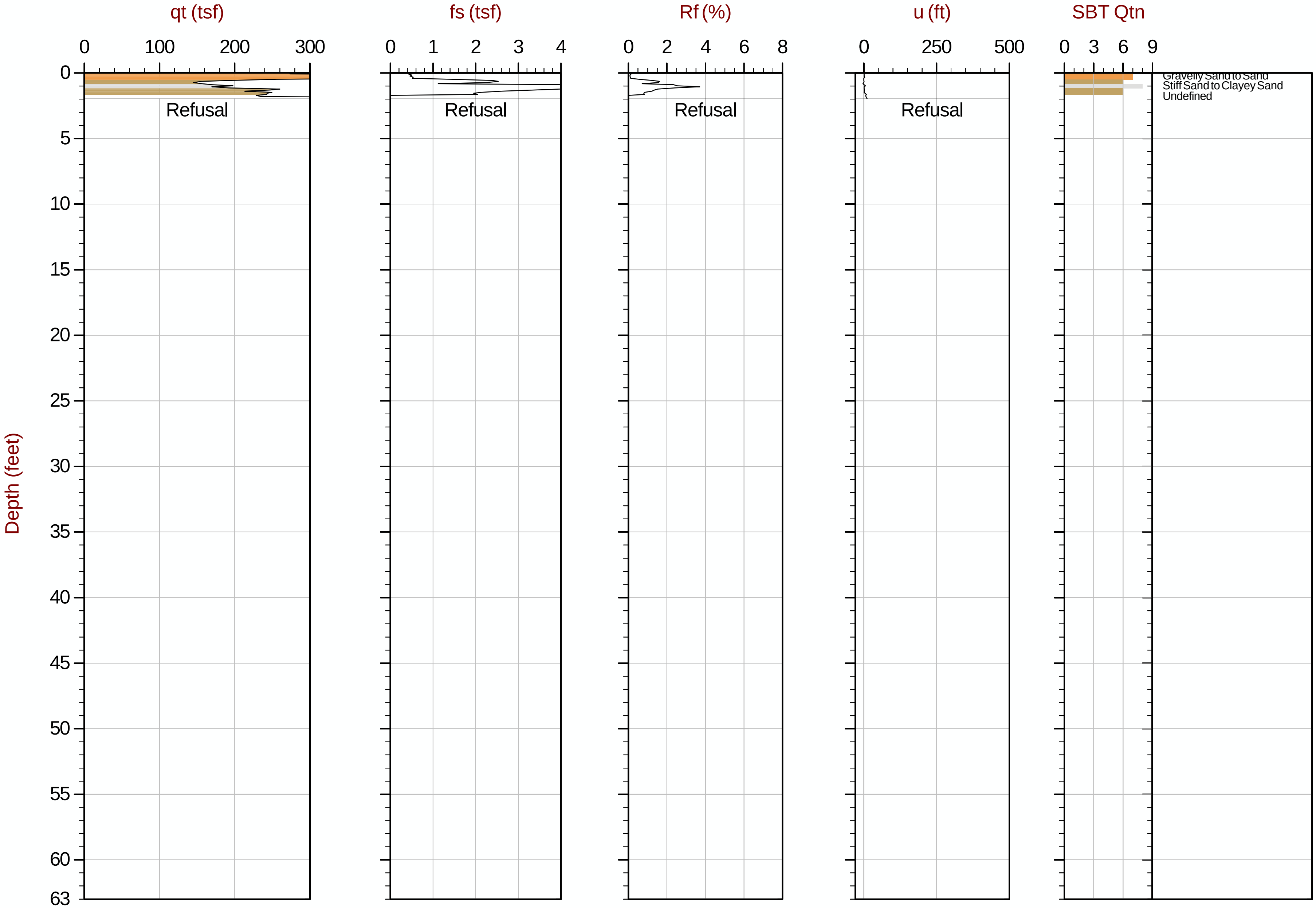
SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695218m E: 324706m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:08
Site: Walden Square Apartments, Cambridge, MA
Sounding: SCPT21-03A
Cone: EC597



Max Depth: 0.600 m / 1.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03A.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695218m E: 324706m

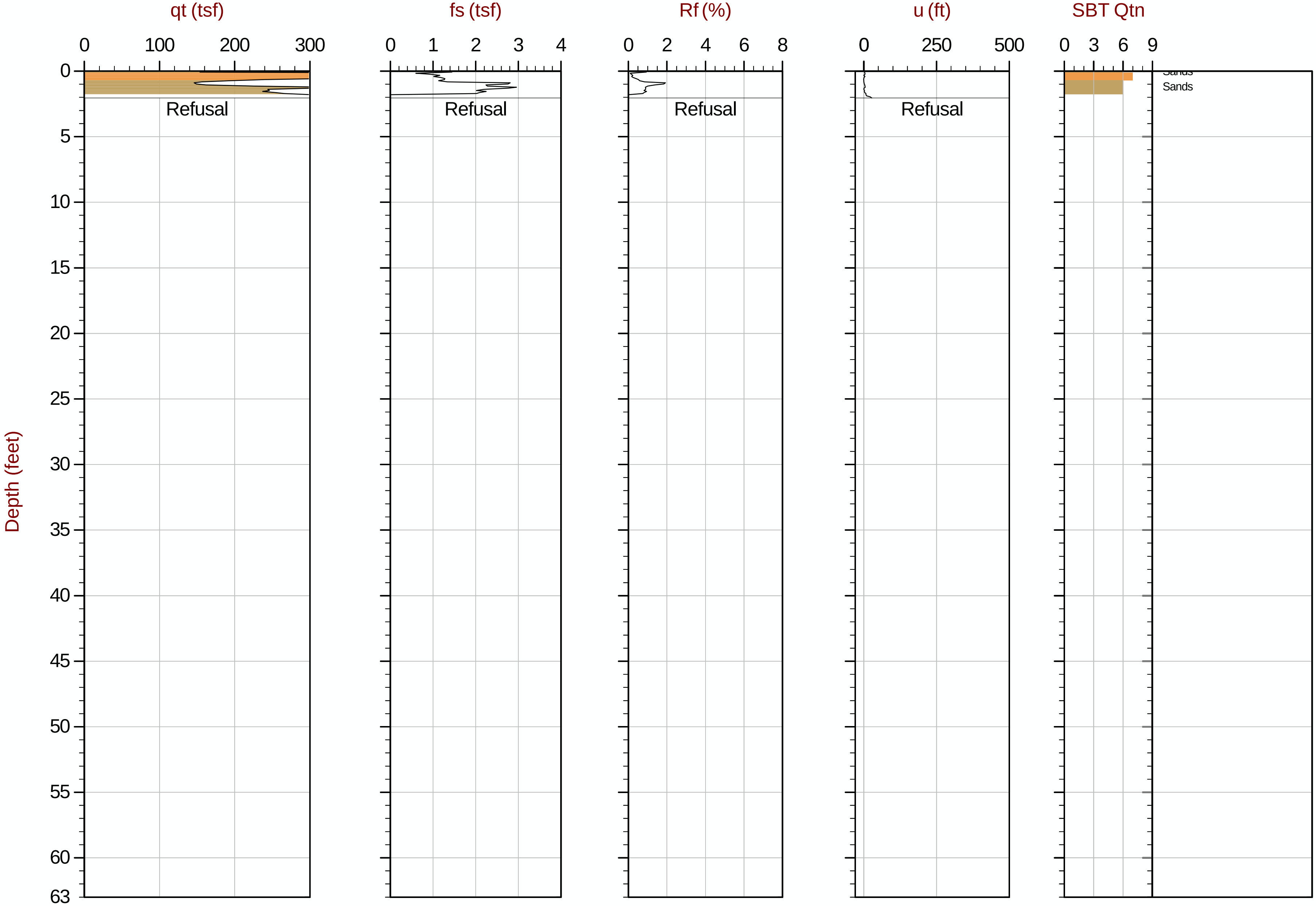
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:17
Site: Walden Square Apartments, Cambridge, MA
Sounding: SCPT21-03B
Cone: EC597



Max Depth: 0.625 m / 2.05 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03B.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695217m E: 324704m

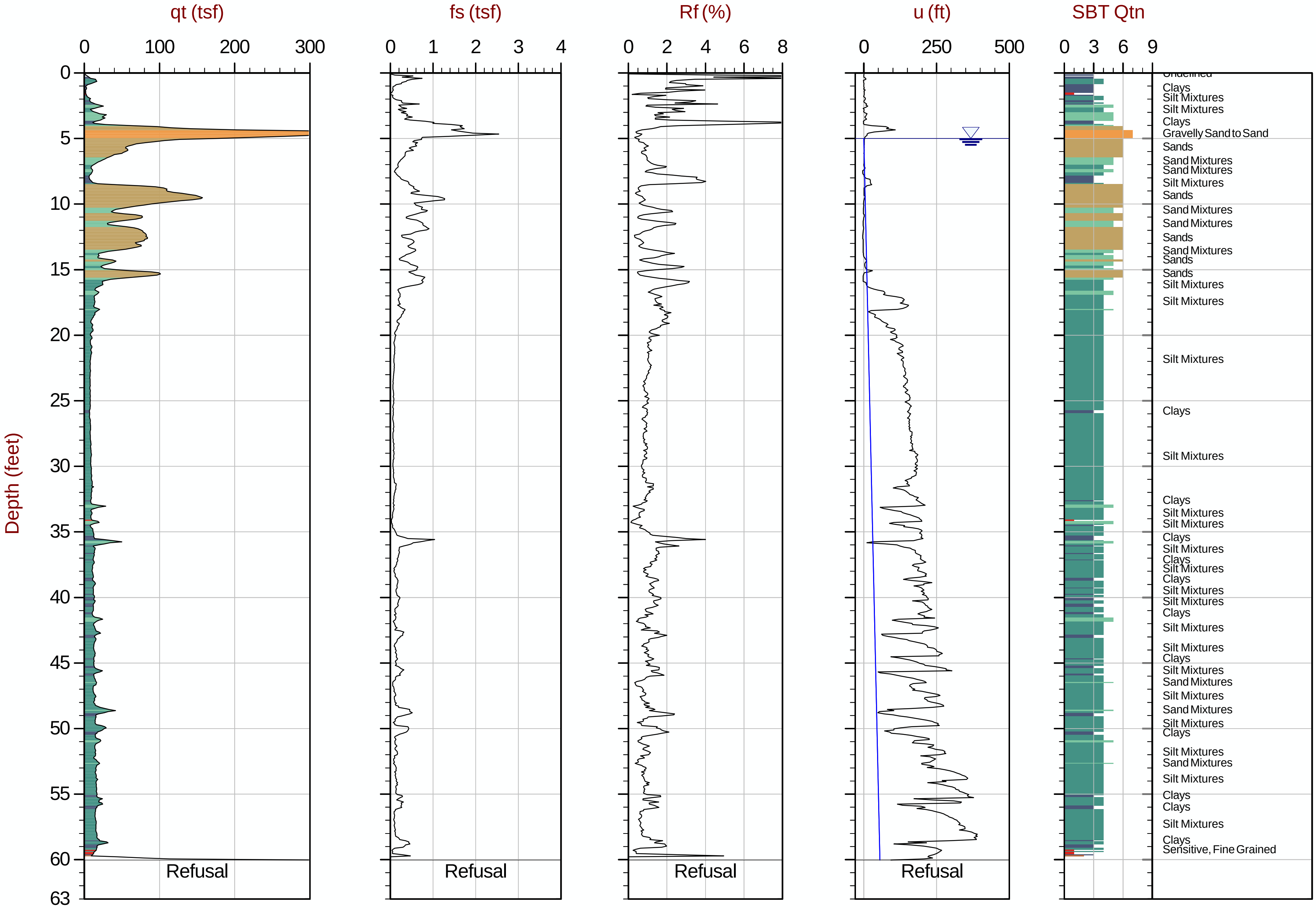
— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:30
Site: Walden Square Apartments, Cambridge, MA
Sounding: SCPT21-03C
Cone: EC597



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03C.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695215m E: 324703m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

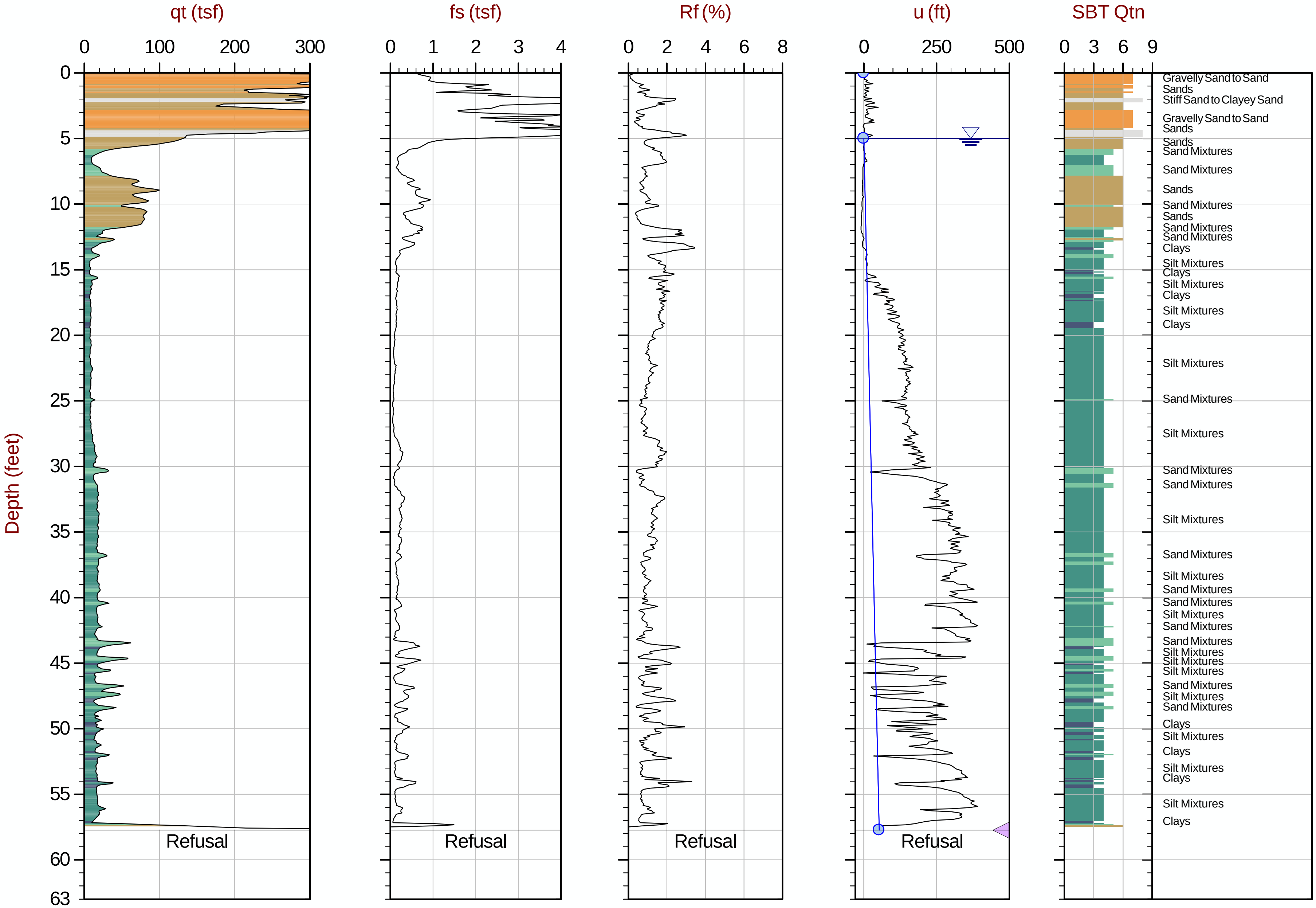
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 10:21
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-04
Cone: EC597



Max Depth: 17.600 m / 57.74 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695219m E: 324724m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

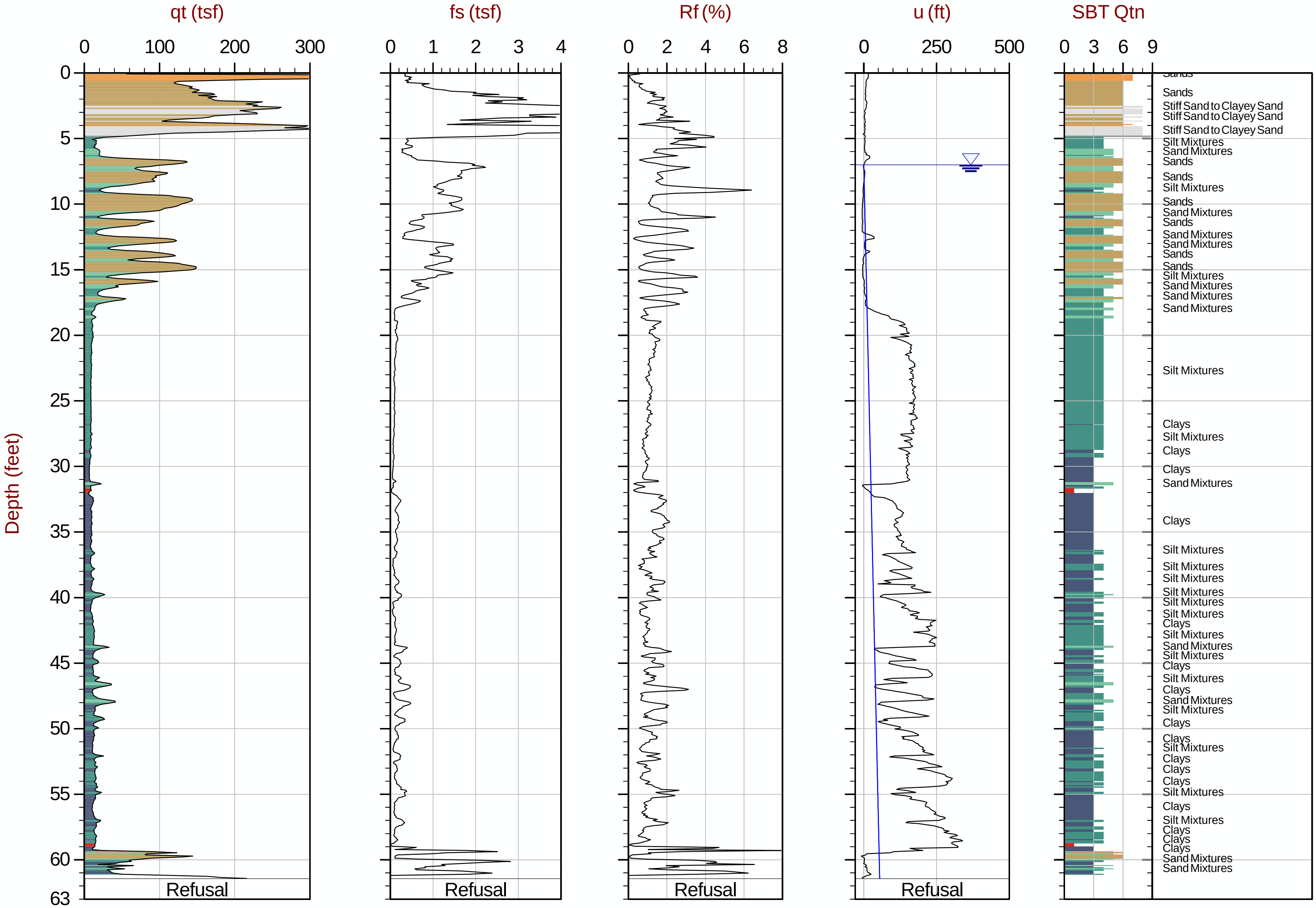
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 02:48
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-05
Cone: EC597



Max Depth: 18.725 m / 61.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695199m E: 324730m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

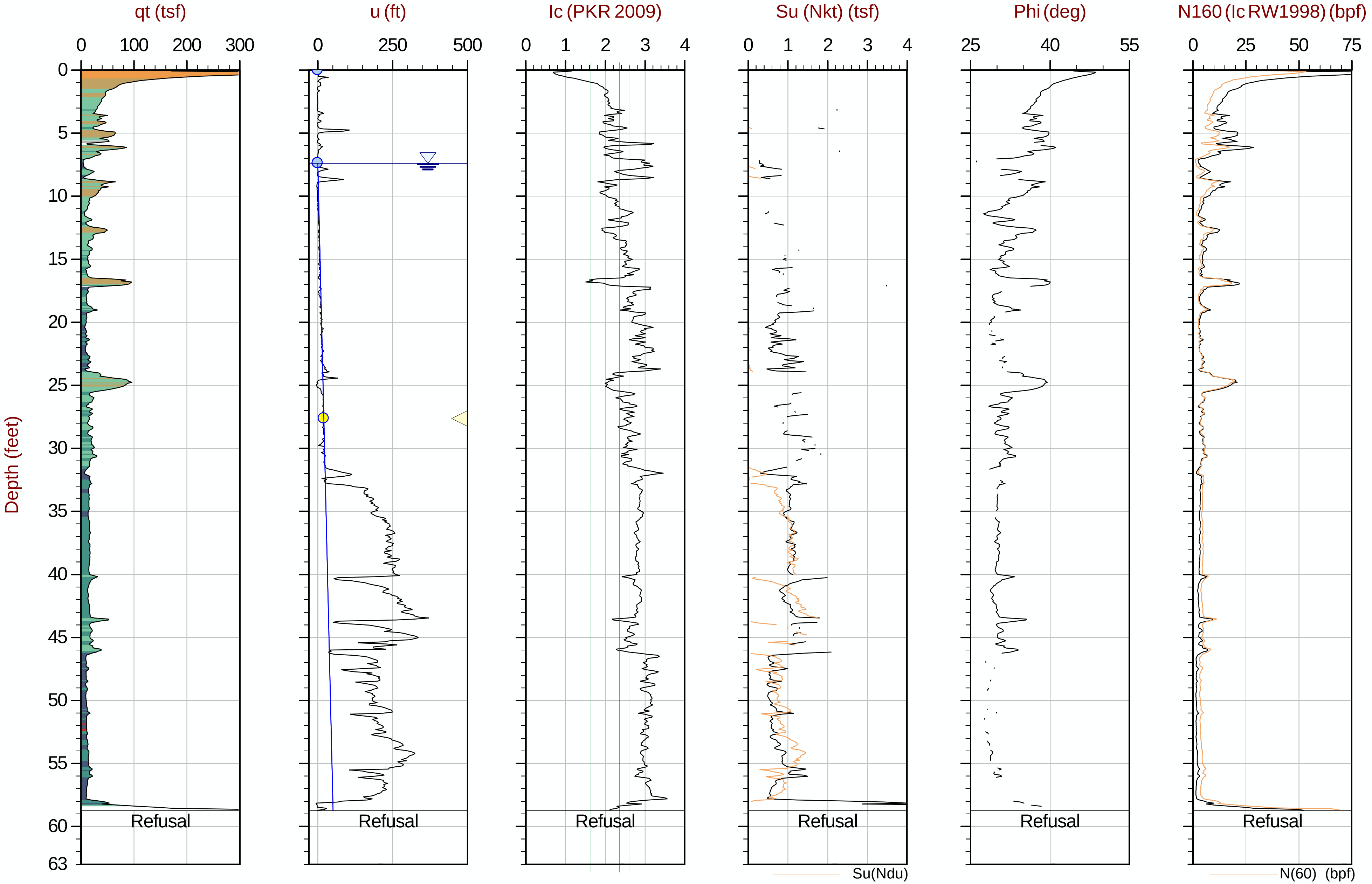
Advanced Cone Penetration Plots with Ic, Su(Nkt), Phi and N1(60)Ic

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 09:00
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-01
Cone: EC597



Max Depth: 17.900 m / 58.73 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP01.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695221m E: 324649m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

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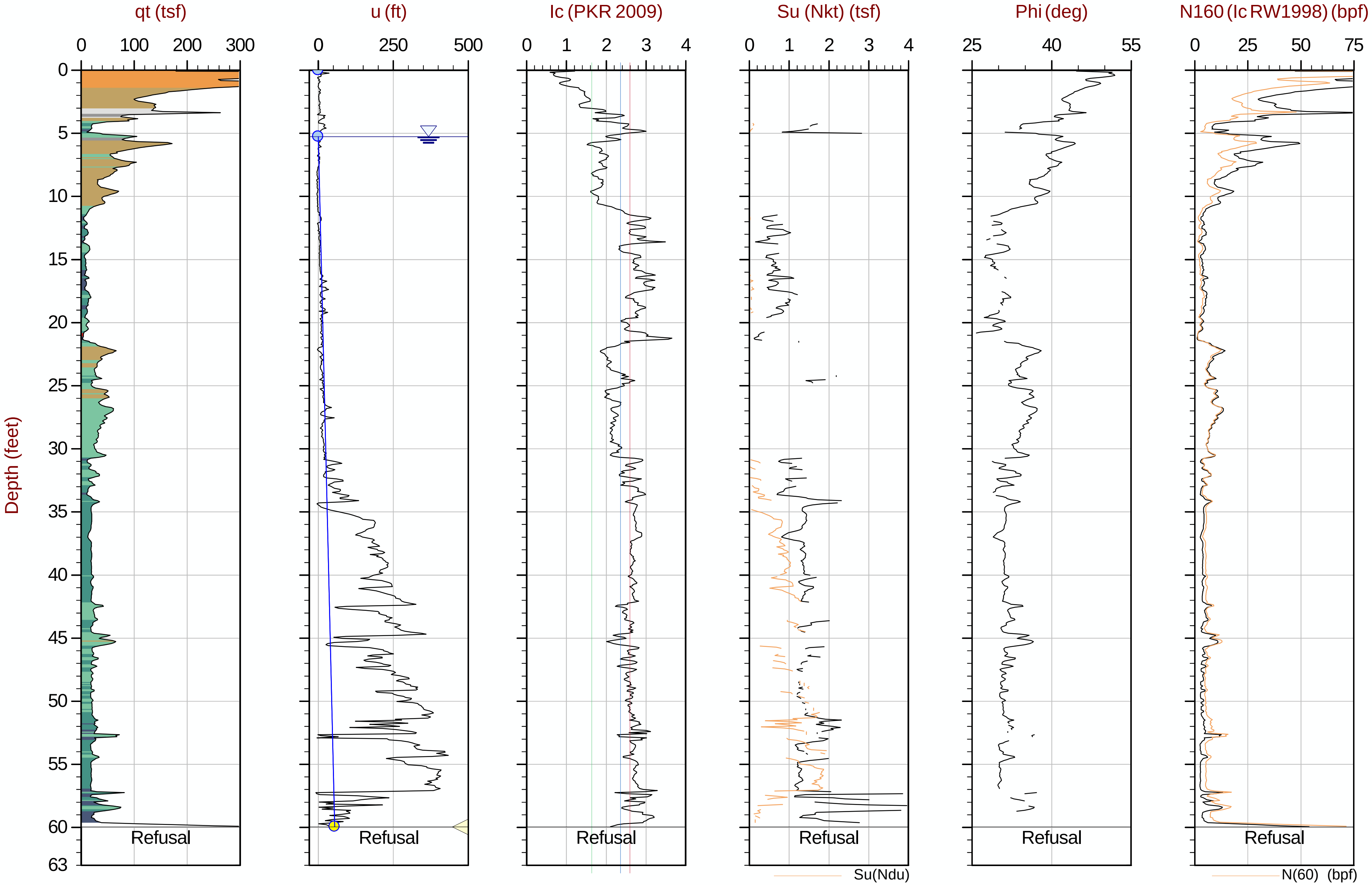
CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 07:31
Site: Walden Square Apartments, Cambridge, MA
Sounding: CPT21-02
Cone: EC597



Max Depth: 18.275 m / 59.96 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP02.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695215m E: 324672m

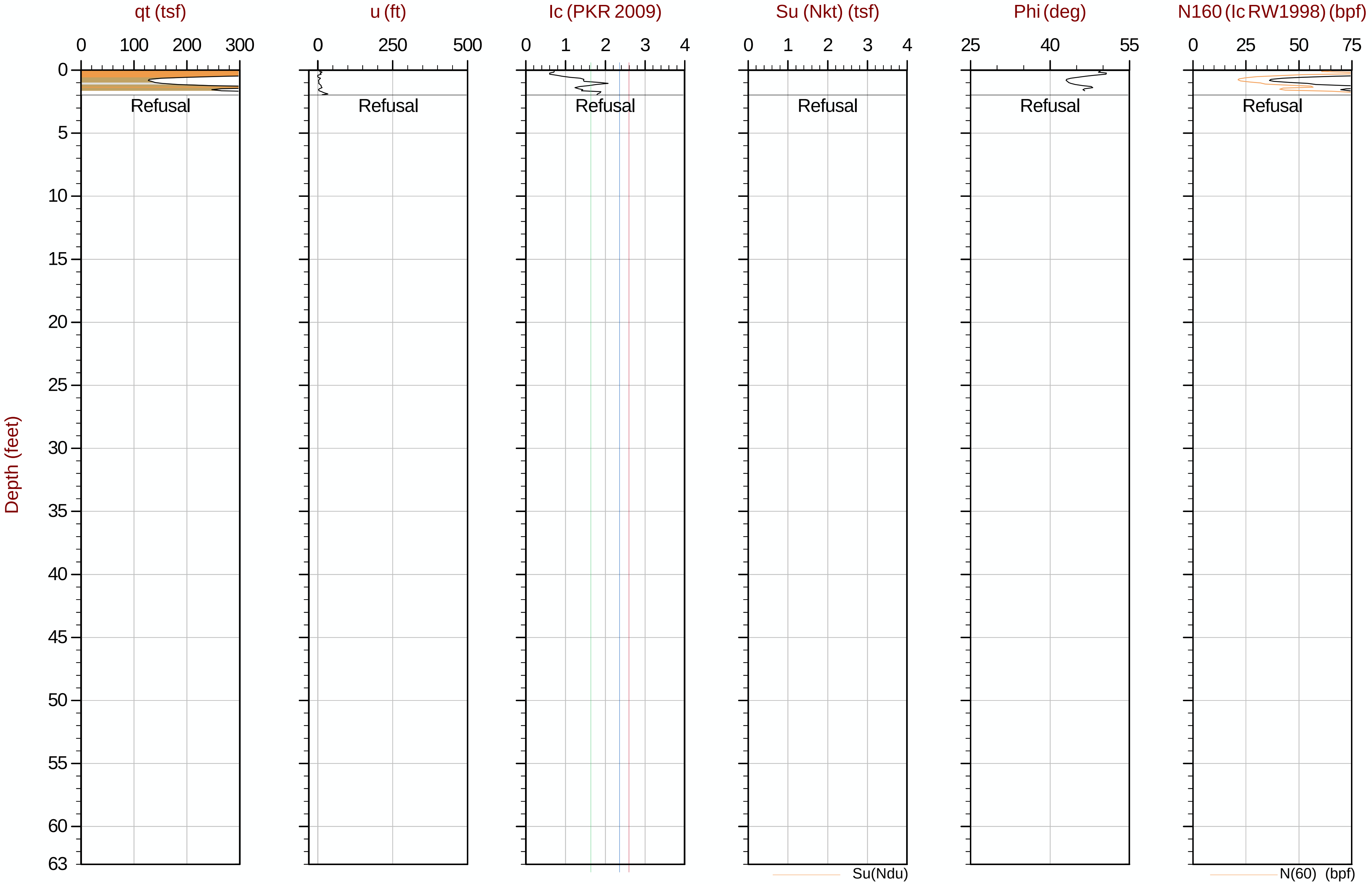
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 11:54
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03
Cone: EC597



Max Depth: 0.600 m / 1.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695218m E: 324706m

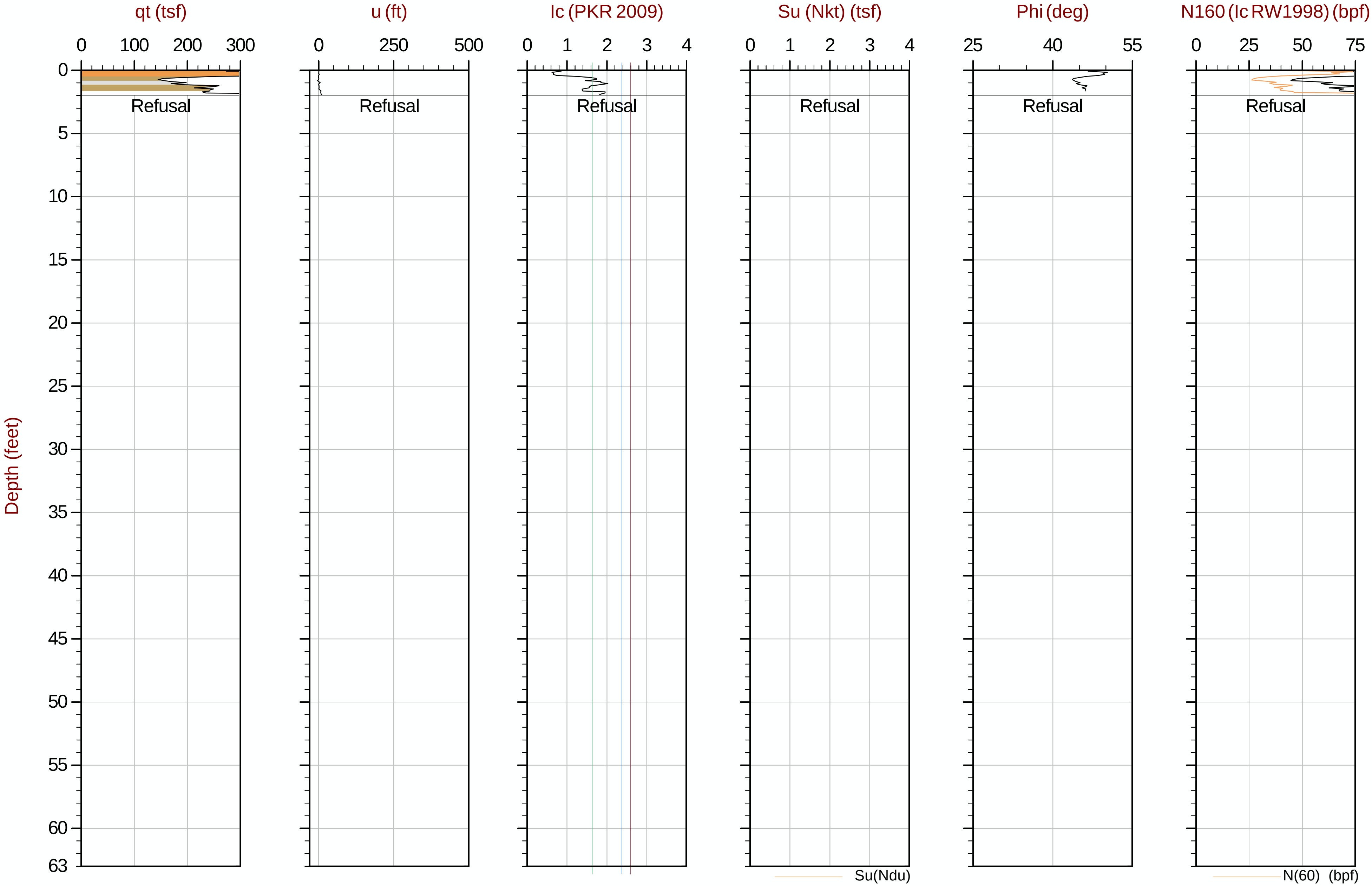
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:08
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03A
Cone: EC597



Max Depth: 0.600 m / 1.97 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03A.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695218m E: 324706m

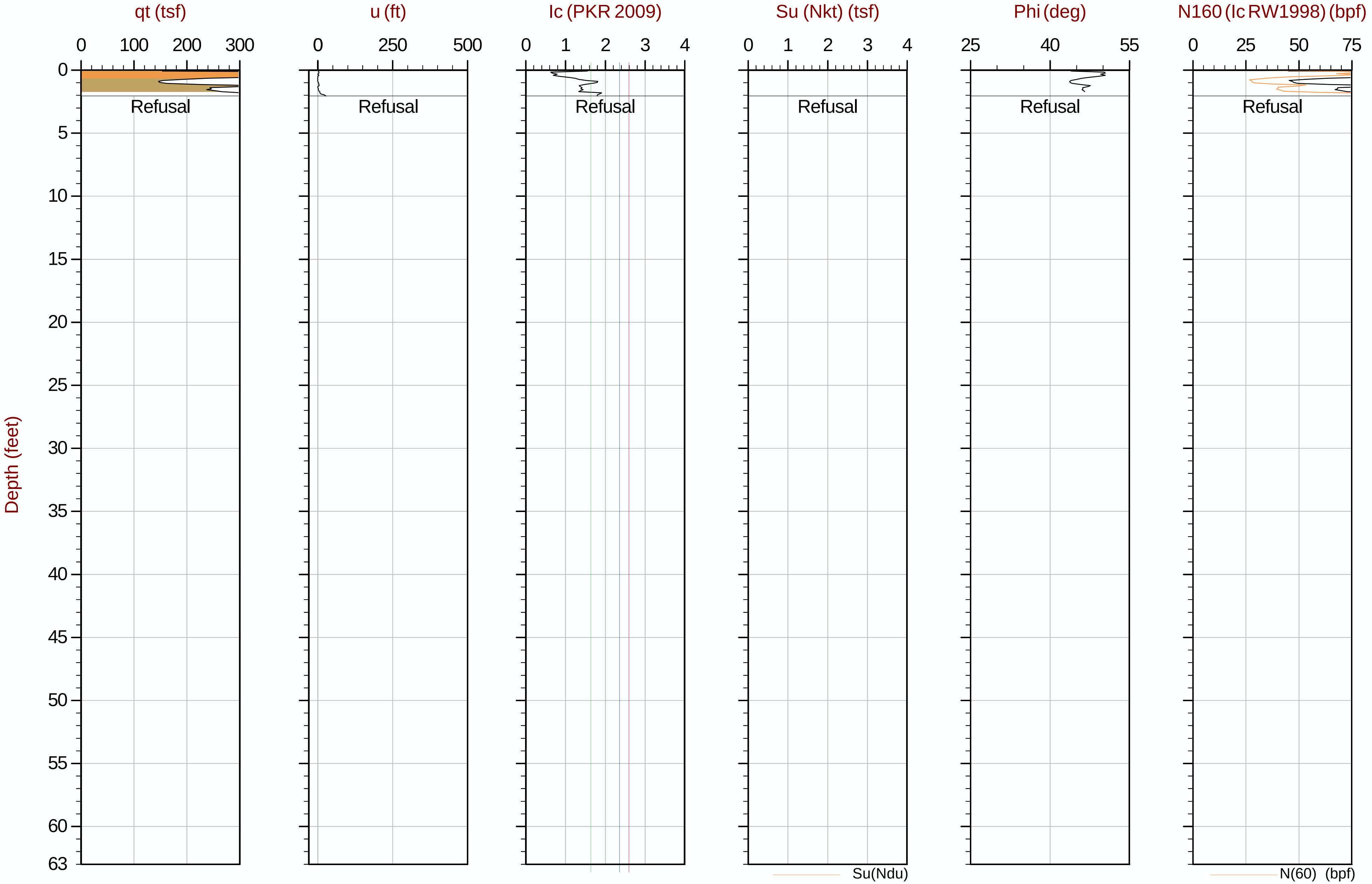
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:17
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03B
Cone: EC597



Max Depth: 0.625 m / 2.05 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03B.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695217m E: 324704m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

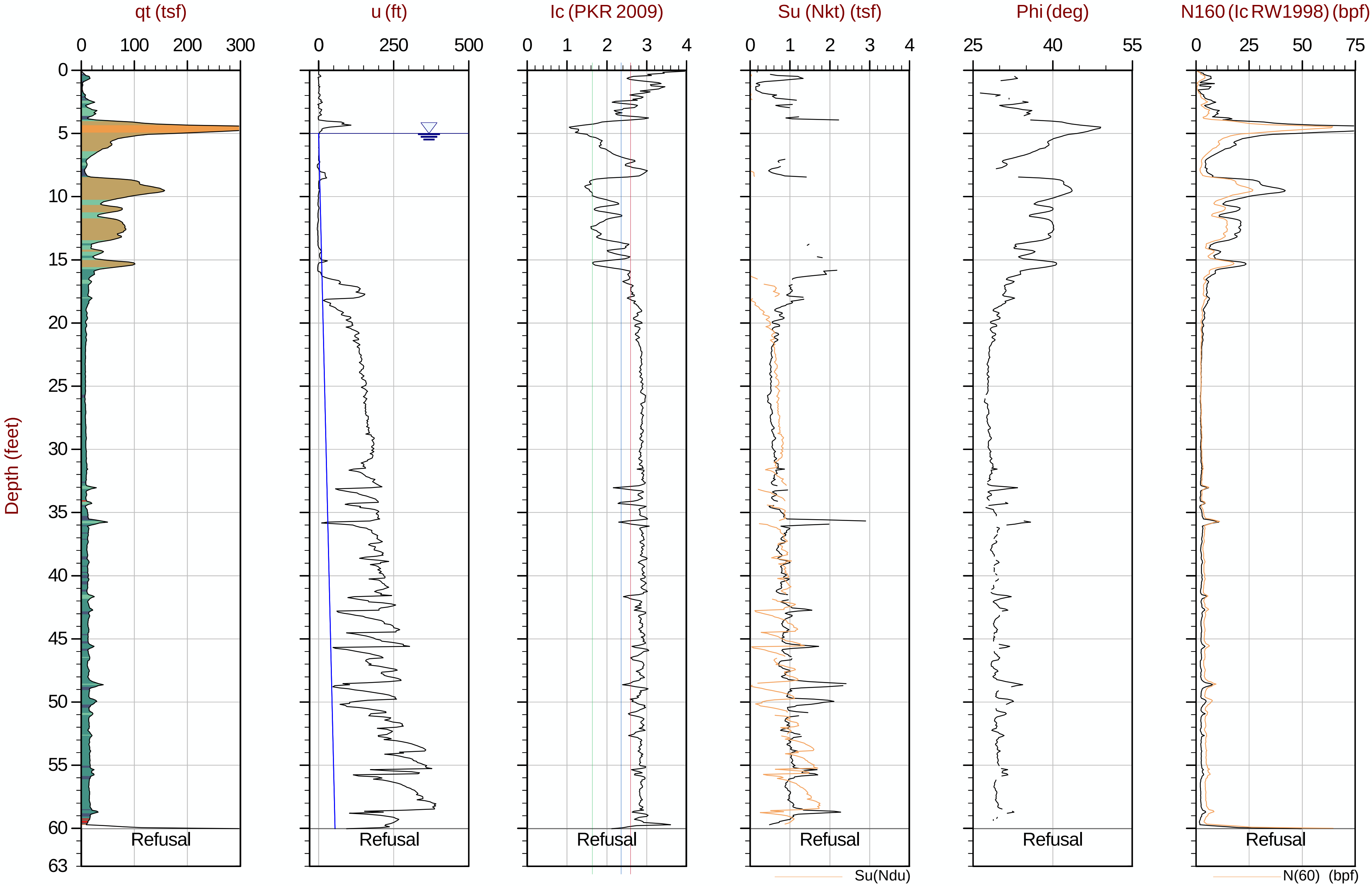
The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:30
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03C
Cone: EC597



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03C.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695215m E: 324703m

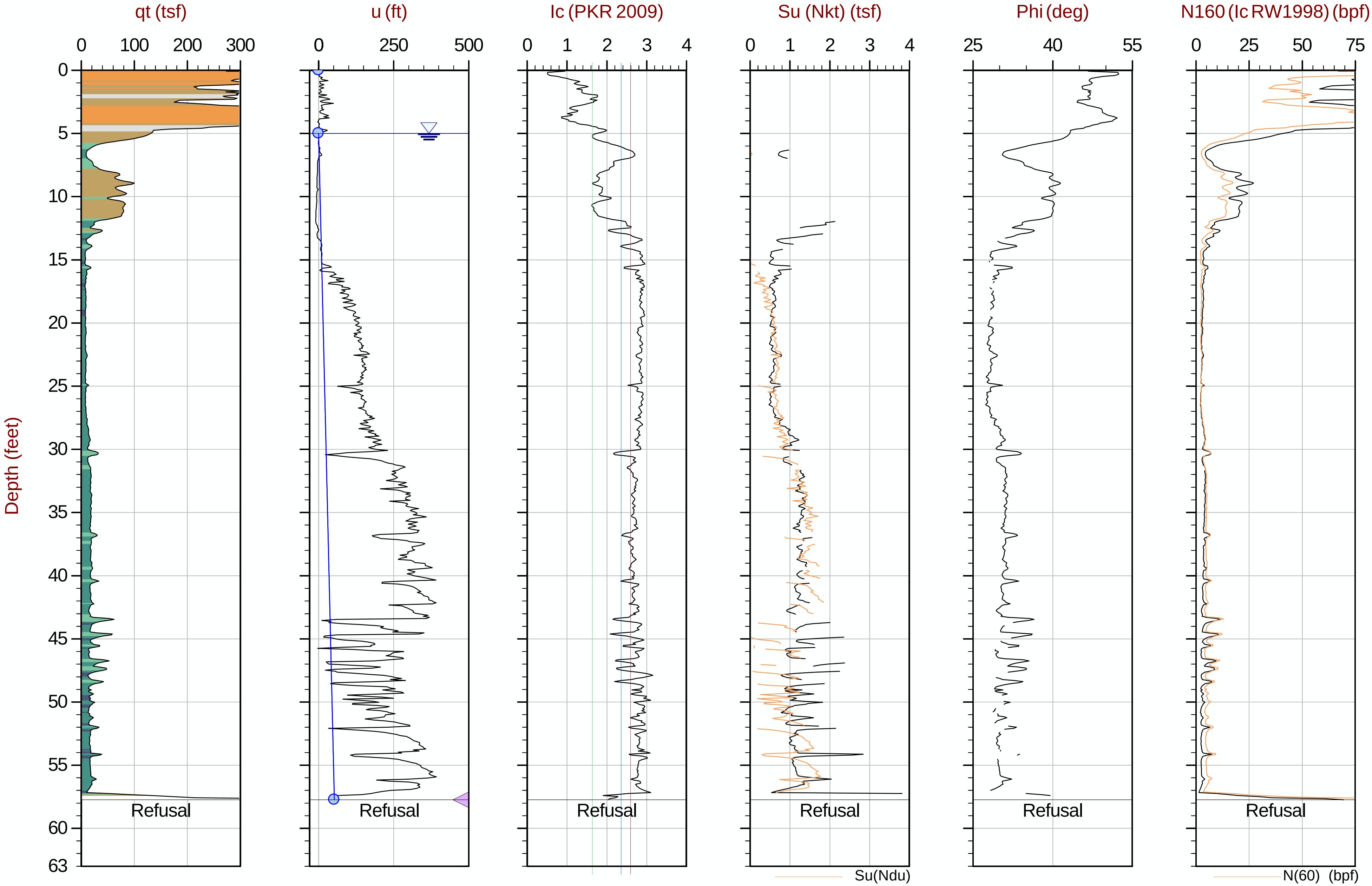
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 10:21
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-04
Cone: EC597



Max Depth: 17.600 m / 57.74 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP04.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695219m E: 324724m

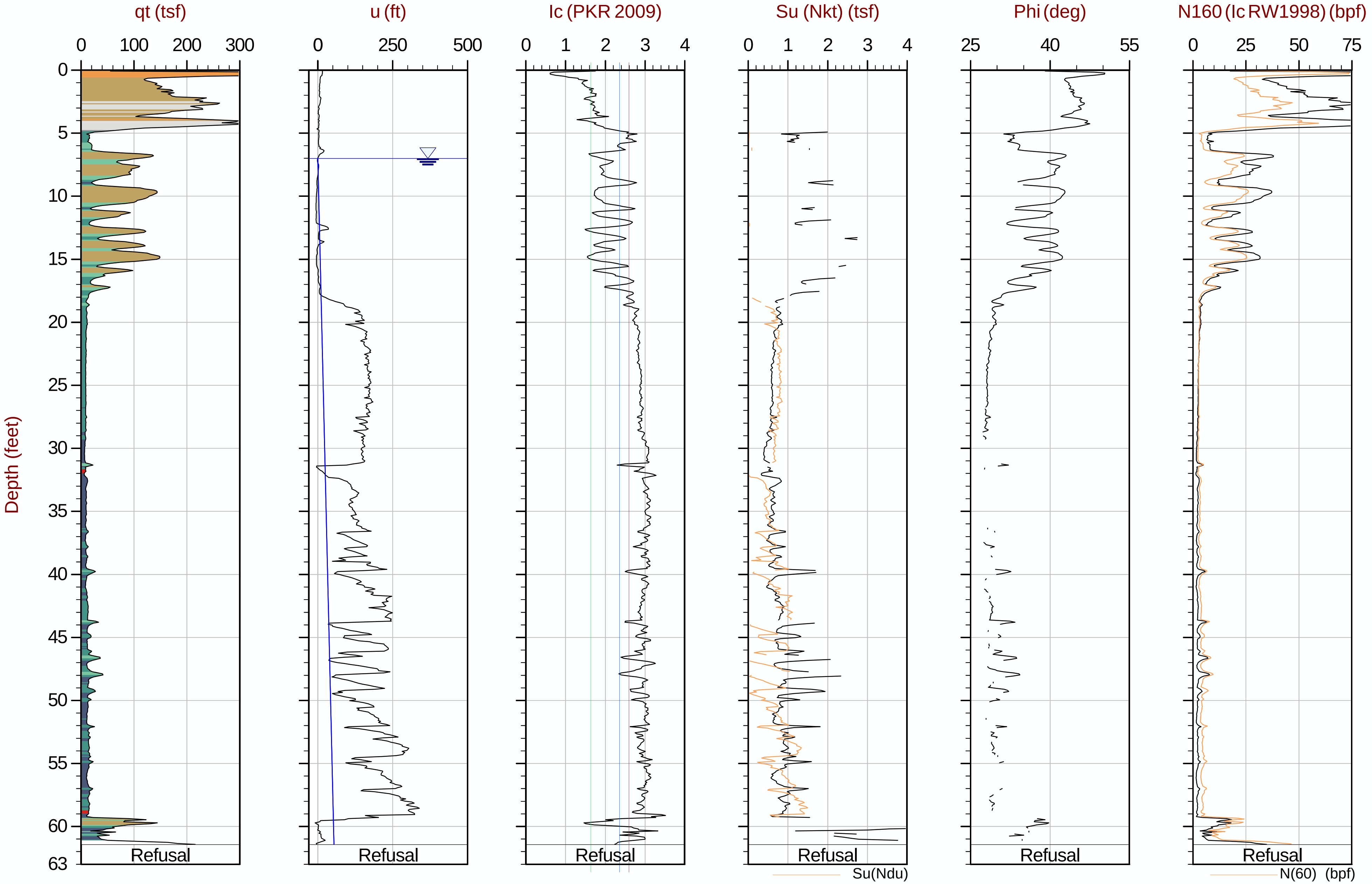
Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 02:48
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-05
Cone: EC597



Max Depth: 18.725 m / 61.43 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_CP05.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt/Ndu: 12.5 / 6.0

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695199m E: 324730m

Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

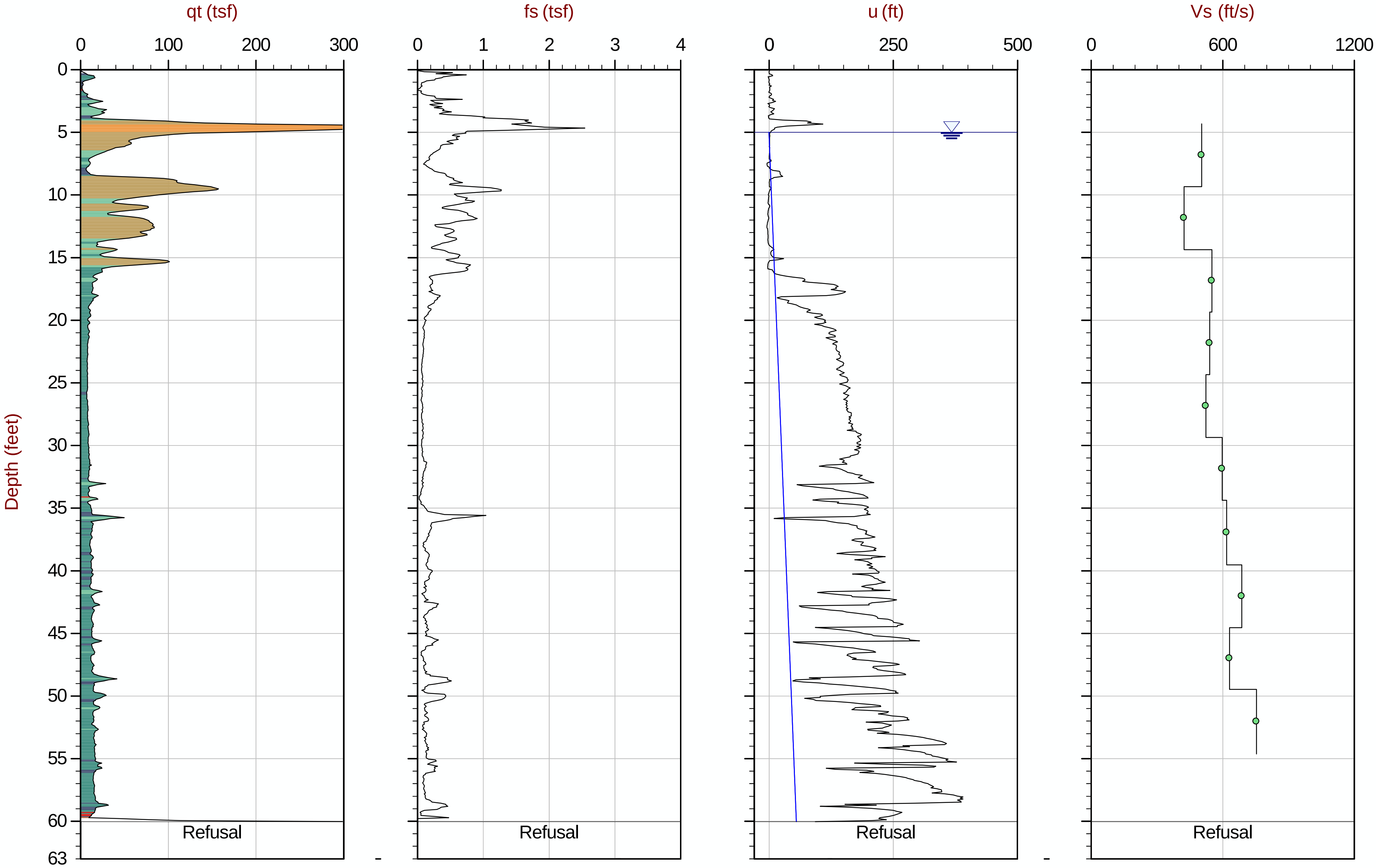
Seismic Cone Penetration Test Plots

ConeTec

CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:30
Site: Walden Square Apartments, Cambridge, MA
Sounding: SCPT21-03C
Cone: EC597



Max Depth: 18.300 m / 60.04 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-53-22085_SP03C.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: UTM Zone 19 N: 4695215m E: 324703m

— Hydrostatic Line ● Ueq ● Assumed Ueq ◁ PPD, Ueq achieved ◁ PPD, Ueq not achieved

The reported coordinates were acquired from consumer-grade GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Shear Wave (Vs) Traces

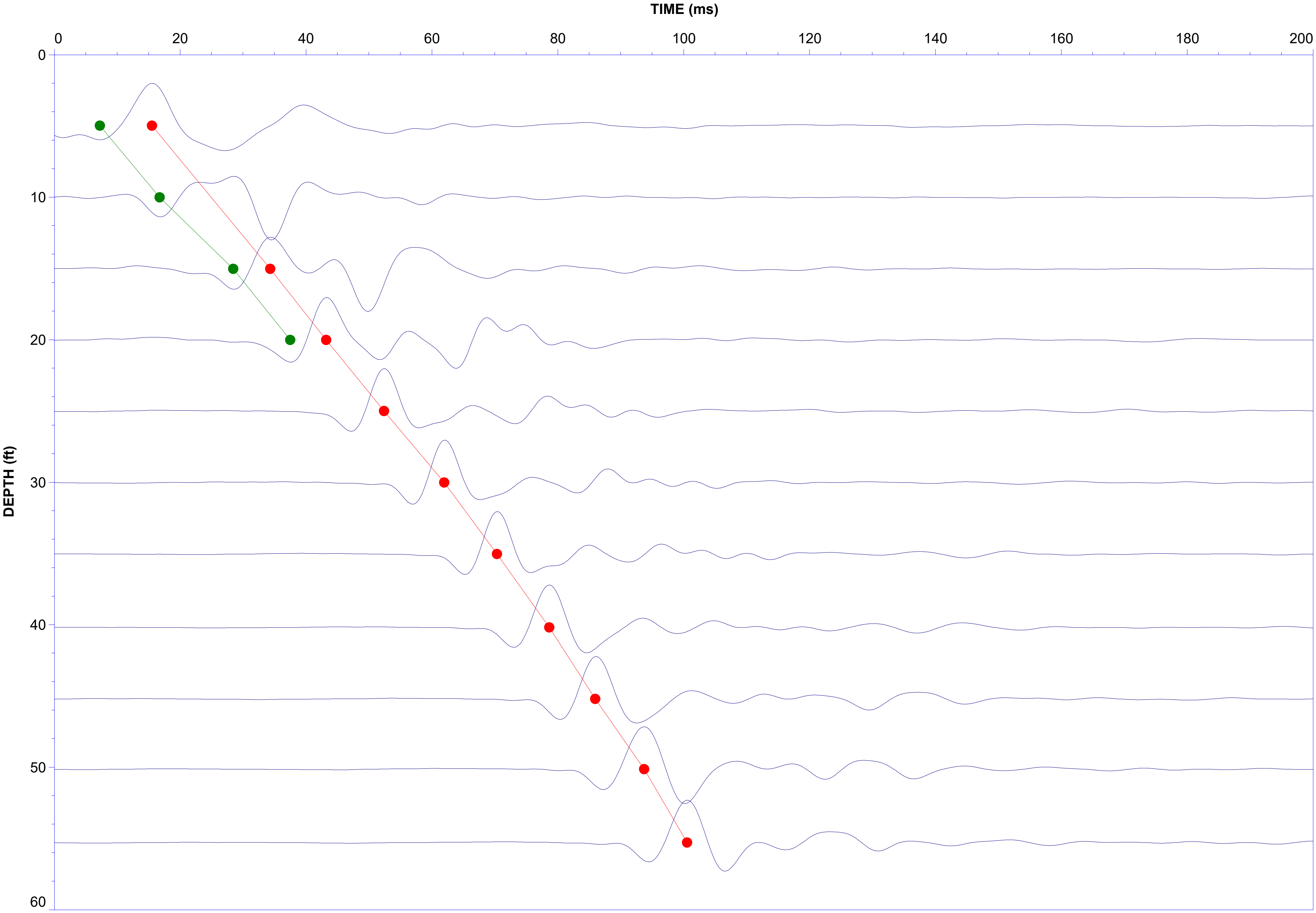
Job No: 21-53-22085
Date: 17-Mar-2021

Client: McPhail Associates

Project: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03C

Filter: 25-175hz



Seismic Cone Penetration Test Tabular Results

ConeTec

Job No: 21-53-22085
Client: McPhail Associates
Project: Walden Square Apartments, Cambridge, MA
Sounding ID: SCPT21-03C
Date: 17-Mar-2021

Seismic Source: Beam
Source Offset (ft): 1.97
Source Depth (ft): 0
Geophone Offset (ft): 0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

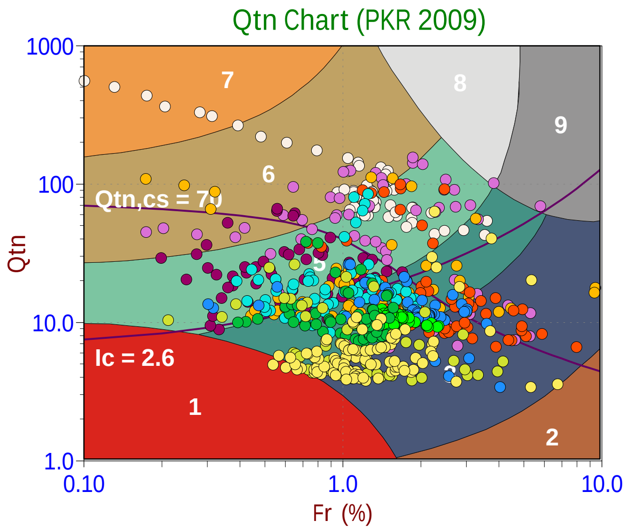
Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.99	4.33	4.76			
10.01	9.35	9.56	4.80	9.51	504
15.03	14.37	14.50	4.95	11.67	424
20.01	19.36	19.46	4.95	8.98	551
25.00	24.34	24.42	4.97	9.18	541
30.02	29.36	29.43	5.01	9.56	523
35.04	34.38	34.44	5.01	8.39	598
40.19	39.53	39.58	5.14	8.32	618
45.21	44.55	44.60	5.01	7.29	688
50.13	49.47	49.51	4.92	7.79	631
55.28	54.63	54.66	5.15	6.82	754

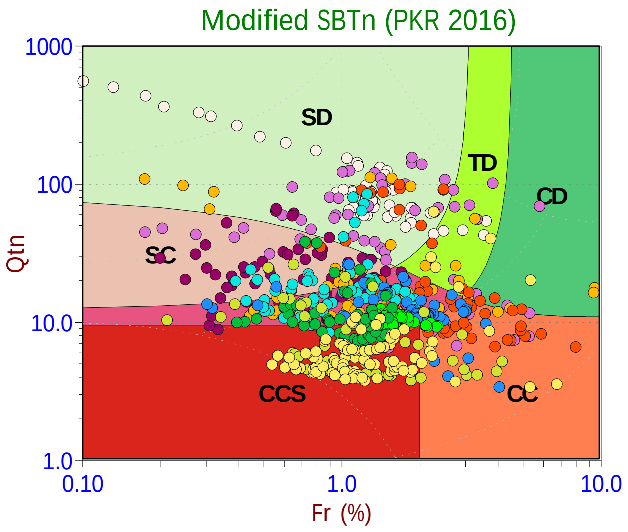
Soil Behavior Type (SBT) Scatter Plots

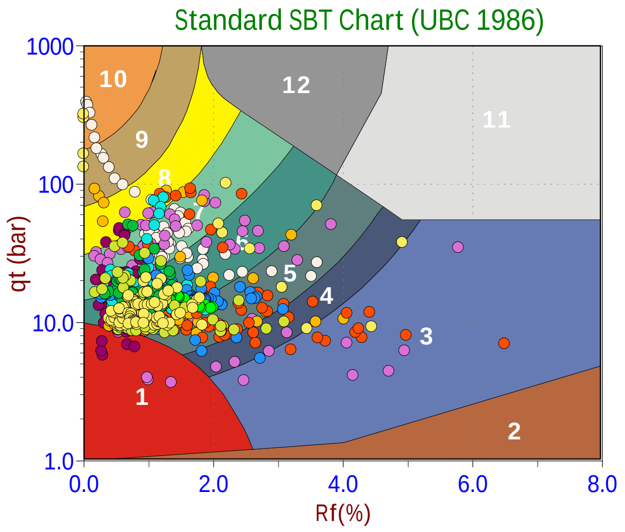
McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 09:00
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-01
Cone: EC597







Depth Ranges

- ● >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

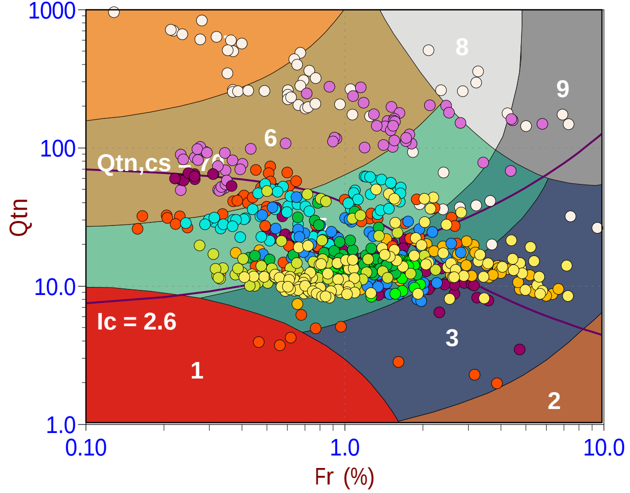
CONETEC

McPhail Associates

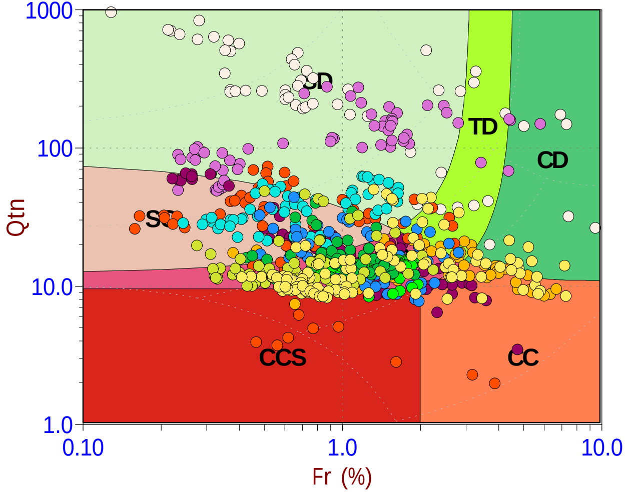
Job No: 21-53-22085
Date: 2021-03-17 07:31
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-02
Cone: EC597

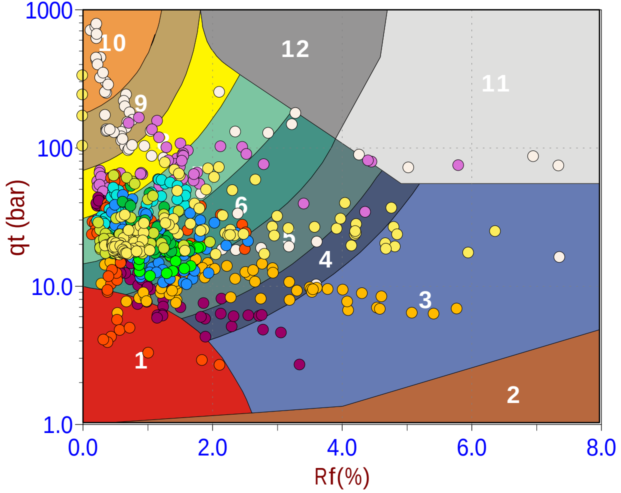
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges
- ● >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend
- ■ Sensitive, Fine Grained
- ■ Organic Soils
- ■ Clays
- ■ Silt Mixtures
- ■ Sand Mixtures
- ■ Sands
- ■ Gravelly Sand to Sand
- ■ Stiff Sand to Clayey Sand
- ■ Very Stiff Fine Grained

Legend
- ■ CCS (Cont. sensitive clay like)
- ■ CC (Cont. clay like)
- ■ TC (Cont. transitional)
- ■ SC (Cont. sand like)
- ■ CD (Dil. clay like)
- ■ TD (Dil. transitional)
- ■ SD (Dil. sand like)

Legend
- ■ Sensitive Fines
- ■ Organic Soil
- ■ Clay
- ■ Silty Clay
- ■ Clayey Silt
- ■ Silt
- ■ Sandy Silt
- ■ Silty Sand/Sand
- ■ Sand
- ■ Gravelly Sand
- ■ Stiff Fine Grained
- ■ Cemented Sand

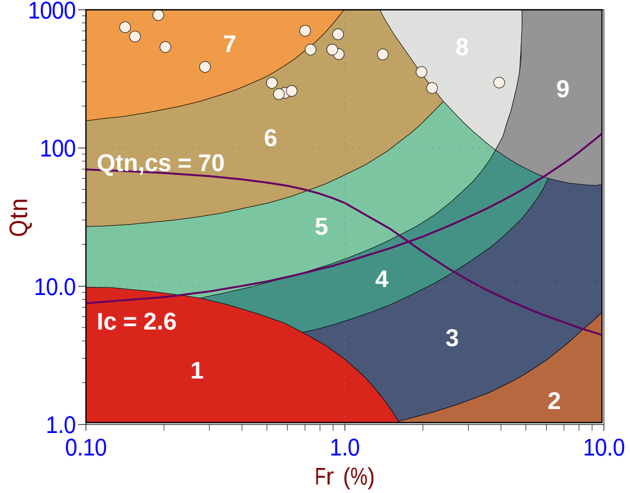
CONETEC

McPhail Associates

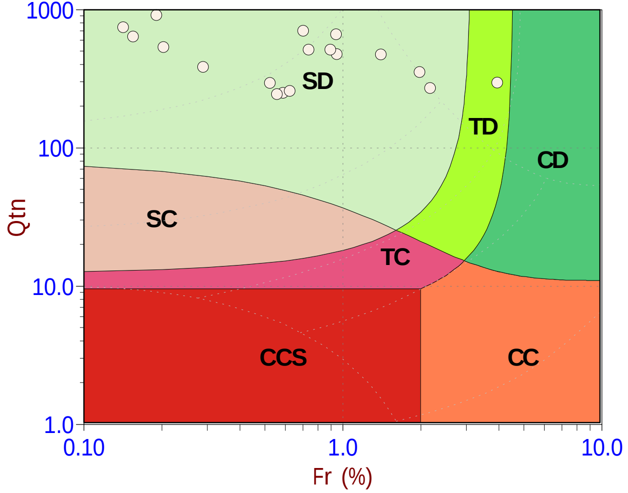
Job No: 21-53-22085
Date: 2021-03-17 11:54
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03
Cone: EC597

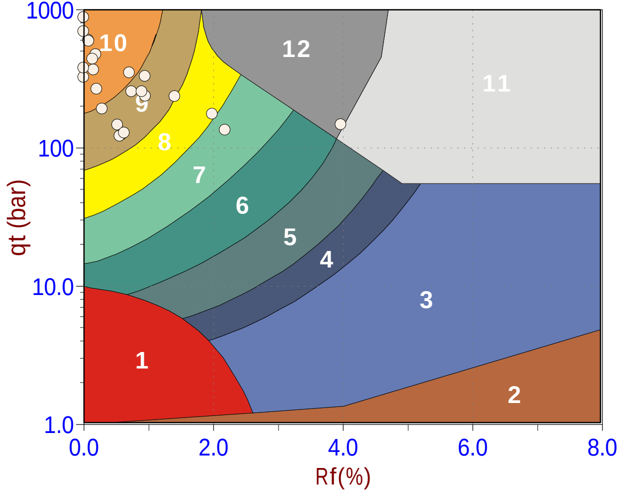
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges
- ⚪ >0.0 to 5.0 ft
- 🟣 >5.0 to 10.0 ft
- 🟣 >10.0 to 15.0 ft
- 🟠 >15.0 to 20.0 ft
- 🔴 >20.0 to 25.0 ft
- 🔵 >25.0 to 30.0 ft
- 🔵 >30.0 to 35.0 ft
- 🟢 >35.0 to 40.0 ft
- 🟢 >40.0 to 45.0 ft
- 🟡 >45.0 to 50.0 ft
- 🟡 >50.0 ft

Legend
- 🟥 Sensitive, Fine Grained
- 🟫 Organic Soils
- 🟦 Clays
- 🟩 Silt Mixtures
- 🟩 Sand Mixtures
- 🟫 Sands
- 🟧 Gravelly Sand to Sand
- ⬜ Stiff Sand to Clayey Sand
- ⬛ Very Stiff Fine Grained

Legend
- 🟥 CCS (Cont. sensitive clay like)
- 🟧 CC (Cont. clay like)
- 🟥 TC (Cont. transitional)
- 🟫 SC (Cont. sand like)
- 🟩 CD (Dil. clay like)
- 🟩 TD (Dil. transitional)
- 🟩 SD (Dil. sand like)

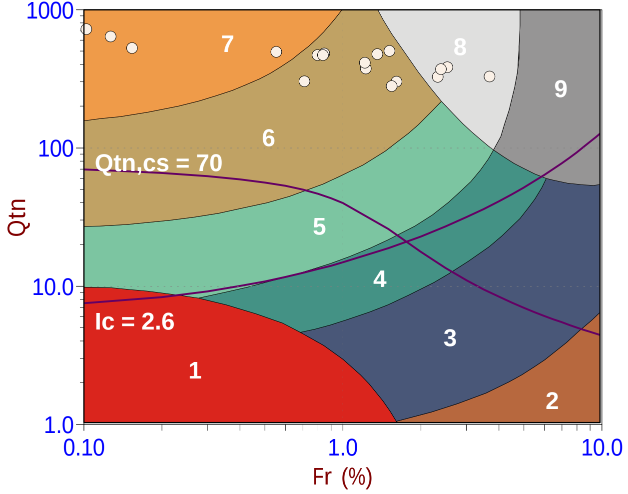
Legend
- 🟥 Sensitive Fines
- 🟫 Organic Soil
- 🟦 Clay
- 🟦 Silty Clay
- ⬛ Clayey Silt
- 🟩 Silt
- 🟩 Sandy Silt
- 🟨 Silty Sand/Sand
- 🟫 Sand
- 🟧 Gravelly Sand
- ⬜ Stiff Fine Grained
- ⬛ Cemented Sand

McPhail Associates

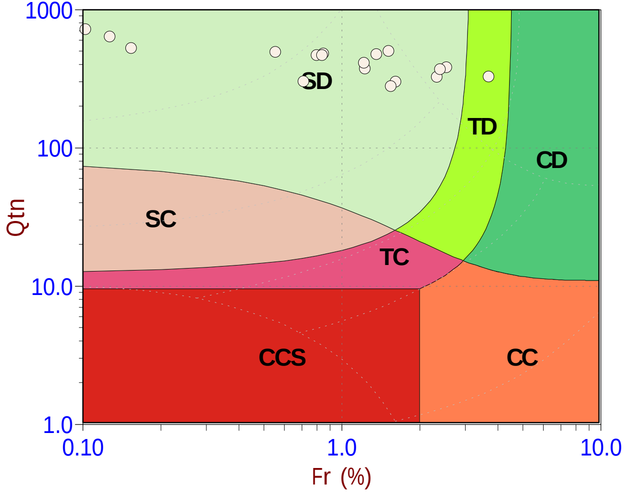
Job No: 21-53-22085
Date: 2021-03-17 12:08
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03A
Cone: EC597

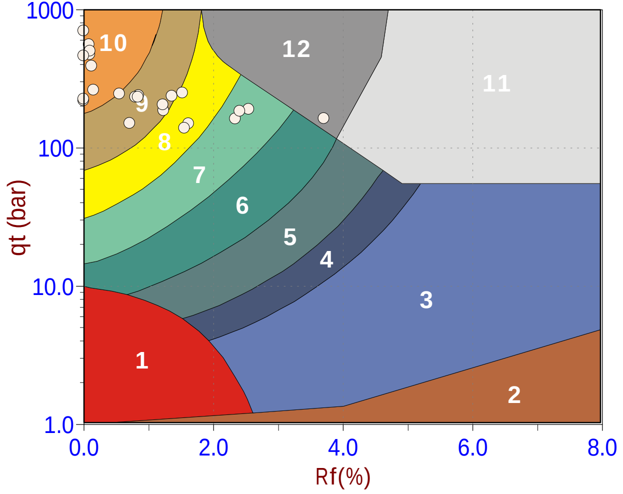
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges

- ● >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend

- ■ Sensitive, Fine Grained
- ■ Organic Soils
- ■ Clays
- ■ Silt Mixtures
- ■ Sand Mixtures
- ■ Sands
- ■ Gravelly Sand to Sand
- ■ Stiff Sand to Clayey Sand
- ■ Very Stiff Fine Grained

Legend

- ■ CCS (Cont. sensitive clay like)
- ■ CC (Cont. clay like)
- ■ TC (Cont. transitional)
- ■ SC (Cont. sand like)
- ■ CD (Dil. clay like)
- ■ TD (Dil. transitional)
- ■ SD (Dil. sand like)

Legend

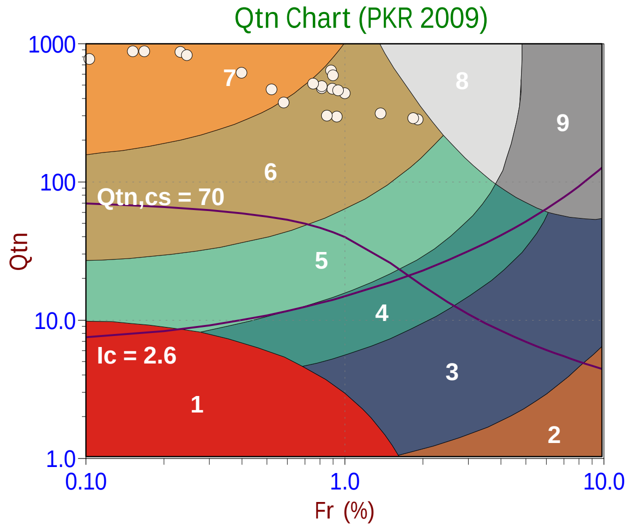
- ■ Sensitive Fines
- ■ Organic Soil
- ■ Clay
- ■ Silty Clay
- ■ Clayey Silt
- ■ Silt
- ■ Sandy Silt
- ■ Silty Sand/Sand
- ■ Sand
- ■ Gravelly Sand
- ■ Stiff Fine Grained
- ■ Cemented Sand

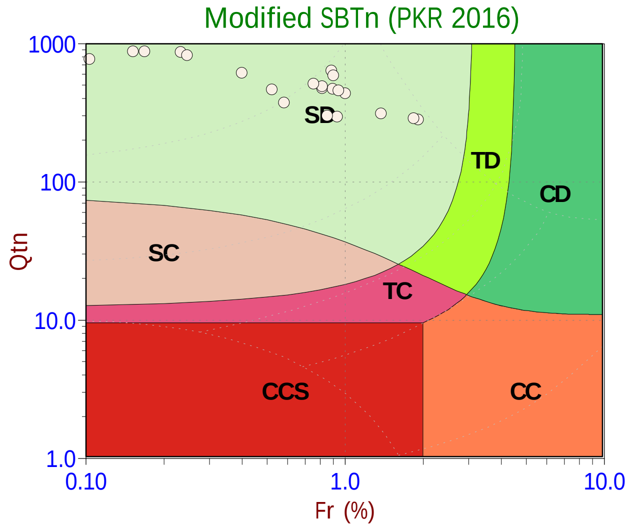
CONETEC

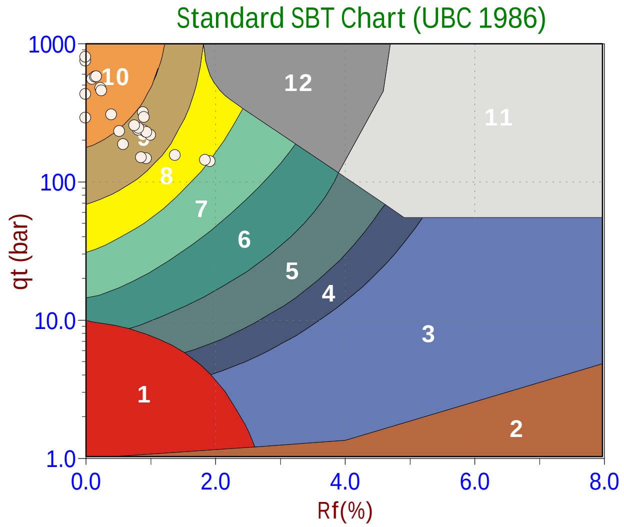
McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 12:17
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03B
Cone: EC597







Depth Ranges
- ○ >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend
- 🟥 Sensitive, Fine Grained
- 🟫 Organic Soils
- 🟦 Clays
- 🟩 Silt Mixtures
- 🟩 Sand Mixtures
- 🟫 Sands
- 🟧 Gravelly Sand to Sand
- ⬜ Stiff Sand to Clayey Sand
- ⬛ Very Stiff Fine Grained

Legend
- 🟥 CCS (Cont. sensitive clay like)
- 🟧 CC (Cont. clay like)
- 🟥 TC (Cont. transitional)
- 🟫 SC (Cont. sand like)
- 🟩 CD (Dil. clay like)
- 🟩 TD (Dil. transitional)
- 🟩 SD (Dil. sand like)

Legend
- 🟥 Sensitive Fines
- 🟫 Organic Soil
- 🟦 Clay
- 🟦 Silty Clay
- 🟩 Clayey Silt
- 🟩 Silt
- 🟩 Sandy Silt
- 🟨 Silty Sand/Sand
- 🟫 Sand
- 🟧 Gravelly Sand
- ⬜ Stiff Fine Grained
- ⬛ Cemented Sand

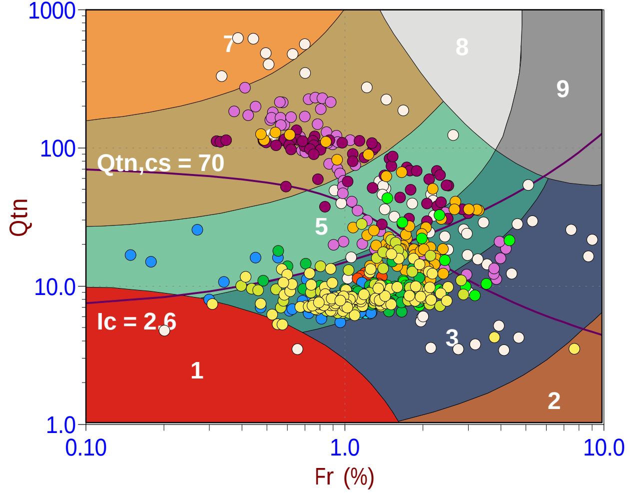
CONETEC

McPhail Associates

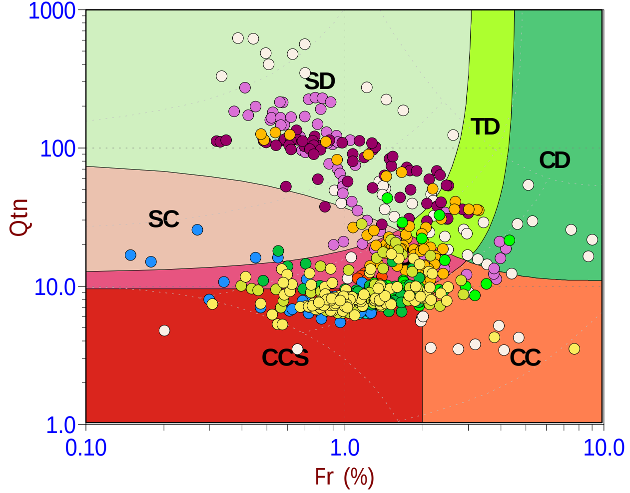
Job No: 21-53-22085
Date: 2021-03-17 12:30
Site: Walden Square Apartments, Cambridge, MA

Sounding: SCPT21-03C
Cone: EC597

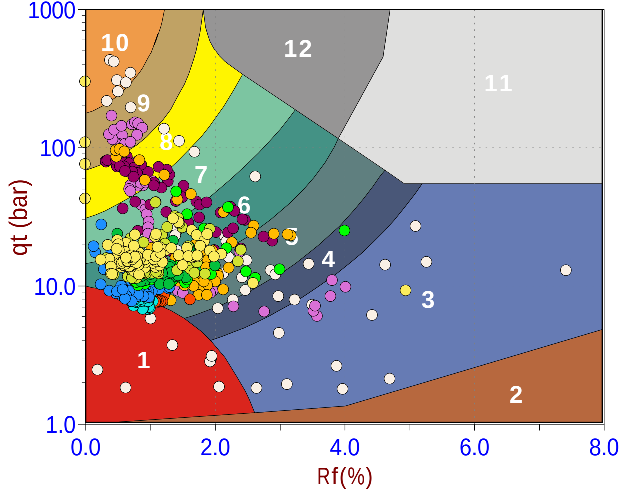
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges

- ● >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend

- 🟥 Sensitive, Fine Grained
- 🟫 Organic Soils
- 🟦 Clays
- 🟩 Silt Mixtures
- 🟩 Sand Mixtures
- 🟫 Sands
- 🟧 Gravelly Sand to Sand
- ⬜ Stiff Sand to Clayey Sand
- ⬛ Very Stiff Fine Grained

Legend

- 🟥 CCS (Cont. sensitive clay like)
- 🟧 CC (Cont. clay like)
- 🟥 TC (Cont. transitional)
- 🟫 SC (Cont. sand like)
- 🟩 CD (Dil. clay like)
- 🟩 TD (Dil. transitional)
- 🟩 SD (Dil. sand like)

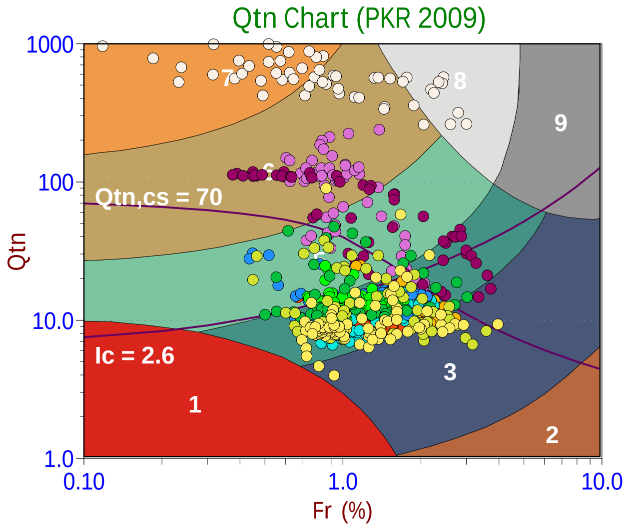
Legend

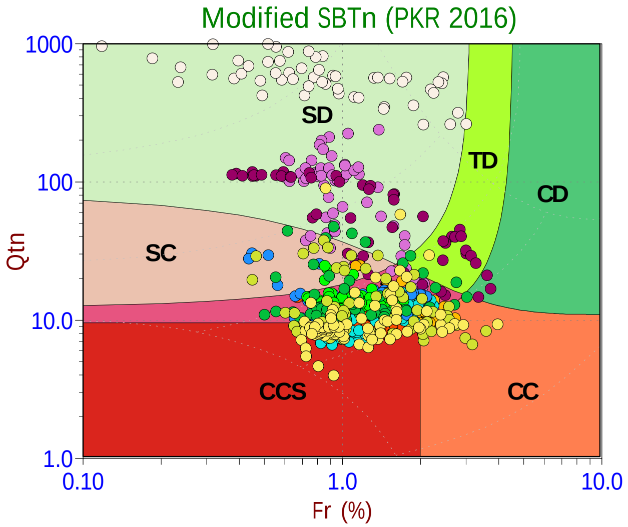
- 🟥 Sensitive Fines
- 🟫 Organic Soil
- 🟦 Clay
- 🟦 Silty Clay
- 🟩 Clayey Silt
- 🟩 Silt
- 🟩 Sandy Silt
- 🟨 Silty Sand/Sand
- 🟫 Sand
- 🟧 Gravelly Sand
- ⬜ Stiff Fine Grained
- ⬛ Cemented Sand

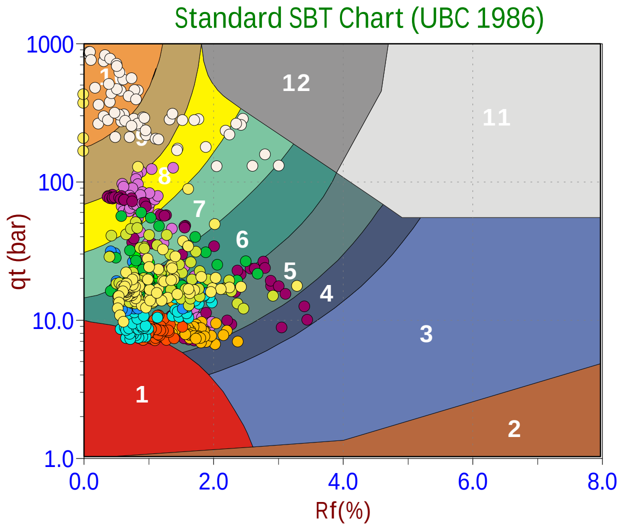
CONETEC

McPhail Associates

Job No: 21-53-22085
Date: 2021-03-17 10:21
Site: Walden Square Apartments, Cambridge, MA
Sounding: CPT21-04
Cone: EC597







Depth Ranges
- ● >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend
- 🟥 Sensitive, Fine Grained
- 🟫 Organic Soils
- ■ Clays
- ■ Silt Mixtures
- ■ Sand Mixtures
- ■ Sands
- 🟧 Gravelly Sand to Sand
- ■ Stiff Sand to Clayey Sand
- ■ Very Stiff Fine Grained

Legend
- 🟥 CCS (Cont. sensitive clay like)
- 🟧 CC (Cont. clay like)
- ■ TC (Cont. transitional)
- ■ SC (Cont. sand like)
- 🟩 CD (Dil. clay like)
- ■ TD (Dil. transitional)
- ■ SD (Dil. sand like)

Legend
- 🟥 Sensitive Fines
- 🟫 Organic Soil
- 🟦 Clay
- ■ Silty Clay
- ■ Clayey Silt
- ■ Silt
- ■ Sandy Silt
- 🟨 Silty Sand/Sand
- ■ Sand
- 🟧 Gravelly Sand
- ■ Stiff Fine Grained
- ■ Cemented Sand

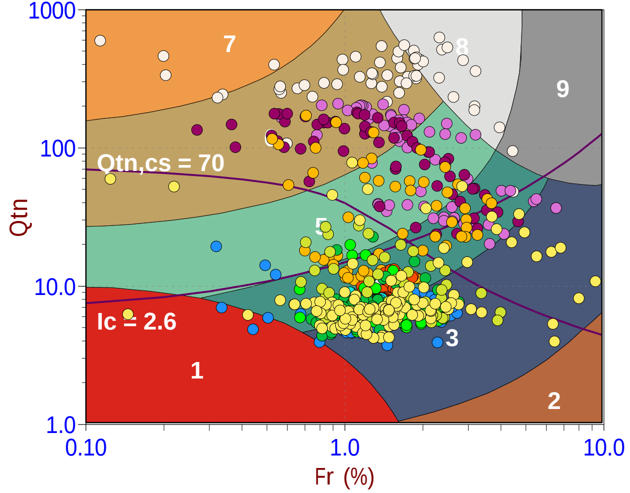
CONETEC

McPhail Associates

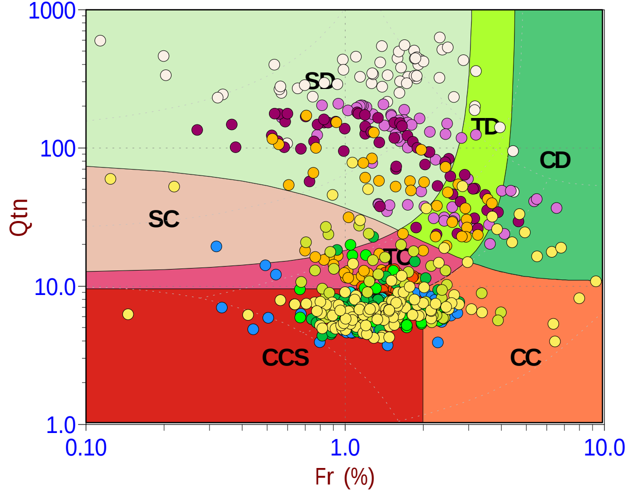
Job No: 21-53-22085
Date: 2021-03-17 02:48
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-05
Cone: EC597

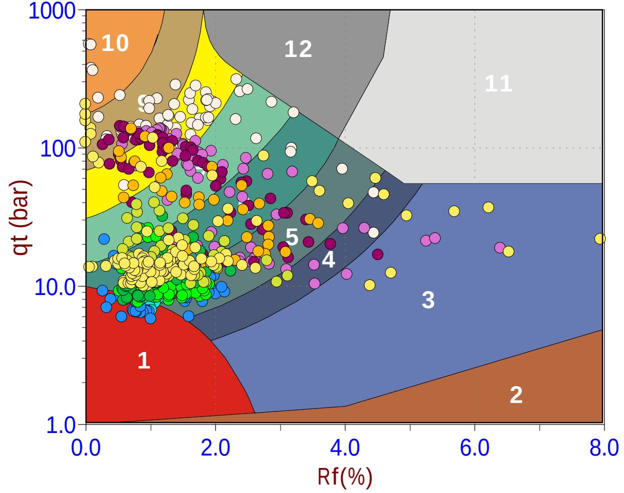
Qtn Chart (PKR 2009)



Modified SBTn (PKR 2016)



Standard SBT Chart (UBC 1986)



Depth Ranges

- ○ >0.0 to 5.0 ft
- ● >5.0 to 10.0 ft
- ● >10.0 to 15.0 ft
- ● >15.0 to 20.0 ft
- ● >20.0 to 25.0 ft
- ● >25.0 to 30.0 ft
- ● >30.0 to 35.0 ft
- ● >35.0 to 40.0 ft
- ● >40.0 to 45.0 ft
- ● >45.0 to 50.0 ft
- ● >50.0 ft

Legend

- 🟥 Sensitive, Fine Grained
- 🟫 Organic Soils
- ▨ Clays
- 🟩 Silt Mixtures
- 🟩 Sand Mixtures
- 🟫 Sands
- 🟧 Gravelly Sand to Sand
- ⬜ Stiff Sand to Clayey Sand
- ▨ Very Stiff Fine Grained

Legend

- 🟥 CCS (Cont. sensitive clay like)
- 🟧 CC (Cont. clay like)
- 🟥 TC (Cont. transitional)
- ▨ SC (Cont. sand like)
- 🟩 CD (Dil. clay like)
- 🟩 TD (Dil. transitional)
- 🟩 SD (Dil. sand like)

Legend

- 🟥 Sensitive Fines
- 🟫 Organic Soil
- 🟦 Clay
- ▨ Silty Clay
- ▨ Clayey Silt
- 🟩 Silt
- 🟩 Sandy Silt
- 🟨 Silty Sand/Sand
- 🟫 Sand
- 🟧 Gravelly Sand
- ⬜ Stiff Fine Grained
- ▨ Cemented Sand

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

ConeTec

Job No: 21-53-22085
Client: McPhail Associates
Project: Walden Square Apartments, Cambridge, MA
Start Date: 17-Mar-2021
End Date: 17-Mar-2021

CPTu PORE PRESSURE DISSIPATION SUMMARY

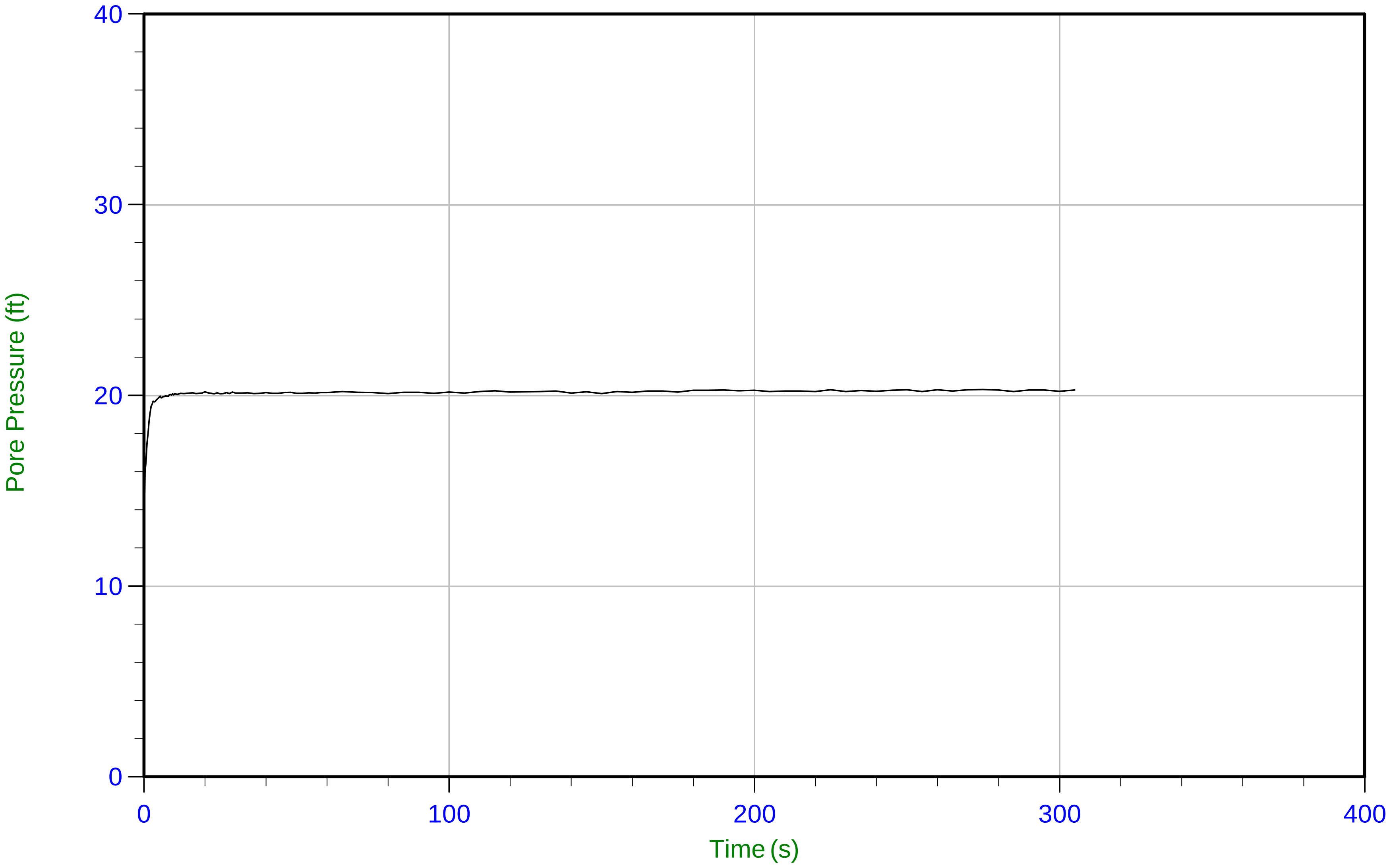
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)	Estimated Phreatic Surface (ft)	t_{50} [a] (s)	Assumed Rigidity Index (I_r)	c_h [b] (cm^2/min)
CPT21-01	21-53-22085_CP01	15	305	27.64	20.3	7.4				
CPT21-02	21-53-22085_CP02	15	500	59.96	54.7	5.3				
CPT21-04	21-53-22085_CP04	15	610	57.74	52.7		5.0	145	100	4.8
Totals	3 dissipations		23.6 min							

a. Time is relative to where umax occurred.
b. Houlsby and Teh, 1991.

McPhail Associates

Job No: 21-53-22085
Date: 03/17/2021 09:00
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-01
Cone: EC597 Area=15 cm²



Trace Summary:

Filename: 21-53-22085_CP01.ppd2
Depth: 8.425 m / 27.641 ft
Duration: 305.0 s

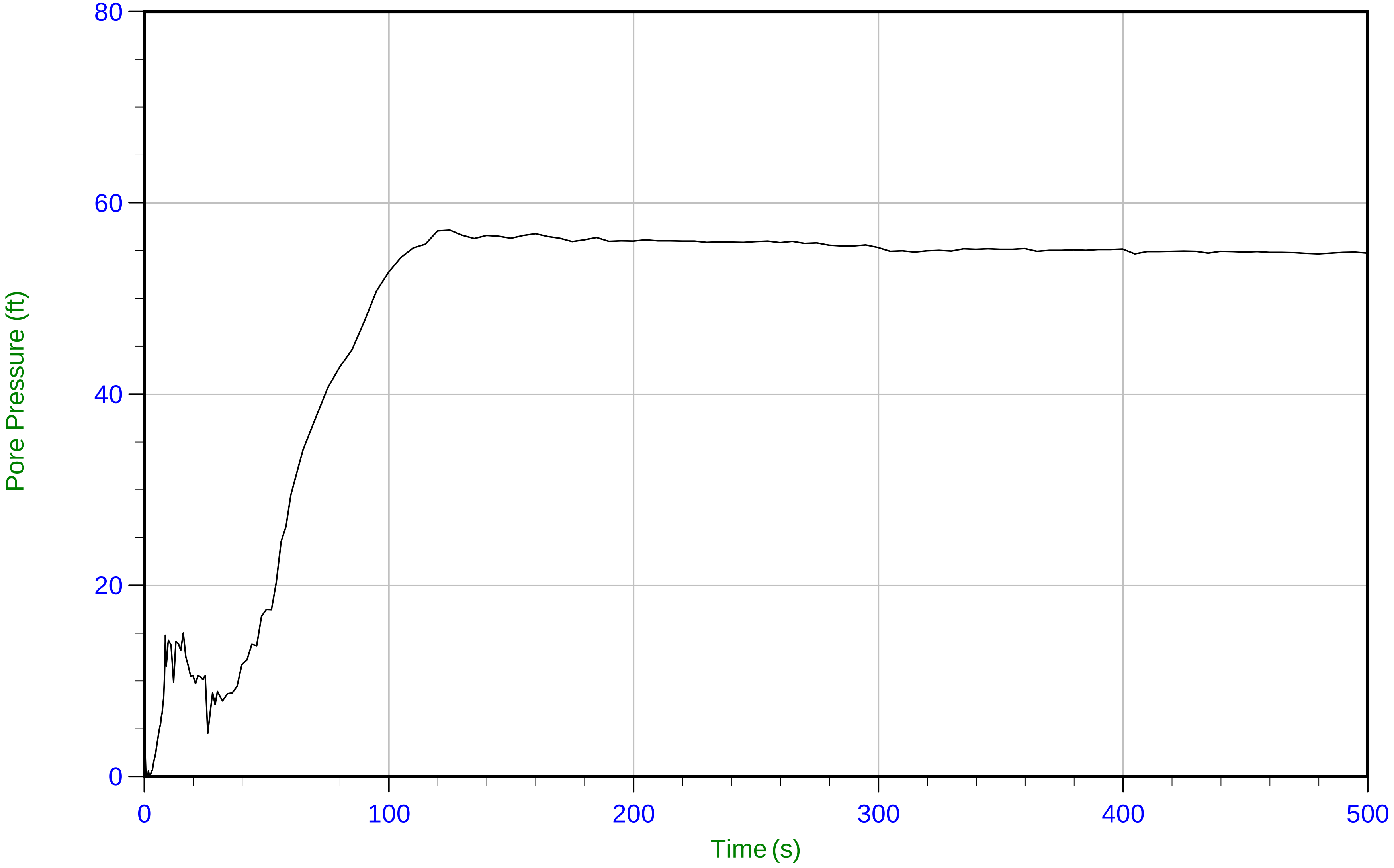
u Min: 12.8 ft
u Max: 20.3 ft
u Final: 20.3 ft

WT: 2.251 m / 7.385 ft
Ueq: 20.3 ft

McPhail Associates

Job No: 21-53-22085
Date: 03/17/2021 07:31
Site: Walden Square Apartments, Cambridge, MA

Sounding: CPT21-02
Cone: EC597 Area=15 cm²

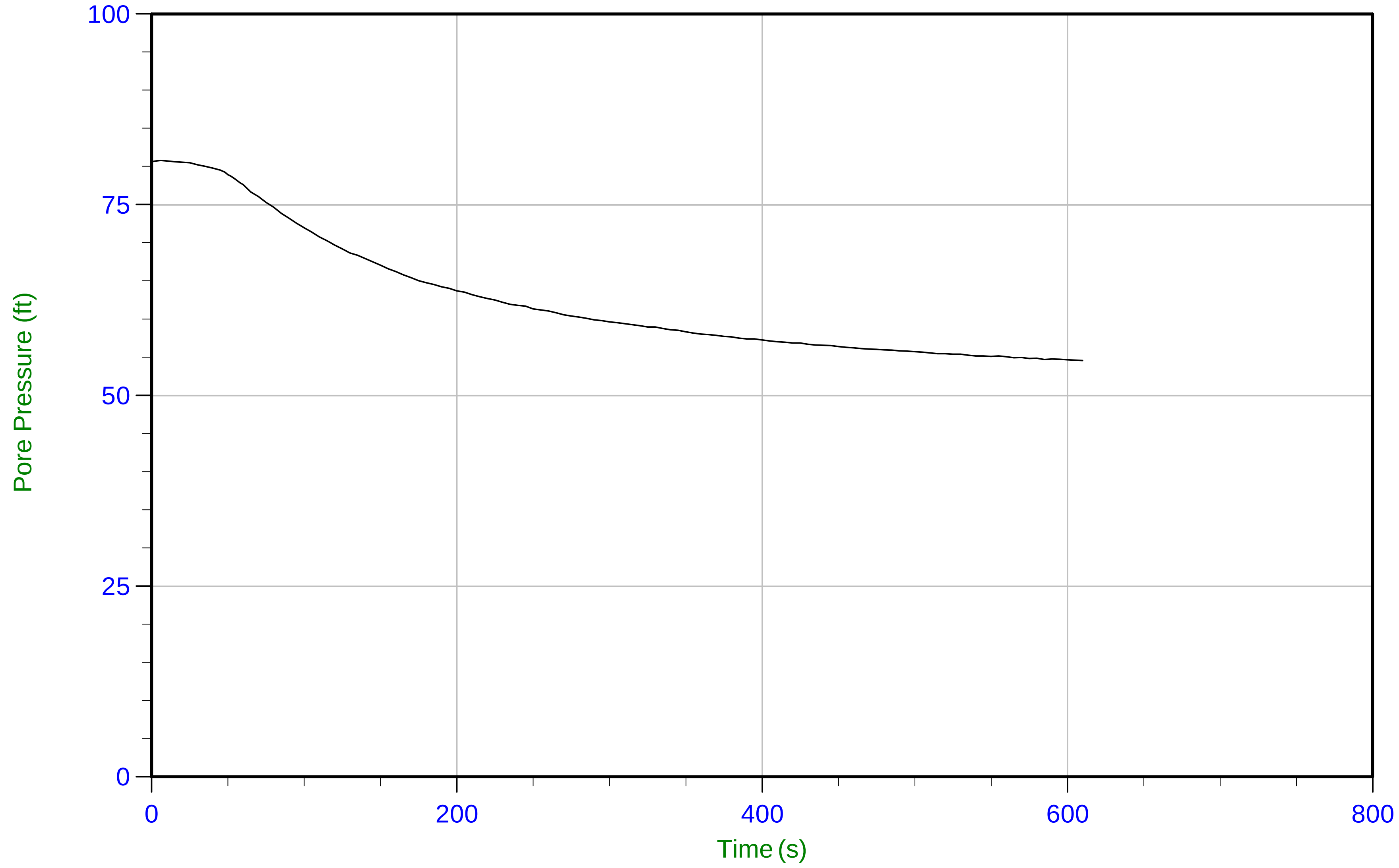


Trace Summary:

Filename: 21-53-22085_CP02.ppd2
Depth: 18.275 m / 59.957 ft
Duration: 500.0 s

u Min: -0.5 ft
u Max: 57.2 ft
u Final: 54.8 ft

WT: 1.605 m / 5.266 ft
Ueq: 54.7 ft



Trace Summary:

Filename: 21-53-22085_CP04.ppd2
Depth: 17.600 m / 57.742 ft
Duration: 610.0 s

u Min: 54.6 ft
u Max: 80.8 ft
u Final: 54.6 ft

WT: 1.524 m / 5.000 ft
Ueq: 52.7 ft
U(50): 66.78 ft

T(50): 147.2 s
Ir: 100
Ch: 4.8 cm²/min

APPENDIX D:

LOGS OF PREVIOUS BORINGS

TEST BORING REPORT

BORING # : MW-1

GREEN ENVIRONMENTAL

216 Ricciuti Drive, Quincy, MA 02169
Telephone (617)479-0550 Fax (617)479-5150
Hazardous Waste Management - Consulting/Contracting Services

PROJECT: Walden Square Apartments

LOCATION: Cambridge, MA

CONTRACTOR: Green Environmental, Inc.

JOB NUMBER: 3286

CLIENT: Walden Square Apartment Co.

DRILLER: F. Doyle

FIELD REP: A. Paulson

	SAMPLER	CASING	CORE BARREL
TYPE	Split Spoon	HSA	
SIZE (ID)	1 3/8"	4.25"	
HAMMER WEIGHT	140#		---
HAMMER FALL	30"		---

DEPTH TO GROUNDWATER				
DATE				
TIME				
DEPTH				
CASING @				

DEPTH (feet)	SAMPLE No	SAMPLE DEPTH	SAMPLE PEN/REC	SAMPLE BLOWS/6"	GW LEVEL	DESCRIPTION OF MATERIALS	PID ppm
	1	0' - 2'	24"/12"	22-16-26-16		Dense, brown, coarse to medium SAND and medium to fine GRAVEL. Little brick fragments, glass, wood.	0.0
5	2	5' - 7'	24"/6"	3-7-3-4		Medium dense, grey/black, coarse to fine SAND. Some ash and cinders. Little silt. Trace gravel, brick fragments, wood.	0.0
10	3	10' - 12'	24"/18"	5-5-5-8	▼	Medium stiff, grey, SILT. Some fine sand.	0.0
15	4	15' - 17'	24"/14"	1-2-1-3		Soft, grey, SILT. Some clay (at 17'). Trace fine sand.	0.0
						Bottom of Exploration at 18'	
20							
25							
30							

DRILLING RIG TYPE: Mobil B-61

MONITORING WELL INSTALLED: Yes

RISER FROM: 0' TO: 8' SCREEN FROM: 8' TO: 18'

SURFACE ELEVATION:

START DATE: February 19, 1997

END DATE: February 19, 1997

PROPORTIONS USED		COHESIONLESS DENSITY		COHESIVE DENSITY		SUMMARY	
Trace	0-10%	0-4	Very Loose	0-2	Very Soft		
Little	10-20%	4-10	Loose	2-4	Soft	Overburden (feet):	18'
Some	20-35%	10-30	Medium Dense	4-8	Medium Stiff	Rock Cored (feet):	--
And	35-50%	30-50	Dense	8-15	Stiff	# of samples: 1	4
		50+	Very Dense	15-30	Very Stiff	Well set (feet):	18'
				30+	Hard		

TEST BORING REPORT

BORING # : MW-2

GREEN ENVIRONMENTAL

216 Ricciuti Drive, Quincy, MA 02169
Telephone (617)479-0550 Fax (617)479-5150
Hazardous Waste Management - Consulting/Contracting Services

PROJECT: Walden Square Apartments

LOCATION: Cambridge, MA

CONTRACTOR: Green Environmental, Inc.

JOB NUMBER: 3286

CLIENT: Walden Square Apartment Co.

DRILLER: F. Doyle

FIELD REP: A. Paulson

	SAMPLER	**CASING**	**CORE BARREL**
TYPE	Split Spoon	HSA	
SIZE (ID)	1 3/8"	4.25"	
HAMMER WEIGHT	140#		---
HAMMER FALL	30"		---

DEPTH TO GROUNDWATER				
DATE				
TIME				
DEPTH				
CASING @				

DEPTH (feet)	**SAMPLE** No	**SAMPLE** DEPTH	**SAMPLE** PEN/REC	**SAMPLE** BLOWS/6"	**GW LEVEL**	**DESCRIPTION OF MATERIALS**	**PID** ppm
	1	0' - 2'	OA	OA		Brown, coarse to fine SAND. Some medium to fine gravel.	0.0
5	2	5' - 7'	24"/3"	1/12"-1/12"		Very loose, grey, medium to fine SAND. Trace fine gravel, silt.	0.0
					▼		
10	3	10' - 12'	24"/4"	1/12"-1/12"		Very loose, grey, ASH and CINDERS. Little silt.	0.0
15	4	15' - 17'	24"/5"	1/12"-1/12"		Very loose, grey, ASH and CINDERS. Little silt.	0.0
						Bottom of Exploration at 17'	
20							
25							
30							

DRILLING RIG TYPE: *Mobil B-61*

MONITORING WELL INSTALLED: Yes

RISER FROM: 0' TO: 5' SCREEN FROM: 5' TO: 15'

SURFACE ELEVATION:

START DATE: February 19, 1997

END DATE: February 19, 1997

PROPORTIONS USED		COHESIONLESS DENSITY		COHESIVE DENSITY		SUMMARY	
Trace	0-10%	0-4	Very Loose	0-2	Very Soft		
Little	10-20%	4-10	Loose	2-4	Soft	Overburden (feet):	17'
Some	20-35%	10-30	Medium Dense	4-8	Medium Stiff	Rock Cored (feet):	--
And	35-50%	30-50	Dense	8-15	Stiff	# of samples: 1	4
		50+	Very Dense	15-30	Very Stiff	Well set (feet):	15'
				30+	Hard		

APPENDIX E:

GROUNDWATER MONITORING REPORTS

Groundwater Monitoring Report

Well I.D.: MA-3
Project: Walden Square Apartments
Location: Cambridge, MA
Project No.: 7160
Elev. Datum: Cambridge City Base

Road Box Elev.: +25.2
Top of PVC Elev.:
Top of Well Screen Elev.:
Bot. of Well Screen Elev.:
Well Diameter:

Date	Time	Elapsed Time	Depth from Road Box (feet)	Groundwater Elev. (feet)	McPhail Representative	Comments
03/24/21		Initial	8.5	+16.7	JDM	Initial Reading
03/25/21		1 Day(s)	8.5	+16.7	JDM	
03/26/21		2 Day(s)	8.4	+16.8	JDM	
03/30/21		6 Day(s)	8.7	+16.5	JDM	
05/24/21	12:15 PM	61 Day(s)	8.5	+16.7	LE	

Groundwater Monitoring Report

Well I.D.: MW-2
Project: Walden Square Apartments
Location: Cambridge, MA
Project No.: 7160
Elev. Datum: Cambridge City Base

Road Box Elev.: +23.0
Top of PVC Elev.:
Top of Well Screen Elev.:
Bot. of Well Screen Elev.:
Well Diameter:

Date	Time	Elapsed Time	Depth from Road Box (feet)	Groundwater Elev. (feet)	McPhail Representative	Comments
05/24/21	12:20 PM	Initial	7.5	+15.5	LE	Initial Reading