



PRELIMINARY GEOTECHNICAL REPORT

**COMBINED SEWER OVERFLOW
LONG-TERM CONTROL PLAN UPDATE
BELLIS CIRCLE FACILITY/TANK**

**CITY OF CAMBRIDGE, MASSACHUSETTS
DEPARTMENT OF PUBLIC WORKS**

June 02, 2025

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A Report Prepared for:

Board of Public Works
City of Cambridge, Massachusetts
147 Hampshire St.
Cambridge, MA 02139

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1 INTRODUCTION

1.1 GENERAL

The objective of this preliminary geotechnical report is to present the results of Kleinfelder’s geotechnical subsurface exploration program, and to provide geotechnical design recommendations and construction considerations for the proposed City of Cambridge - Department of Public Works (the Client) Combined Sewer Overflow Long-Term Control Plan Update – Bellis Circle Facility/Tank project (the Project) planned in Cambridge, Massachusetts. This report summarizes the results of our subsurface exploration program, which included soil borings, slug testing, and laboratory testing performed on selected soil samples obtained from the test borings, per the executed contract titled “House Doctor Engineering Service for On-Going Combined Sewer Overflow Long-Term Control Plan with Amendment #1” dated February 2025.

This report was prepared in general accordance with the provision of the Massachusetts amendments to the 2021 International Building Code (IBC), 10th Edition (collectively MSBC, i.e., the Code). This report is subject to the Limitations included herein and the Limitations Section included in **Appendix E**.

Unless otherwise specified, in this report, latitude and longitude are referenced to the Massachusetts State Plane Coordinate System (Main Zone)/North American Datum of 1983 (NAD83) horizontal datum. Elevations (El.) provided in this report reference to Cambridge City Vertical Datum (CCVD) and are in feet. Approximate elevations are based on the survey of “Existing condition of Sherman Street Cambridge, Massachusetts” plan prepared by WSP Inc., dated May 23, 2025. The approximate location of the site in relation to the surrounding area is presented as a vicinity map provided in **Figure 1**.

1.2 BACKGROUND INFORMATION

Our understanding of the proposed project is based on the following documents:

- Contract titled “House Doctor Engineering Service for On-Going Combined Sewer Overflow Long-Term Control Plan with Amendment #1” executed between the City of Cambridge Department of Public Works and Kleinfelder Inc. in March 2025.
- Survey drawing titled “Existing Condition Survey Sherman St Cambridge, Massachusetts” prepared by WSP USA Inc, dated May 23, 2025.
- Report titled “Phase I Environmental Site Assessment – 41 Bellis Circle” prepared by Kleinfelder Inc., dated August 11, 2023 (the Phase I ESA).
- Report titled “Permanent Solution with No Condition Statement and Release Abatement Measure Completion” prepared by EBI Consulting, dated October 2016.

1.3 EXISTING CONDITIONS

The site consists of a parcel located at 41 Bellis Circle in Cambridge, Massachusetts. The parcel is bound by Sherman Street to the east, Bellis Circle to the south, residential properties to the west, and the Massachusetts Bay Transportation Authority commuter rail (Fitchburg Line) to the north. The existing parcel is comprised of an asphalt parking lot surrounded by a perimeter chain link fence. The site grades are relatively flat with elevations ranging between approximately elevation (El.) 25 and 27 feet. The existing conditions are shown on the attached **Figure 2**.

Based on our review of the Phase I ESA, it is understood that the site was previously developed as the West Cambridge Depot, which included two railroad spurs as early as 1900 until 1934. By 1935, the site had been redeveloped by Diamond Coal Company which consisted of a coal storage area and adjacent structure with a small footprint. The Diamond Coal Company reportedly operated until late 1960’s and all buildings and underground storage were demolished in the early 1980’s. In August 2016, an area of contaminated soil was excavated from the parking lot under a Release Abatement Measure (RAM) plan. The average depth of the excavation was approximately 13 to 15 feet below the ground surface (bgs). The approximate disposal site boundary and historic building footprints are shown on the attached **Figure 2**.

1.4 PROPOSED CONSTRUCTION

The Project is currently in the conceptual stage of design. Based on architectural drawings prepared by HKT Architects and dated August 2023, the proposed development is expected to include the construction of a new two-story building with a ground-level parking area and an upper-level office space, as well as an exterior surface parking lot. The proposed construction also includes a 1 to 2 million-gallon underground wet weather storage tank and pump station, which could extend between approximately 15 to 20 ft below grade to receive stormwater from Sherman Street. The building and tank footprints, structural loading, and proposed grades for the Project were not available at the time of this report. The existing conditions are shown on **Figure 2**.

2 SUBSURFACE EXPLORATIONS AND SUBSURFACE CONDITIONS

2.1 PREVIOUS EXPLORATIONS COMPLETED BY OTHERS

A subsurface exploration program was performed by CDM Smith for the City as part of the “Danehy Park Environmental Assessment” in October 2024. One test boring, designated MW-102S, was completed within the project site and completed as a monitoring well. The subsurface conditions encountered are consistent with our recent subsurface investigation program. The monitoring well installation log for MW-102S is provided in **Appendix A**.

2.2 SUBSURFACE EXPLORATIONS AND SUBSURFACE CONDITIONS

A subsurface exploration program was performed by Kleinfelder within the proposed project limits between April 7 and 11, 2025. An overview of the locations of the explorations performed at the site are shown on **Figure 3**. The boring logs from the subsurface exploration program are provided in **Appendix B**.

2.2.1 Test Borings

Between April 7 and April 11, 2025, Kleinfelder retained Soil X Corporation of Leominster, Massachusetts to advance four (4) test borings, designated KLF-1 through KLF-4, using a truck mounted drill rig using a combination of soft digging, hollow stem auger, and drive and wash drilling techniques. A 4-inch and a 3-inch inside diameter (ID) casing was used during drilling to

advance the boreholes. The depths of the borings ranged between approximately 26 and 65.25 feet below ground surface (bgs).

Prior to the start of drilling, a Kleinfelder representative marked the test borings in the field and contacted the driller to notify Digsafe to locate underground utilities. Soft digging was performed using vacuum excavation methods at all borings to a depth of approximately 6 feet bgs, to ensure the boring locations were clear from subsurface utilities. Soft digging included a combination of air-hammer, vacuum excavation, and hand-tool digging.

Standard Penetration Test's (SPT's), in general accordance with ASTM D1586, were performed during drilling. Standard penetration testing entails driving a 1.38-inch ID (approximately 2-inch outside diameter - OD) split spoon sampler into a soil layer using a 140-lb weight (hammer) dropping freely from a height of 30 inches and recording the number of hammer blows (blow count) for four (4) consecutive advancements of the split spoon measuring 6 inches each, for a total advancement of the split spoon of 24 inches. An automatic hammer was used to complete SPTs for this project. Split spoon samples were obtained continuously from the bottom of vacuum excavation to a depth of 12 feet bgs and at standard five-foot intervals thereafter. A photoionization detector (PID) was used to screen the headspace of the soil samples collected during explorations and the screening results are shown on the test boring logs.

Test boring KLF-3 was completed as groundwater monitoring well. Upon drilling completion, Soil X Corporation backfilled the test borings with soil cuttings and restored the ground surface with cold patch bituminous pavement. The test boring completed as a monitoring well was finished with a concrete road box for future observation. The monitoring well installation details are shown in **Appendix B**.

A Kleinfelder engineer performed full-time drilling observations during the subsurface exploration program. The Kleinfelder engineer prepared boring logs that included the blow counts recorded during the SPTs; a description of the soil samples in general accordance with the Unified Soil Classification System (USCS). Soil samples collected during drilling were stored in sealed soil jars and brought to the Kleinfelder office for review by a senior geotechnical engineer and selected for geotechnical laboratory testing.

2.2.2 Hydraulic Conductivity Testing

On April 30, 2025, Kleinfelder performed in-situ hydraulic conductivity (k) testing on monitoring wells, MW-102S and KLF-3, to evaluate hydraulic conductivity of the underlying natural silty sand and sand with silt utilizing both falling head and rising head slug test methods. The tests were performed in accordance with ASTM Standard D4044/D4044M, "Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug Tests) for Determining Hydraulic Properties of Aquifers". The slug tests utilized a plastic slug and transducer to collect the data. The data was post-processed using methods by Bouwer Herman and Rice, R.C. (1976) and Hyder et al. (1994), also known as the KGS (Kansas Geological Survey) Model.

2.3 LABORATORY TESTING

Geotechnical laboratory testing was performed on select soil samples from the test borings to evaluate engineering soil properties and confirm soil classification. The geotechnical laboratory testing was performed by GeoTesting Express Inc. of Acton, Massachusetts. The following lab tests were completed:

- Five (5) grain size analyses (ASTM D6913),
- Two (2) hydrometer analyses (ASTM 7928),
- Three (3) moisture content tests (ASTM D2216),
- Three (3) Atterberg limits (ASTM D4318)

The results of the laboratory tests are included on the test boring logs and copies of the laboratory test results are included in **Appendix C**.

2.4 SUBSURFACE CONDITIONS

The generalized subsurface conditions described below summarize trends observed in the borings at the time of drilling. Actual subsurface conditions between borings could be more variable. The boundaries between soil strata presented in the boring logs are based on observations during drilling and on widely spaced soil samples and should be considered approximate.

2.4.1 Soil Stratigraphy

Surficial Material: Approximately 2.5 inches of asphalt was encountered in all test borings.

Granular Fill: Variable density inorganic, granular fill was encountered below the asphalt and generally extended to depths between approximately 2 to 5 feet bgs. Deeper fill was encountered at KLF-3, which extended to 14 feet bgs and is likely associated with the UST excavation. The granular fill was generally described as silty sand or as poorly graded sand with various amounts of silt or poorly graded gravel with various amounts of silt and sand. The fill contained trace amounts of deleterious material including bricks, rubbles and roots.

Silty Sand / Sandy Silt: Beneath the fill, a deposit of very loose to medium dense silty sand or sandy silt was encountered in borings KLF-1, KLF-2, and KLF-4. This layer was generally described as silty sand, silt with sand, or sandy silt and ranged in thickness between approximately 8 and 9 feet.

Boston Blue Clay: A deposit of Boston Blue Clay (BBC) was encountered beneath the fill layer in boring KLF-3 and beneath the sandy silt and/or silty sand layer in borings, KLF-1, KLF-2, and KLF-4. The BBC generally consists of very soft to stiff clay with varying silt content, and intermittent sand and gravel seams. The thickness of this layer ranged between approximately 12 and 49 feet. A medium stiff to stiff crust was observed at the top of the clay layer and ranged in thickness between approximately 7 and 21 feet.

Glacial Till: Glacial till layer was encountered beneath the BBC, in boring KLF-2, at approximately El. -48 feet. The glacial till consists of a very dense poorly graded gravel with varying amounts of silt and sand.

It should be noted that layers in these test borings were not fully penetrated and were terminated in the clay and glacial till layers. Therefore, the thickness of these layers may be greater than what was observed.

2.4.2 Groundwater

On April 30, 2025 stabilized groundwater measurements were collected from existing monitoring wells designated KLF-3 and MW-102S. Depth to groundwater varied from approximately 7.4 to 8.3 feet bgs. The series of groundwater measurements are shown on **Table 2** and the locations of the wells are shown on **Figure 2**.

Groundwater measurements noted on the borings logs (not completed as monitoring wells) were taken during drilling and should not be considered to be representative of stabilized groundwater levels. It should be noted groundwater levels will vary depending on seasonal variations in temperature and precipitation and can also be influenced by subsurface utilities, construction activities and other factors.

3 GEOTECHNICAL CONSIDERATIONS

The primary geotechnical issues associated with the design of the proposed development based on the subsurface conditions observed in the borings are as follows:

Previously Developed Site: Based on the review of historic site use, the remnants of demolition of the historical structures may be encountered during excavations for the proposed development. Underground obstructions such as foundation elements and/or abandoned utility lines may be present. Utility lines, if encountered within the building or storage tank footprint, should be removed completely.

Presence of Variable Density Fill: Up to approximately 14 feet bgs of fill was encountered within KLF-3. The fill has variable density and may contain pockets of debris and other deleterious materials that are considered unsuitable for support of foundation elements. As such, care must be taken at the time of construction to evaluate the bottom of each foundation of buildings/facilities elevation as discussed herein. Weak or unsuitable materials identified at within the zone of influence of foundations should be removed and replaced with structural fill. Pre-excavation may be necessary prior to foundation or support of excavation installation to remove any potential obstructions.

Presence of Compressible Layer: A soft clay layer was encountered beneath the clay crust. This layer is susceptible to long-term, consolidation settlement and is considered unsuitable for structural support. Any material excavated in this layer may also be considered unsuitable for on-site re-use due to their high fines content.

Temporary Excavation Support: Temporary excavation support may be necessary if deeper excavations are needed for the underground storage tank. It is our opinion that support of excavation for the underground storage tank can be achieved by driving sheet piles, a secant pile system, or equivalent methods.

Dewatering: Dewatering will be necessary if construction is completed during wet period of the year for shallow foundations and for deeper excavations associated with storage tank construction. Dewatering may be achieved through pumps and filtered sumps. For deeper proposed excavations, dewatering methods are provided in Section 5.2.4 herein.

4 PRELIMINARY GEOTECHNICAL RECOMMENDATIONS

The analyses and recommendations included in this report are based on the data obtained from the relatively widely spaced borings and our understanding of the proposed project. The nature and extent of variations between explorations may not become evident until construction. If significant variations from the subsurface conditions observed in the borings appear during construction, or if changes occur in the design of the proposed structures, it will be necessary to re-evaluate the following recommendations.

4.1 GENERAL

4.1.1 Seismic Design Considerations

As prescribed by the Code, the Seismic Site Class (SSC) was determined in accordance with ASCE 7-16. The SSC was evaluated using the average SPT resistance method N-values from the borings. The design spectral response accelerations adjusted for Seismic Site Class E are summarized in **Table 1**.

TABLE 1 - SEISMIC DESIGN PARAMETERS

Design Parameter	Description	Recommended Value
SSC		E
S_{DS} (g)	5%-damped, numeric design spectral response accelerations at short period/0.2-second	0.431
S_{D1} (g)	5%-damped, numeric design spectral response accelerations at 1-second	0.186
PGA_M (g)	Site-modified peak ground acceleration value	0.344

4.1.2 Liquefaction Potential

Based on the soil and groundwater conditions encountered in the areas of the proposed buildings are not susceptible to liquefaction based on the criteria set forth in Section 1806.4 of the Code.

4.1.3 Design groundwater depth

The FEMA Flood Insurance Rate Map places the project site within the “Zone X-Area of Minimal Flood Hazard”. A 100-year flood elevation was not defined for this site. Based on groundwater measurements taken during drilling, we recommend using a design groundwater level of 7 feet below ground surface to calculate hydrostatic pressures.

4.1.4 Hydraulic Conductivity

The collected data from the in-situ slug testing was analyzed using AQTESOLV™ software, applying curve-matching or straight-line methods. The analysis methods were chosen based on the nature of aquifer condition, degree of well penetration and aquifer response. **Table 1** provides the estimated hydraulic conductivity for each monitoring well and soil type encountered.

TABLE 2: HYDRAULIC CONDUCTIVITY

Well ID	Material	Estimated Hydraulic Conductivity, k (cm/s)
MW-102S ⁽¹⁾	Sandy Silt	6×10^{-4} to 2×10^{-3}
KLF-3 ⁽²⁾	Fill	1×10^{-2} to 2×10^{-2}

Notes:

1. The hydraulic conductivity was estimated using KGS method
2. The hydraulic conductivity was estimated using Bouwer & Rice method

4.2 FOUNDATIONS

4.2.1 Building

The building foundations and below-grade structures should be designed and constructed in accordance with the Massachusetts State Building Code, 10th Edition which incorporates the International Building Code (IBC) 2021 with Massachusetts Amendments (Building Code).

We recommend that the proposed building structure be supported on conventional spread footings bearing on the natural silty sand or compacted structural fill placed over natural soils. Fill or sand Silt may need to be over-excavated depending on final loading of the proposed structure.

4.2.2 Bearing Capacity and Settlement

For building foundations constructed as recommended in this report, we recommend a net allowable bearing pressure of 4 kips per square foot (ksf) for spread footings bearing on silty sand or structural fill placed over the natural silty sand. At the recommended bearing capacity, the total and differential settlement is expected not to exceed 1 inch and ½-inch, respectively. The minimum recommended lateral dimension for isolated footings is 3 feet, while continuous wall footings should be at least 1.5 feet wide.

4.2.3 Frost Protection and Waterproofing

Footings founded on soils subject to frost heave should bear at least 4 feet below the lowest adjacent exterior grade; interior footings may bear 18 inches below exterior grade; however, consideration should be given to interior footings in unheated areas and interior footing depth should be increased, as necessary. A deeper embedment depth will increase conservatism against frost heave and allow more counterweight from backfill soil for uplift resistance. The design team should also take into consideration waterproofing or damp-proofing the tank based on the performance criteria. Waterproofing should be performed in accordance with Section 1805 of the Code, based on the design groundwater elevation provided herein (Section 4.2).

4.2.4 Sliding and Overturning

All footings and walls should be verified for sliding and overturning. For the sliding resistance analysis, a coefficient of friction equal to 0.55 should be used for concrete foundations on compacted structural fill or on ¾" crushed stone. A coefficient of friction equal to 0.40 should be used for cast-in-place concrete foundations bearing on the native silty sand or structural fill. Values for pre-cast concrete should be reduced by one-third. For sliding and overturning resistance, backfill unit weight should be 135 pcf assuming backfill is placed and compacted as described herein (Section 5). The minimum factors of safety for sliding and overturning under static loads should be 1.5. The minimum factors of safety for sliding and overturning under seismic loads may be reduced to 1.1.

4.2.5 Slab-on-Grade

Provided the subgrade soils are prepared as recommended herein; the slab may consist of a soil supported slab-on-grade. Slab subgrade preparation procedures and soil gradation and compaction requirements are provided in the Construction section below. After over excavation of the existing unsuitable soils from within the zone of influence of the building slab and replaced with structural fill or $\frac{3}{4}$ " crushed stone wrapped in non-woven geotextile, the building slab may be designed as a slab-on-grade bearing on 12 inches of Massachusetts Department of Transportation (MassDOT) Item M2.01.7 (Dense-graded Crushed Stone). For slab designs as a beam on an elastic foundation may be designed as a slab-on-grade to be bearing on over-excavated and replaced:

- Compacted structural fill with the recommended modulus of subgrade reaction, k_1 , of 150 pci, or
- Compacted $\frac{3}{4}$ " crushed stone with the recommended modulus of subgrade reaction, k_1 , of 200 pci.

Structural slabs should be designed and constructed in accordance with recommendations of ACI 318R-19 and Committee Reports 360 R-10 and 302.1 R-04.

The use of a vapor barrier may be considered beneath the interior floor slabs in areas with moisture sensitive flooring. If a vapor barrier is needed, the slab designer and slab contractor should refer to ACI 302.1R-15 for procedures and cautions about the use and placement of vapor barrier.

4.2.6 Lateral Earth Pressures

Support of excavation structures and the below grade tank will extend into the granular fill, silty sand, and clay layers. We recommend that below grade walls be preliminarily designed using the active, passive, and at-rest coefficients provided in **Table 3**.

TABLE 3 - SUMMARY OF LATERAL EARTH PRESSURE AND SOIL PARAMETERS

Soil Type	Unit Weight, γ_m (pcf)	Friction Angle, ϕ' (deg)	Triangular Pressure			Approx. Undrained Shear Strength S_u (psf)
			K_a (-)	K_p (-)	K_o (-)	
Granular Fill	120	30	0.33	3.00	0.50	-
Silty Sand	120	32	0.31	3.25	0.47	-
Sandy Silt	110	-	1.00	1.00	1.00	1,500
Clay	105	-	1.00	1.00	1.00	500
Structural Fill	135	36	0.26	3.85	0.47	-

- Hydrostatic water pressure along the height of the wall below groundwater should be included for walls with undrained backfill. Add a triangular groundwater pressure below the groundwater table using 62.4 pcf as the water unit weight if hydrostatic conditions are encountered.
 - Structures restrained from lateral movement, such as buried structures, or walls close to buried utilities, should be designed using the at-rest coefficient of earth pressure.
 - Passive earth pressures ($K_p=1/K_a$) should only be used where special measures or provisions are taken to prevent disturbance or future removal of the soil on the passive side of the wall, or in areas where the wall design includes a key.

Walls should also be designed to resist an earthquake force F_w evaluated in accordance with Section 1610.2 of the Code as follows:

- $F_w = 0.100 \times (S_s) \times (F_a) \times (\gamma_t) \times (H^2)$

Where:

- S_s is the spectral response acceleration parameters at 0.2-second period ($S_s=0.278$)
- F_a is the site coefficient from Table 1613.2.3(1) per the 2021 IBC ($F_a=2.321$ for Site Class E)
- γ_t is the soil total unit weight ($\gamma_t=135$ pcf for compacted structural fill, see above)
- H is the height of the wall.

The force resulting from active and passive earth pressure should be applied at a height of $H/3$ from the bottom of the base. The force resulting from surcharges behind the proposed wall should be applied at a height of $H/2$ from the bottom of the base. The force resulting from seismic shaking of the soil behind the proposed retaining wall should be applied at a height of $2/3 H$ from the bottom of the base.

4.3 UNDERGROUND STORAGE

If final loads and dimensions of the tank allow, the underground storage tank may be supported using a mat foundation floating on the clay crust. This foundation may bear on a concrete mud mat (to also be used as a working platform), or a minimum 18-inch thick bedding layer compacted structural fill or crushed stone extending down to the undisturbed natural clay layer. A geogrid or increased subgrade may be considered to reduce potential for differential settlement. Structures with below grade portions which extend below the groundwater table should consider upward buoyant forces which could be exerted on the base of the structures. If necessary, uplift forces can be counteracted by increasing structure dead loads.

4.3.1 Allowable Bearing Capacity and Settlement

For the underground storage tank, if a mat foundation is considered, we recommend a net allowable bearing pressure of 4 ksf and a modulus of subgrade reaction of 50 pci for the design of the slab bearing on clay crust. The underground storage tank should be evaluated for heaving (upward movement) as a result of the proposed excavations due to unloading. The structure should also be evaluated for final settlement when fully loaded for differential and total displacement on top of the clay crust. Shallow foundations bearing on this layer could pose differential and total settlement control challenges to design due to consolidation. The proposed structure bearing on the clay layer may also pose constructability challenges due to potential high volumes of unacceptable material which may require disposal. Further evaluation of the compressible clay layer and anticipated loading conditions should be used in conjunction with design considerations.

4.3.2 Deep Foundations

The underground storage tank may also be supported using deep foundations. Driven concrete piles or steel H-piles may be suitable to meet anticipated design loads. Deep foundation elements should be designed in accordance with Section 1810 of the Code. Should deep foundations be

pursued as a main option, we recommend one pile type be used for the underground storage tank, for ease of constructability.

4.4 PAVEMENT

Pavement areas should be constructed in accordance with guidelines and specifications provided by the Massachusetts Department of Transportation (MassDOT) Standard Specifications for Highways and Bridges: 2025 Edition.

Traffic loading and frequency was not provided at the time of this report. The following sections provide general recommendations regarding both standard duty and heavy duty pavement designs for each design scenario presented. **It is up to the project Civil Engineer to determine which thickness of pavement to use and where, based on the desired design life.**

4.4.1 Pavement Sections

The pavement design is intended to strike a balance between performance and cost in consideration of the soil available at the Site and anticipated traffic loads (passenger vehicles). We recommend the following (minimum) flexible pavement cross-sections for both standard and heavy-duty applications. These recommendations are made based on the 1993 AASHTO Design Guide for Pavement Structures developed by the American Concrete Pavement Association, our understanding of local and MassDOT design guidelines, and our experience on similar projects. Recommended pavement sections for the planned parking lot improvements are summarized in the following table.

TABLE 4: MINIMUM PAVEMENT DESIGN CRITERIA

Layer	Standard Duty	Heavy Duty
	Thickness (inches)	
Asphaltic Concrete Surface Course (MassDOT item M3.11.03)	2	2
Asphaltic Binder Course (MassDOT Item M3.11.03)	2	4
Aggregate Base Course (MassDOT Item 1.09.0) or Dense-graded Crushed Stone, (MassDOT Item M2.01.7)	12	12

4.4.2 General Construction Guidelines

Appropriate spacing of joints shall be required to control slab curling, thermal expansion and shrinkage cracking. The pavement should be isolated from adjacent foundations and utilities, and the pavement joints should be sealed against foreign materials and dowelled as required for facilitating load transfer. Sufficient reinforcement, filler, sealant and number of joints (such as isolation joint, contraction joint, expansion joint, longitudinal joint, transverse joint) should be placed in the rigid pavement slab in accordance with the latest MassDOT, AASHTO and ACI requirements.

At all times during construction, the subgrade and all ditches shall be constructed and maintained such that the roadbed will be effectively drained by means of positive drainage such as stub drains to inlets to prevent erosion.

The recommended pavement sections do not consider “staged” construction, where construction traffic “runs” on the base course and the final wearing surface is placed near project completion. Construction traffic running on the base course will more than likely result in base course failure. Pavement materials and construction methods should comply with the latest edition of the Massachusetts Department of Transportation (MassDOT) Highway Design Manual.

5 GEOTECHNICAL CONSTRUCTION CONSIDERATIONS

5.1 SITE PREPARATION

Remove pavement and topsoil, where applicable, from within the proposed excavation area. Care should be taken to avoid mixing of these materials with other excavated soils. Stockpile, transport and dispose all excavated material in accordance with Federal, State, and local regulations.

5.2 SITE EXCAVATIONS

5.2.1 General

Excavation should conform to OSHA health and safety standards for excavation contained in 29 CFR Part 1926, latest edition. Excavation height, depth and slope should conform to these OSHA standards and all local, State, and Federal safety regulations. As a safety measure, it is recommended that vehicles and soil piles be kept a minimum lateral distance of 5 feet from the edge of excavations. On-site construction safety is solely a responsibility of the Contractor. The information provided herein is provided as a service to our Client and should not be interpreted to mean that Kleinfelder is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

5.2.2 Excavation Equipment for Soil

It is anticipated that excavations for this project may be accomplished by using regular earth moving equipment (Caterpillar E320 excavator or similar).

5.2.3 Excavation Slopes and Support

We anticipate that building foundation excavations will be accomplished by sloping or benching the sides of the excavations. Cut slopes are recommended to be no steeper than 2 horizontal (H) to 1 vertical (V). Flatter slopes may be required once final design grades are established.

For the proposed underground storage tank, we anticipate an engineered support of excavation system is required (i.e., excavations 20 feet deep or greater). Possible engineered support of excavation systems include cantilevered systems such as soldier pile and lagging support of excavation. We recommend supporting the excavations with interlocked steel sheeting to control

groundwater seepage into the excavation. Based on the excavation depths, we anticipate one or more levels of internal bracing will be required. The engineered support of excavation systems should be selected by the Contractor and designed by an experienced Professional Engineer registered in the State of Massachusetts retained by the Contractor.

Trench boxes may be used for support of shallower, incidental excavations, but should be noted they do not provide continuous contact and can lead to sloughing or soil loss towards the excavation. Trench boxes are not recommended if utilities or structures sensitive to movement are located within a 1 horizontal (H) to 1 vertical (V) soil wedge extending from the bottom of the excavation base to the ground surface. Trench excavations for duct banks and utilities should be accomplished using shield systems such as trench boxes or slide rails. Shield systems are only for protection of workers during utility installation and should not be used as an engineered support of excavation for excavation extending within the zone of influence of existing or new structures. When advancing shield systems, the maximum unsupported trench height should not be more than 2 feet or as recommended by the Engineer.

The design of shoring systems must be provided by a qualified engineer registered in the Commonwealth of Massachusetts and experienced in the design and construction of shoring under similar conditions. The design must take into account lateral loading exerted by soil, groundwater, and surcharge loads such as sloped backfill, stockpiled soil, adjacent loading, and construction equipment as appropriate. Once the final excavation and shoring plans are complete, the plans and design should be reviewed by Kleinfelder for conformance with the design intent and geotechnical recommendations provided in this report.

5.2.4 Excavation Dewatering

Based on the groundwater levels measured in the borings, groundwater will be encountered during excavations of the proposed underground storage tank, but not likely for the proposed building and parking. Construction dewatering during excavation for the tank installation may be required and extend to a minimum depth of 2 feet below the proposed excavation subgrade.

If construction dewatering is required, dewatering may be accomplished by means of a series of sump pits and/or diversion trenches within and around excavations. Sumps should be provided with filters suitable to prevent pumping of fine-grained soil particles. Sumps should be located outside of the zone of influence of the proposed tank foundation. It is anticipated that most of the

construction dewatering for the tank will be from the silty sand and fill above the clay stratum for the underground storage tank, and generally in the fill later for the proposed building structure as needed. Installation and operation of the contractor's dewatering system should be integrated with other earthwork operations such as sequence of excavation, foundation construction, and backfilling. The contractor must control water seepage, precipitation, groundwater infiltration, and surface water inflow within the excavation and site at all times to minimize subgrade disturbance, maintain integrity of soil surfaces, and permit foundation and structure construction proceed in-the-dry. For the proposed building, we recommend temporary control measures be implemented to reduce the amount of surface water (from rainfall events) from potentially entering and ponding in the excavations. Temporary measures may include construction of drainage ditches and/or berms to divert and/or reduce the amount of surface water flowing over exposed subgrades during construction. Temporary measures may include construction of drainage ditches and/or berms to divert and/or reduce the amount of surface water flowing over exposed subgrades during construction.

Based on construction and/or weather conditions, the bottoms of excavations should be protected by completing excavations immediately before placing formwork and not allowing excavations to remain open overnight. If excavations must be allowed to remain open for longer periods, the bottom of excavations may be protected by placing a 2-inch-thick mud mat of lean concrete or a 6-inch-thick working mat of crushed stone wrapped in non-woven geotextile.

The Contractor should dispose of water produced during dewatering in accordance with local, State and Federal regulations. Recommendations for environmental disposal of water produced during dewatering is beyond the scope of this report and should be evaluated separately. At this site, after the necessary treatment, water produced during dewatering could either be reinfilted, discharged to the local sewer system or transported and disposed off-site. Refer to Hydraulic Conductivity results presented in **Table 2** with respect to anticipated infiltration rates.

5.3 SUBGRADE PREPARATION

Areas of weak and unstable soils - as defined in this report - observed at the final excavation subgrade should be over excavated and replaced with compacted structural fill or $\frac{3}{4}$ " crushed stone wrapped in non-woven geotextile. If encountered at the excavation subgrade, boulders should also be removed from within the zone of influence of the proposed building foundations, underground storage tank, and replaced with structural fill or $\frac{3}{4}$ " crushed stone.

For the building foundation, we recommend over-excavation and replacement of 2 feet below the bottom of footing within the zone of influence of the footing. The foundation subgrade of the building and proposed underground storage tank should be inspected by Kleinfelder to ensure that any unsuitable soils beneath either structure's footprint be removed. The bearing zone is defined as the volume of soil underneath footings defined by a 1-horizontal to 1-vertical (1H:1V) plane extending downward and outward from one foot beyond the edge of foundations.

Exposed subgrades in cohesionless soil should be proof-compacted prior to placement of footings, utilities or structural fill with at least 4 passes of a heavy (10,000 lb.) vibratory roller or 10 passes of a smaller walk-behind vibratory plate compactor. When near the water table, proof-compaction should be performed at the discretion of Kleinfelder and may need to be performed using static (non-vibratory) methods to limit disturbance of the subgrade. Exposed subgrades in cohesive soil should be excavated 12 inches below final subgrade using a smooth-edge bucket and backfilled with $\frac{3}{4}$ " crushed stone wrapped in non-woven geotextile.

If encountered at the excavation subgrade, boulders should also be removed from within the zone of influence of the proposed structures and replaced with structural fill or $\frac{3}{4}$ " crushed stone.

Following subgrade preparation, place, and compact the proposed backfill in accordance with the methods described herein.

5.4 FILL PLACEMENT

Backfill should be placed in 12-inch maximum loose lift thickness (evaluated prior to compaction). or 6-inch lifts thickness in restricted areas such as trenches, behind walls or around footings. Backfill should be compacted to a minimum Relative Compaction (RC, defined as backfill target dry density as a percentage of backfill maximum dry density, obtained as described in ASTM D-1557) as follows:

- RC= 95 percent underneath structures, pavement (pavement base/subbase) and utilities
- RC= 92 percent in landscape areas.

Backfill moisture during compaction should not be higher than the optimum moisture content plus 2% and should not be lower than the optimum moisture content minus 2%.

Structural fill should be used for replacement of unsuitable materials, as described herein, below structures and pavement areas, as trench backfill underneath structures and for other over-excavations. Dense graded crushed stone may be used underneath structures in lieu of structural fill. On-Site fill should be used in landscaping areas or as trench backfill as described herein. On-Site fill should not be used within the zone of influence of new or existing structures or as pavement base or subbase.

Trenches in landscape areas may be backfilled with On-Site fill. Trenches within the zone of influence of new or existing structures should be backfilled with structural fill. Trenches underneath pavements may be backfilled with On-Site fill. **Table 5** presents the gradation requirements for imported and on-site material.

TABLE 5 – GRADATION REQUIREMENTS OF IMPORTED AND ON-SITE MATERIAL

Sieve Size	Percent Finer by Weight				
	On-Site Fill	Structural Fill	3/4" Crushed Stone	MassDOT Item M1.03.1-1: Processed Gravel for Subbase	MassDOT Item M2.01.7-1: Dense Graded Crushed Stone
6-inch	100	-	-	-	-
3-inch	-	-	-	100	-
2-inch	90-100	100	-	-	100
1-1/2 inch	-	-	-	70-100	70-100
1-inch	-	-	100	-	-
3/4-inch	-	-	90-100	50-85	50-85
1/2-inch	-	50-85	10-50	-	-
3/8-inch	-	-	0-20	-	-
No. 4	20-65	40-75	0-5	30-60	30-55
No. 10	-	-	-	-	-
No. 16	-	-	-	-	-
No. 50	-	8-28	-	-	8-24
No. 60	-	-	-	-	-
No. 200	0-25	0-10	-	0-10	3-10

Testing of the placed and compacted backfill should be performed to verify that the recommended relative compaction and moisture content have been achieved by the Contractor. Backfill testing should be performed by an experienced testing agency using methods and equipment as described in ASTM D6938 or, alternatively, ASTM D1556. Testing frequency should be 1 test per backfill lift per every 1,000 square feet of backfill placed or 1 test per lift in confined spaces.

5.5 REUSE OF ON-SITE SOILS

Existing site soils, excluding topsoil, may be re-used as On-Site fill, provided the soil meets environmental requirements, gradation requirements as specified above, is free of organic matter, debris, or other unsuitable material, and can be compacted to the required density and moisture content. On-Site soils can be re-used as structural fill, provided they meet the gradations requirements described herein or as specified in appropriate Federal, State, and local regulations. Based on the results of the geotechnical laboratory testing for this project, most of the site soils encountered in the borings have moderate to high fines (silt) content and will retain moisture. Hence, the site soils are anticipated to be unsuitable for reuse as structural fill without some form of moisture conditioning.

If off-site disposal of soil is required, the disposal should be performed by the Contractor in accordance with applicable Federal, State, and local regulations. The evaluation of existing site soil for off-site disposal purpose was not included in the scope of this report.

5.6 ADDITIONAL SUBSURFACE EXPLORATIONS

Once the proposed grades, anticipated building and tank footprints, and associated loads with each structure are available, we recommend completing additional subsurface explorations to evaluate depth to bedrock if deep foundations are required or compressibility of the clay if a mat foundation can support the tank. The future exploration program should delineate the clay layer's consolidation characteristics, swell potential during excavation, and undrained shear strength. Additionally, a seismic Cone Penetration Test program should be considered to potentially improve the Seismic Site Class (SSC) from "E" to "D". Shear wave velocity testing has historically been proven to be a more efficient method of measuring SSC and could potentially lead to significant savings for the project.

6 LIMITATIONS

We have prepared this report for the exclusive use of the City of Cambridge Department of Public Works and their authorized agents for the Combined Sewer Overflow Long-Term Control Plan Update – Bellis Circle Facility/Tank project located in Cambridge, Massachusetts.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express, or implied, should be understood. Please refer to Appendix E

7 REFERENCES

Bouwer, H., and R. C. Rice. 1976. "A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells." *Water Resources Research* 12, no. 3: 423–28.

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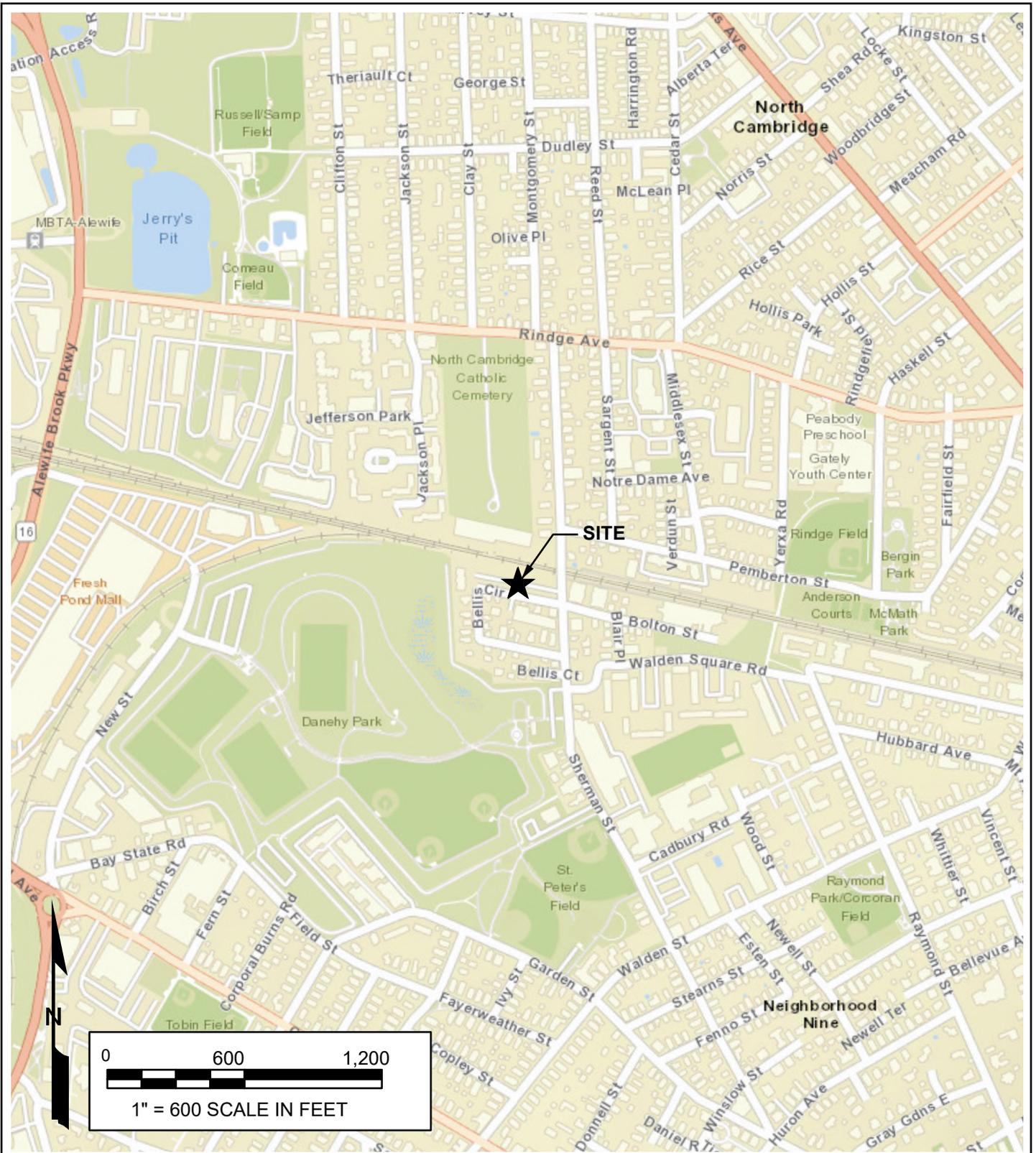
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Zen, E., R. Goldsmith, N. M. Ratcliffe, P. Robinson, and R. S. Stanley. 1983. *Bedrock Geologic Map of Massachusetts*. United States Geological Survey.

Figures



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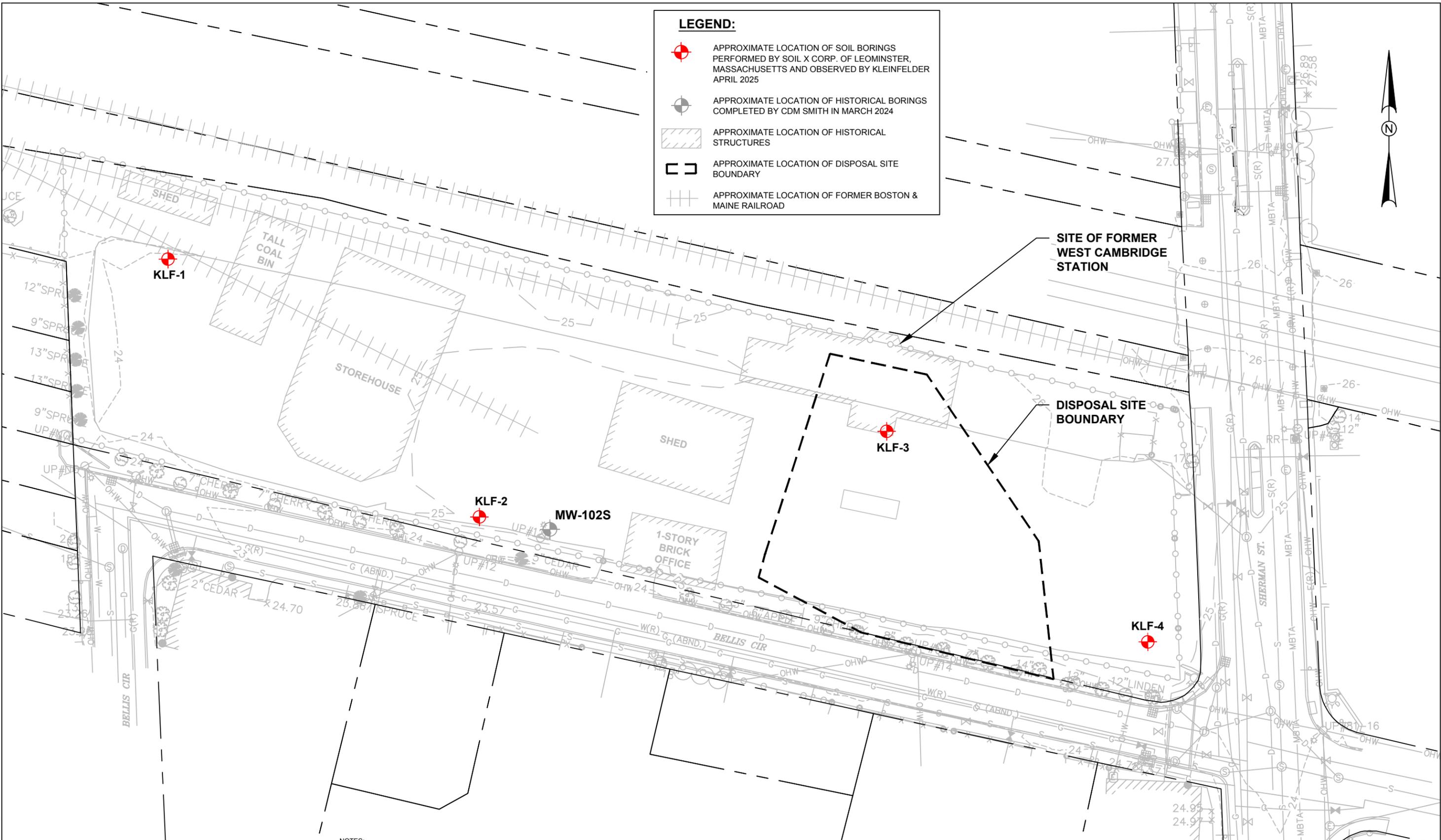
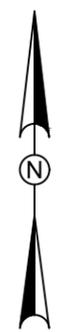
- NOTES:**
1. BASE MAPPING CREATED FROM LAYERS COMPILED BY ESRI PRODUCTS.
 2. COORDINATE SYSTEM: NAD 1983 2011 STATEPLANE MASSACHUSETTS MAINLAND FIPS 2001

	PROJECT NO. 20231168.006A	VICINITY MAP Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA	FIGURE 1
	DRAWN BY: AD CHECKED BY: MNR DATE: 05-20-2025		

CAD FILE: L:\City Of Cambridge MA\20231168.006A-Cambridge MA-CSO Long-Term\Working\Drawings\CAD\Figures\Geotech\GEO_FIG-2.dwg LAYOUT: Layout1

LEGEND:

-  APPROXIMATE LOCATION OF SOIL BORINGS PERFORMED BY SOIL X CORP. OF LEOMINSTER, MASSACHUSETTS AND OBSERVED BY KLEINFELDER APRIL 2025
-  APPROXIMATE LOCATION OF HISTORICAL BORINGS COMPLETED BY CDM SMITH IN MARCH 2024
-  APPROXIMATE LOCATION OF HISTORICAL STRUCTURES
-  APPROXIMATE LOCATION OF DISPOSAL SITE BOUNDARY
-  APPROXIMATE LOCATION OF FORMER BOSTON & MAINE RAILROAD



- NOTES:**
1. BASE MAP CREATED FROM THE SURVEY PLAN COMPLETED BY WSP USA INC. AND DATED MAY 2025.
 2. HISTORICAL SITE FEATURES BASED ON SURVEY COMPLETED BY SHORFIELD BROTHERS, DATED MARCH 1961.
 3. EXISTING DISPOSAL BOUNDARY LIMITS APPROXIMATED BASED ON REPORT TITLED "PHASE 1 ENVIRONMENTAL SITE ASSESSMENT - 41 BELLIS CIRCLE" COMPLETED BY KLEINFELDER DATED AUGUST 11, 2023.
 4. BORING LOCATIONS WERE SURVEYED BY WSP USA INC.



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PROJECT NO. 20231168
 DRAWN BY KAM
 CHECKED BY MNR
 DATE: JUNE 2025
 REVISED:

EXPLORATION LOCATION PLAN
 COMBINED SEWER OVERFLOW LONG-TERM CONTROL PLAN UPDATE BELLIS CIRCLE FACILITY/TANK
 41 BELLIS CIRCLE
 CAMBRIDGE, MASSACHUSETTS

FIGURE
2
 PAGE: 2 of 2

Table 1 – Summary of Subsurface Conditions



**Table 1 - Summary of Subsurface Conditions
City of Cambridge**

Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank, Cambridge, Massachusetts

Boring ID	Top of Boring El. (ft)	Bottom of Boring El. (ft)	Boring Depth (ft)	Groundwater Depth. (ft)	Groundwater El. (ft)	Surficial Material		Granular Fill		Silty Sand / Sandy Silt		Boston Blue Clay		Glacial Till
						Stratum Top El. (ft)	Stratum Thickness (ft)	Stratum Top El. (ft)	Stratum Thickness (ft)	Stratum Top El. (ft)	Stratum Thickness (ft)	Stratum Top El. (ft)	Stratum Thickness (ft)	Stratum Top El. (ft)
KLF-1	24.1	-27.0	51.0	5.5	18.6	24.1	0.2	23.9	1.8	22.1	8.0	14.1	41.0	-
KLF-2	25.1	-40.2	65.3	5.0	20.1	25.1	0.2	24.9	4.8	20.1	9.0	11.1	49.0	-37.9
KLF-3	25.7	-0.3	26.0	10.0	15.7	25.7	0.2	25.5	13.8	-	-	11.7	-	-
KLF-4	25.5	-0.6	26.0	10.0	15.5	25.5	0.2	25.3	1.8	23.5	8.2	15.3	-	-

Notes:

"-": Indicates stratum was not encountered or full thickness not penetrated.

Soil strata in the general order of their occurrence in the borings are presented from left to right in this table.

The groundwater levels herein only represent the conditions encountered at the location and time indicated. Groundwater levels fluctuate due to local and regional factors including seasonal changes, well pumping, and periods of wet or dry weather, nearby construction dewatering, infiltration basins, etc.

Boring ground surface elevations (El.) are based on survey shown on a drawing titled Existing Condition Survey Sherman Street Cambridge, Massachusetts prepared by WSP USA Inc. dated May 23, 2025.

Borings were drilled by Soil X Corp. of Leominster, MA on April 7, 2025 using drive and wash drilling techniques.

Borings were terminated in clay or glacial till. Therefore, the thickness of these strata may be greater than penetrated strata thicknesses indicated on this table.

Table 2 – Summary of Groundwater Elevations

Table 2 Summary of Groundwater Elevations
Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank, Cambridge, Massachusetts

Monitoring Well	KLF-3	MW-102S
Top of Ground Surface Elevation (ft, CCVD)	25.05	25.28
Top of PVC to Ground Surface (ft)	0.27	0.29
Top of PVC Elevation (ft, CCVD)	24.78	24.99
4/22/2025		
Depth to Water from Top of PVC (ft)	7.95	7.31
Groundwater Elevation (ft, CCVD)	16.83	17.68
4/28/2025		
Depth to Water from Top of PVC (ft)	7.97	7.51
Groundwater Elevation (ft, CCVD)	16.81	17.48
4/30/2025		
Depth to Water from Top of PVC (ft)	8	7.15
Groundwater Elevation (ft, CCVD)	16.78	17.84

Notes:

1. Data presented are based on water level measurements collected by Kleinfelder Northeast, Inc. (KLF), on the dates shown.
2. Elevations are referenced to the Cambridge City Vertical Datum (CCVD). Depths shown are in feet.

Appendix A – Boring Logs Completed by CDM Smith (2024)

MONITORING WELL DETAIL

MW-102S

Client: City of Cambridge
Project Location: Cambridge, MA

Project Name: Danehy Park Environmental Assessment
Project Number: 285308

Drilling Contractor: Geosearch
Drilling Method/Rig: DPT/Track-Mounted Geoprobe 6822DT
Drillers: E. Belsky / M. Kelly
Drilling Date: Start: 3/19/2024 **End:** 3/21/2024
Logged By: S. Marshall
Field Screening Instrument: PID and 4-gas

Surface Elevation (ft.): 25.2
Top of PVC Riser Elevation (ft.): 24.99
Total Depth (ft.): 20
Depth to Initial Water Level (ft. BGS): 7.26
Development Method: Surge and purge

BEEBE MW LOG - DANEHY PARK 2024 SOIL BORING AND MONITORING WELL LOGS - UPDATED 10-16-2024.GPJ - CDM_MA.GDT 10/23/24

Sample Type	Sample Number	Field Instrument Reading (ppm)	Blows per 6 Inches	Sample Recovery (inches)	Stratum Designation	Material Description	Graphic Log	Elev. Depth (ft.)	Well Construction Detail
					ASPH	(0-0.25') Asphalt.		25.2	<p>Protective Casing Top of Riser @ 24.99 ft.</p> <p>Ground Surface (0-1') Concrete</p> <p>(1-8') Medium Bentonite Chips</p> <p>(0-8') 2" Schedule 40 PVC riser</p>
HA	S-1	0.0	NA	6/6	FILL	(0.25-0.75') Moist, gray-brown, coarse-medium-fine SAND, some fine gravel, trace silt and asphalt. (0.75-2') Air knife-vac to 2' BGS.		0	
HA	S-2	0.0	NA	6/6	FILL	(2-2.5') Moist, dark gray-brown, coarse-medium-fine SAND, some coarse-medium-fine gravel, trace silt. (2.5-4') Air knife-vac to 4' BGS. Note: Fill sand encountered at approximately 3.75' BGS.			
HA	S-3	0.0	NA	6/6	FILL	(4-4.5') Moist, tan-brown, medium-fine SAND, little fine gravel, trace silt. (4.5-8') Air knife-vac to 8' BGS.		20.2 5	
								15.2	

EXPLANATION OF ABBREVIATIONS

DRILLING METHODS:
 HSA - Hollow Stem Auger
 SSA - Solid Stem Auger
 HA - Hand Auger
 AR - Air Rotary
 AH - Air Hammer
 DTR - Dual Tube Rotary
 FR - Foam Rotary
 MR - Mud Rotary
 RC - Reverse Circulation
 CT - Cable Tool
 JET - Jetting
 D - Driving
 DTC - Drill Through Casing

SAMPLING TYPES:
 AS - Auger/Grab Sample
 CS - California Sampler
 BX - 1.5" Rock Core
 NX - 2.1" Rock Core
 GP - Geoprobe
 HP - Hydro Punch
 SS - Split Spoon
 ST - Shelby Tube
 WS - Wash Sample
OTHER:
 AGS - Above Ground Surface

REMARKS

BGS = Below Ground Surface
 PID = Photoionization Detection
 TBC = To Be Completed
 NA = Not Applicable
 NM = Not Measured

Depth to water measured from top of inner PVC on 5/1/2024

Reviewed by: N. Castonguay

Date: 8/21/2024

Appendix B – Test Boring Logs Completed by Kleinfelder

DRILLING METHOD/SAMPLER TYPE GRAPHICS



STANDARD PENETRATION SPLIT SPOON SAMPLER
(2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

VacTruck

GROUND WATER GRAPHICS

- WATER LEVEL (level where first observed)
- WATER LEVEL (level after stabilizing period)
- WATER LEVEL (additional levels after exploration)
- OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Solid lines separating strata on the logs represent approximate boundaries only, dashed lines are inferred or extrapolated boundaries. Actual transitions may be gradual or differ from those represented.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System (ASTM D2488/D2487) designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, i.e., CL-ML, GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

WOH - Weight of Hammer
WOR - Weight of Rod

REFERENCES

1. American Society for Testing and Materials (ASTM), 2011, ASTM D2487: Classification of Soils for Engineering Purposes (Unified Soil Classification System).

UNIFIED SOIL CLASSIFICATION SYSTEM¹

GRAVELS (More than 50% of coarse fraction retained on No. 200 Sieve)	GRAVELS WITH <5% FINES		GW	WELL-GRADED GRAVEL, WELL-GRADED GRAVEL WITH SAND		
			GP	POORLY GRADED GRAVEL, POORLY GRADED GRAVEL WITH SAND		
		GRAVELS WITH 5% TO 12% FINES		GW-GM	WELL-GRADED GRAVEL WITH SILT, WELL-GRADED GRAVEL WITH SILT AND SAND	
				GW-GC	WELL-GRADED GRAVEL WITH CLAY (OR SILTY CLAY), WELL-GRADED GRAVEL WITH CLAY AND SAND (OR SILT CLAY AND SAND)	
				GP-GM	POORLY GRADED GRAVEL WITH SILT, POORLY GRADED GRAVEL WITH SILT AND SAND	
				GP-GC	POORLY GRADED GRAVEL WITH CLAY (OR SILTY CLAY), POORLY GRADED GRAVEL WITH CLAY AND (OR SILTY CLAY AND SAND)	
	GRAVELS WITH > 12% FINES		GM	SILTY GRAVEL, SILTY GRAVEL WITH SAND		
			GC	CLAYEY GRAVEL, CLAYEY GRAVEL WITH SAND		
			GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL WITH SAND		
		COARSE GRAINED SOILS (More than 50% retained on No. 200 Sieve)	CLEAN SANDS WITH <5% FINES		SW	WELL-GRADED SAND, WELL-GRADED SAND WITH GRAVEL
					SP	POORLY GRADED SAND, POORLY GRADED SAND WITH GRAVEL
			SANDS WITH 5% TO 12% FINES		SW-SM	WELL-GRADED SAND WITH SILT, WELL-GRADED SAND WITH SILT AND GRAVEL
	SW-SC			WELL-GRADED SAND WITH CLAY (OR SILTY CLAY), WELL-GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)		
	SP-SM			POORLY GRADED SAND WITH SILT, POORLY GRADED SAND WITH SILT AND GRAVEL		
	SP-SC			POORLY GRADED SAND WITH CLAY, POORLY GRADED SAND WITH CLAY AND GRAVEL (OR SILTY CLAY AND GRAVEL)		
SANDS WITH > 12% FINES		SM	SILTY SAND, SILTY SAND WITH GRAVEL			
		SC	CLAYEY SAND, CLAYEY SAND WITH GRAVEL			
		SC-SM	SILTY, CLAYEY SAND, SILTY, CLAYEY SAND WITH GRAVEL			
FINE GRAINED SOILS (50% or more passes the No. #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)		ML	SILT, SILT WITH SAND, SILT WITH GRAVEL		
			CL	LEAN CLAY, LEAN CLAY WITH SAND, LEAN CLAY WITH GRAVEL		
			CL-ML	SILTY CLAY, SILTY CLAY WITH SAND, SILTY CLAY WITH GRAVEL		
	SILTS AND CLAYS (Liquid Limit 50 or greater)		OL	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL		
			MH	ELASTIC SILT, ELASTIC SILT WITH SAND, ELASTIC SILT WITH GRAVEL		
			CH	FAT CLAY, FAT CLAY WITH SAND, FAT CLAY WITH GRAVEL		
			OH	ORGANIC CLAY, ORGANIC CLAY WITH SAND, ORGANIC CLAY WITH GRAVEL, ORGANIC SILT, ORGANIC SILT WITH SAND, ORGANIC SILT WITH GRAVEL		

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 20231168.006A	GRAPHICS KEY Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA
	DRAWN BY: RD/AD CHECKED BY: MNR DATE: 4/17/2025	

GRAIN SIZE¹

DESCRIPTION	SIEVE SIZE	GRAIN SIZE
Boulders	>12 in.	>12 in. (304.8 mm.)
Cobbles	3 - 12 in.	3 - 12 in. (76.2 - 304.8 mm.)
Gravel	coarse	3/4 - 3 in. (19 - 76.2 mm.)
	fine	#4 - 3/4 in. 0.19 - 0.75 in. (4.8 - 19 mm.)
Sand	coarse	#10 - #4 0.079 - 0.19 in. (2 - 4.9 mm.)
	medium	#40 - #10 0.017 - 0.079 in. (0.43 - 2 mm.)
	fine	#200 - #40 0.0029 - 0.017 in. (0.07 - 0.43 mm.)
Fines	Passing #200	<0.0029 in. (<0.07 mm.)

SECONDARY CONSTITUENT¹

Term of Use	AMOUNT	
	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

PLASTICITY¹

DESCRIPTION	CRITERIA
Non-Plastic	A 1/8 in. (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

MOISTURE CONTENT¹

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CONSISTENCY - FINE-GRAINED SOIL^{2,3}

CONSISTENCY	SPT - N (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q _u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Easily penetrated several inches by fist
Soft	2 - 4	0.25 ≤ PP < 0.5	500 - 1,000	Easily penetrated several inches by thumb
Medium Stiff	4 - 8	0.5 ≤ PP < 1	1,000 - 2,000	Can be penetrated several inches by thumb with moderate effort
Stiff	8 - 15	1 ≤ PP < 2	2,000 - 4,000	Readily indented by thumb but penetrated only with great effort
Very Stiff	15 - 30	2 ≤ PP < 4	4,000 - 8,000	Readily indented by thumbnail
Hard	>30	4 ≤ PP	>8,000	Indented by thumbnail with difficulty

APPARENT DENSITY - COARSE-GRAINED SOIL²

APPARENT DENSITY	SPT-N (# blows / ft)
Very Loose	<4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	>50

STRUCTURE¹

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. (6mm) thick, note thickness.
Laminated	Alternating layers of varying material or color with the layers less than 1/4-in. (6 mm) thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.
Homogeneous	Same color and appearance throughout

ANGULARITY¹

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

REACTION WITH HYDROCHLORIC ACID¹

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

CEMENTATION¹

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or little finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

REFERENCES

- American Society for Materials and Testing (ASTM), 2017, ASTM D2488: Standard Practice for Description and Identification of Soils (Visual Manual Procedures).
- Terzaghi, K and Peck, R., 1948, Soil Mechanics in Engineering Practice, John Wiley & Sons, New York.
- United States Department of the Interior Bureau of Reclamation (USBR), 1998, Earth Manual, Part I.



PROJECT NO.: 20231168.006A
 DRAWN BY: RD/AD
 CHECKED BY: MNR
 DATE: 4/17/2025

SOIL DESCRIPTION KEY
 (For additional tables, see ASTM D2488)

Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank
 41 Bellis Circle
 Cambridge, MA

PLOTTED: 06/02/2025 11:18 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/08/2025 **Drilling Company:** Soil X Corp.
Logged By: A. Darajat **Drill Crew:** C. Targ
Hor.-Vert. Datum: NAD83 - Cambridge City **Drilling Equipment:** B29 Mobile **Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge: -90 degrees **Drilling Method:** HSA and Drive and Wash
Weather: Rainy 30-40s **Exploration Diameter:** 4 and 3 in. I.D.

BORING LOG KLF-1

Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION						LABORATORY RESULTS						
		Latitude: 42.39073° Longitude: -71.13406° Ground Surface Elevation (ft.): 24.05 Surface Condition: Asphalt		Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
		Lithologic Description												
23.85	Asphalt 2.5 Inches			G-1										PID: 0.0
23.05	FILL Poorly Graded SAND with Silt and Gravel (SP-SM): fine to coarse sand, brown, moist			G-2										PID: 0.1
22.05	Poorly Graded SAND (SP): fine to coarse sand, black, moist, trace bricks and roots			G-3										PID: 0.1
	Silty SAND (SM): fine to medium sand, light brown, moist			G-4										PID: 0.1
	becomes wet			G-5										PID: 0.1
				G-6										PID: 0.1
18.05	SILT with Sand (ML): light brown, wet, stiff			S-1	BC=5 6 9 10	16"	ML		100	77				PID: 0.0
				S-2	BC=10 7 7 9	22"								PID: 0.0
14.05	Lean CLAY (CL): gray, wet, stiff			S-3	BC=8 7 6 6 PP=1.25	24"	CL	26.4			34	14		PID: 0.0
10.05	Sandy CLAY (CL): gray, wet, medium stiff			S-4	BC=10 4 2 4 PP=0.5	18"	CL							PID: 0.1
				S-5	BC=3 3 3 3 PP=0.5	22"								PID: 0.3
0.05	Lean CLAY (CL): gray, wet, medium stiff			S-6	BC=3 3	24"								PID: 0.0

PROJECT NUMBER: 20231168.006A
OFFICE FILTER: BOSTON
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.:
20231168.006A

DRAWN BY: RD
CHECKED BY: MNR
DATE: 4/17/2025

BORING LOG KLF-1

Combined Sewer Overflow Long-Term
Control Plan Update Bellis Circle Facility/Tank
41 Bellis Circle
Cambridge, MA

PLOTTED: 06/02/2025 11:18 AM BY: ADarajat
 PROJECT NUMBER: 20231168.006A
 OFFICE FILTER: BOSTON
 GINT LIBRARY: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]
 GINT FILE: KLF_gint_master_2023
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: <u>4/07/2025 - 4/08/2025</u>	Drilling Company: <u>Soil X Corp.</u>	BORING LOG KLF-1
Logged By: <u>A. Darajat</u>	Drill Crew: <u>C. Targ</u>	
Hor.-Vert. Datum: <u>NAD83 - Cambridge City</u>	Drilling Equipment: <u>B29 Mobile</u>	Hammer Type - Drop: <u>140 lb. Auto - 30 in.</u>
Plunge: <u>-90 degrees</u>	Drilling Method: <u>HSA and Drive and Wash</u>	
Weather: <u>Rainy 30-40s</u>	Exploration Diameter: <u>4 and 3 in. I.D.</u>	

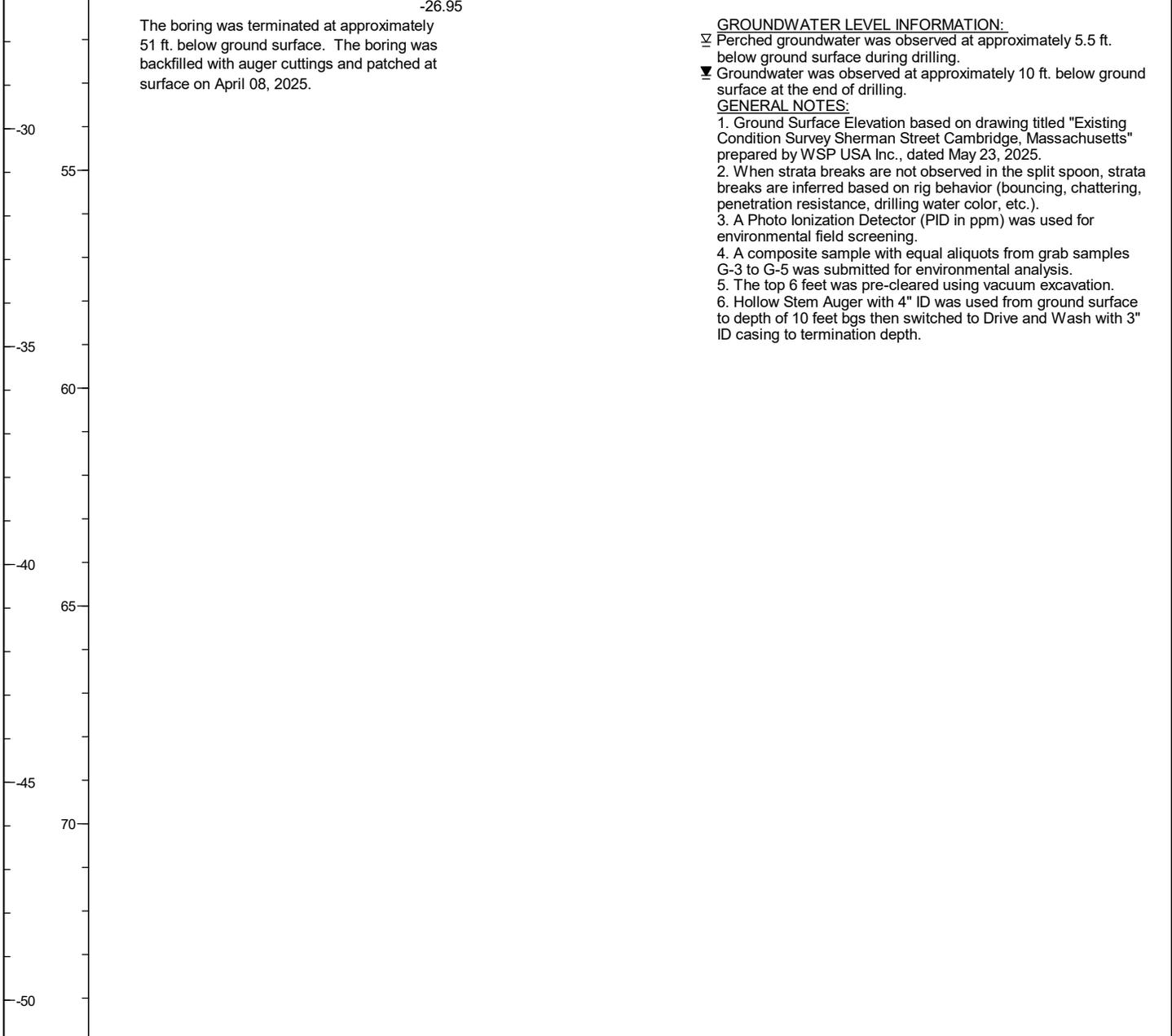
Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS									
			Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks		
				S-6 (cont.)	4 3 PP=0.5	24" (cont.)											
	-5			S-7	BC=2 2 3 4 PP=0.25	24"											PID: 0.1
	-10		becomes soft	S-8	BC=4 2 2 3 TV=1	24"											PID: 0.0
	-15		becomes very soft	S-9	BC=WOH WOH WOH WOH TV=0.5	24"											PID: 0.0
	-20			S-10	BC=WOR WOR WOR WOR	10"											PID: 0.1
	-25			S-11	BC=WOR WOR	16"											PID: 0.2

 <p>KLEINFELDER Bright People. Right Solutions.</p>	PROJECT NO.: 20231168.006A	BORING LOG KLF-1
	DRAWN BY: RD CHECKED BY: MNR DATE: 4/17/2025	Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA

PLOTTED: 06/02/2025 11:18 AM BY: ADarajat

Date Begin - End: <u>4/07/2025 - 4/08/2025</u>	Drilling Company: <u>Soil X Corp.</u>	BORING LOG KLF-1
Logged By: <u>A. Darajat</u>	Drill Crew: <u>C. Targ</u>	
Hor.-Vert. Datum: <u>NAD83 - Cambridge City</u>	Drilling Equipment: <u>B29 Mobile</u>	Hammer Type - Drop: <u>140 lb. Auto - 30 in.</u>
Plunge: <u>-90 degrees</u>	Drilling Method: <u>HSA and Drive and Wash</u>	
Weather: <u>Rainy 30-40s</u>	Exploration Diameter: <u>4 and 3 in. I.D.</u>	

Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION						LABORATORY RESULTS						
			Latitude: 42.39073° Longitude: -71.13406° Ground Surface Elevation (ft.): 24.05 Surface Condition: Asphalt	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
Lithologic Description															
				S-11 (cont.)		WOR WOR	16" (cont.)								



PROJECT NUMBER: 20231168.006A OFFICE FILTER: BOSTON
GINT LIBRARY: E:\KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]

	PROJECT NO.: 20231168.006A	BORING LOG KLF-1
	DRAWN BY: RD CHECKED BY: MNR DATE: 4/17/2025	Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA

PLOTTED: 06/02/2025 11:19 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/11/2025 **Drilling Company:** Soil X Corp.
Logged By: A. Darajat **Drill Crew:** C. Targ
Hor.-Vert. Datum: NAD83 - Cambridge City **Drilling Equipment:** B29 Mobile **Hammer Type - Drop:** 140 lb. Auto - 30 in.
Plunge: -90 degrees **Drilling Method:** HSA and Drive and Wash
Weather: Rainy 30-40s **Exploration Diameter:** 4 and 3 in. I.D.

BORING LOG KLF-2

Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION						LABORATORY RESULTS						
		Latitude: 42.39050° Longitude: -71.13368° Ground Surface Elevation (ft.): 25.06 Surface Condition: Asphalt		Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
		Lithologic Description												
	Asphalt 2.5 Inches		24.86	G-1										PID: 0.1
	FILL Poorly Graded GRAVEL with Silt and Sand (GP-GM): fine to coarse gravel, reddish brown, moist		24.06	G-2										PID: 0.1
	Poorly Graded SAND (SP): fine to coarse sand, black, moist, with cobbles		23.06	G-3										PID: 0.1
	Silty SAND (SM): fine to medium sand, dark brown/yellow, moist, trace roots, brick fragments			G-4										PID: 0.0
	becomes light brown			G-5										PID: 0.0
	Silty SAND (SM): fine to medium sand, light brown/gray, moist		20.66	G-6										PID: 0.0
	Sandy SILT (ML): light brown/gray, moist, medium stiff		19.06	S-1	BC=2 2 3 6	15"	ML		100	68				PID: 0.0
				S-2A	BC=3 10	12"								PID: 0.0 Soil Mottling Observed
	Lean CLAY (CL): brown, wet		16.06	S-2B	BC=6 6	4"	CL							PID: 0.0
	becomes light gray			S-3A	BC=3 12	12"								PID: 0.0
	Silty SAND (SM): light gray, wet		14.06	S-3B	BC=18 25	12"	SM							PID: 0.0
	Sandy CLAY (CL): gray, wet, medium stiff		11.06	S-4	BC=WOH 4 3 2 PP=0.5	24"	CL							PID: 0.
	Lean CLAY (CL): gray, wet, soft		6.06	S-5	BC=WOH WOH 3 2 PP=0.25	24"	CL							PID: 0.0
	becomes very soft			S-6	BC=1 1	24"								PID: 0.0

PROJECT NUMBER: 20231168.006A
OFFICE FILTER: BOSTON
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.:
20231168.006A

DRAWN BY: AD
CHECKED BY: MNR
DATE: 4/17/2025

BORING LOG KLF-2

Combined Sewer Overflow Long-Term
Control Plan Update Bellis Circle Facility/Tank
41 Bellis Circle
Cambridge, MA

PLOTTED: 06/02/2025 11:19 AM BY: ADarajat

Date Begin - End: <u>4/07/2025 - 4/11/2025</u>	Drilling Company: <u>Soil X Corp.</u>	BORING LOG KLF-2
Logged By: <u>A. Darajat</u>	Drill Crew: <u>C. Targ</u>	
Hor.-Vert. Datum: <u>NAD83 - Cambridge City</u>	Drilling Equipment: <u>B29 Mobile</u>	Hammer Type - Drop: <u>140 lb. Auto - 30 in.</u>
Plunge: <u>-90 degrees</u>	Drilling Method: <u>HSA and Drive and Wash</u>	
Weather: <u>Rainy 30-40s</u>	Exploration Diameter: <u>4 and 3 in. I.D.</u>	

Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS							
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			S-6 (cont.)		1 PP=0.25	24" (cont.)								
-5	30	becomes soft	S-7		BC=1 2 2 4 PP=0.25	16"								PID: 0.0 2" Sand seam at bottom of spoon
-10	35	becomes very soft	S-8		BC=WOH WOH WOH 1 TV=0.25	6"								PID: 0.0
-15	40	Clayey SILT (ML): gray, wet, very soft	S-9	-13.94	BC=WOR WOR WOR WOH TV=0.25	24"	ML	39.3			39	13	PID: 0.0	
-20	45	Silty CLAY (CL): gray, wet, very soft	S-10	-23.94	BC=WOR WOR	6"								PID: 0.0

PROJECT NUMBER: 20231168.006A
OFFICE FILTER: BOSTON
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.:
20231168.006A

DRAWN BY: AD
CHECKED BY: MNR
DATE: 4/17/2025

BORING LOG KLF-2

Combined Sewer Overflow Long-Term
Control Plan Update Bellis Circle Facility/Tank
41 Bellis Circle
Cambridge, MA

PLOTTED: 06/02/2025 11:19 AM BY: ADarajat

OFFICE FILTER: BOSTON
PROJECT NUMBER: 20231168.006A
PROJECT LIBRARY: 2023.GLB [KLF_BORING/TEST PIT SOIL LOG]
GINT FILE: KLF_gint_master_2023
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB

Date Begin - End: 4/07/2025 - 4/11/2025	Drilling Company: Soil X Corp.	BORING LOG KLF-2	
Logged By: A. Darajat	Drill Crew: C. Targ		
Hor.-Vert. Datum: NAD83 - Cambridge City	Drilling Equipment: B29 Mobile		Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees	Drilling Method: HSA and Drive and Wash		
Weather: Rainy 30-40s	Exploration Diameter: 4 and 3 in. I.D.		

Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS							Additional Tests/ Remarks
		Latitude: 42.39050° Longitude: -71.13368° Ground Surface Elevation (ft.): 25.06 Surface Condition: Asphalt	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Torvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	
Lithologic Description														
-30	55		S-10 (cont.)	WOR WOR	6" (cont.)									
-35	60		S-11	BC=WOH WOH WOH 6	24"								PID: 0.0	
-40	65			Glacial Till Poorly Graded GRAVEL with Silt (GP-GM): fine to coarse gravel, gray, wet, very dense	-37.94	GP-GM							Drill rig chattered at 63 feet bgs. PID: 0.0	
			S-12	BC=42 48 50/3"	12"									
					-40.19	<p>The boring was terminated at approximately 65.25 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on April 11, 2025.</p> <p>GROUNDWATER LEVEL INFORMATION: <input checked="" type="checkbox"/> Perched groundwater was observed at approximately 5 ft. below ground surface during drilling. <input checked="" type="checkbox"/> Groundwater was observed at approximately 8 ft. below ground surface at the end of drilling.</p> <p>GENERAL NOTES: 1. Ground Surface Elevation based on drawing titled "Existing Condition Survey Sherman Street Cambridge, Massachusetts" prepared by WSP USA Inc., dated May 23, 2025. 2. When strata breaks are not observed in the split spoon, strata breaks are inferred based on rig behavior (bouncing, chattering, penetration resistance, drilling water color, etc.). 3. A Photo Ionization Detector (PID in ppm) was used for environmental field screening. 4. A composite sample with equal aliquots from grab samples G-1 to G-5 was submitted for environmental analysis. 5. The top 6 feet was pre-cleared using vacuum excavation. 6. Hollow Stem Auger with 4" ID was used from ground surface to depth of 10 feet bgs then switched to Drive and Wash with 3" ID casing to termination depth.</p>								

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 20231168.006A	BORING LOG KLF-2
	DRAWN BY: AD CHECKED BY: MNR DATE: 4/17/2025	

PLOTTED: 06/02/2025 11:20 AM BY: ADarajat
 PROJECT NUMBER: 20231168.006A
 OFFICE FILTER: BOSTON
 GINT FILE: KLF_gint_master_2023
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]

Date Begin - End: 4/07/2025 - 4/10/2025	Drilling Company: Soil X Corp.	BORING LOG KLF-3
Logged By: A. Darajat	Drill Crew: C. Targ	
Hor.-Vert. Datum: NAD83 - Cambridge City	Drilling Equipment: B29 Mobile	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees	Drilling Method: HSA and Drive and Wash	
Weather: Sunny-Rainy 30-40s	Exploration Diameter: 4 in. I.D.	

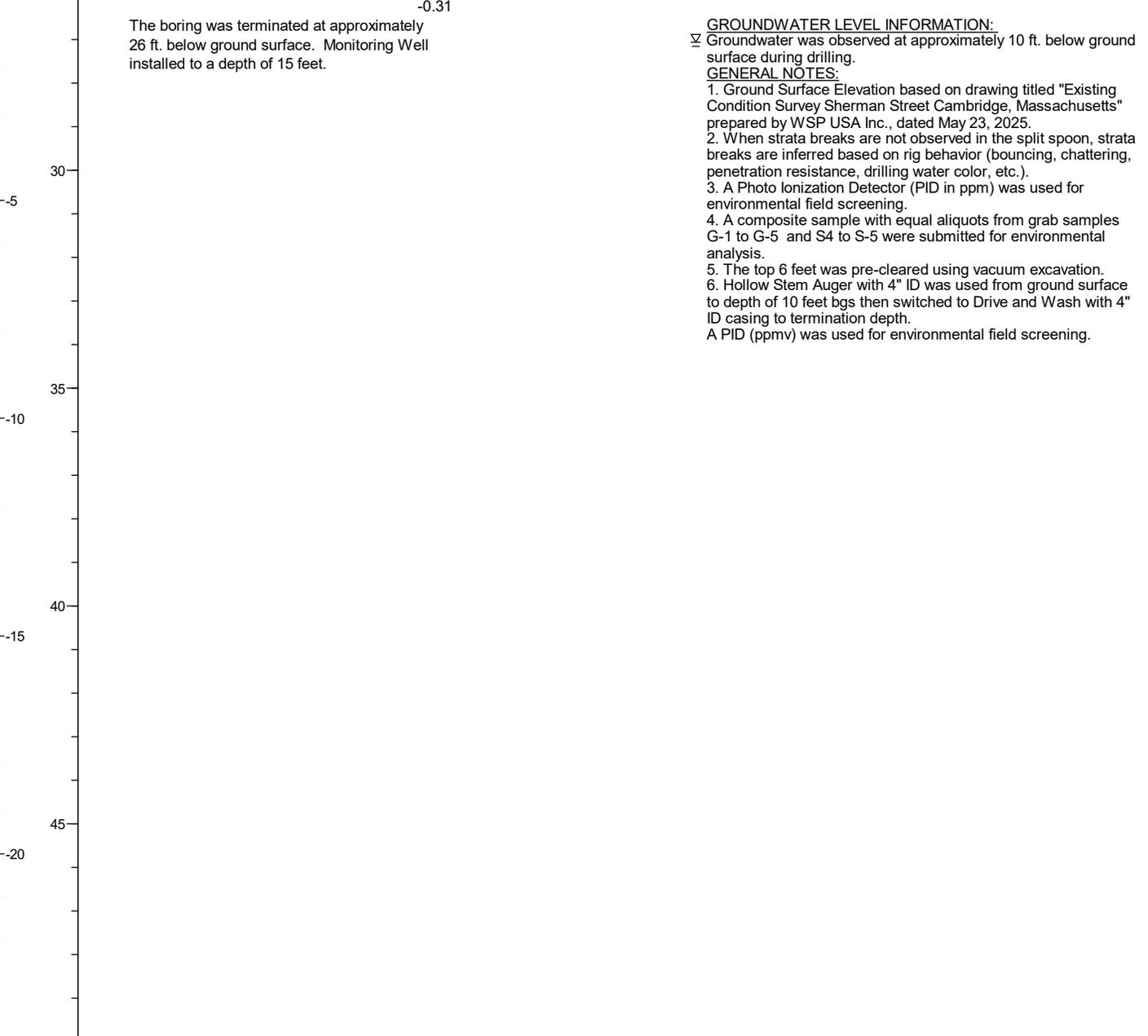
Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS						
		Latitude: 42.39057° Longitude: -71.13317° Ground Surface Elevation (ft.): 25.69 Surface Condition: Asphalt	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
		Lithologic Description											
25	Asphalt 2.5 Inches	25.49	G-1			SP-SM							PID: 0.1
	FILL Poorly Graded SAND with Gravel and Silt (SP-SM): fine to coarse sand, brown, moist	24.69	G-2										PID: 0.1
	Poorly Graded GRAVEL with Silt and Sand (GP-GM): fine to coarse gravel, brown, moist, trace brick and concrete pieces		G-3			GP-GM							PID: 0.0
			G-4										PID: 0.0
			G-5										PID: 0.0
			G-6										PID: 0.0
20	becomes dense		S-1		BC=11 19 30 31								PID: 0.1
	Poorly Graded SAND with Gravel and Silt (SP-SM): fine to coarse sand, brown, moist, dense	17.69	S-2		BC=28 21 15 11	SP-SM			68	10			PID: 2.3
	becomes medium dense, wet		S-3		BC=5 6 10 5								PID: 0.0
15			S-4		BC=5 5 5 5 PP=0.75	CL	29.6				25	8	PID: 0.0
10	Sandy CLAY (CL): gray, wet, stiff	11.69	S-5		BC=6 5 4 5 PP=0.75	CL							PID: 0.1
	Lean CLAY (CL): gray, wet, stiff	9.69	S-6		BC=WOH 4 4 6 PP=1								PID: 0.0
5	becomes medium stiff		S-7		BC=2 3								PID: 0.0

 <p>KLEINFELDER Bright People. Right Solutions.</p>	PROJECT NO.: 20231168.006A	BORING LOG KLF-3
	DRAWN BY: RD CHECKED BY: MNR DATE: 4/17/2025	Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA

PLOTTED: 06/02/2025 11:20 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/10/2025	Drilling Company: Soil X Corp.	BORING LOG KLF-3
Logged By: A. Darajat	Drill Crew: C. Targ	
Hor.-Vert. Datum: NAD83 - Cambridge City	Drilling Equipment: B29 Mobile	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees	Drilling Method: HSA and Drive and Wash	
Weather: Sunny-Rainy 30-40s	Exploration Diameter: 4 in. I.D.	

Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION						LABORATORY RESULTS							
			Latitude: 42.39057° Longitude: -71.13317° Ground Surface Elevation (ft.): 25.69 Surface Condition: Asphalt	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Pocket Pen(PP)= tsf	Tonnage(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
0				S-7 (cont.)		3 4 PP=0.5		20" (cont.)								



PROJECT NUMBER: 20231168.006A OFFICE FILTER: BOSTON
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]

	PROJECT NO.: 20231168.006A	BORING LOG KLF-3
	DRAWN BY: RD CHECKED BY: MNR DATE: 4/17/2025	Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA

PLOTTED: 06/02/2025 11:21 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/10/2025
Logged By: A. Darajat
Hor.-Vert. Datum: NAD83 - Cambridge City
Plunge: -90 degrees
Weather: Sunny-Rainy 30-40s

Drilling Company: Soil X Corp.
Drill Crew: C. Targ
Drilling Equipment: B29 Mobile
Drilling Method: See Drilling Method Column
Exploration Diameter: 4 in. I.D.

BORING LOG KLF-3

Hammer Type - Drop: 140 lb. Auto - 30 in.

Elevation (feet)	Depth (feet)	Drilling Method	Sample Type	Sample Number	Recovery (NR=No Recovery)	PID / FID (ppmv)	Graphical Log	FIELD EXPLORATION		MONITORING WELL CONSTRUCTION	
								Lithologic Description	Completion Method: Roadbox		
25							Latitude: 42.39057° Longitude: -71.13317° Ground Surface Elevation (ft.): 25.69 Surface Condition: Asphalt				
							Asphalt 2.5 Inches	25.49			Concrete
							FILL	24.69			Soil cuttings
							Poorly Graded SAND with Gravel and Silt (SP-SM): fine to coarse sand, brown, moist				2" SCH 40 Solid PVC Riser
							Poorly Graded GRAVEL with Silt and Sand (GP-GM): fine to coarse gravel, brown, moist, trace brick and concrete pieces				Bentonite Chips
							becomes dense				
							Poorly Graded SAND with Gravel and Silt (SP-SM): fine to coarse sand, brown, moist, dense	17.69			2" SCH 40 Slotted 0.010 PVC Screen
							becomes medium dense, wet				
							Sandy CLAY (CL): gray, wet, stiff	11.69			
							Lean CLAY (CL): gray, wet, stiff	9.69			
							becomes medium stiff				Sand

OFFICE FILTER: BOSTON

PROJECT NUMBER: 20231168.006A
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_ENVIRONMENTAL LOG]

GINT FILE: KLF_gint_master_2023



PROJECT NO.:
20231168.006A

DRAWN BY: RD

CHECKED BY: MNR

DATE: 4/17/2025

BORING LOG KLF-3

Combined Sewer Overflow Long-Term
Control Plan Update Bellis Circle Facility/Tank
41 Bellis Circle
Cambridge, MA

PLOTTED: 06/02/2025 11:21 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/10/2025	Drilling Company: Soil X Corp.	BORING LOG KLF-3	
Logged By: A. Darajat	Drill Crew: C. Targ		
Hor.-Vert. Datum: NAD83 - Cambridge City	Drilling Equipment: B29 Mobile		Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees	Drilling Method: See Drilling Method Column		
Weather: Sunny-Rainy 30-40s	Exploration Diameter: 4 in. I.D.		

Elevation (feet) Depth (feet)	Drilling Method	Sample Type	FIELD EXPLORATION				MONITORING WELL CONSTRUCTION	
			Sample Number	Recovery (NR=No Recovery)	PID / FID (ppmv)	Graphical Log	Lithologic Description	Completion Method: Roadbox
0						Latitude: 42.39057° Longitude: -71.13317° Ground Surface Elevation (ft.): 25.69 Surface Condition: Asphalt		
					-31			



OFFICE FILTER: BOSTON

PROJECT NUMBER: 20231168.006A
 GINT_TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_ENVIRONMENTAL LOG]

GINT FILE: KLF_gint_master_2023



PROJECT NO.:
20231168.006A

DRAWN BY: RD

CHECKED BY: MNR

DATE: 4/17/2025

BORING LOG KLF-3

Combined Sewer Overflow Long-Term
Control Plan Update Bellis Circle Facility/Tank
41 Bellis Circle
Cambridge, MA

Page: 2 of 2

PLOTTED: 06/02/2025 11:20 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/10/2025
Logged By: A. Darajat
Hor.-Vert. Datum: NAD83 - Cambridge City
Plunge: -90 degrees
Weather: Sunny-Rainy 30-40s
Drilling Company: Soil X Corp.
Drill Crew: C. Targ
Drilling Equipment: B29 Mobile
Drilling Method: HSA and Drive and Wash
Exploration Diameter: 4 and 3 in. I.D.

BORING LOG KLF-4

Hammer Type - Drop: 140 lb. Auto - 30 in.

Elevation (feet) Depth (feet)	Graphical Log	FIELD EXPLORATION					LABORATORY RESULTS						
		Lithologic Description	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in. Pocket Pen(PP)= tsf Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)
25	Asphalt 2.5 Inches	25.26	G-1										PID: 0.1
	FILL Poorly Graded GRAVEL with Silt (GP-GM) fine to coarse gravel, reddish brown, moist	24.45	G-2						100	39			PID: 0.0
	Silty SAND (SM): fine to medium sand, black, moist, with brick pieces	23.45	G-3										PID: 0.0 Soil Motting Observed
	Silty SAND (SM): fine to medium sand, light brown, moist		G-4										PID: 0.0
			G-5										PID: 0.0
			G-6										PID: 0.0
5	becomes medium dense		S-1		BC=2 5 7 11	16"			100	21			PID: 0.0
	becomes brown		S-2		BC=12 10 9 11	16"							PID: 0.0 Soil Motting Observed In Bottom 4 Inches
10			S-3		BC=3 4 5 6	24"							PID: 0.1
15	Sandy CLAY (CL): gray, wet, stiff	15.28											
			S-4		BC=3 4 5 5 PP=1	24"							PID: 0.5
10													
5	Lean CLAY (CL): gray, wet, medium stiff	6.45	S-5		BC=3 3 5 7 PP=0.5	15"							PID: 0.6
	becomes stiff		S-6		BC=1 2	18"							PID: 0.4 2" Sand seam at bottom of

PROJECT NUMBER: 20231168.006A
 OFFICE FILTER: BOSTON
 GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]



PROJECT NO.:
20231168.006A
 DRAWN BY: RD
 CHECKED BY: MNR
 DATE: 4/17/2025

BORING LOG KLF-4
 Combined Sewer Overflow Long-Term
 Control Plan Update Bellis Circle Facility/Tank
 41 Bellis Circle
 Cambridge, MA
 Page: 1 of 2

PLOTTED: 06/02/2025 11:20 AM BY: ADarajat

Date Begin - End: 4/07/2025 - 4/10/2025	Drilling Company: Soil X Corp.	BORING LOG KLF-4
Logged By: A. Darajat	Drill Crew: C. Targ	
Hor.-Vert. Datum: NAD83 - Cambridge City	Drilling Equipment: B29 Mobile	Hammer Type - Drop: 140 lb. Auto - 30 in.
Plunge: -90 degrees	Drilling Method: HSA and Drive and Wash	
Weather: Sunny-Rainy 30-40s	Exploration Diameter: 4 and 3 in. I.D.	

Elevation (feet)	Depth (feet)	Graphical Log	FIELD EXPLORATION						LABORATORY RESULTS								
			Latitude: 42.39038° Longitude: -71.13285° Ground Surface Elevation (ft.): 25.45 Surface Condition: Asphalt	Sample Number	Sample Type	Blow Counts(BC)= Uncorr. Blows/6 in.	Pocket Pen(PP)= tsf	Tonvane(TV)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
0				S-6 (cont.)		7 PP=0.5		4		18" (cont.)							spoon.
			<p style="text-align: center;">-0.55</p> <p>The boring was terminated at approximately 26 ft. below ground surface. The boring was backfilled with auger cuttings and patched at surface on April 10, 2025.</p>						<p>GROUNDWATER LEVEL INFORMATION: <input checked="" type="checkbox"/> Groundwater was observed at approximately 10 ft. below ground surface during drilling.</p> <p>GENERAL NOTES:</p> <ol style="list-style-type: none"> Ground Surface Elevation based on drawing titled "Existing Condition Survey Sherman Street Cambridge, Massachusetts" prepared by WSP USA Inc., dated May 23, 2025. When strata breaks are not observed in the split spoon, strata breaks are inferred based on rig behavior (bouncing, chattering, penetration resistance, drilling water color, etc.). A Photo Ionization Detector (PID in ppm) was used for environmental field screening. The top 6 feet was pre-cleared using vacuum excavation. Hollow Stem Auger with 4" ID was used from ground surface to depth of 10 feet bgs then switched to Drive and Wash with 3" ID casing to termination depth. 								

GINT FILE: KLF_gint_master_2023
GINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2023.GLB [KLF_BORING/TEST PIT SOIL LOG]
PROJECT NUMBER: 20231168.006A
OFFICE FILTER: BOSTON

 KLEINFELDER <i>Bright People. Right Solutions.</i>	PROJECT NO.: 20231168.006A	BORING LOG KLF-4
	DRAWN BY: RD CHECKED BY: MNR DATE: 4/17/2025	Combined Sewer Overflow Long-Term Control Plan Update Bellis Circle Facility/Tank 41 Bellis Circle Cambridge, MA

Appendix C – Geotechnical Laboratory Test Results



Client:	Kleinfelder, Inc.		
Project:	DPW Facility Tank		
Location:	Cambridge, MA	Project No:	GTX-320897
Boring ID:	---	Sample Type:	---
Sample ID:	---	Test Date:	04/25/25
Depth :	---	Test Id:	812285
		Tested By:	ajl
		Checked By:	ank

Moisture Content of Soil and Rock - ASTM D2216

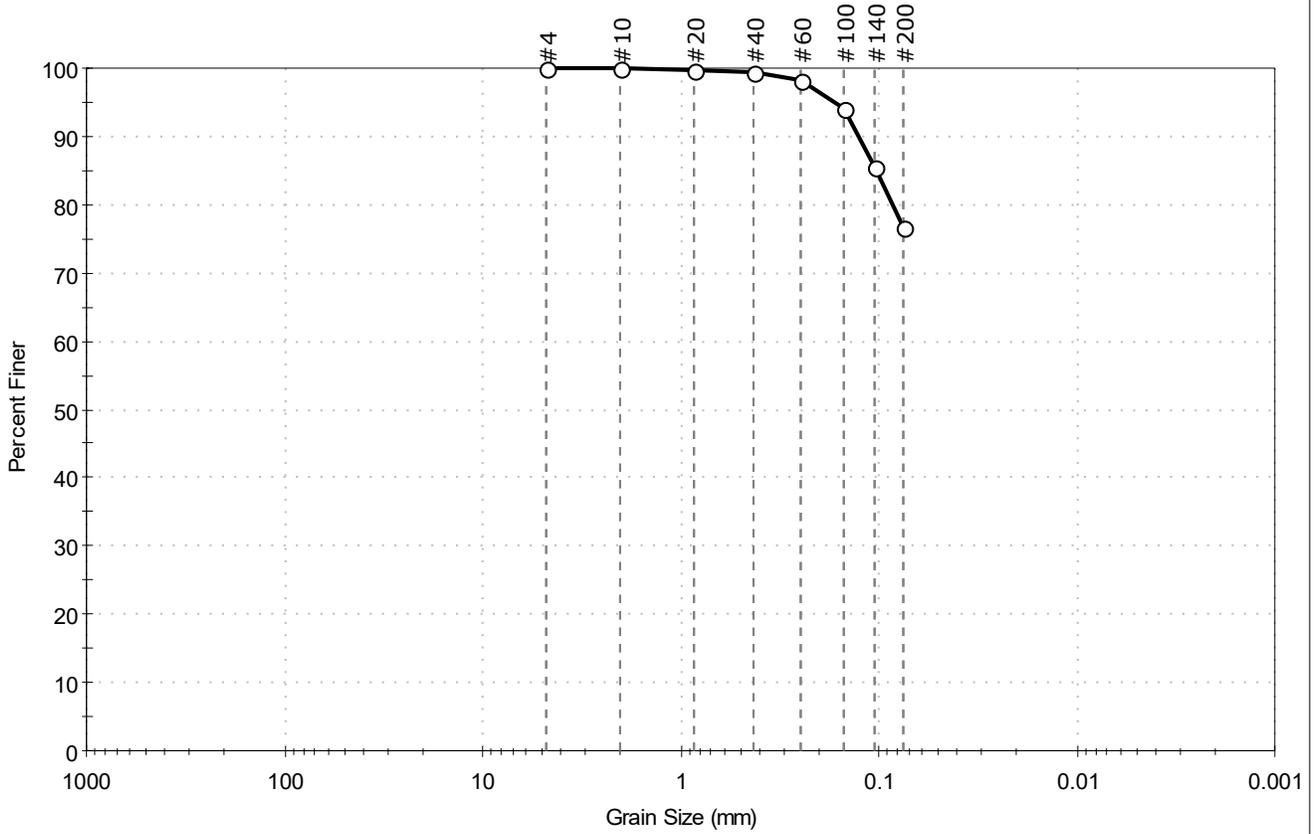
Boring ID	Sample ID	Depth	Description	Moisture Content, %
KLF-1	S- 3	10-12	Moist, dark gray clay	26.4
KLF-2	S- 9	39-41	Moist, olive gray silt	39.3
KLF-3	S- 4	14-16	Moist, dark gray clay	29.6

Notes: Temperature of Drying : 110° Celsius



Client: Kleinfelder, Inc.	Project No: GTX-320897
Project: DPW Facility Tank	
Location: Cambridge, MA	
Boring ID: KLF-1	Sample Type: Jar
Sample ID: S-1	Test Date: 04/23/25
Depth: 6-8	Test Id: 812270
Test Comment: ---	Tested By: ajl
Visual Description: Moist, olive brown silt with sand	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	23.2	76.8

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	100		
#40	0.42	99		
#60	0.25	98		
#100	0.15	94		
#140	0.11	86		
#200	0.075	77		

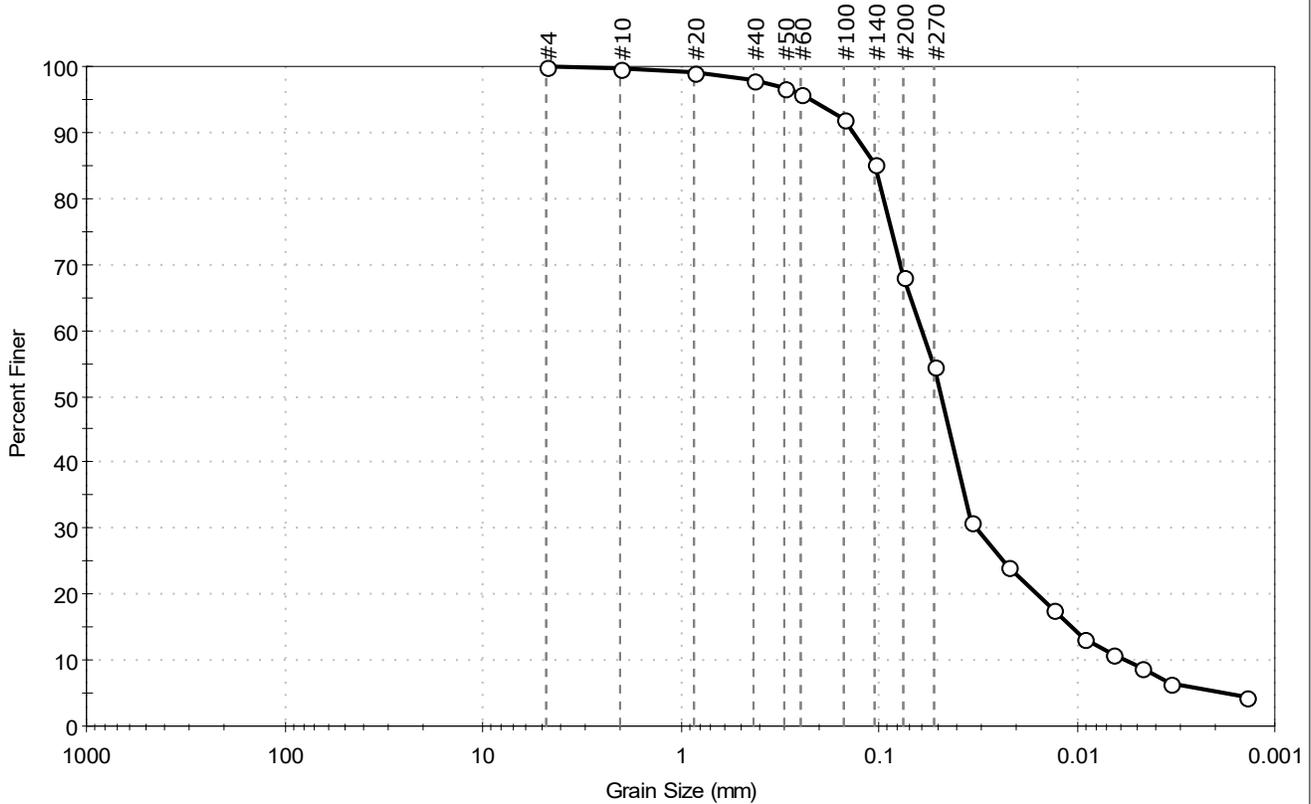
Coefficients	
D ₈₅ = 0.1038 mm	D ₃₀ = N/A
D ₆₀ = N/A	D ₁₅ = N/A
D ₅₀ = N/A	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0)) ML

Sample/Test Description
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---

Client: Kleinfelder, Inc.	Project No: GTX-320897
Project: DPW Facility Tank	
Location: Cambridge, MA	
Boring ID: KLF-2	Sample Type: Jar
Sample ID: S-1 and S-2A	Test Date: 04/22/25
Depth: 6-9	Test Id: 812273
Test Comment: ---	Tested By: ajl
Visual Description: Moist, olive brown sandy silt	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	31.8	68.2

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	98		
#50	0.30	97		
#60	0.25	96		
#100	0.15	92		
#140	0.11	85		
#200	0.075	68		
#270	0.053	54		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0346	31		
---	0.0222	24		
---	0.0130	18		
---	0.0091	13		
---	0.0065	11		
---	0.0047	9		
---	0.0033	7		
---	0.0014	4		

Coefficients

D ₈₅ = 0.1052 mm	D ₃₀ = 0.0325 mm
D ₆₀ = 0.0610 mm	D ₁₅ = 0.0105 mm
D ₅₀ = 0.0489 mm	D ₁₀ = 0.0056 mm
C _u = 10.893	C _c = 3.092

Classification

ASTM	N/A
AASHTO	Silty Soils (A-4 (0)) ML

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

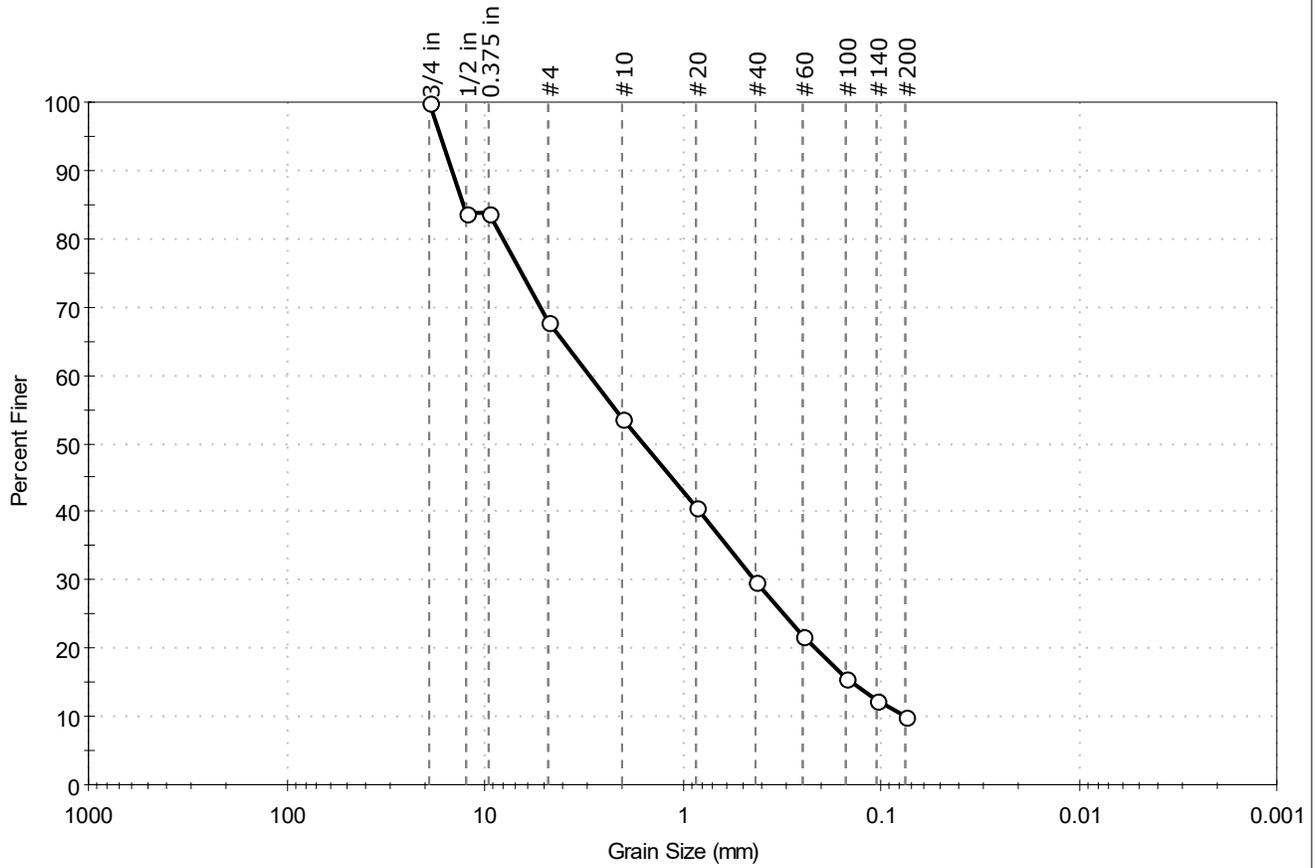
Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client: Kleinfelder, Inc.	Project No: GTX-320897
Project: DPW Facility Tank	
Location: Cambridge, MA	
Boring ID: KLF-3	Sample Type: Jar
Sample ID: S-2	Test Date: 04/23/25
Depth: 8-10	Test Id: 812271
Test Comment: ---	Tested By: ajl
Visual Description: Moist, grayish brown sand with silt and gravel	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	32.1	57.8	10.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
3/4 in	19.00	100		
1/2 in	12.50	84		
0.375 in	9.50	84		
#4	4.75	68		
#10	2.00	54		
#20	0.85	41		
#40	0.42	30		
#60	0.25	22		
#100	0.15	16		
#140	0.11	13		
#200	0.075	10		

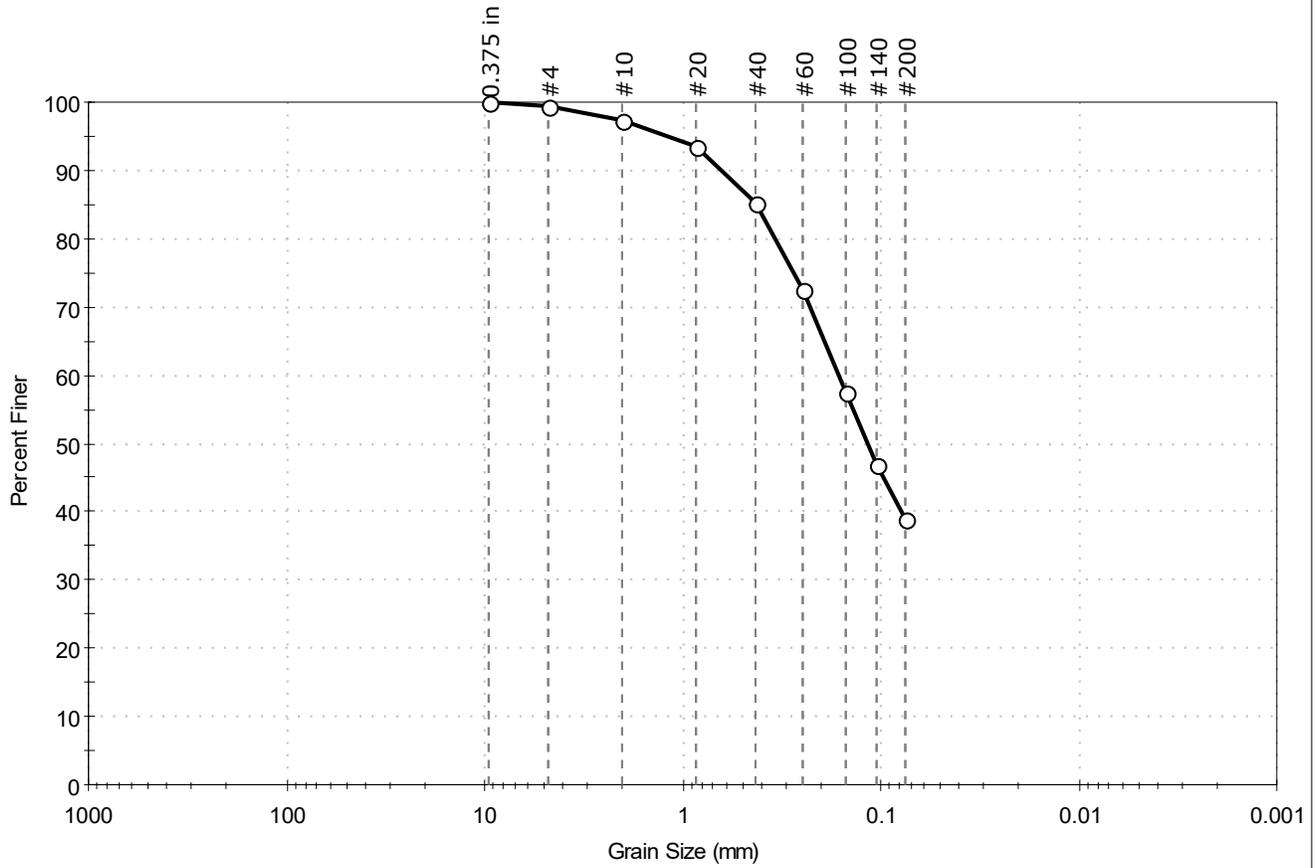
Coefficients	
D ₈₅ = 12.9101 mm	D ₃₀ = 0.4294 mm
D ₆₀ = 2.9443 mm	D ₁₅ = 0.1403 mm
D ₅₀ = 1.5749 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

Classification	
ASTM	N/A
AASHTO	Stone Fragments, Gravel and Sand (A-1-b (0))
	SP-SM

Sample/Test Description
Sand/Gravel Particle Shape : ANGULAR
Sand/Gravel Hardness : HARD

Client: Kleinfelder, Inc.	Project No: GTX-320897
Project: DPW Facility Tank	
Location: Cambridge, MA	
Boring ID: KLF-4	Sample Type: Jar
Sample ID: G-2	Test Date: 04/24/25
Depth: 1-2	Test Id: 812272
Test Comment: ---	Tested By: ajl
Visual Description: Moist, olive brown silty sand	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.5	60.4	39.1

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
0.375 in	9.50	100		
#4	4.75	99		
#10	2.00	97		
#20	0.85	94		
#40	0.42	85		
#60	0.25	73		
#100	0.15	57		
#140	0.11	47		
#200	0.075	39		

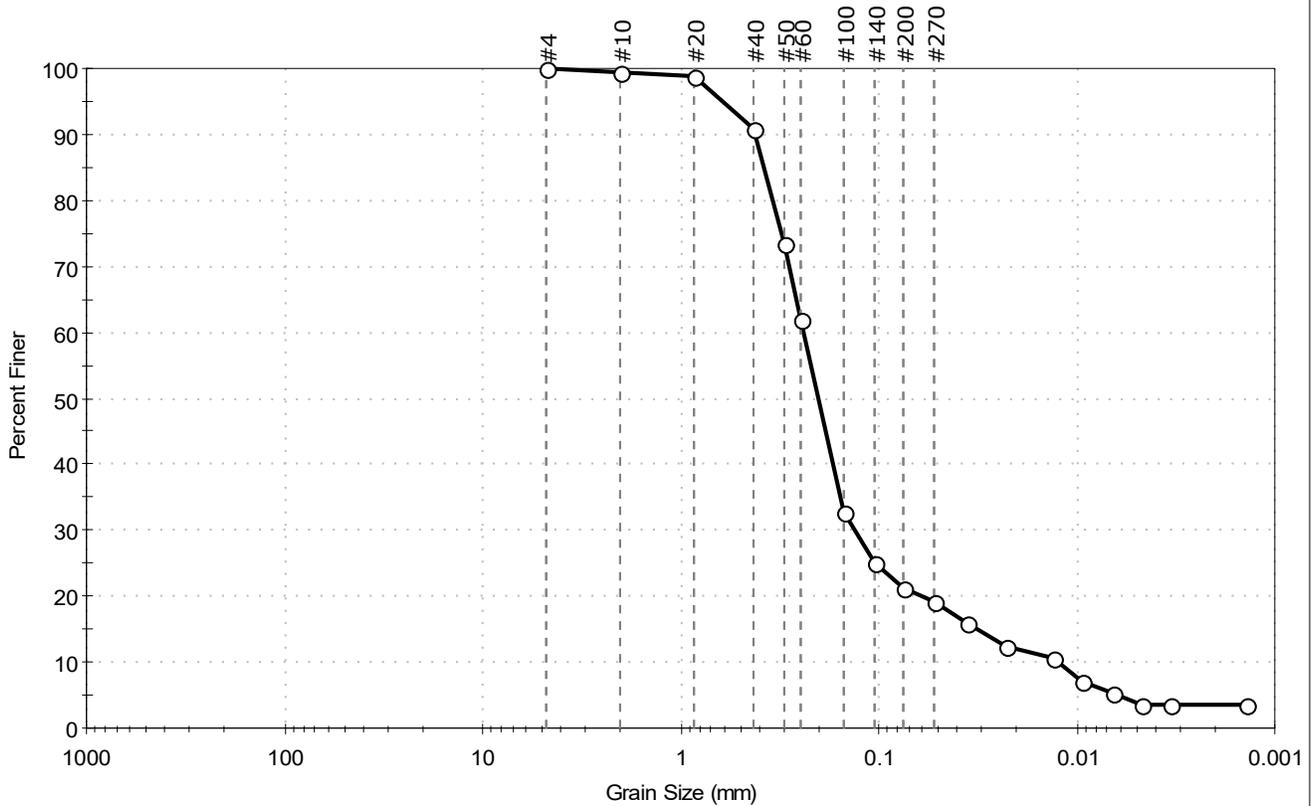
<u>Coefficients</u>	
D ₈₅ = 0.4226 mm	D ₃₀ = N/A
D ₆₀ = 0.1634 mm	D ₁₅ = N/A
D ₅₀ = 0.1172 mm	D ₁₀ = N/A
C _u = N/A	C _c = N/A

<u>Classification</u>	
ASTM	N/A
AASHTO	Silty Soils (A-4 (0)) SM

<u>Sample/Test Description</u>
Sand/Gravel Particle Shape : ---
Sand/Gravel Hardness : ---

Client: Kleinfelder, Inc.	Project No: GTX-320897
Project: DPW Facility Tank	
Location: Cambridge, MA	
Boring ID: KLF-4	Sample Type: Jar
Sample ID: S-1	Test Date: 04/22/25
Depth: 6-8	Test Id: 812274
Test Comment: ---	Tested By: ajl
Visual Description: Moist, light brown silty sand	Checked By: ank
Sample Comment: ---	

Particle Size Analysis - ASTM D6913/D7928



% Cobble	% Gravel	% Sand	% Silt & Clay Size
—	0.0	78.7	21.3

Sieve Name	Sieve Size, mm	Percent Finer	Spec. Percent	Complies
#4	4.75	100		
#10	2.00	100		
#20	0.85	99		
#40	0.42	91		
#50	0.30	73		
#60	0.25	62		
#100	0.15	33		
#140	0.11	25		
#200	0.075	21		
#270	0.053	19		
Hydrometer	Particle Size (mm)	Percent Finer	Spec. Percent	Complies
---	0.0361	16		
---	0.0227	12		
---	0.0132	11		
---	0.0094	7		
---	0.0067	5		
---	0.0048	4		
---	0.0034	4		
---	0.0014	4		

Coefficients

D ₈₅ = 0.3785 mm	D ₃₀ = 0.1322 mm
D ₆₀ = 0.2414 mm	D ₁₅ = 0.0325 mm
D ₅₀ = 0.2026 mm	D ₁₀ = 0.0126 mm
C _u = 19.159	C _c = 5.746

Classification

ASTM	N/A
AASHTO	Silty Gravel and Sand (A-2-4 (0))

Sample/Test Description

Sand/Gravel Particle Shape : ---

Sand/Gravel Hardness : ---

Dispersion Device : Apparatus A - Mech Mixer

Dispersion Period : 1 minute

Est. Specific Gravity : 2.65

Separation of Sample: #270 Sieve

Client: Kleinfelder, Inc.	Project No: GTX-320897	
Project: DPW Facility Tank		
Location: Cambridge, MA		
Boring ID: KLF-2	Sample Type: Jar	Tested By: ajl
Sample ID: S-1 and S-2A	Test Date: 04/25/25	Checked By: ank
Depth: 6-9	Test Id: 812275	
Test Comment: ---		
Visual Description: Moist, olive brown sandy silt		
Sample Comment: ---		

USDA Textural Classification

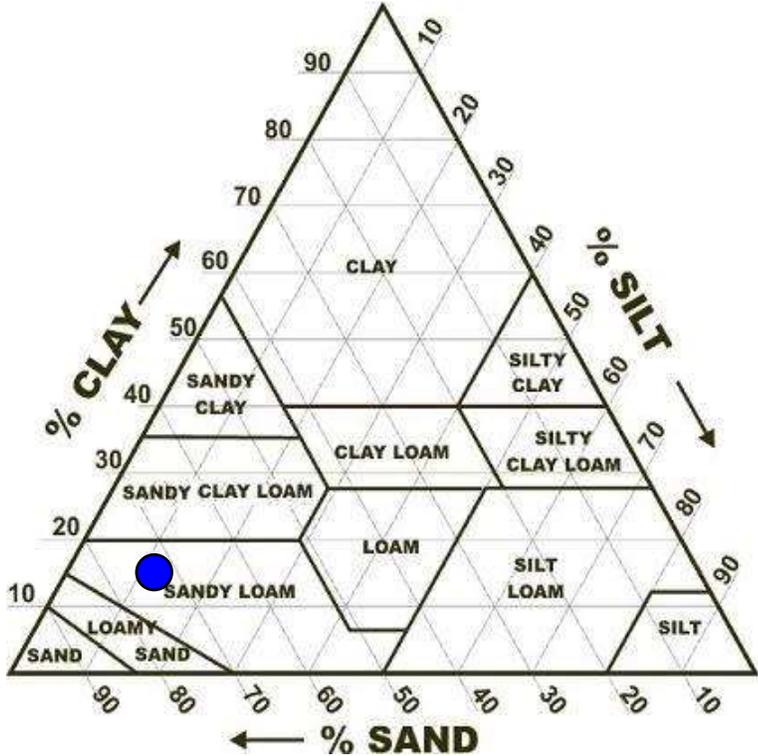
Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
KLF-2	S-1 and S-2A	6-9	49	46	5	Sandy Loam

Classifications based only on material passing the #10 sieve

Sand: material passing 2.0 mm and retained on 0.05 mm diameter

Silt: material passing 0.05 mm and retained on 0.002 mm diameter

Clay: material passing 0.002 mm diameter



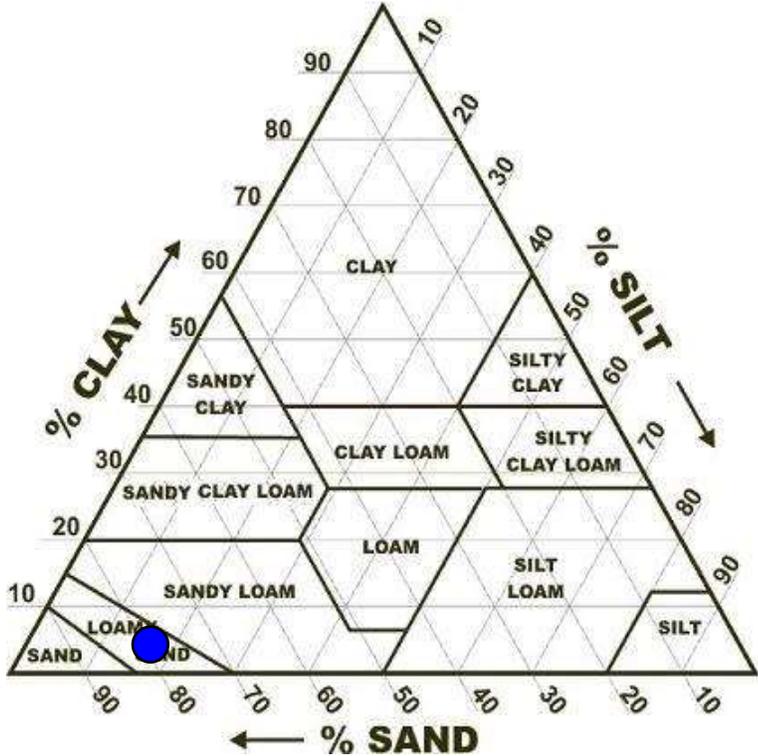
Client: Kleinfelder, Inc.	Project No: GTX-320897	
Project: DPW Facility Tank		
Location: Cambridge, MA		
Boring ID: KLF-4	Sample Type: Jar	Tested By: ajl
Sample ID: S-1	Test Date: 04/25/25	Checked By: ank
Depth: 6-8	Test Id: 812276	
Test Comment: ---		
Visual Description: Moist, light brown silty sand		
Sample Comment: ---		

USDA Textural Classification

Boring ID	Sample ID	Depth	Sand, %	Silt, %	Clay, %	Classification
KLF-4	S-1	6-8	81	15	4	Loamy sand

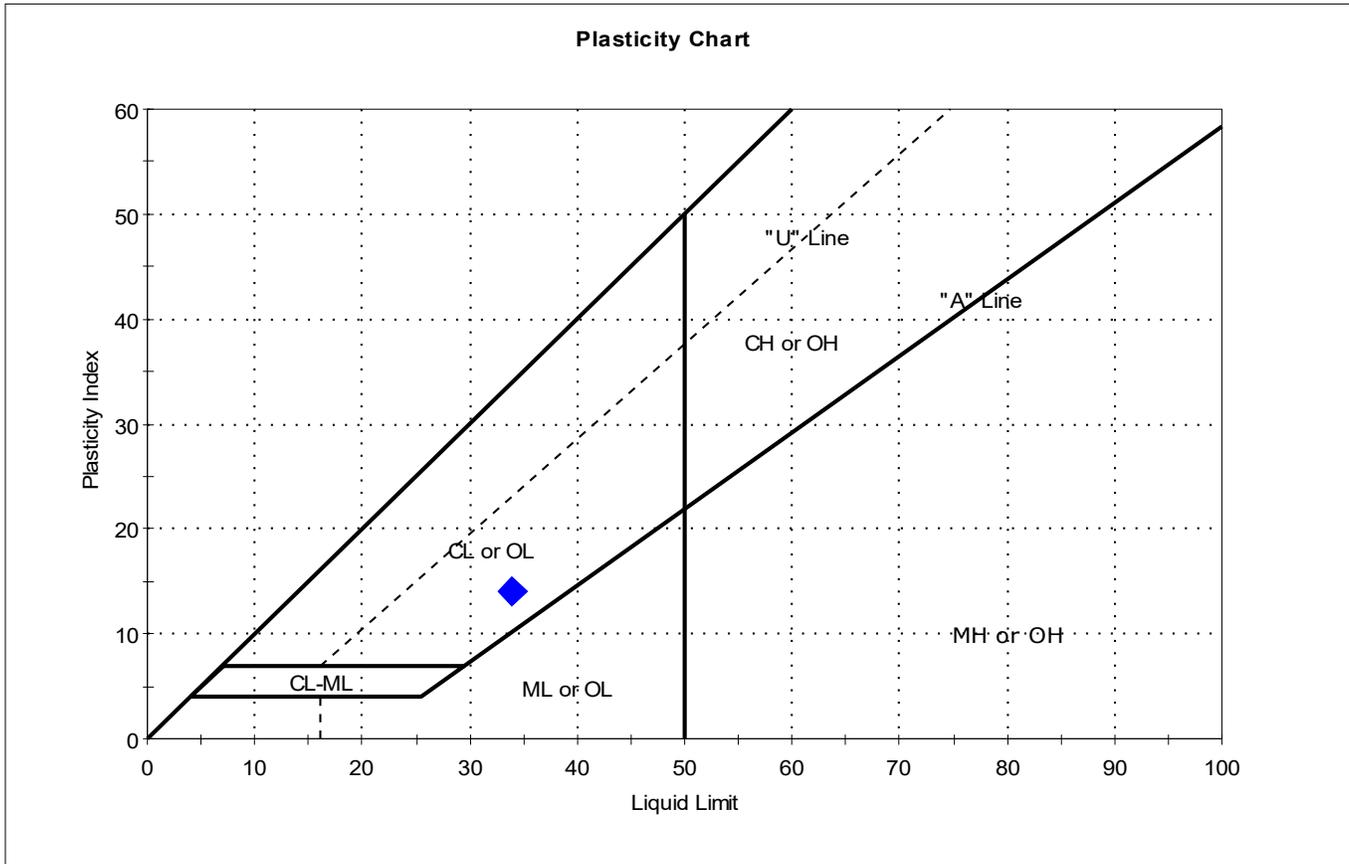
Classifications based only on material passing the #10 sieve

- Sand: material passing 2.0 mm and retained on 0.05 mm diameter
- Silt: material passing 0.05 mm and retained on 0.002 mm diameter
- Clay: material passing 0.002 mm diameter



Client: Kleinfelder, Inc.	Project: DPW Facility Tank	Location: Cambridge, MA	Project No: GTX-320897
Boring ID: KLF-1	Sample Type: Jar	Tested By: cam	
Sample ID: S-3	Test Date: 04/22/25	Checked By: ank	
Depth: 10-12	Test Id: 812267		
Test Comment: ---			
Visual Description: Moist, dark gray clay			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-3	KLF-1	10-12	26	34	20	14	0.5	CL

Sample Prepared using the WET method

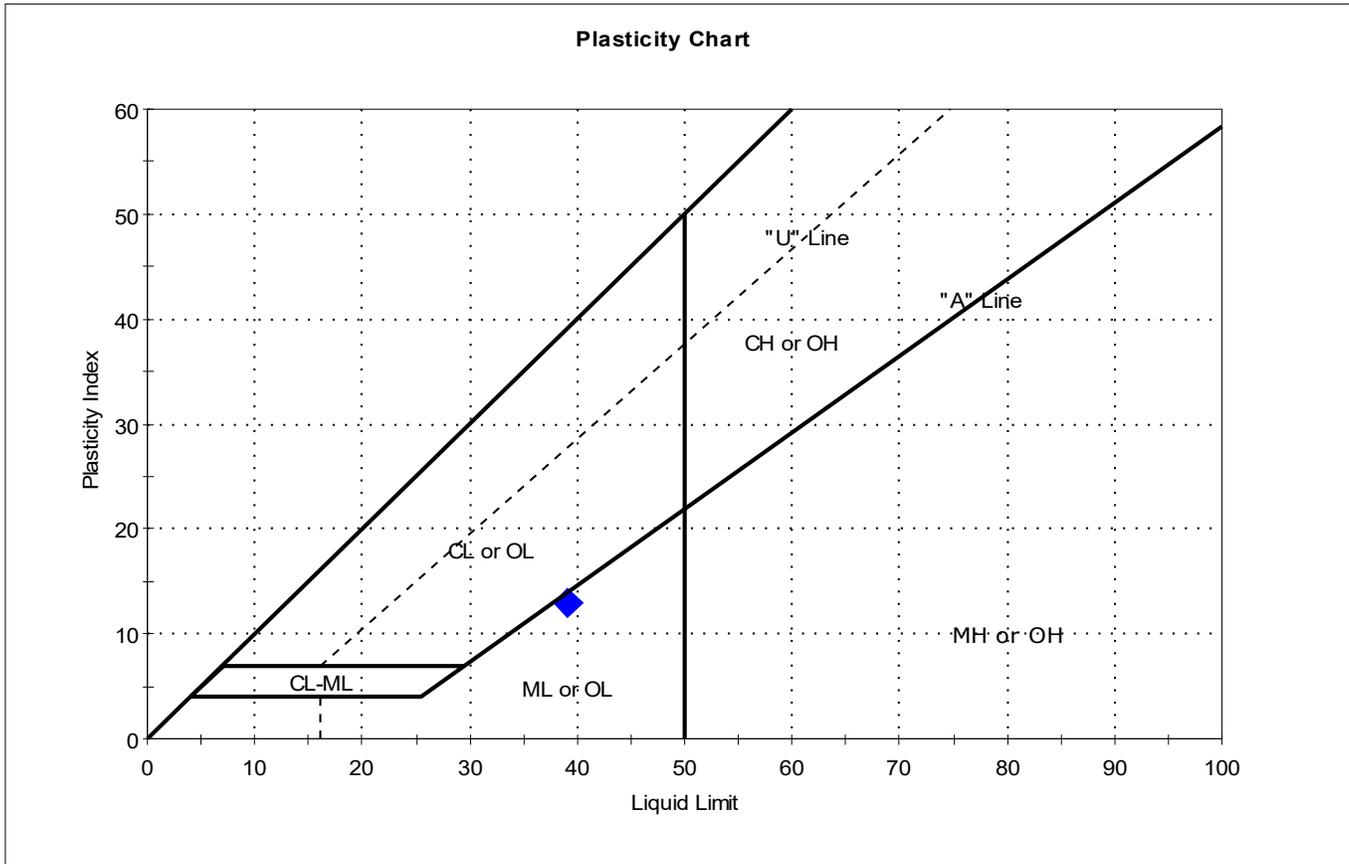
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client: Kleinfelder, Inc.	Project: DPW Facility Tank	Location: Cambridge, MA	Project No: GTX-320897
Boring ID: KLF-2	Sample Type: Jar	Tested By: cam	
Sample ID: S-9	Test Date: 04/22/25	Checked By: ank	
Depth: 39-41	Test Id: 812268		
Test Comment: ---			
Visual Description: Moist, olive gray silt			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-9	KLF-2	39-41	39	39	26	13	1	ML

Sample Prepared using the WET method

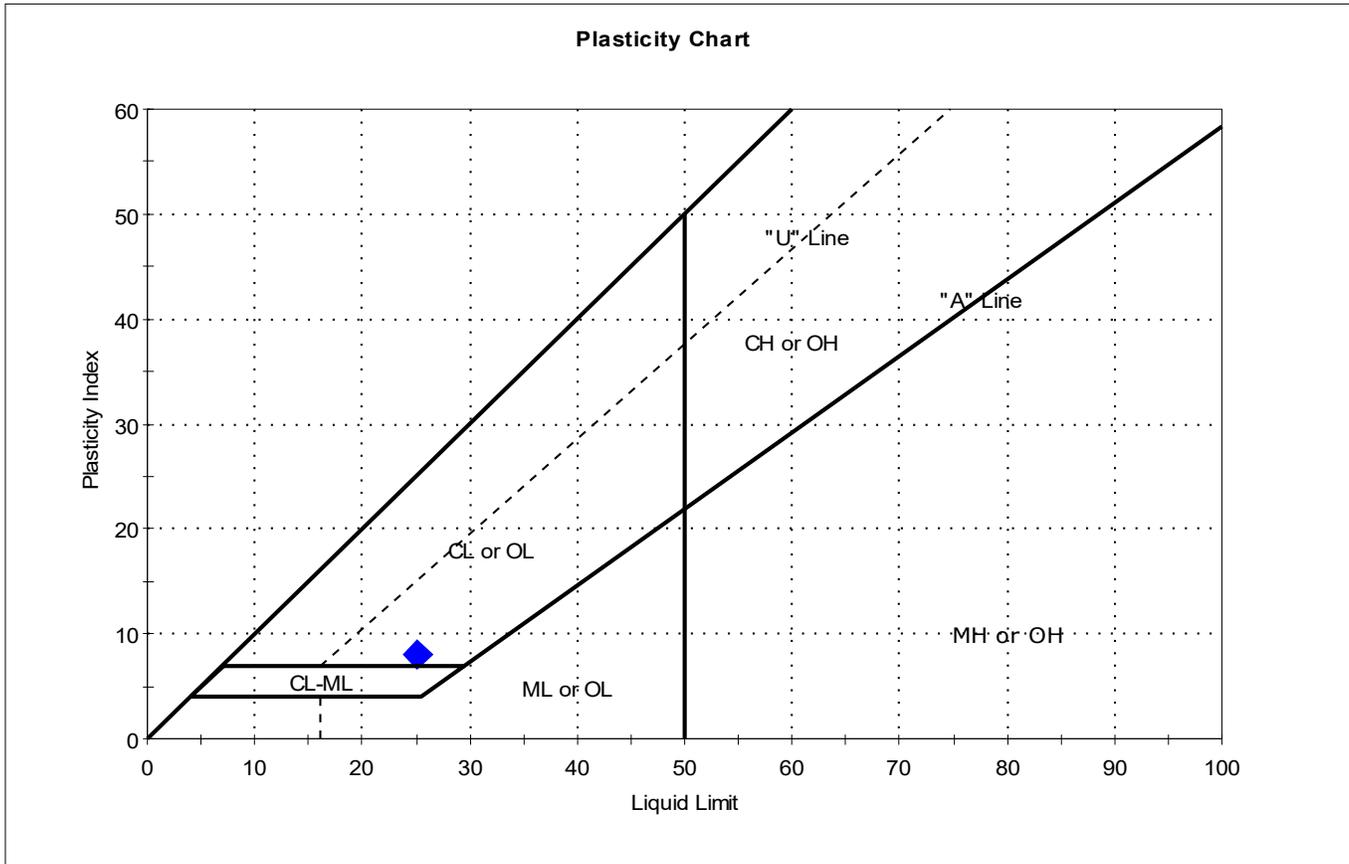
Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Client: Kleinfelder, Inc.	Project: DPW Facility Tank	Location: Cambridge, MA	Project No: GTX-320897
Boring ID: KLF-3	Sample Type: Jar	Tested By: cam	
Sample ID: S-4	Test Date: 04/22/25	Checked By: ank	
Depth: 14-16	Test Id: 812269		
Test Comment: ---			
Visual Description: Moist, dark gray clay			
Sample Comment: ---			

Atterberg Limits - ASTM D4318



Symbol	Sample ID	Boring	Depth	Natural Moisture Content, %	Liquid Limit	Plastic Limit	Plasticity Index	Liquidity Index	Soil Classification
◆	S-4	KLF-3	14-16	30	25	17	8	1.6	CL

Sample Prepared using the WET method

Dry Strength: VERY HIGH

Dilatancy: SLOW

Toughness: LOW

Appendix D – GBA Information Sheet

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, you can benefit from a lowered exposure to problems associated with subsurface conditions at project sites and development of them that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed herein, contact your GBA-member geotechnical engineer. Active engagement in GBA exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Understand the Geotechnical-Engineering Services Provided for this Report

Geotechnical-engineering services typically include the planning, collection, interpretation, and analysis of exploratory data from widely spaced borings and/or test pits. Field data are combined with results from laboratory tests of soil and rock samples obtained from field exploration (if applicable), observations made during site reconnaissance, and historical information to form one or more models of the expected subsurface conditions beneath the site. Local geology and alterations of the site surface and subsurface by previous and proposed construction are also important considerations. Geotechnical engineers apply their engineering training, experience, and judgment to adapt the requirements of the prospective project to the subsurface model(s). Estimates are made of the subsurface conditions that will likely be exposed during construction as well as the expected performance of foundations and other structures being planned and/or affected by construction activities.

The culmination of these geotechnical-engineering services is typically a geotechnical-engineering report providing the data obtained, a discussion of the subsurface model(s), the engineering and geologic engineering assessments and analyses made, and the recommendations developed to satisfy the given requirements of the project. These reports may be titled investigations, explorations, studies, assessments, or evaluations. Regardless of the title used, the geotechnical-engineering report is an engineering interpretation of the subsurface conditions within the context of the project and does not represent a close examination, systematic inquiry, or thorough investigation of all site and subsurface conditions.

Geotechnical-Engineering Services are Performed for Specific Purposes, Persons, and Projects, and At Specific Times

Geotechnical engineers structure their services to meet the specific needs, goals, and risk management preferences of their clients. A geotechnical-engineering study conducted for a given civil engineer

will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client.

Likewise, geotechnical-engineering services are performed for a specific project and purpose. For example, it is unlikely that a geotechnical-engineering study for a refrigerated warehouse will be the same as one prepared for a parking garage; and a few borings drilled during a preliminary study to evaluate site feasibility will not be adequate to develop geotechnical design recommendations for the project.

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project or purpose;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, the reliability of a geotechnical-engineering report can be affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying the recommendations in it. A minor amount of additional testing or analysis after the passage of time – if any is required at all – could prevent major problems.

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read the report in its entirety. Do not rely on an executive summary. Do not read selective elements only. *Read and refer to the report in full.*

You Need to Inform Your Geotechnical Engineer About Change

Your geotechnical engineer considered unique, project-specific factors when developing the scope of study behind this report and developing the confirmation-dependent recommendations the report conveys. Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the elevation, configuration, location, orientation, function or weight of the proposed structure and the desired performance criteria;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project or site changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept*

responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.

Most of the “Findings” Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site’s subsurface using various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing is performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgement to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team through project completion to obtain informed guidance quickly, whenever needed.

This Report’s Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, they are not final, because the geotechnical engineer who developed them relied heavily on judgement and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* exposed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals’ misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a continuing member of the design team, to:

- confer with other design-team members;
- help develop specifications;
- review pertinent elements of other design professionals’ plans and specifications; and
- be available whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction-phase observations.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note*

conspicuously that you’ve included the material for information purposes only. To avoid misunderstanding, you may also want to note that “informational purposes” means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. This happens in part because soil and rock on project sites are typically heterogeneous and not manufactured materials with well-defined engineering properties like steel and concrete. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled “limitations,” many of these provisions indicate where geotechnical engineers’ responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a “phase-one” or “phase-two” environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually provide environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures.* If you have not obtained your own environmental information about the project site, ask your geotechnical consultant for a recommendation on how to find environmental risk-management guidance.

Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, the engineer’s services were not designed, conducted, or intended to prevent migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, *proper implementation of the geotechnical engineer’s recommendations will not of itself be sufficient to prevent moisture infiltration.* **Confront the risk of moisture infiltration** by including building-envelope or mold specialists on the design team. **Geotechnical engineers are not building-envelope or mold specialists.**



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Appendix E – Limitations

LIMITATIONS

This report was prepared for the proposed City of Cambridge Department of Public Works Combined Sewer Overflow Long-Term Control Plan Update - Bellis Circle Facility/Tank project in Cambridge, MA in accordance with generally accepted soil engineering practices and the Limitations in this section and throughout this report. This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the Client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than four (4) years from the date of the report.

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is possible that soil or groundwater conditions could vary between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, we must be notified immediately so that we may reevaluate the recommendations of this report. If the scope of the proposed construction changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed, and the conclusions of this report are modified or approved in writing, by Kleinfelder. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

The scope of services for this geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site. Kleinfelder has prepared a separate report under a separate cover to present the assessment of environmental conditions at this site.

The work performed was based on project information provided by Kleinfelder's project design team. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field. Kleinfelder must be retained so that all geotechnical aspects of construction will be monitored on a full-time basis by a representative from Kleinfelder, including site preparation, preparation of subgrades, and placement of engineered fill and trench backfill. These services provide Kleinfelder the opportunity to observe the actual soil, rock, and groundwater conditions encountered during construction and to evaluate the applicability of the recommendations presented in this report to the site conditions. If changed site conditions affect

the recommendations presented herein, Kleinfelder must also be retained to perform a supplemental evaluation and to issue a revision to our original report. In addition, if there are any changes in the field to the plans and specifications, the Client must obtain written approval from Kleinfelder's engineer that such changes do not affect our recommendations. Failure to do so will invalidate our recommendations.

The boring logs and laboratory test data attached to this report may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that the Team's geotechnical engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions.