



**GEOTECHNICAL TEST PIT EXPLORATION SUMMARY
REPORT**

FOR

**PROPOSED SUBURBAN ROAD APTS
0 SUBURBAN ROAD, WORCESTER, MASSACHUSETTS**

**PREPARED
FOR:**

**PREPARED
BY:**

**YANKEE ENGINEERING & TESTING, INC.
WORCESTER, MASSACHUSETTS**

PROJECT #97105B

January 24, 2024

**10 Mason Street Worcester Massachusetts 01609
Tel (508) 831-7404 Fax (508) 831-7388
CONSTRUCTION INSPECTION & MATERIALS TESTING
www.yankeeengineering.com**



January 24, 2024

**RE: Preliminary Geotechnical Test Pit Exploration Summary
Proposed Suburban Road Apts
0 Suburban Road
Worcester, MA**

Project #97105B

Dear Mr.

The purpose of this report is to present the field observations, laboratory results and our professional geotechnical engineering recommendations/conclusions from a limited subsurface soil exploration, completed on January 15, 2024, at the above referenced site.

Per the agreement, Yankee conducted a soil test pit exploration program to assess the subsurface soils and groundwater conditions in relation to the proposed development, based on the plans available at the time of this report. The findings, including field observations and laboratory data, have been used to develop the geotechnical conclusions and professional engineering recommendations included within this report. No warranty is expressed nor implied.

EXISTING PROPERTY CONDITIONS:

The property, spanning approximately 16.25 acres, is situated roughly 175 feet north of the intersection of Highland Street and Suburban Road, Worcester, Massachusetts. Residential dwellings border the subject property on the west, east, and southern boundaries. Towards the north and northwestern portion of the parcel, a wooded area was observed.

During the initial site tour our Geotechnical Engineer, Mr. John Gentile, E.I., met with Mr. Mark Allen from Botany Bay Construction, and reviewed the proposed test pit locations. At that time the proposed excavation locations were deemed satisfactory. It should be noted that the site elevations referenced herein were estimated from Google Earth.

PROPOSED DEVELOPMENT:

Yankee's analysis, guided by the provided plans and client discussions, is focused on the construction of the three proposed multifamily low-rise residential buildings, inclusive of site improvements like parking, utilities, and drainage. Test pit locations and sampling have been specifically tailored to support these low-rise building developments and their geotechnical considerations.

GEOLOGIC SITE CONDITIONS:

Based on the USGS Scientific Investigation Map 3402 Quadrangle 80, Surficial Materials Map of the Worcester North Quadrangle, Massachusetts (2018) the area of the site is mapped as having “coarse deposits”. These coarse deposits typically consist of gravel deposits, sand and gravel deposits, and sand deposits. Further, the sorting and bedding thickness vary with the deposit types.

According to the US Geological Survey map prepared in cooperation with the Commonwealth of Massachusetts, Department of Public Works and Joseph A. Sinnott, State Geologist, (1983) the surficial deposits are mapped as generally being underlain by metamorphic rocks of the Silurian Age Paxton Formation. Local to the site this Formation consists of undifferentiated biotite granofels, calc silicate granofels, and sulfidic schist.

Bedrock was not observed local to this site.

KNOWN SITE HISTORY:

A Google Earth historical map review from 5/1996 to the present day showed that the site has been wooded for some time. No further historical records were searched as part of this assessment.

SUBSURFACE EXPLORATION SERVICES:

The limited subsurface excavation exploration program consisted of nine “test pits” (TP-114 to TP-122), performed by Botany Bay Const, under the supervision of Mr. John Gentile E.I., a *Yankee* Geotechnical Engineer. The test pit locations are shown in Figure 1, the Test Pit Location Plan. It should be noted that the general test pit locations were chosen in relation to the provided plans to provide a cross section of the materials underlying the proposed building with direction from Mr. Allen. The excavation termination depths varied based on test pit locations.

TEST PIT OBSERVATIONS:

| Average Depth Range (ft.) | Generalized Soil Description |
|--|---|
| 0 - 2 | Predominantly damp, medium dense to loose, varying from light brown to dark brown, often with urban fill materials like trash, construction debris, bricks, and concrete. |
| 3 - 5 | Mixed layers of damp peat, loose to medium dense sand, often with construction debris or rocks. Soil color varies from tan to dark brown. |
| 6 - 8 | Varied composition, including wet medium dense sand with cobbles or rocks, and occasional organic material like peat. Soil color ranges from tan to gray. |
| 9 - 12 | Occasional presence of medium dense gray sand and layers similar to upper strata. Some pits terminated before this depth. |

It is important to note that the urban fill identified in various test pits, as illustrated in the test pit logs, is laden with trash and household debris at various depths throughout the testing areas. These soils, due to their composition and the presence of such materials, are considered unsuitable for construction purposes. Therefore, it is strongly recommended that they be removed down to natural ground (where feasible) prior to the commencement of any construction activities.

LABORATORY TESTS & RESULTS:

Laboratory gradation analyses were completed, per ASTM D-422 washed sieve methods, on three soil samples recovered from native fill elevation. The lab gradation results (copies attached) classified the soils as predominantly tan to brown silty sands with gravel (SM). The soil composition results (gravel/sand/silt percentages), as shown on the attached curves, can be summarized as follows:

| Test Pit No | Sample No# | Depth | Gravel (% > #4) | Sand (#4 to #200) | Silt/Clay (% < #200) |
|-------------|------------|-------|-----------------|-------------------|----------------------|
| TP-116 | L-33957 | 8' | 2 | 85 | 13 |
| TP-117 | L-33956 | 8' | 52 | 44 | 4 |
| TP-118 | L-33959 | 5'-6' | 1 | 49 | 50 |
| TP-122 | L-33958 | 7' | 23 | 71 | 7 |

The table provided illustrates that in general, while the soil samples contain a fair amount of gravel (over 20%), they also have a high fines content (greater than 10 % passing the #200 sieve). The laboratory test results suggest that these soils are moderately sensitive to moisture and vibration. Additionally, they exhibit poor drainage properties and a moderate potential for frost heave. Consequently, the reuse of these onsite soils for structures or roadways could be challenging due to their susceptibility to moisture.



Special attention may need to be paid to ensure that the reuse and placement of this material is $3\% \pm$ of the soil samples optimum moisture content.

These soil grain size distributions would generally fall within SBC Soil Class #F, of SBC Table 1806.2 material classification, and were applied in determining the maximum allowable soil bearing capacity presented later in this report.

MASSACHUSETTS STATE BUILDING CODE:

The SBC section 9.4.1.2.1 applies site classes A/B/C/D/E/F based on boring standard penetration numbers (SPN's or "blow counts") for soil(s) at/below the proposed footing elevation. Our evaluation, based on the subsurface peat, resulted in general site classification F (requiring site specific engineering). However, the native sands/gravels underlying the organic/peat layer were judged to be not considered susceptible to "liquefaction", according to SBC Section 1805.

Seismic Parameters:

The design engineer should note that, based on SBC Code Table 1604.11 (Worcester) Mapped Earthquake Design Factors $S_S=0.18$ and $S_1=0.066$ would apply to the site. Further, based on State Code Table 9.4.1.2.4a (using site class F) there are no short period spectral coefficient factor (F_a) available.

Thus, the maximum short period acceleration (S_{M1}) is $F_a \times S_S$ is not calculable.

From Table 9.4.1.2.4b, the 1 second spectral coefficient factor (F_v) for site class F is not available.

Thus, the maximum 1 second acceleration (S_{m1}) is $F_v \times S_1$ is not calculable

Lateral Earth Pressures:

We recommended that the static lateral earth pressure (at rest = K_o) for any restrained walls, which will effectively serve as retaining walls with greater than 6' exposed, should be calculated using an equivalent fluid pressure of 60 pcf (pounds per cubic foot). This value is based on the backfill consisting of granular (less than 10% passing #200 sieve) soils, being compacted to greater than 95%. It is calculated as $K_o = 1 - \sin \phi$ where ϕ is the soil shear angle (assumed to be $30^\circ \pm$ for "granular" sand/gravel with a unit weight of $120 \pm$ pcf). Thus, the at rest (no wall movement) soil "fluid" pressure is $K_o \times \text{soil unit weight} = 0.5 \pm \times 120 \pm \text{ pcf} = 60 \text{ pcf}$.

The static lateral earth pressure (outward wall movement allowed "active" pressure = K_a) for "unrestrained" retaining walls, is calculated as $K_a = \tan^2 (45^\circ - \sin \phi / 2)$ where ϕ is the soil shear angle (assumed $30^\circ \pm$ for granular soil). Thus the "active" soil pressure is $K_a \times \text{soil unit weight}$ ($0.33 \pm \times 120 \pm \text{ pcf}$) yields an active equivalent fluid pressure of 40 pcf. Additional pressure(s) exerted from surcharge loads (acting within 1.5 times the wall height) should be considered as a uniform pressure equal to $0.5q$, where q (psf) is the surcharge load. Further, granular backfill should have less than 12% silt ($\% < \#200$ sieve) and be compacted to a minimum of 95%. Also, for cast-in-place concrete footings bearing on native soil or compacted structural fill, we recommend a maximum design "sliding friction" coefficient not exceeding 0.40.



Seismic Loads on Foundation Walls:

Exterior foundation walls and retaining walls shall be designed to resist an earthquake force, F_w , for horizontal backfill surface, equal to:

$$F_w = 0.100 (S_s) (F_a) (\gamma) (H)^2 \quad \text{where:}$$

S_s listed above

F_a listed above

γ is total unit weight of the soil

H is the height of the wall measured as the difference in elevation of finished ground surface or floor in front of and behind the wall

The earthquake force from the backfill shall be distributed as an inverted triangle over the height of the wall. The minimum safety factor for retaining walls shall be 1.5 for sliding and 2.0 for overturning.

CONSTRUCTION:

The site's high water table, coupled with loose urban fill overlying organic peat, and test pit excavations that did not clearly define natural ground, necessitate further investigation. We recommend additional borings with Standard Penetration Testing (SPT) to gain a more comprehensive understanding of the subsurface conditions in these areas. While preliminary assessments suggest Rammed Aggregate Piers or Rigid Inclusions for soil improvement, further boring and SPT data may reveal a more suitable foundation solution for the proposed construction. The cost of typical Rammed Aggregate Piers (RAP) and Rigid Inclusion (GCC) ground improvement range from approximately \$20.00 to \$40.00 per square foot. For a more accurate cost estimation, it's recommended to obtain quotes from local contractors who are familiar with the ground conditions and construction in the project area.

Anticipate additional costs of around \$35,000 for this necessary soil exploration, which is essential for the specialty contractor's scope of work.

SHALLOW FOUNDATIONS:

Due to the presence of loose urban fill and organic (peat) soil zones, the site is **unsuitable** for a standard spread footing foundation in its current state, as this could lead to long-term settlement from the decomposition and compression of the organic layers and urban fill with debris.

Given the shallow depth to suitable bearing soil and the high-water table, it is advisable for the owner to consider ground improvement methods like Rammed Aggregate Piers (RAP) or Rigid Inclusions for supporting the proposed foundation and slab on grade. Obtaining a quote from a subcontractor experienced in these methods, such as *Helical Drilling*, for RAP/Ground Column Construction (GCC) installation is recommended. The owner should be aware of the additional costs for design and construction of the ground improvements. However, these methods will minimize the generation of excess soil requiring disposal.



**Preliminary Geotechnical Test Pit Exploration Summary
Proposed Suburban Apt
0 Suburban Road, Worcester, MA**

**January 24, 2024
Project #97105B**

After completion of soil improvement as recommended, *Yankee* anticipates that the native medium dense sand with gravel (at a depth of approximately 7' to 8' below land surface) possess a maximum allowable net bearing capacity of up to 2.0 TSF (4000 psf).

SLABS ON GRADE:

Considering the presence of loose and/or organic strata in the subsurface conditions, the concrete slab-on-grade will require structural support through a ground improvement technique such as Rammed Aggregate Piers or Rigid Inclusions. We also recommend that any backfill within the building footprint be prepared in lifts not exceeding 1' in thickness and compacted to 95% of the soil materials optimum proctor value. Further, we recommend that 12" of imported Slab Base Gravel, meeting State M1.03.0 type B "gravel borrow" specifications, should be prepared and compacted to 95%+, of the soil materials optimum proctor value, directly beneath the concrete slab. Any surficial "urban fill" should be excavated and stockpiled onsite for possible future reuse if determined acceptable by the geotechnical engineer.

The following soil gradation specifications are recommended for Granular Fill, Gravel Base, and Dense Graded crushed stone materials referenced herein:

| Sieve Size | Granular Fill | Gravel Base | Dense Grade |
|------------|---------------|-------------|-------------|
| 6" | 100 | 100 | 100 |
| 3" | 95-100 | 100 | 100 |
| 1/2" | 60-95 | 50-85 | 50-80 |
| #4 | 50-80 | 40-75 | 30-55 |
| #10 | 30-70 | 30-60 | n/a |
| #40 | 10-70 | 10-35 | 10-25 |
| #100 | 0-25 | 0-8 | n/a |
| #200 | 0-12 | 0-8 | 3-10 |

All backfill soils shall be free from snow, ice, roots, topsoil, and/or other deleterious materials.

Place and compact granular fill up to the required subgrade elevation. The recommended minimum degree of compactio based on the percentage of the soil's maximum dry density according to ~~ASTM~~ methods, is specified below:

| General Backfill Areas | Minimum Compaction |
|--|--------------------|
| Beneath Footings, Slab, and for Pavement Gravel Base | 95% |
| Below Pavement Base Course Material | 95% |
| Beneath Landscaped Areas | 90% |

Due to the observed soil types, granular sands, the contractor should be aware that OSHA safety standards, for excavations exceeding 4 feet in depth, may require significant widening to maintain the required slope(s). This report does not address any safety issues, which is the responsibility of others.



**Preliminary Geotechnical Test Pit Exploration Summary
Proposed Suburban Apt
0 Suburban Road, Worcester, MA**

**January 24, 2024
Project #97105B**

FOUNDATIONS:

Foundations will be designed with ground improvement methods in mind. Dewatering to native soils at observed water table depth and importing sufficient structural fill may not be not feasible nor is advised at the time of this report's publication.

However, once ground improvement is completed, the bearing soil at the bottom of footing trenches should be recompacted/proof rolled using vibratory equipment of sufficient weight to obtain the SBC specified 95% minimum compaction. Backfilling of the foundation walls should occur on both sides to avoid unbalanced loading.

Due to the observed soil types, granular sand to silty sands, the contractor should be aware that OSHA safety standards, for excavations exceeding 4 feet in depth, may require significant widening to maintain the required slope(s). This report does not attempt to address any site safety issues, which are the responsibility of others.

GEOTECHNICAL CONCLUSIONS:

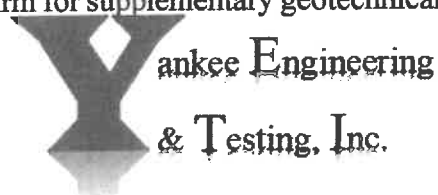
This report outlines the results of *Yankee's* focused subsurface soil exploration at the specified location, encompassing field observations and laboratory results. The purpose of this exploration was to evaluate the compatibility of the subsurface soils and groundwater conditions for the planned low-rise multi-family residential complex.

Our preliminary findings suggests ground improvement methods such as Rammed Aggregate Piers (RAP) or Rigid Inclusions (GCC) for the foundation, considering the high water table and soil conditions as a cost-effective foundation option. Additional borings, using standard penetration testing is strongly advised for a more detailed subsurface analysis and comprehensive understanding of the subsurface composition.

After completion of soil improvement as recommended, *Yankee* anticipates that the native medium dense sand with gravel possesses a maximum allowable net bearing capacity of up to 3.0 TSF (6000 psf). We propose a maximum design net soil bearing capacity of 2.0 TSF for the location, factoring in the marginally increased content of soil fines. The site is advised to be classified as SBC Site Class "F," underlain by undisturbed, unknown density sands/gravels with silt at the time of this report's publication.

During the construction phase, we advocate for the excavation of unsuitable materials (urban fill and debris) and their substitution with compacted granular fill or crushed stone where deemed necessary per industry standards.

This report is predicated on the conditions encountered during our exploration and does not guarantee consistency of site conditions. Should there be any changes in subsurface conditions during construction, immediate consultation with our firm for supplementary geotechnical engineering assessment is advised.



Preliminary Geotechnical Test Pit Exploration Summary
Proposed Suburban Apt
0 Suburban Road, Worcester, MA

January 24, 2024
Project #97105B

We trust that the information and engineering viewpoints presented herein are comprehensive and succinct. However, for any inquiries or additional geotechnical services, please feel free to contact us at our Worcester office. We are grateful for this opportunity to assist your firm and eagerly anticipate collaborating with you until the project's completion.

Prepared by:



John Gentile, E.I.
Geotechnical Engineer

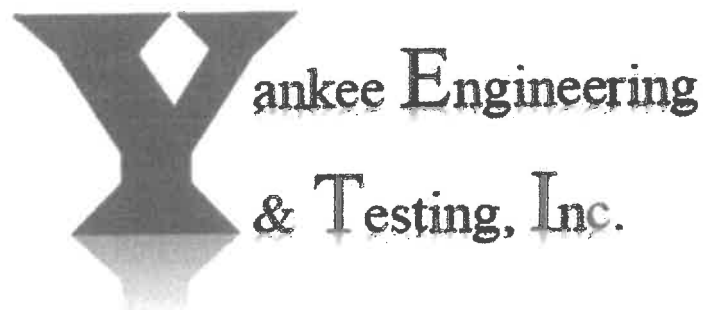
Reviewed by:

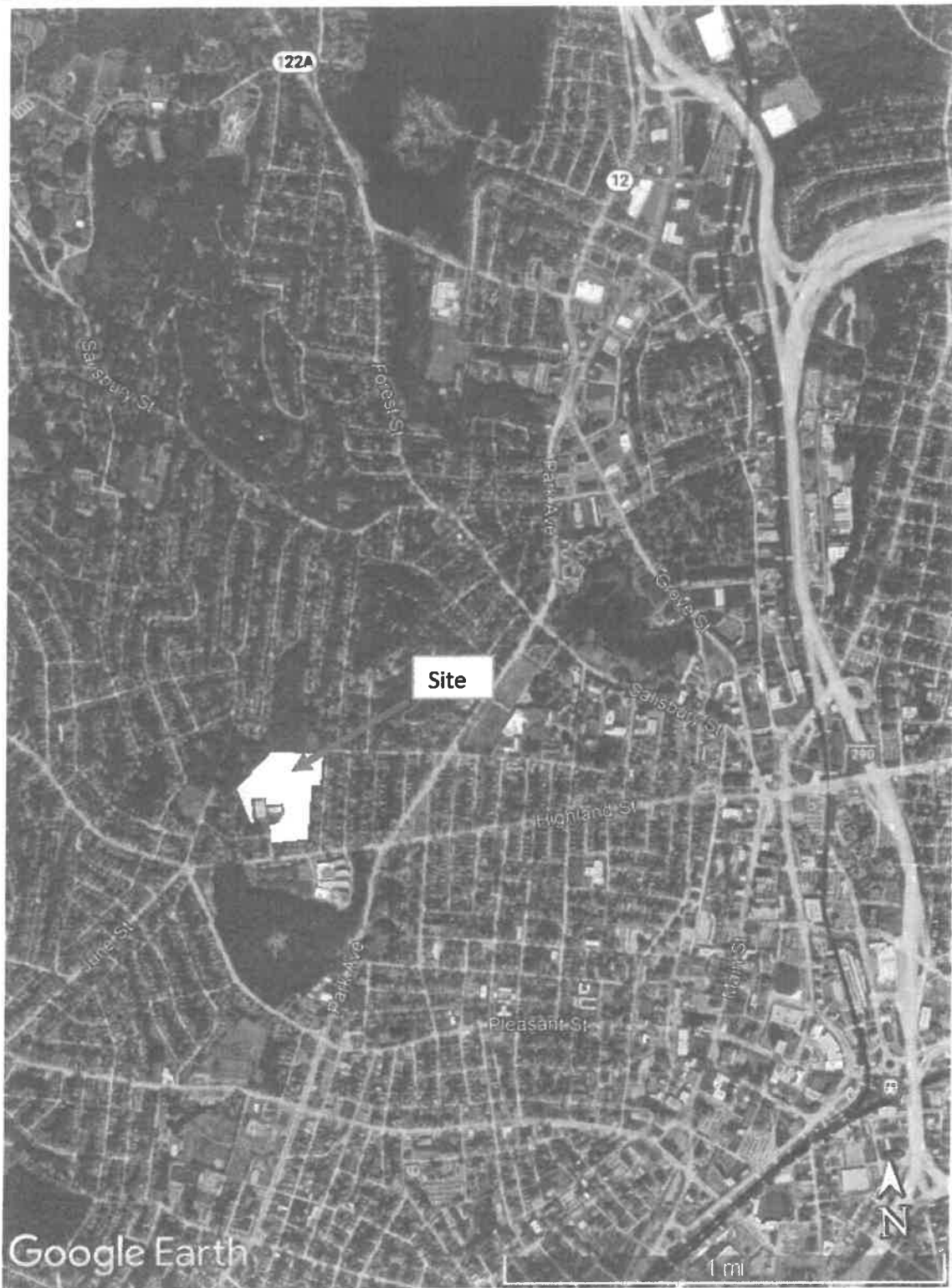


Scott M. Mensen, P.E., P.G.
Director of Engineering Services



APPENDIX A





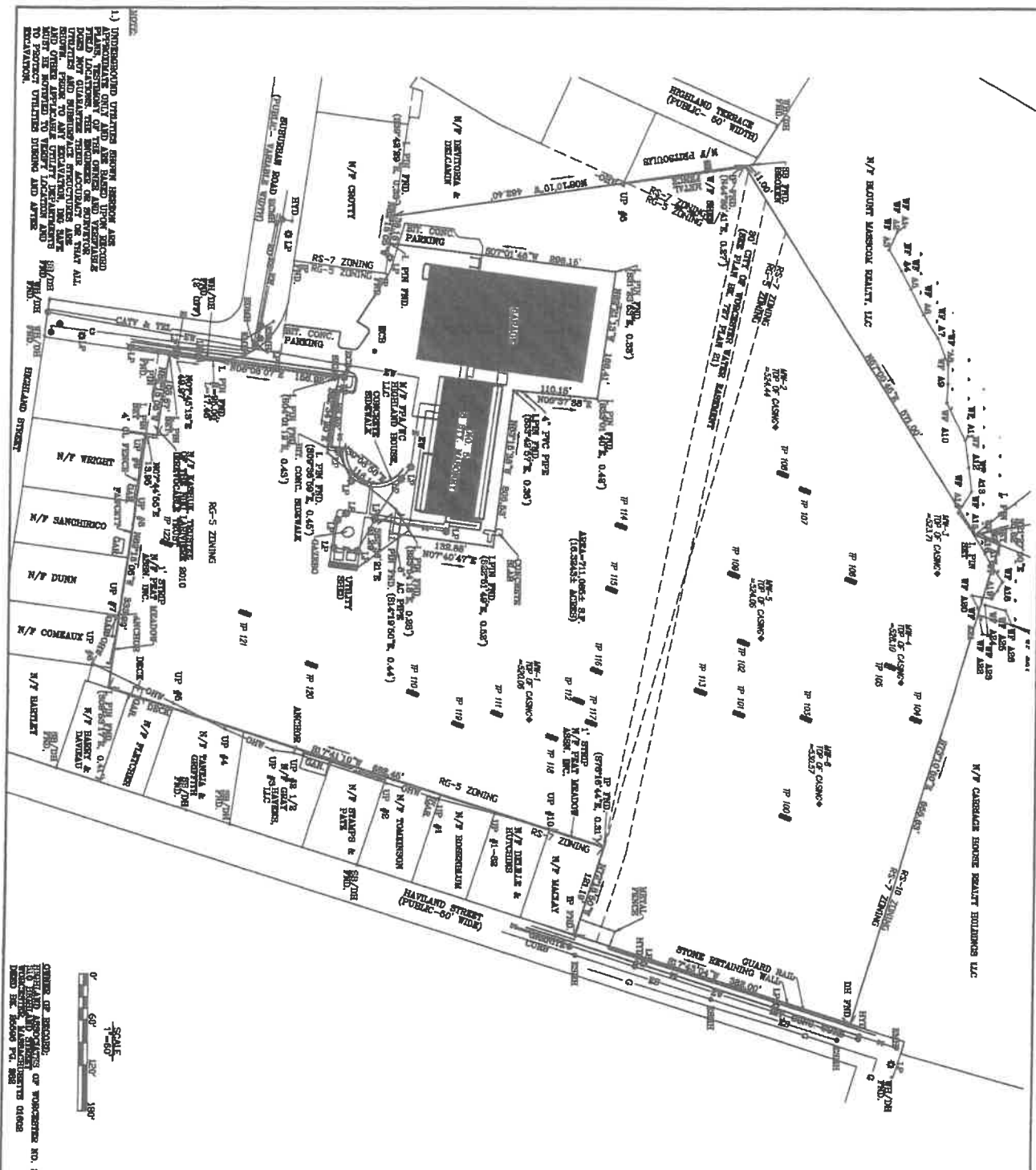
Yankee Engineering & Testing, Inc.
 10 Mason Street
 Worcester, MA 01609
 Phone: (508) 831-7404
 Fax: (508) 831-7388

Project: Suburban Road Apts
Location: Suburban Rd, Worcester, MA
Project #: 97105B
Date: January 15, 2024
Client:

FROM: Google Earth

TEST PIT LOCATION PLAN
FIGURE 1

Approx. Scale:
 As Shown



PLAN No. 86 256 PLAN 78

SOIL TESTING AND MONITORING WELL LOCATION PLAN
WORCESTER, MASSACHUSETTS

DATE: 01/22/24
ISSUE: 1
REVISION: 1

DRAWN BY: [Name]
CHECKED BY: [Name]
SCALE: 1" = 60'

PROJECT NO. 230016

SHEET 1 OF 1

LEGEND

- EXH EXISTING EXHIBIT CO. VARIANCE
- EXH EXISTING CONCRETE SEWER MAINS
- EXH EXISTING SEWER MAINS
- EXH EXISTING SEWER MAINS
- EXH EXISTING OVERHEAD WIRES
- EXH EXISTING SANITARY LINES
- EXH EXISTING SEWER LINES
- EXH EXISTING WATER LINES
- EXH EXISTING UNDERGROUND CABLE & TELEVISION LINES
- EXH EXISTING GAS GATE VALVE
- EXH EXISTING WATER GATE VALVE
- EXH EXISTING UTILITY POLE
- EXH EXISTING WELL LOCATION
- EXH SOIL TEST PIT LOCATION

ZONING DISTRICTS - REG-5 (MIXED-DENSITY DEVELOPMENT, LOW DENSITY)

- MIN. LOT AREA: 5,000 S.F. + 1,000 S.F. PER D.U.
- MIN. FRONT YARD: 60' + 6' PER D.U.
- MIN. SIDE YARD: 15'
- MIN. REAR YARD: 15'
- MAX. BUILDING HEIGHT: 60'
- MAX. OVERHANG: 5'
- MAX. FLOOR TO AREA RATIO: 3%

ZONING DISTRICTS - RS-7 (SINGLE-FAMILY DWELLING)

- MIN. LOT AREA: 7,000 S.F.
- MIN. FRONT YARD: 60'
- MIN. SIDE YARD: 15'
- MIN. REAR YARD: 15'
- MAX. BUILDING HEIGHT: 60'
- MAX. OVERHANG: 5'
- MAX. FLOOR TO AREA RATIO: 3%

ZONING DISTRICTS - RG-5 (GENERAL RESIDENTIAL)

- MIN. LOT AREA: 7,000 S.F.
- MIN. FRONT YARD: 60'
- MIN. SIDE YARD: 15'
- MIN. REAR YARD: 15'
- MAX. BUILDING HEIGHT: 60'
- MAX. OVERHANG: 5'
- MAX. FLOOR TO AREA RATIO: 3%

ZONING DISTRICTS - N-7 (NEIGHBORHOOD RESIDENTIAL)

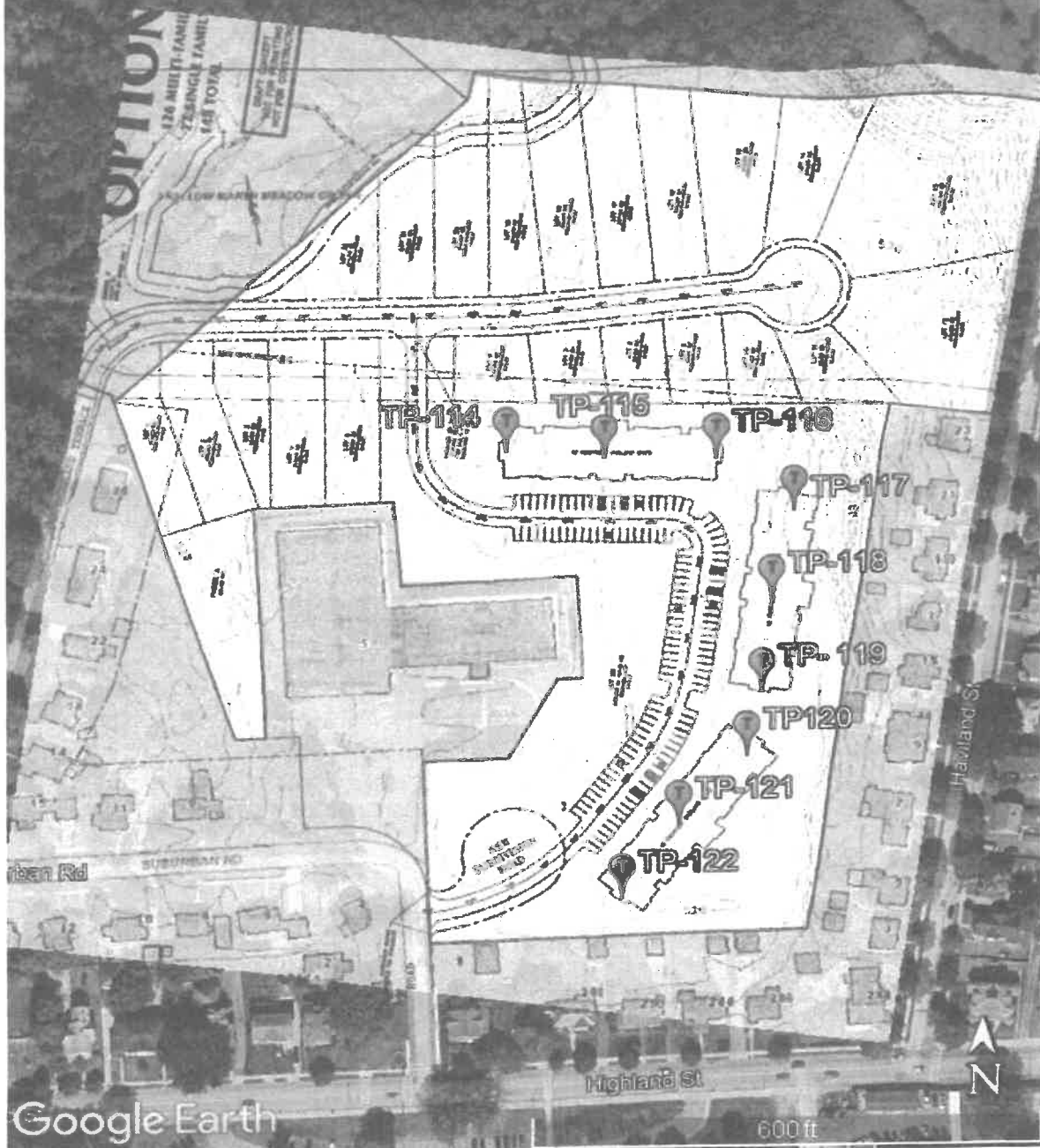
- MIN. LOT AREA: 7,000 S.F.
- MIN. FRONT YARD: 60'
- MIN. SIDE YARD: 15'
- MIN. REAR YARD: 15'
- MAX. BUILDING HEIGHT: 60'
- MAX. OVERHANG: 5'
- MAX. FLOOR TO AREA RATIO: 3%

NOTES:

- 1) REFER TO THE 2020E P.L. 2022
- 2) REFER TO THE 2020E P.L. 2022
- 3) ZONING CLASSIFICATION: RG-5
- 4) PLAN REVISIONS: 1-2

ADDITIONAL NOTES:

- 1) ANYTHING REMOVED FROM THESE PLANS SHALL BE AT THE OWNER'S RISK.
- 2) THE USER OF THESE PLANS SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF WORCESTER.
- 3) THESE PLANS ARE FOR INFORMATION ONLY AND DO NOT CONSTITUTE A CONTRACT.
- 4) THE USER SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY PERMITS AND APPROVALS FROM THE CITY OF WORCESTER.



Yankee Engineering & Testing, Inc.
 10 Mason Street
 Worcester, MA 01609
 Phone: (508) 831-7404
 Fax: (508) 831-7388

Project: Suburban Road Apts
Location: Suburban Rd, Worcester, MA
Project #: 97105B
Date: January 15, 2024
Client:

FROM: Project Site Plan

**TEST PIT LOCATION PLAN
 FIGURE 1**

Approx. Scale:
 As Shown

SOIL TEST PIT LOG

| | | | |
|---|----------|--|------------------------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts Suburban Rd, Worcester | Test Pit No# TP - 114 |
| | Job No: | 97105B | Current Elev. \approx 520' |
| | Date: | January 15, 2024 | Location: SC North Bldg |
| | | | |

| | |
|--|--------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>\approx1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size/count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|---|--------------------|-----------------------------|
| 1' | X | Light Brown to brown, damp to wet, LOOSE urban Land Fill with trash, bricks and household debri | N/A | 0-6" Topsoil, Urban Fill |
| 2' | | | | |
| 3' | | | | |
| 4' | | | | |
| 5' | | | | |
| 6' | | | | |
| 7' | | | | |
| 8' | | | | |
| 9' | | | | |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | Test Pit Terminated @ 12' bls | | \approx 508' |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | <u>Test Pit Dimensions (ft)</u> | | <u>Soil Description Terminology</u> |
|---------------------------------------|------|-------|-----------------|---------------------------------|--------|--|
| Date | Time | Depth | Comments | Length: | Width: | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 12' | Upon Completion | 8 | 3 | |
| | | | | 12 | | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 115 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 520' |
| | Job No: | 97105B | Location: | Center N. Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|--------------------------------------|
| Equipment: Mini-Ex | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: _____ Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|--|---------------------|-----------------------------|
| 1' | Σ | Light Brown to brown, damp to wet, LOOSE urban Land Fill with trash and household debris | | 0-6" Topsoil, Urban Fill |
| 2' | | | | |
| 3' | | | | |
| 4' | | | | |
| 5' | | | | |
| 6' | | | | |
| 7' | | | | |
| 8' | | | | |
| 9' | | Test Pit Terminated @ 8' bls | | ≈ 512' |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|---|--|
| Date | Time | Depth | Comments | Length: | 8 | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 8' | Upon Completion | Width: | 3 | |
| | | | | Depth: | 8 | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 116 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 522' |
| | Job No: | 97105B | Location: | E. North Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|---------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep: <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: <u>i</u> |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|--|---------------------|-----------------------------|
| 1' | | Dark brown to brown, damp, Topsoil | N/A | Topsoil |
| 2' | ∇ | Tan to gray, wet, LOOSE, Urban Fill with bricks and concrete | N/A | Urban fill |
| 3' | | | | |
| 4' | | | | |
| 5' | | | | |
| 6' | | Brown to dark brown, wet, LOOSE, Peat | N/A | Organics |
| 7' | | | | |
| 8' | | | | |
| 9' | | Gray, wet, Medium dense, sand with silt trace gravel | N/A | Native L-33957 |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | Test Pit Terminated @ 12' bls | | ≈ 510' |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | <u>Soil Description Terminology</u> and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
|---------------------------------------|------|-------|-----------------|--------------------------|----|---|
| Date | Time | Depth | Comments | Length: | 8 | |
| 01/15/24 | - | 12' | Upon Completion | Width: | 3 | |
| | | | | Depth: | 12 | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 117 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 525' |
| | Job No: | 97105B | Location: | N. East Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|--------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|---|---------------------|-----------------------------|
| 1' | | Light to dark brown, damp, medium dense, silty sand trace roots | N/A | 6" topsoil |
| 2' | | | | |
| 3' | | Dark brown damp, LOOSE, peat | N/A | Organics |
| 4' | ∇ | Gray to tan, damp sand and rocks | N/A | Native |
| 5' | | | | |
| 6' | | | | |
| 7' | | Tan, wet, gravel and sand, trace silt | N/A | Native |
| 8' | | | | L-33956 |
| 9' | | Test Pit Terminated @ 8' bls | | ≈ 517' |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|--------|--|
| Date | Time | Depth | Comments | Length: | Width: | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 8' | Upon Completion | 8 | 3 | |
| | | | | 8 | | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report

* - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 118 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 522' |
| | Job No: | 97105B | Location: | C. East Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|--------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|---|---------------------|---------------------------------|
| 1' | | Brown to tan, damp, LOOSE, silty sand with construction debris, asphalt and brick | N/A | 6" Topsoil with concrete debris |
| 2' | | | | |
| 3' | | | | |
| 4' | | Dark brown, damp, LOOSE, peat | N/A | Organics |
| 5' | | Brown to tan, damp, medium dense, silty sand trace gravel | N/A | Native |
| 6' | | | | L-33959 |
| 7' | Σ | Gray to tan, wet, medium dense, sand with rocks | N/A | Native |
| 8' | | | | |
| 9' | | Test Pit Terminated @ 8' bls | | ≈ 514' |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|---|--|
| Date | Time | Depth | Comments | Length: | 8 | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 8' | Upon Completion | Width: | 3 | |
| | | | | Depth: | 8 | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|--|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts Suburban Rd, Worcester | Test Pit No# | TP - 119 |
| | Job No: | 97105B | Current Elev. | ≈ 522' |
| | Date: | January 15, 2024 | Location: | S. East Bldg |
| | | | | |

| | |
|---|--------------------------------------|
| Equipment: Mini-Ex | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|---|---------------------|-----------------------------|
| 1' | | Brown, damp, medium dense, Topsoil with trash | N/A | Some Urban Fill |
| 2' | | Tan, damp, LOOSE, sand | N/A | Fill |
| 3' | | | | |
| 4' | | | | |
| 5' | | Tan to brown, damp, medium dense, course sand some rocks | N/A | Native |
| 6' | | | | |
| 7' | | | | |
| 8' | | | | |
| 9' | | | | |
| 10' | ⚡ | | | |
| 11' | | Test Pit Terminated @ 10' bls | | ≈ 512' |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|----|--|
| Date | Time | Depth | Comments | Length: | 8 | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 10' | Upon Completion | Width: | 3 | |
| | | | | Depth: | 10 | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 120 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 520' |
| | Job No: | 97105B | Location: | N. South Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|--------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|--|---------------------|-----------------------------|
| 1' | | Brown, damp, medium dense, Topsoil with trash | N/A | Some Urban Fill |
| 2' | X | Tan, damp, LOOSE, sand with construction debri, bricks | N/A | Urban Fill |
| 3' | | | | |
| 4' | | | | |
| 5' | | Dark gray, wet, LOOSE peat | N/A | Organics |
| 6' | | | | |
| 7' | | Tan, wet, medium dense, sand and rocks | N/A | Native |
| 8' | | | | |
| 9' | | Test Pit Terminated @ 8' bls | | ≈ 512' |
| 10' | | | | |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|--------|--|
| Date | Time | Depth | Comments | Length: | Width: | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 8' | Upon Completion | 8 | 3 | |
| | | | | 8 | | |
| | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report

* - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | |
|---|--|---|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: <u>Suburban Road Apts</u> Suburban Rd, Worcester Job No: <u>97105B</u> Date: <u>January 15, 2024</u> | Test Pit No# <u>TP - 121</u> Current Elev. <u>≈ 523'</u> Location: <u>C. South Bldg</u> |
|---|--|---|

| | |
|---|--|
| Equipment: <u>Mini-Ex</u> Contractor: _____ Operator: _____ Make: <u>Kimono</u> Model: <u>U55-5</u> Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | YET Rep <u>Mr. John Gentle, E.I.</u> Client: _____ Weather: <u>Sunny 20°</u> |
|---|--|

| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|--|---------------------|-----------------------------|
| 1' | | Dark brown to tan, damp, medium dense to LOOSE, sand and construction debri | N/A | Urban Fill |
| 2' | | | | |
| 3' | Σ | Tan, wet, LOOSE to medium dense, tan sand with rocks some construction debri | N/A | Fill |
| 4' | | | | |
| 5' | | | | |
| 6' | | Dark brown, wet, LOOSE, peat | N/A | Organics |
| 7' | | | | |
| 8' | | | | |
| 9' | | Gray, wet medium dense, gray sand | N/A | Native |
| 10' | | Test Pit Terminated @ 9' bls | | ≈ 514' |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| Field Groundwater Observations & Data | | | | Test Pit Dimensions (ft) | Soil Description Terminology |
|---------------------------------------|------|-------|-----------------|--------------------------|--|
| Date | Time | Depth | Comments | Length: <u>8</u> | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% |
| 01/15/24 | - | 9' | Upon Completion | Width: <u>3</u> | |
| | | | | Depth: <u>9</u> | |
| | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report
 * - ground elevation based on Google Earth.

SOIL TEST PIT LOG

| | | | | |
|---|----------|------------------------|---------------|-----------------|
| Yankee Engineering & Testing, Inc 10 Mason Street Worcester, MA 01609 phone 508-831-7404 fax 508-831-7388 | Project: | Suburban Road Apts | Test Pit No# | TP - 122 |
| | | Suburban Rd, Worcester | Current Elev. | ≈ 522' |
| | Job No: | 97105B | Location: | S. South Bldg |
| | Date: | January 15, 2024 | | |

| | |
|---|---------------------------------------|
| Equipment: <u>Mini-Ex</u> | YET Rep: <u>Mr. John Gentle, E.I.</u> |
| Contractor: _____ | Client: _____ |
| Operator: _____ | Weather: <u>Sunny 20°</u> |
| Make: <u>Kimono</u> Model: <u>U55-5</u> | |
| Capacity: <u>≈1.0cy</u> Reach: <u>18'</u> | |

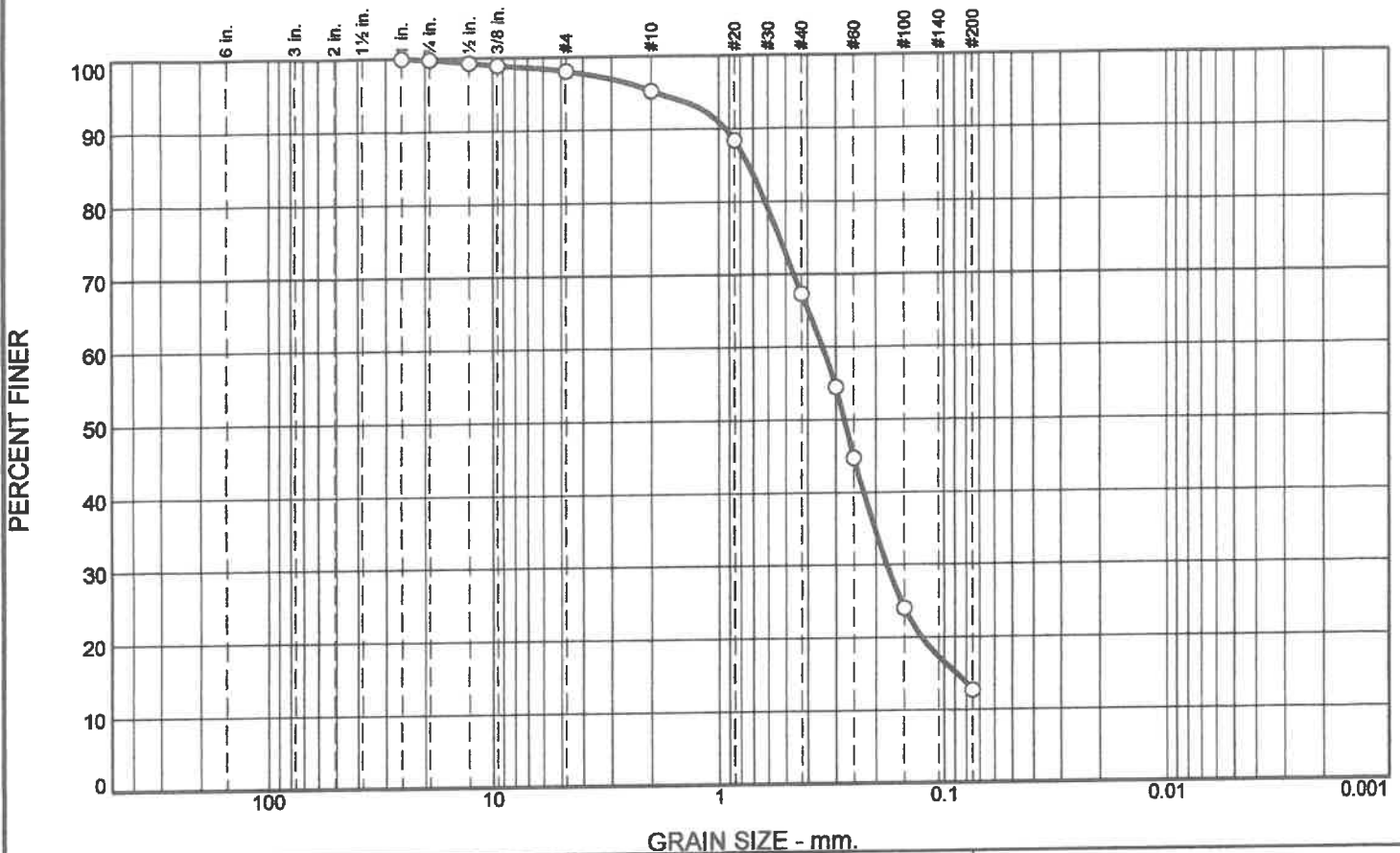
| DEPTH (ft.) | STRATA CHANGE | SOIL VISUAL DESCRIPTION (estimate of soil composition) | BOULDER size//count | OTHER TEST PIT OBSERVATIONS |
|-------------|---------------|---|---------------------|-----------------------------|
| 1' | Σ | Dark brown to tan, damp, medium dense to LOOSE, sand and construction debri | N/A | Urban Fill |
| 2' | | | | |
| 3' | | | | |
| 4' | | | | |
| 5' | | Dark brown, wet, LOOSE, peat | N/A | Organics |
| 6' | | | | |
| 7' | | | | |
| 8' | | Gray, wet, medium dense, sand | N/A | Native |
| 9' | | some gravel trace silt | | L-33958 |
| 10' | | Test Pit Terminated @ 9' bls | | ≈ 513' |
| 11' | | | | |
| 12' | | | | |
| 13' | | | | |
| 14' | | | | |
| 15' | | | | |

| | | | | | | | |
|--|------|-------|-----------------|---------------------------------|---|--|--|
| <u>Field Groundwater Observations & Data</u> | | | | <u>Test Pit Dimensions (ft)</u> | | <u>Soil Description Terminology</u> | |
| Date | Time | Depth | Comments | Length: | 8 | and = 35%+ some = 20% to 35% little = 10% to 20% trace = <10% | |
| 01/15/24 | - | 9' | Upon Completion | Width: | 3 | | |
| | | | | Depth: | 9 | | |
| | | | | | | | |

Geotechnical Information and Remarks: For additional information refer to the geotechnical report

* - ground elevation based on Google Earth.

Particle Size Distribution Report



| % +3" | % Gravel | | % Sand | | | % Fines |
|-------|----------|------|--------|--------|------|---------|
| | Coarse | Fine | Coarse | Medium | Fine | |
| 0.0 | 0.1 | 1.8 | 2.9 | 27.9 | 54.6 | 12.7 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|------------|---------------|----------------|--------------|
| 1" | 100.0 | | |
| 3/4" | 99.9 | | |
| 1/2" | 99.3 | | |
| 3/8" | 98.9 | | |
| #4 | 98.1 | | |
| #10 | 95.2 | | |
| #20 | 88.4 | | |
| #40 | 67.3 | | |
| #50 | 54.5 | | |
| #60 | 44.7 | | |
| #100 | 24.0 | | |
| #200 | 12.7 | | |

Material Description
Gray/brown silty sand trace gravel

Atterberg Limits
 PL= NP LL= NP PI= NP

Coefficients
 D₈₅= 0.7327 D₆₀= 0.3435 D₅₀= 0.2755
 D₃₀= 0.1788 D₁₅= 0.0882 D₁₀=
 C_u= C_c=

Classification
 USCS= SM AASHTO= A-2-4(0)

Remarks
 Sampled by JG (Yankee) on 01/15/24
 Met M1.03.0 "Gravel Borrow" gradation limits

* (no specification provided)

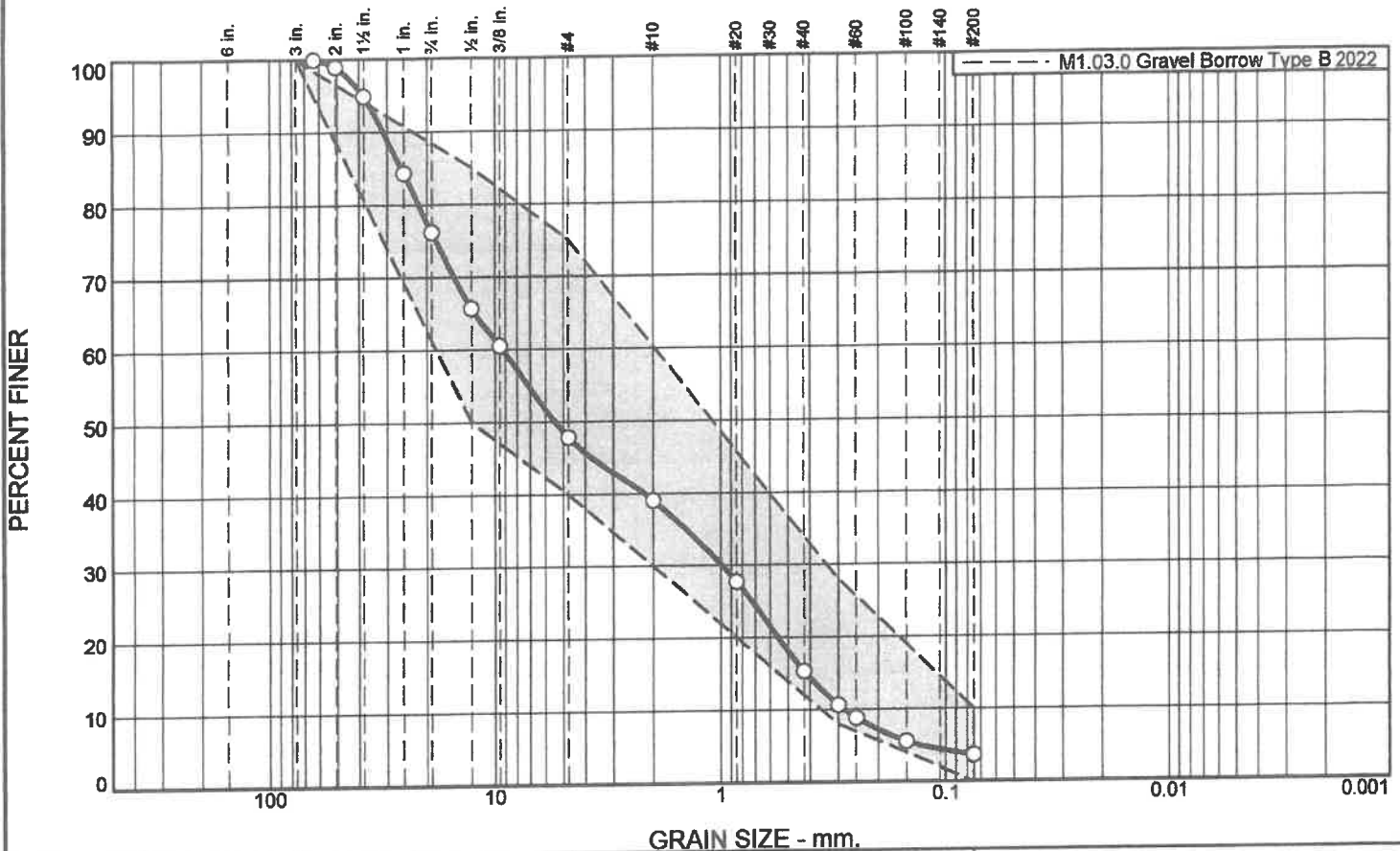
Sample No.: L-33957
Location: TP-116

Source of Sample: Suburban Apartments - Worcester MA (97105)
Date: **Elev./Depth:** 8' BLS

| | |
|---|--|
| YANKEE ENGINEERING & TESTING, INC. | Client: |
| | Project: Various Sites/Projects |
| | Project No: 97105 |
| | Figure |

Tested By: AK _____

Particle Size Distribution Report



| % +3" | % Gravel | | % Sand | | | % Fines |
|-------|----------|------|--------|--------|------|---------|
| | Coarse | Fine | Coarse | Medium | Fine | |
| 0.0 | 23.8 | 28.4 | 8.8 | 23.7 | 11.7 | 3.6 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|------------|---------------|----------------|--------------|
| 2-1/2" | 100.0 | | |
| 2" | 99.0 | | |
| 1-1/2" | 94.9 | | |
| 1" | 84.3 | | |
| 3/4" | 76.2 | | |
| 1/2" | 65.7 | 50-85 | |
| 3/8" | 60.5 | | |
| #4 | 47.8 | 40-75 | |
| #10 | 39.0 | | |
| #20 | 27.7 | | |
| #40 | 15.3 | | |
| #50 | 10.6 | 8-28 | |
| #60 | 8.8 | | |
| #100 | 5.5 | | |
| #200 | 3.6 | 0-10 | |

Material Description

Gray/brown 2.5" max gravel and m/c sand trace silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 26.0499 D₆₀= 9.2554 D₅₀= 5.4548
D₃₀= 0.9885 D₁₅= 0.4160 D₁₀= 0.2836
C_u= 32.64 C_c= 0.37

Classification

USCS= GP AASHTO= A-1-a

Remarks

Sampled by JG (Yankee) on 01/15/24
Met M1.03.0 "Gravel Borrow" gradation limits

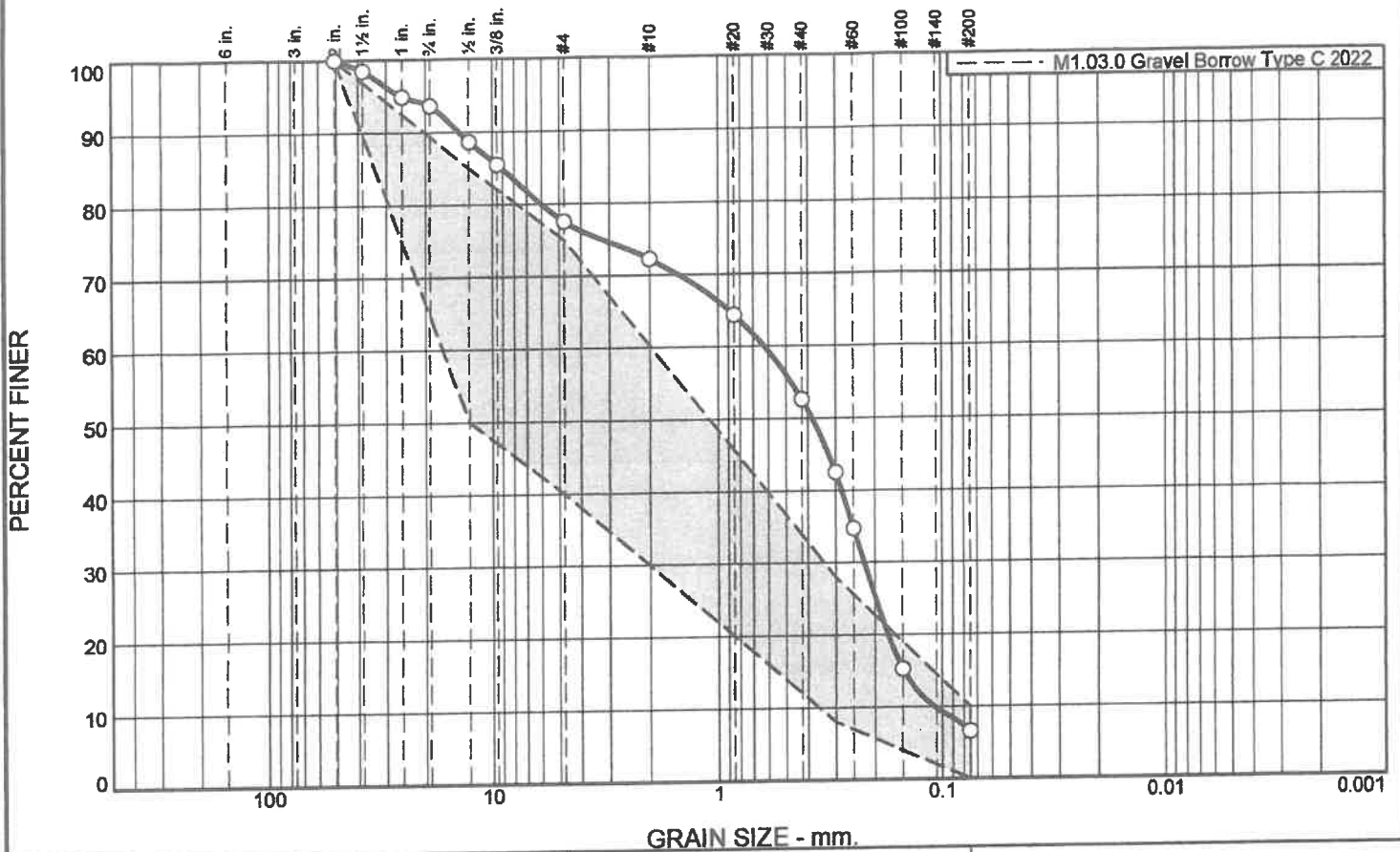
* M1.03.0 Gravel Borrow Type B 2022

Sample No.: L-33956 **Source of Sample:** Suburban Apartments - Worcester MA (97105) **Date:** **Elev./Depth:** 8' BLS
Location: TP-117

| | |
|--|---|
| <h2 style="margin: 0;">YANKEE ENGINEERING & TESTING, INC.</h2> | Client: Project: Various Sites/Projects Project No: 97105 Figure |
|--|---|

Tested By: AK _____

Particle Size Distribution Report



| % +3" | % Gravel | | % Sand | | | % Fines |
|-------|----------|------|--------|--------|------|---------|
| | Coarse | Fine | Coarse | Medium | Fine | |
| 0.0 | 6.3 | 16.2 | 5.3 | 19.6 | 46.0 | 6.6 |

| SIEVE SIZE | PERCENT FINER | SPEC.* PERCENT | PASS? (X=NO) |
|------------|---------------|----------------|--------------|
| 2 | 100.0 | 100 | |
| 1.5 | 98.5 | | |
| 1 | 94.9 | | |
| .75 | 93.7 | | |
| .5 | 88.6 | 50-85 | X |
| 3/8 | 85.5 | | |
| #4 | 77.5 | 40-75 | X |
| #10 | 72.2 | | |
| #20 | 64.4 | | |
| #40 | 52.6 | | |
| #50 | 42.5 | 8-28 | X |
| #60 | 34.7 | | |
| #100 | 15.2 | | |
| #200 | 6.6 | 0-10 | |

Material Description

Gray/brown 2" max f/m sand some gravel trace silt

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D₈₅= 9.1450 D₆₀= 0.6253 D₅₀= 0.3821
D₃₀= 0.2233 D₁₅= 0.1485 D₁₀= 0.1083
C_u= 5.77 C_c= 0.74

Classification

USCS= SP-SM AASHTO= A-3

Remarks

Sampled by JG (Yankee) on 01/15/24

* M1.03.0 Gravel Borrow Type C 2022

Sample No.: L-33958
Location: TP-122

Source of Sample: Suburban Apartments - Worcester MA (97105)
Date: **Elev./Depth:** 7' BLS

YANKEE ENGINEERING & TESTING, INC.

Client: **Project:** Various Sites/Projects
Project No.: 97105

Figure

Tested By: AK

APPENDIX B



GEOTECHNICAL LIMITATIONS

- The analyses and recommendations submitted in this report are based upon the data obtained from the subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it may be necessary to reevaluate the geotechnical engineering recommendations contained in this report.
- The generalized soil profile(s) is intended to show trends in the subsurface soil conditions. The boundaries between strata are approximated and have been developed by interpretation of the widely spaced explorations and samples. The actual soil transitions are probably more erratic.
- Water level readings have been made in the explorations at the times, and under the conditions, stated on the boring logs. However, it must be noted that fluctuations in the level of the groundwater will occur due to variations in rainfall, season, temperature and other factors.
- In the event that changes in the nature, design, or location of the proposed buildings are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by the preparer.
- It is recommended that this firm be provided the opportunity for a review of the final construction design and specifications, in order to confirm that the earthwork and foundation recommendations are properly implemented.
- It is recommended that this firm be retained to provide the geotechnical engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design concepts, material specifications and engineering recommendations, and to allow for changes in the event that conditions differ from those anticipated.
- This report has been prepared for the exclusive use of Botany Bay Const. Co., Inc for specific applications to the Warehouse project, located in Fall River, Massachusetts, in accordance with accepted foundation engineering practices. No other warranty, expressed or implied, is made.
- This report should be considered for foundation design purposes only, and is not sufficient to prepare an accurate or complete bid. Contractors wishing a copy of the report may secure it with the understanding that the reports scope is limited to general design considerations only.

SECTION 1: RESPONSIBILITIES

1.1 Yankee Engineering & Testing, Inc., ("Yankee"), has the responsibility for providing the services described under the Scope of Services section. The work is to be performed according to accepted standards of care and is to be completed in a timely manner. The term "Yankee" as used herein includes all of Yankee Engineering & Testing, Inc's agents, employees, professional staff, and subcontractors.

1.2 The Client or a duly authorized representative is responsible for providing Yankee with a clear understanding of the project nature and scope. The Client shall supply Yankee with sufficient and adequate information, including, but not limited to, maps, site plans, reports, surveys and designs, to allow Yankee to properly complete the specified services. The Client shall also communicate changes in the nature and scope of the project as soon as possible during performance of the work so that the changes can be incorporated into the work product.

1.3 The Client acknowledges that Yankee's responsibilities in providing the services described under the Scope of Services section is limited to those services described therein, and the Client hereby assumes any collateral or affiliated duties necessitated by or for those services. Such duties may include, but are not limited to, reporting requirements imposed by any third party such as federal, state, or local entities, the provision of any required notices to any third party, or the securing of necessary permits or permissions from any third parties required for Yankee's provision of the services so described, unless otherwise agreed upon by both parties.

1.4 Universal will not be responsible for scheduling our services and will not be responsible for tests or inspections that are not performed due to a failure to schedule our services on the project or any resulting damages.

SECTION 2: STANDARD OF CARE

2.1 Services performed by Yankee under this Agreement will be conducted in a manner consistent with the level of care and skill ordinarily exercised by members of Yankee's profession practicing contemporaneously under similar conditions in the locality of the project. No other warranty, express or implied, is made.

2.2 The Client recognizes that subsurface conditions may vary from those observed at locations where borings, surveys, or other explorations are made, and that site conditions may change with time. Data, interpretations, and recommendations by Yankee will be based solely on information available to Yankee at the time of service. Yankee is responsible for those data, interpretations, and recommendations, but will not be responsible for other parties' interpretations or use of the information developed.

2.3 Execution of this document by Yankee is not a representation that Yankee has visited the site, become generally familiar with local conditions under which the services are to be performed, or correlated personal observations with the requirements of the Scope of Services. It is the Client's responsibility to provide Yankee with all information necessary for Yankee to provide the services described under the Scope of Services, and the Client assumes all liability for information not provided to Yankee that may affect the quality or sufficiency of the services so described.

2.4 Should Yankee be retained to provide threshold inspection services, Client acknowledges that Yankee's services thereunder do not constitute a guarantee that the construction in question has been properly designed or constructed, and Yankee's services do not replace any of the obligations or liabilities associated with any architect, contractor, or structural engineer. Therefore it is explicitly agreed that the Client will not hold Yankee responsible for the proper performance of service by any architect, contractor, structural engineer or any other entity associated with the project.

SECTION 3: SITE ACCESS AND SITE CONDITIONS

3.1 Client will grant or obtain free access to the site for all equipment and personnel necessary for Yankee to perform the work set forth in this Agreement. The Client will notify any and all possessors of the project site that Client has granted Yankee free access to the site. Yankee will take reasonable precautions to minimize damage to the site, but it is understood by Client that, in the normal course of work, some damage may occur, and the correction of such damage is not part of this Agreement unless so specified in the Proposal.

3.2 The Client is responsible for the accuracy of locations for all subterranean structures and utilities. Yankee will take reasonable precautions to avoid known subterranean structures, and the Client waives any claim against Yankee, and agrees to defend, indemnify, and hold Yankee harmless from any claim or liability for injury or loss, including costs of defense, arising from damage done to subterranean structures and utilities not identified or accurately located. In addition, Client agrees to compensate Yankee for any time spent or expenses incurred by Yankee in defense of any such claim with compensation to be based upon Yankee's prevailing fee schedule and expense reimbursement policy.

SECTION 4: SAMPLE OWNERSHIP AND DISPOSAL

4.1 Soil or water samples obtained from the project during performance of the work shall remain the property of the Client.

4.2 Yankee will dispose of or return to Client all remaining soils and rock samples 60 days after submission of report covering those samples. Further storage or transfer of samples can be made at Client's expense upon Client's prior written request.

4.3 Samples which are contaminated by petroleum products or other chemical waste will to be returned to Client for treatment or disposal, consistent with all appropriate federal, state, or local regulations.

SECTION 5: BILLING AND PAYMENT

5.1 Yankee will submit invoices to Client monthly or upon completion of services. Invoices will show charges for different personnel and expense classifications.

5.2 Payment is due 30 days after presentation of invoice and is past due 31 days from invoice date. Client agrees to pay a finance charge of one and one-half percent (1 ½ %) per month, or the maximum rate allowed by law, on past due accounts.

5.3 If Yankee incurs any expenses to collect overdue billings on invoices, the sums paid by Yankee for reasonable attorneys' fees, court costs, Yankee's time, Yankee's expenses, and interest will be due and owing by the Client.

SECTION 6: OWNERSHIP OF DOCUMENTS

6.1 All reports, boring logs, field data, field notes, laboratory test data, calculations, estimates, and other documents prepared by Yankee, as instruments of service, shall remain the property of Yankee.

6.2 Client agrees that all reports and other work furnished to the Client or his agents, which are not paid for, will be returned upon demand and will not be used by the Client for any purpose.

6.3 Yankee will retain all pertinent records relating to the services performed for a period of five (5) years following submission of the report, during which period the records will be made available to the Client at all reasonable times.

6.4 All reports, boring logs, field data, field notes, laboratory test data, general calculations, estimates, and/or other documents presented by Yankee, are prepared for the sole and exclusive use of our Client, and may not be given to any other party or used or relied upon by any such party without the express written consent of Yankee.

SECTION 7: DISCOVERY OF UNANTICIPATED HAZARDOUS MATERIALS

- 7.1 Client warrants that a reasonable effort has been made to inform Consultant of known or suspected hazardous materials on or near the project site. Under this agreement, the term hazardous materials include hazardous materials (40 CFR 172.01), hazardous wastes (40 CFR 261.2), hazardous substances (40 CFR 300.6), petroleum products, polychlorinated biphenyls, and asbestos.
- 7.2 Hazardous materials may exist at a site where there is no reason to believe they could or should be present. Yankee and Client agree that the discovery of unanticipated hazardous materials constitutes a changed condition mandating a renegotiation of the scope of work. Yankee and Client also agree that the discovery of unanticipated hazardous materials may make it necessary for Yankee to take immediate measures to protect health and safety. Client agrees to compensate Yankee for any equipment decontamination or other costs incident to the discovery of unanticipated hazardous waste.
- 7.3 Yankee agrees to notify Client when unanticipated hazardous materials or suspected hazardous materials are encountered. Client agrees to make any disclosures required by law to the appropriate governing agencies. Client also agrees to hold Yankee harmless for any and all consequences of disclosures made by Yankee which are required by governing law. In the event the project site is not owned by Client, Client recognizes that it is the Client's responsibility to inform the property owner of the discovery of unanticipated hazardous materials or suspected hazardous materials.
- 7.4 Notwithstanding any other provision of the Agreement, Client waives any claim against Yankee, and to the maximum extent permitted by law, agrees to defend, indemnify, and save Yankee harmless from any claim, liability, and/or defense costs for injury or loss arising from Yankee's discovery of unanticipated hazardous or suspected hazardous materials including any costs created by delay of the project and any cost associated with possible reduction of the property's value. Client will be responsible for ultimate disposal of any samples secured by Yankee which are found to be contaminated.
- 7.5

SECTION 8: RISK ALLOCATION

- 8.1 Client agrees that Yankee's liability for any damage on account of any breach of contract, error, omission or other professional negligence will be limited to a sum not to exceed \$10,000 or Yankee's fee, whichever is greater.

SECTION 9: INSURANCE

- 9.1 Yankee represents and warrants that it and its agents, staff and consultants employed by it, is and are protected by worker's compensation insurance and that Yankee has such coverage under public liability and property damage insurance policies which Yankee deems to be adequate. Certificates for all such policies of insurance shall be provided to Client upon request in writing. Within the limits and conditions of such insurance, Yankee agrees to indemnify and save Client harmless from and against loss, damage, or liability arising from negligent acts by Yankee, its agents, staff, and consultants employed by it. Yankee shall not be responsible for any loss, damage or liability beyond the amounts, limits, and conditions of such insurance or the limits described in Section 8, whichever is less. The Client agrees to defend, indemnify and save Yankee harmless for loss, damage or liability arising from acts by Client, Client's agent, staff, and other Yankees employed by Client.

SECTION 10: DISPUTE RESOLUTION

- 10.1 All claims, disputes, and other matters in controversy between Yankee and Client arising out of or in any way related to this Agreement will be submitted to alternative dispute resolution (ADR) such as mediation or arbitration, before and as a condition precedent to other remedies provided by law, including the commencement of litigation.
- 10.2 If a dispute arises related to the services provided under this Agreement and that dispute requires litigation instead of ADR as provided above, then:
- (a) the claim will be brought and tried in judicial jurisdiction of the court of the county where Yankee's principal place of business is located and Client waives the right to remove the action to any other county or judicial jurisdiction, and
 - (b) The prevailing party will be entitled to recovery of all reasonable costs incurred, including staff time, court costs, attorneys' fees, and other claim related expenses.

SECTION 11: TERMINATION

- 11.1 This agreement may be terminated by either party upon seven (7) days written notice in the event of substantial failure by the other party to perform in accordance with the terms hereof. Such termination shall not be effective if that substantial failure has been remedied before expiration of the period specified in the written notice. In the event of termination, Yankee shall be paid for services performed to the termination notice date plus reasonable termination expenses.
- 11.2 In the event of termination, or suspension for more than three (3) months prior to completion of all reports contemplated by the Agreement, Yankee may complete such analyses and records as are necessary to complete its files and may also complete a report on the services performed to the date of notice of termination or suspension. The expense of termination or suspension shall include all direct costs of Yankee in completing such analyses, records and reports.

SECTION 12: ASSIGNS

- 12.1 Neither the Client nor Yankee may delegate, assign, sublet or transfer their duties or interest in this Agreement without the written consent of the other party.

SECTION 13. GOVERNING LAW AND SURVIVAL

- 13.1 The laws of the Commonwealth of Massachusetts will govern the validity of these Terms, their interpretation and performance.
- 13.2 If any of the provisions contained in this Agreement are held illegal, invalid, or unenforceable, the enforceability of the remaining provisions will not be impaired. Limitations of liability and indemnities will survive termination of this Agreement for any cause.

SECTION 14. INTEGRATION CLAUSE

- 14.1 This Agreement represents and contains the entire and only agreement and understanding among the parties with respect to the subject matter of this Agreement, and supersedes any and all prior and contemporaneous oral and written agreements, understandings, representations, inducements, promises, warranties, and conditions among the parties. No agreement, understanding, representation, inducement, promise, warranty, or condition of any kind with respect to the subject matter of this Agreement shall be relied upon by the parties unless expressly incorporated herein.

Important Information about Your 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

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of 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 equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/THE BEST PEOPLE ON EARTH exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with your ASFE-member geotechnical engineer for more information.

ASFE THE GEOPROFESSIONAL BUSINESS ASSOCIATION

8811 Colesville Road/Suite G106, Silver Spring, MD 20910

Telephone: 301/565-2733 Facsimile: 301/589-2017

e-mail: info@asfe.org www.asfe.org

Copyright 2012 by ASFE, Inc. Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with ASFE's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of ASFE, and only for purposes of scholarly research or book review. Only members of ASFE may use this document as a complement to or as an element of a geotechnical engineering report. Any other firm, individual, or other entity that so uses this document without being an ASFE member could be committing negligent or intentional (fraudulent) misrepresentation.