GEOTECHNICAL REPORT

MILTON HIGH SCHOOL ATHLETIC FIELD
MILTON, MASSACHUSETTS

September 8, 2021

GSI Project No. 221219

Prepared for:

Mr. Chris Huntress
Huntress Sports
17 Tewksbury Street
Andover, MA 01810

Prepared by:

Geotechnical Services, Inc.
55 North Stark Highway
Weare, NH 03281

Geotechnical Services Inc.
Geotechnical Engineering ◣ Environmental Studies ◣ Materials Testing ◣ Construction Monitoring

September 8, 2021

Mr. Chris Huntress
Huntress Sports
17 Tewksbury Street
Andover, MA 01810

RE: Geotechnical Investigation Report
Milton High School Athletic Field Improvements
Milton, MA
GSI Project No. 221219

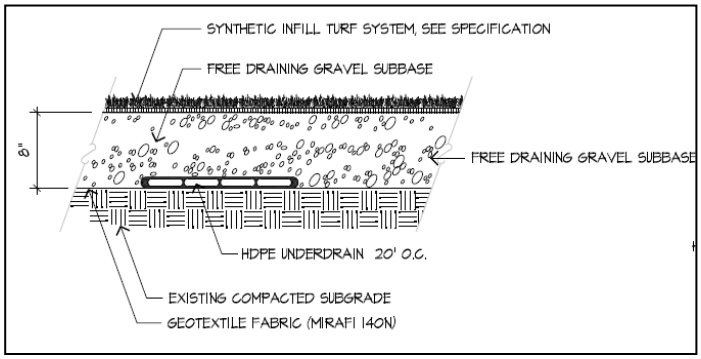
Dear Mr. Huntress:

Geotechnical Services, Inc. (GSI) is pleased to submit this report on the proposed athletic field improvements to the Gile Lower Field located at the Milton High School in Milton, MA. The report consists of the subsurface data obtained through implementation of an exploration program, evaluation of the subsurface data, a summary of our understanding of the proposed development, and the results of an assessment for earthwork design options. The content of this report is subject to the **Limitations** stated in Appendix A.

PROJECT UNDERSTANDING

The project site is located at 25 Gile Road in Milton, MA (See Figure 1, Project Locus). We understand that the planned athletic field improvements will replace the existing grass turf with a synthetic turf field along with new bleachers and a retaining wall along the southern limits of the field. A grading plan was not available at the time this report was prepared; however, the overall site is generally flat.

At the time this report was prepared, the proposed design of the synthetic turf system and the overall grading for the field was not finalized for our review; however, we assume that the synthetic turf system will have a typical cross section shown in Detail 1 consisting of the synthetic turf infill, an 8-in. thick layer of free draining gravel Subbase and a geotextile fabric placed over the existing subgrade soils. The grading for the new synthetic field is assumed to match that of the existing grades with the possibility of re-grading on the order of up to 2-ft (cut/fill).



Detail 1 - Typical Synthetic Turf System

SUBSURFACE INVESTIGATION

Five (5) test pits, designated as TP-1 to TP-5, were excavated at the site on August 18, 2021 by the Milton DPW. The test pits were excavated to depths ranging from 6-ft to 7-ft below the existing grade. The test pits were observed by a GSI engineer and the soils encountered were classified in accordance with the Burmister Classification system. The approximate locations of the test pits are shown on Figures 2, Exploration Location Plan. The finalized logs for the test pits are included as Appendix B. Photographs of the completed test pits were taken and are provided as Appendix C.

SUBSURFACE CONDITIONS

The subsurface conditions encountered in the investigation indicate that the site is underlain by the following soil units/deposits, described in order of increasing depth:

Topsoil: All of the test pits encountered the Topsoil layer at the ground surface. The Topsoil layer generally consists of organic silty soils. The thickness of this soil unit ranges from 7 to 12-in.

Drainage Sand: The Drainage Sand was encountered in all the test pits, except TP-2, directly beneath the Topsoil layer. The Drainage Sand is generally described as a brown, fine to medium SAND with varying amounts of gravel, and silt. The thickness of the Drainage Sand varies from about 4 to 12-in.

Fill: The Fill was encountered in test pits TP-1, TP-4 and TP-5, directly beneath the Drainage Sand layer. The Fill soils are generally described as a gray, fine to coarse SAND and fine to coarse GRAVEL with varying amounts of silt. Occasional cobbles, construction debris, organic soils (topsoil), wood and tree stumps were encountered in the fill soils.

Buried Topsoil: The Buried Topsoil was encountered in test pit TP-1 from about 4.6 to 5.1-ft below the existing grade.

Sand and Gravel Deposits: The Sand and Gravel Deposits were encountered in test pits TP-1, TP-2 and TP-3. The Sand and Gravel are generally described as a gray to brown, fine to coarse SAND and fine to coarse GRAVEL with varying amounts of silt. Occasional cobbles and boulders were encountered within this soil unit.

Groundwater: Groundwater was not observed upon completion of the test pits. Groundwater levels should be expected to vary with season, precipitation, snowmelt, and other factors. As a result, groundwater levels encountered during construction may differ from those encountered in the explorations.

GEOTECHNICAL DESIGN RECOMMENDATIONS

General

As a general guideline, foundation design and construction must conform to the applicable provisions of the Massachusetts Building Code, 9th Edition (Building Code).

Athletic Field Subgrade

Grading plans for the field renovation were not available at the time this report was prepared; however, we assume that minimal site grading (cutting and filling on the order of 2 ft or less) will be required to prepare the fields for the planned construction.

We anticipate that the construction of the new athletic field will involve the following; stripping off the existing Topsoil, removing/relocating any existing utilities (drainage pipe, irrigation lines, electric utilities and any other utilities), grading the field to the planned rough grade, proof-rolling the subgrade and constructing the synthetic turf systems. The Drainage Sand, existing Fill and Sand and Gravel Deposits are suitable for support of the synthetic turf systems provided the subgrade is prepared using the recommendations provided herein.

Retaining Wall Design Recommendations

The retaining wall will be free to rotate and should be designed as a **yielding** structure. Surcharge loads should be considered where they are located within a horizontal distance equal to 1.5 times the height of the wall. Adequate drainage should be installed behind the retaining wall to eliminate hydrostatic forces behind the wall. If drainage systems are not considered for earth retaining exterior walls, the lateral pressures provided herein should be modified accordingly to include the hydrostatic pressures.

The following design criteria for the eastern wall are recommended:

	Yielding
Active Static Lateral Earth Pressure: (Native soil or lightly compacted structural fill as an equivalent fluid unit weight)	40 pcf (drained)
Passive Static Lateral Earth Pressure:	375 psf
Traffic Surcharge: (Distributed uniformly over the height of the wall)	80 psf

Wall footings may be designed using an allowable bearing pressure of **2.0 kips per square foot (ksf)**.

Seismic Lateral Earth Pressures

Per Section 1610.2 of the Building Code, exterior foundation walls and retaining walls shall be designed to resist an earthquake force, F_w, for horizontal backfill surface equal to:

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

where: S_s is the 0.2 sec. (short period) Spectral Acceleration, see "Seismic Design Input",

F_a is the site coefficient for the Short Period, see "Seismic Design Input",

γ_t is the total unit weight of the soil (backfill), and

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

For design, a soil unit weight (γ_t) of 130 pounds per cubic feet (pcf) may be used.

Seismic Design Input

Seismic design parameters for the project site have been obtained from Commonwealth of Massachusetts, State Building Code, 9th Edition. Ground motion parameters at the project site (i.e., the design earthquake for the subject facility) are represented by S_s, 0.2 sec. (short period) Spectral Acceleration, and S_1, 1.0-second period Spectral Acceleration. These parameters have been obtained as:

S_s = 0.205 g

S_1= 0.067 g

Site Class for the project site has been established as "Stiff soil profile" with the designation **Site Class D**. Site Coefficient for the Short Period has been established as F_a= 1.6, and Site Coefficient for the 1-sec Period has been established as F_v = 2.4. Parameters F_a, and F_v relate to the potential amplification of the earthquake induced shear stress waves traveling upward through the soil-rock profile underlying the project site. The soils within the project site are not considered liquefaction susceptible.

Bleacher Seating Foundations

It is anticipated that the foundation will bear upon the prepared existing Fill and Sand and Gravel deposits which are unsuitable for support for the bleachers.

We recommend that bleachers be supported by concrete strip footings bearing directly on the prepared Fill and Sand and Gravel subgrade. A (minimum) 12-inch wide by 48-inch deep concrete strip foundation is recommended under each bleacher frame. Footings with a least lateral dimension (width) of 12-in may be designed using a design bearing pressures of 1.0 ksf.

Alternative foundations for the bleachers may be used, such as, sonotube footings, bearing at least 4-ft below exterior grades.

CONSTRUCTION CONSIDERATIONS

General

In general, all excavation work, dewatering, and other construction activities should conform to the requirements of OSHA and all other applicable regulations. The site soils would typically be classified as Type C based on OSHA 29 CFR 1926.

Excavation

Construction will involve stripping off the Topsoil, adding or cutting fill to achieve design grades, and constructing the synthetic fields and bleacher foundations. We anticipate that most of the site grading can be accomplished with conventional earth-moving equipment.

Temporary cut soil slopes should, typically, be stable if constructed no steeper than about 1.5H:1V. Some sloughing and raveling should be anticipated in temporary earth slopes.

Construction Dewatering

Based on the available subsurface data it is anticipated that during the general site work, no significant dewatering measures will be necessary to conduct the construction "in-the-dry." The Contractor should take measures to prevent stormwater from entering into excavated areas, and be prepared to remove ponded surface water by means of localized sumps and pumps. The Contractor should select whichever dewatering procedures may be effective to maintain dry, stable excavation bottoms.

Existing Utilities and Foundations of Former Structures

Unknown and/or undocumented subsurface features, structures, and utilities may be present within the project site. The unknown structures and piping, should be anticipated during excavation work, and will need to be carefully removed to limit disturbance to underlying soil deposits and backfilled with compacted Granular Fill prior to construction of the planned field and track.

Preparation and Protection of Bearing Surfaces

Final excavation should be conducted in a manner that minimizes disturbance to the subgrade soils when excavating for bearing surfaces. All final excavation and footing construction should be conducted in-the-dry. We recommend that the exposed subgrade soils be observed in the field by a geotechnical engineer to confirm the projected soil bearing conditions. It may be necessary to over-excavate and replace weak, disturbed or otherwise unacceptable foundation bearing materials.

Following excavation to bearing grades, exposed soil surfaces should be re-compacted (proofrolled) prior to placing engineered fill, or constructing foundations, with a minimum of four passes with a heavy vibratory roller or other heavy vibratory compaction equipment.

If subgrade protection difficulties are encountered due to surface or groundwater, various methods can be utilized:

- Leave subgrades high until immediately before forming and concreting to minimize the time the subgrade is exposed.
- Over excavate footings by 8 in. using a smooth edged bucket and backfill to the design bearing elevation using compacted Granular Fill.

Each such encounter is probably best resolved individually in the field upon observation of the subgrade conditions.

In the event that a boulder becomes partially exposed at subgrade level or at footing bearing level, one of the following options should be utilized:

- Remove the boulder, and fill the void with crushed stone, compacted structural fill or lean concrete, or
- Remove a portion of the boulder sufficient to provide placement of 6 in. of crushed stone (with filter fabric) beneath the slab or footing over the boulder. Each such encounter is probably best resolved individually in the field.

Compaction

Minimum compaction requirements refer to percentages of the maximum dry density determined in accordance with ASTM D1557. Recommended compaction requirements are as follows:

Location	Minimum Compaction Requirements
Beneath athletic field and bleacher footings	95 %
Landscaped areas	90 % nominal compaction

Filling and Backfilling

Placement of compacted soil fills should not be conducted when air temperatures are low enough (approximately 30 degrees F, or below) to cause freezing of the moisture in the fill during or before placement. Fill materials should not be placed on snow, ice or uncompacted frozen soil. Compacted fill should not be placed on frozen soil. No fill should be allowed to freeze prior to compaction. At the end of each day's operations, the last lift of fill, after compaction, should be rolled by a smooth-wheeled roller to eliminate ridges of uncompacted soil.

Soil Materials

- ***Granular Fill***

  Granular Fill should consist of clean, sand and gravel, free of organic material, snow ice, or other objectionable materials and should be well-graded within the following limits:

Sieve Size	Percent Passing by Weight
6 inch	100
No. 4	30-90
No. 40	10-50
No. 200	0-12

  Granular Fill should be placed in 9-inch loose lift thickness, unless otherwise specified. Cobbles exceeding 6 inch in size should be screened and removed prior to compaction. Compaction equipment should be selected to meet the requirements of that particular location in earthwork operation, thus the Contractor should provide both vibratory and static rollers, as well as hand-guided vibratory plate compactors. Where vibratory plate compactor is used the loose lift thickness should not exceed 6 inch. A minimum of four systematic passes of the compaction equipment should be implemented to compact each lift.

- ***Free Draining Granular Fill***

  Free Draining Granular Fill should consist of clean sand and gravel meeting the following gradation requirements (note: this recommendation may be superseded by the synthetic turf manufacturer's gradation requirements for free draining subbase material):

Sieve Size	Percent Passing by Weight
1-inch	100
No. 4	60-90
No. 200	0-8

CONSTRUCTION MONITORING

It is recommended that a geotechnical engineer or technician qualified by training and experience be present during construction to:

- Confirm that soils used as fill and backfill are in accordance with the contract requirements.
- Observe and test placement and compaction of Granular Fill and other compacted fills.
- Observe preparation of field and pavement bearing surfaces.

Monitoring by experienced personnel will be important to the efficiency and integrity of the geotechnical aspects of the project construction. It is recommended that GSI be retained to provide the recommended monitoring services during construction. This will enable us to observe compliance with the design concepts, help resolve construction problems and to facilitate design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

PLAN REVIEW

It is recommended that GSI be provided the opportunity to review the final plans in order to confirm that the recommendations made in this report were interpreted and implemented as intended.

CLOSURE

GSI appreciates the opportunity for participating in this early phase of the project, and looks forward to our continuing association during its subsequent phases towards its successful completion. In the mean time, please do not hesitate to contact us, if you have any questions on the content of this report.

Very truly yours,

GEOTECHNICAL SERVICES, INC.

Glen V. Zoladz, P.E.
Project Manager

Harry K. Wetherbee, P.E.
Principal Engineer

Figure 1. Project Locus
Figure 2. Exploration Location Plan

Appendix A. Limitations
Appendix B. Test Pit Logs
Appendix C. Photographs

	FIGURE 1-PROJECT LOCUS
	MILTON HIGH SCHOOL FIELD **MILTON, MA** **GSI PROJECT NO. 221219**

SCALE: NOT TO SCALE

LEGEND:

TP-1

TEST PIT I.D. AND APPROXIMATE LOCATION

FIGURE 2-EXPLORATION LOCATION PLAN

MILTON HIGH SCHOOL FIELD
MILTON, MA
GSI PROJECT NO. 221219

APPENDIX A

LIMITATIONS

LIMITATIONS

Explorations

1. The analyses, recommendations and designs submitted in this report are based in part upon the data obtained from preliminary subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

2. The generalized soil profile described in the text is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretation of widely spaced explorations and samples; actual soil transitions are probably more gradual. For specific information, refer to the individual test pit and/or boring logs.

3. Water level readings have been made in the test pits and/or test borings under conditions stated on the logs. These data have been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors differing from the time the measurements were made.

Review

4. It is recommended that this firm be given the opportunity to review final design drawings and specifications to evaluate the appropriate implementation of the recommendations provided herein.

5. In the event that any changes in the nature, design, or location of the proposed areas are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of the report modified or verified in writing by Geotechnical Services, Inc.

Construction

6. It is recommended that this firm be retained to provide geotechnical engineering services during the earthwork phases of the work. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

Use of Report

7. This report has been prepared for the exclusive use of Huntress Sports in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made.

8. This report has been prepared for this project by Geotechnical Services, Inc. This report was completed for preliminary design purposes and may be limited in its scope to complete an accurate bid. Contractors wishing a copy of the report may secure it with the understanding that its scope is limited to evaluation considerations only.

APPENDIX B

TEST PIT LOGS

TEST PIT LOG

Test Pit No. TP-1

Page 1 of 1

Project	Milton High School Field	**Project No.**	221219
Location	Milton, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Town of Milton DPW	**Date**	08/18/21
Equipment	Deere 310 SL Backhoe	**Weather**	Sunny 80's

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
1		~1	**-TOPSOIL-**	
2		~2	Br., f/m SAND **-DRAINAGE SAND-**	
3			Gr., f/c SAND and f/c GRAVEL **-FILL-**	
4		~4.6		
5		~5.1	6-in. thick layer of buried Topsoil **-BURIED TOPSOIL-**	
6			Gr. silty f/m SAND, little gravel, wood occasional cobbles **-SAND AND GRAVEL-**	
7			Bottom of excavation at 7-ft. No groundwater encountered	
8				
9				

Standing Water in Completed Pit:
at depth ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	-

Test Pit Dimensions:

Depth	7	ft
Length	5	ft
Width	5	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-2

Page 1 of 1

Project	Milton High School Field	**Project No.**	221219
Location	Milton, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Town of Milton DPW	**Date**	08/18/21
Equipment	Deere 310 SL Backhoe	**Weather**	Sunny 80's

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
			8-in. Topsoil	
		~0.7	**-TOPSOIL-**	
1			Brown, f/c SAND and f/c GRAVEL, some silt, occasional cobbles and boulders	
2				
3				
			-SAND AND GRAVEL-	
4				
5				
6			Bottom of excavation at 6-ft.	
			No groundwater encountered	
7				
8				
9				

Standing Water in Completed Pit:
at depth ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	1

Test Pit Dimensions:

Depth	6	ft
Length	5	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-3

Page 1 of 1

Project	Milton High School Field	**Project No.**	221219
Location	Milton, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Town of Milton DPW	**Date**	08/18/21
Equipment	Deere 310 SL Backhoe	**Weather**	Sunny 80's

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
1			12-in. Topsoil **-TOPSOIL-**	
		~1	Br., f/m SAND **-DRAINAGE SAND-**	
		~1.3	Gr., f/c SAND and f/c GRAVEL, tr. silt	
2				
3			**-SAND AND GRAVEL-**	
4				
5				
		~5.6	Br., f/m SAND, tr. c-sand	
6			Bottom of excavation at 6-ft. No groundwater encountered	
7				
8				
9				

Standing Water in Completed Pit:
at depth ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	1

Test Pit Dimensions:

Depth	6	ft
Length	5	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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TEST PIT LOG

Test Pit No. TP-4

Page 1 of 1

Project	Milton High School Field	**Project No.**	221219
Location	Milton, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Town of Milton DPW	**Date**	08/18/21
Equipment	Deere 310 SL Backhoe	**Weather**	Sunny 80's

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
			8-in. Topsoil	
			-TOPSOIL-	
		~0.7		
1			Br., f/m SAND, some f/c gravel, silt	
			-DRAINAGE SAND-	
		~1.3		
2			Gr., f/m SAND, little f/c gravel, occasional cobbles, wood, tree stumps and steel cables	
3			**-FILL-**	
4				
5				
6				
			Bottom of excavation at 6.5-ft.	
7			No groundwater encountered	
8				
9				

Standing Water in Completed Pit:

at depth ft

Elapsed time after completion of pit:

☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	

Test Pit Dimensions:

Depth	6.5	ft
Length	5	ft
Width	2	ft

Survey Data:

Ground El. ft

El. Datum

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TEST PIT LOG

Test Pit No. TP-5

Page 1 of 1

Project	Milton High School Field	**Project No.**	221219
Location	Milton, MA	**Project Manager**	G. Zoladz
Client	Huntress Sports	**Field Rep.**	G. Zoladz
Contractor	Town of Milton DPW	**Date**	08/18/21
Equipment	Deere 310 SL Backhoe	**Weather**	Sunny 80's

Depth (ft)	Sample ID	Stratum Change Depth (ft)	Description of Soils	Obstructions/Remarks
1		~0.6	7-in. Topsoil **-TOPSOIL-**	
		~1.6	Br., f/m SAND **-DRAINAGE SAND-**	
2			Gr., f/c SAND and f/c GRAVEL, some silt (pockets of buried topsoil with depth)	
3			**-FILL-**	
4				
5				
6			Bottom of excavation at 6-ft. No groundwater encountered	
7				
8				
9				

Standing Water in Completed Pit:
at depth ft
Elapsed time after completion of pit:
☐ hours ☐ min.

Boulders:

Diameter (in.)	Number
12 to 24	
> 24	

Test Pit Dimensions:

Depth	6	ft
Length	5	ft
Width	2	ft

Survey Data:
Ground El. ft
El. Datum

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APPENDIX C

PHOTOGRAPHS

Photo 1 TP-1

Photo 2 TP-2

Photo 3 TP-2

Photo 4 TP-3

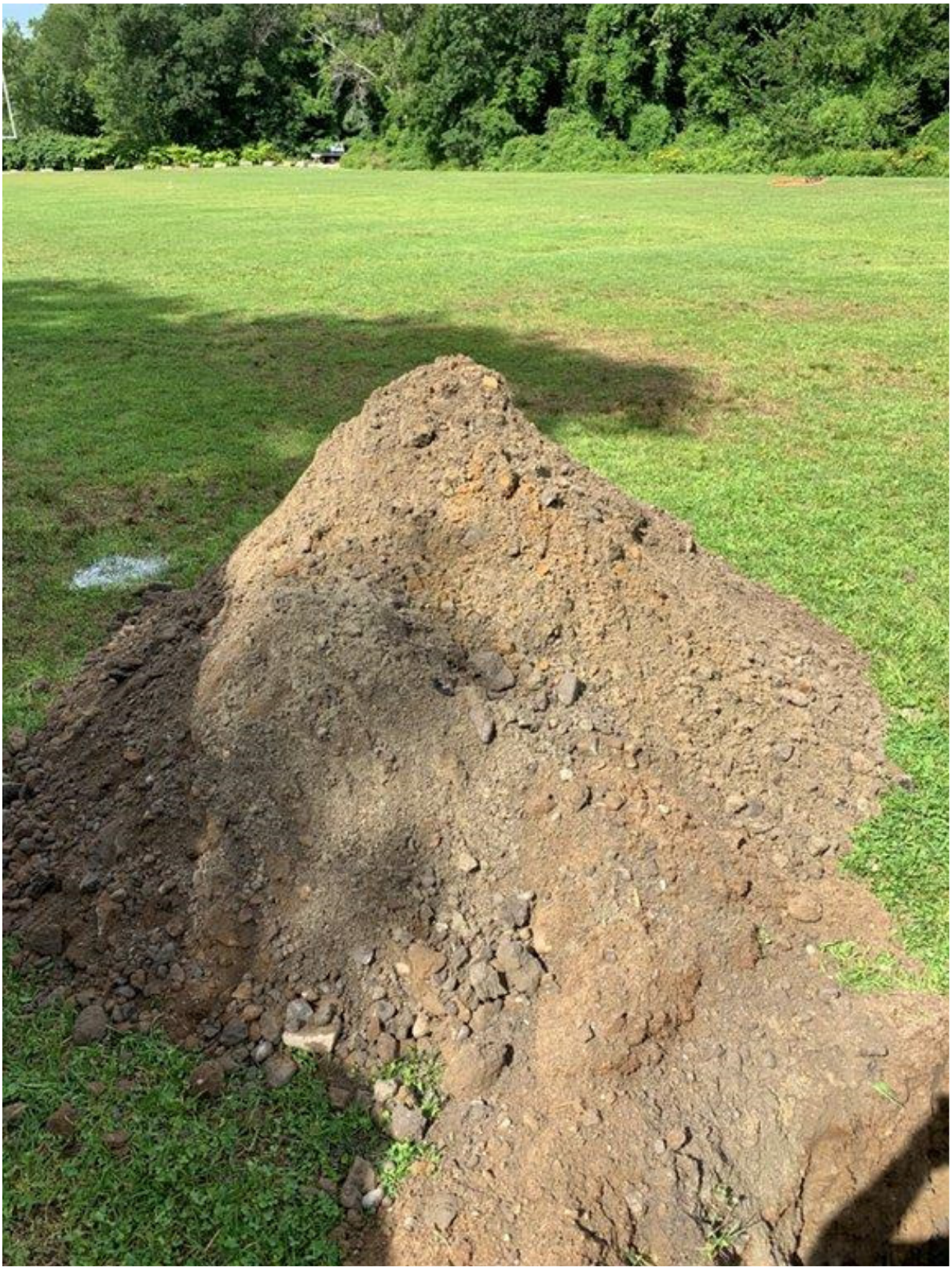

Photo 5 TP-3

Photo 6 TP-4

Photo 7 TP-4

Photo 8 TP-5