EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

REPORT OF GEOTECHNICAL INVESTIGATION

1 MALIN ROAD

PROPOSED 93 UNITS RESIDENTIAL DEVELOPMENT

EAST WHITELAND TOWNSHIP, CHESTER COUNTY

PENNSYLVANIA

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I. INTRODUCTION AND BACKGROUND

A. PROJECT OBJECTIVE AND SCOPE OF WORK

Earth Engineering Incorporated (EEI) has completed the geotechnical investigation for the proposed residential development at 1 Malin Road in East Whiteland Township, Chester County, Pennsylvania. The objective of this investigation was to provide recommendations for the foundation design and general earthworks for the proposed residential development. Based on the encountered conditions and the results of geotechnical analyses performed for this project, EEI has developed geotechnical recommendations for the design and construction of suitable foundation systems. EEI also provides general construction guidelines for the development of the site. These recommendations should be considered preliminary until final grading and structural loading information is provided.

The scope of work for this project included a test boring investigation, geologic analysis of site conditions, laboratory testing of soil samples and a geotechnical engineering analysis of the data obtained. This investigation was performed in general accordance with EEI Proposal No. BB-14292R dated July 16, 2019. The following report sections present the results of the field and laboratory investigations and document recommendations regarding the geotechnical aspects of the proposed development.

B. EXISTING FEATURES AND PROJECT DESCRIPTION

The subject site is located to the south of the intersection of Route 30 (Lancaster Avenue) and east of Malin Road in East Whiteland Township, Chester County, Pennsylvania. The investigated area is bordered to the north by Pennsylvania Railroad Lines, to the east by residential homes, the south by wooded land, and the west by Malin Road. At the time of the investigation, the site included former Bishop Tube facility with 140,000 square feet of building structures, some grass areas, asphalt pavement, concrete curbing and loading docks, and small trees and shrubs. An environmental remediation of the soil beneath the existing building during EEI's geotechnical investigation. Figure 1 below, shows an aerial of the approximate development area.

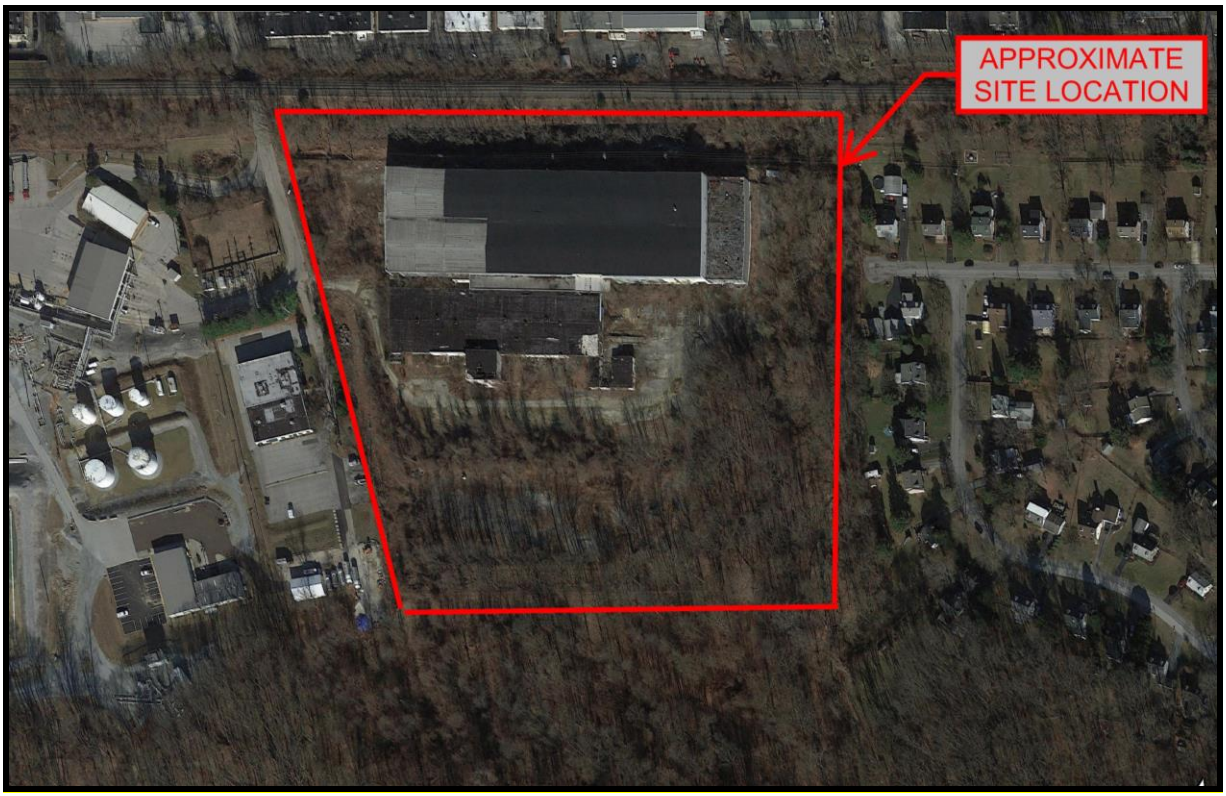

Figure 1: Google Earth 2019

In general, the investigated area slopes moderately downward from southwest to northeast. According to the topographic information shown on the provided plan titled, *Conservation Plan, Malin Road Development, 1 Malin Road, East Whiteland Township, Chester County, Pennsylvania*, compiled by Taylor Wiseman and Taylor (Surveyor), dated September 22, 2018, Drawing No. 018-06476-LD, Sheet 2 of 24, (Conservation Plan) the maximum relief across the investigated portion of the site is approximately seventy four(74) feet. This relief corresponds to elevations across the site ranging from approximately 370.0 to 444.0 feet. A topographic map of the site, from the *Topographic Maps of Pennsylvania* series, Norristown Quadrangle is shown in Plate 1 in the Figures and Drawings to this report.

According to the provided plans and correspondence with the client, the proposed development consists of ninety-three (93) residential townhomes with associated streets and utilities. Based on the *Grading Plan, Drawing Number 018-06476-LD,* dated September 22, 2018, prepared by *Taylor Wiseman & Taylor,* and given the relief of the site, many of the proposed structures have different finished floor elevations (FFE) and lowest level elevations. EEI estimates the proposed bottom of foundation elevation (BFE) to be approximately 3.0 feet lower than the lowest adjacent exterior grade for analysis purposes.

The proposed layout for the site development is shown on the *Testing Location Plan*, EEI Drawing No. 32546.00-B-102, included in the FIGURES AND DRAWINGS section of this report.

Structural loads have not been compiled at the time of preparing this report. Based on similar projects, EEI estimates the maximum column loads for the proposed structures to be approximately 50 kips and wall loads to be approximately 2 kips per lineal foot (klf). Once developed, if actual loads exceed those assumed by EEI within this report, EEI should be notified so our recommendations can be reviewed and revised, as necessary.

II. FIELD INVESTIGATION, OBSERVATIONS, AND DATA

A. FIELD ACTIVITIES AND PROCEDURES

1. Test Borings

Fifteen (15) test borings, denoted in this report as B-1 through B-13, B-16 and B-18 were conducted for this investigation to obtain geotechnical data within the investigation area of the proposed residential development at the site. In addition, one (1) offset boring, designated as B-11A was incorporated due to an obstruction encountered within existing FILL materials. The *Boring Logs* and *Boring Profiles* showing the details of the subsurface materials encountered are included in the Appendix of this report. The borings were completed on February 26, 27, and 28, 2020 by Main Line Drilling Company, Incorporated of Wayne, Pennsylvania utilizing a *Mobile B-57* truck-mounted drilling rig. Supervision and monitoring of the test boring program were performed by representatives of EEI. The test borings were field located by EEI using existing features prior to drilling and are shown on the *Testing Location Plan*, which is also included in the *Appendix* to this report. The ground surface elevations at the boring locations were estimated using the topographic contours shown on the Conservation plan. *Boring Profiles* showing a graphical representation of the test boring logs are included in the Figures and Drawings of this report. The test boring logs are included in the Appendix to this report.

The test borings were advanced using two (2) inch outer diameter spilt-barrel samplers and three and one quarter (3.25) inch inner diameter hollow stem augers. Split-barrel samples, conducted in accordance with ASTM standard D1586. Standard Penetration Test (SPT) values were recorded for each split-barrel sample. An SPT value, which is a measure of soil density and consistency, is the number of blows required to drive a two (2) inch outer diameter split-barrel sampler six (6) inches using a one-hundred and forty (140) pound weight dropped thirty (30) inches. The number of blows required to advance the sampler over the twelve (12) inch

interval from six (6) to eighteen (18) inches is considered the N-value. The hammer system utilized for this investigation was an automatic trip hammer.

2. Groundwater Observations

Groundwater measurements were taken in each boring advanced during the subsurface investigation immediately upon completion. Groundwater was initially encountered at test borings B-1 through B-10, B-12 and B-13 at depths ranging from 2.0 to 16.5 feet below existing grade. Subsequent groundwater readings were also taken at times ranging from 0.5 hours to 24.0 hours after completion of the borings. Groundwater was subsequently encountered at depths ranging from 0.0 (surface) to 14.0 feet below existing grade. The highest initial groundwater elevation observed was 394.0 feet at test boring B-6.

It should be noted that groundwater elevations may fluctuate with daily, seasonal, and climatic events. The contractor should also be advised that they may conduct their own investigations to verify groundwater elevations prior to performing excavations on site. Table 1 summarizes the groundwater elevations observed at the site.

TABLE 1 – GROUNDWATER DEPTH AND ELEVATION READINGS

Test Location	Ground Surface Elevation (ft.) 1)	Depth to Groundwater		Highest Measured Groundwater Elevation (ft.)
		Initial Reading (ft.) 2)	Subsequent Readings (ft) 2)3)	
B-1	388.0	5.0	5.0 @ 3.0 hrs	383.0
B-2	387.0	5.5	5.0 @ 24 hrs	382.0
B-3	387.0	10.0	8.5 @ 24 hrs	378.5
B-4	387.0	11.5	11.5 @ 24 hrs	375.5
B-5	387.0	14.0	14.0 @ 24 hrs	373.0
B-6	400.0	6.0	10.0 @ 24 hrs	394.0
B-7	387.0	2.0	0.0 @ 24 hrs	387.0
B-8	387.0	11.0	10.5 @ 24 hrs	376.5
B-9	400.0	12.0	12.0 @ 0.50 hrs	388.0
B-10	398.0	16.5	13.0 @ 24 hrs	385.0
B-11	411.0	dry	dry @ 0.50 hrs	-
B-11A	411.0	dry	dry @ 24 hrs	-
B-12	401.0	12.0	12.0 @ 5.50 hrs	389.0
B-13	399.5	10.3	10.5 @ 24 hrs	389.2

TABLE 1 – GROUNDWATER DEPTH AND ELEVATION READINGS				
Test Location	Ground Surface Elevation (ft.) 1)	Depth to Groundwater		Highest Measured Groundwater Elevation (ft.)
		Initial Reading (ft.) 2)	Subsequent Readings (ft) 2)3)	
B-16	427.5	dry	dry @ 6.75 hrs	-
B-18	421.0	dry	dry @ 24 hrs	-

1.) The ground surface elevation at each boring location was interpolated from plans provided
2.) Referenced depths were measured from existing site grades at the time of the investigation.

B. GEOTECHNICAL LABORATORY TESTING

Fifteen (15) representative soil samples recovered from the geotechnical subsurface field investigation were submitted for laboratory testing. The laboratory testing was performed to verify visual classifications and to establish engineering parameters required for geotechnical engineering analysis. The tests performed included Particle Size Analysis (ASTM D2487), Natural Moisture Content (ASTM D2216), and Atterberg Limits Determination (ASTM D4318). A Unified Soil Classification System (USCS) Group Symbol and ASTM Group Name was assigned to each sample based on the laboratory testing. The results of the laboratory testing are presented in the following table. Gradation curves, which graphically and numerically depict the results of the analyses are included in the *Appendix*.

TABLE 2 LABORATORY TESTING RESULTS				
Sample Location	B-1	B-3	B-4	B-4
Sample Number	S-3, S-4	S-5	S-1, S-2	S-7
Sample Depths (feet)	5.0 – 9.0	9.0 – 11.0	1.0 – 5.0	18.5 – 20.5
Stratum	Stratum II	Stratum II	Existing FILL	Stratum II
Atterberg Limits				
Liquid Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plastic Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plasticity Index	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Natural Moisture Content (%)	25.2	18.5	12.9	17.3
Percent Passing #200 Sieve	41.5	37.9	50.2	22.5
Unified Soil Classification System (USCS) Group Symbol	SM	SM	ML	SM
ASTM Group Name	Silty sand	Silty sand	Sandy silt with gravel	Silty sand

Sample Location	B-5	B-5	B-6	B-7
Sample Number	S-4	S-9	S-6	S-4
Sample Depths (feet)	7.0 – 9.0	18.5 – 20.5	13.5 – 15.0	6.0 – 8.0
Stratum	Existing FILL	Stratum III	Stratum II	Stratum II
Atterberg Limits				
Liquid Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plastic Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plasticity Index	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Natural Moisture Content (%)	14.7	19.5	16.6	21.5
Percent Passing #200 Sieve (%)	43.7	22.0	28.8	32.9
Unified Soil Classification System (USCS) Group Symbol	SM	SM	SM	SM
ASTM Group Name	Silty sand with gravel	Silty sand	Silty sand	Silty sand
Sample Location	B-8	B-8	B-9	B-9
Sample Number	S-2	S-7, S-8	S-3	S-6
Sample Depths (feet)	2.0 – 4.0	13.5 – 17.5	5.0 – 7.0	13.5 – 15.0
Stratum	Existing FILL	Stratum II	Stratum I	Stratum II
Atterberg Limits				
Liquid Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plastic Limit	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Plasticity Index	Non-plastic	Non-plastic	Non-plastic	Non-plastic
Natural Moisture Content (%)	16.6	16.2	18.8	19.7
Percent Passing #200 Sieve (%)	61.1	27.1	51.4	39.1
Unified Soil Classification System (USCS) Group Symbol	ML	SM	ML	SM
ASTM Group Name	Sandy silt	Silty sand	Sandy silt	Silty sand
Sample Location	B-10	B-11A	B-18	
Sample Number	S-6	S-1	S-2	
Sample Depths (feet)	13.5 – 15.5	4.0 – 6.0	2.0 – 4.0	
Stratum	Stratum II	Stratum I	Existing FILL	
Atterberg Limits				
Liquid Limit	Non-plastic	Non-plastic	Non-plastic	
Plastic Limit	Non-plastic	Non-plastic	Non-plastic	
Plasticity Index	Non-plastic	Non-plastic	Non-plastic	

Natural Moisture Content (%)	10.9	20.2	18.4	
Percent Passing #200 Sieve (%)	20.3	52.2	44.6	
Unified Soil Classification System (USCS) Group Symbol	SM	ML	SM	
ASTM Group Name	Silty sand with gravel	Sandy silt	Silty sand with gravel	

C. PUBLISHED GEOLOGICAL INFORMATION

According to the Commonwealth of Pennsylvania, Pennsylvania Geological Survey, *Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania*, 1978, Malvern Quadrangle, the site is underlain by the Conestoga Formation (Geologic Symbol: O€c) and the Octoraro Formation (denoted with geologic symbol *€Zo*). Plate 2, included in the Appendix, shows the location of the site on a geologic map of the area.

According to the Commonwealth of Pennsylvania, Topographic and Geologic Survey, *Engineering Characteristics of The Rocks of Pennsylvania*, Fourth (4th) Series, Revised 1982 and Sloto 1990, the Conestoga Formation is typically composed of light gray lower section of inter-bedded medium to thick beds of dolomite and thin beds of limestone, some basal beds are composed of limestone conglomerate. The middle section is typically a thinly bedded, dark graphitic phyllite; the upper section is a bluish gray thickly bedded, medium grained crystalline, micaceous limestone with shaley partings and occasional large quartz/calcite lenses and layers. The Conestoga Formation is crudely bedded, from thin laminae to medium thickness. The beds are often intensely folded and deformed at an outcrop scale. This formation is moderately resistant to weathering. The mantle thickness is highly variable and may be extremely thick. The bedrock/soil interface is characterized by the presence of pinnacles and numerous quartz veins. According to this publication, the Conestoga Formation provides good foundation stability, although solution cavities and bedrock pinnacles should be thoroughly investigated. If bedrock pinnacles are encountered, the excavation of this rock is considered difficult in comparison to other rock types.

It is noted that the limestone of the Conestoga Formation is a carbonate rock. Carbonate rock is susceptible to dissolution when exposed to water, particularly slightly acidic water. The term Karst topography is used to reference a landscape resulting from surface and underground solution of carbonate rock. Some features commonly associated with Karst topography are very soft and moist soil conditions, sinkholes, and voids within the bedrock.

According to the Pennsylvania Geological Survey, Fourth Series, Open-File Report OFBM-06-04.0, *Bedrock Geologic Map of the Chester Valley and Piedmont Portion of the Germantown, Malvern, Norristown, and Valley Forge Quadrangles, Chester, Delaware, Montgomery, and Philadelphia Counties, Pennsylvania*, by Howell Bosbyshell, 2006, the site is also underlain by the Octoraro Formation (denoted with geologic symbol *ЄZo*).

According to the above referenced publication, the Octoraro Formation consists of schist to phyllite composed of quartzofeldspathic material of centimeter to decimeter thickness interlayered with phyllonitic muscovite-rich and chlorite-rich rock. The quartzofeldspathic material occurs as discontinuous, lens-shaped bodies bounded by foliation surfaces implying that the rock has undergone extensive transposition. Extension veins filled with quartz and/or chlorite are locally common. Carbonate (calcite or dolomite) is present in some samples. Weathered surfaces are dark gray to greenish-gray or rusty orange-yellow, and fresh rock is dark greenish-black. The rock displays a well-developed schistosity that in the more highly sheared zones imparts fissility. The quartz-rich varieties are stable, but tectonized sections are subject to slumping in open cuts. The rock is moderately easy to excavate and provides good foundation support in sound material. Quartz-rich sections may be useful as fill, but the extreme fissility of tectonized material renders it of questionable economic value.

Based upon the soil samples observed in the test borings, it appears that phyllite and micaceous limestone underlies the investigated area.

D. SINKHOLE DEVELOPMENT POTENTIAL

As previously discussed in the *PUBLISHED GEOLOGICAL INFORMATION* section of this report, the site is underlain by carbonate bedrock. Carbonate bedrock is susceptible to dissolution which results in the formation of sinkholes. Characteristics associated with this rock type commonly include localized soft and/or moist soil conditions indicative of sinkhole activity. Sinkholes are the result of soil loss, transported via infiltrating water, through voids and fractures within the bedrock. Based on this local geology, EEI reviewed the Open File Report for this site. The Open File Report is a geologic survey indicating the presence of sinkholes, closed depressions, and other geologic features. As shown on Plate 3 – Karst Related Features, included with this report, no sinkholes or closed depressions were mapped within the proposed development area. During the on-site investigation, no sinkholes or closed depressions were observed during the field investigation. However, sinkhole development potential across the site will be increased when the subsurface stratigraphy is subjected to the proposed excavations and construction related activities.

The potential for sinkhole development always exists in karst geology and no construction methodology or engineering recommendation can guarantee against the development of sinkholes. In the same vein, no remediation method for a single sinkhole guarantees that additional sinkholes will not manifest themselves in close proximity to the original. For these reasons, contingencies should be developed for the proper repair of sinkholes during construction. However, the risk and potential severity of sinkhole related problems can be significantly reduced by taking precautions within the design phase, as well as during and following construction. General guidelines/procedures for minimizing the potential for sinkhole development, both during and after construction, are included below.

RECOMMENDED CONSTRUCTION PRACTICES FOR MINIMIZING SINKHOLE DEVELOPMENT IN CARBONATE AREAS

1. Utmost care must be taken to prevent collection and drainage of surface water into excavated or low-lying areas of the site during the excavation and construction of roadways, ramps, or structures. This may be done by constructing earth berms, dikes, or diversion ditches around open excavations or otherwise preventing the collection and ponding of water in low-lying areas. Typically, excavations should not be made during predicted periods of precipitation. Excavations should be filled as soon as practical, especially over weekends or periods of inactivity.

2. The soil situated above a zone of solution activity is usually soft and wet. It is, therefore, important to locate areas exhibiting these conditions, wherever they may exist or be encountered. If structural fill is to be placed in areas suspected of sinkhole activity, the subgrade should be proof-rolled, and all soft areas suitably replaced and compacted prior to construction. If the area is to be excavated, proof-rolling should be conducted after excavating to the finished subgrade elevation. Proof-rolling should be conducted under the observations of a representative of the Geotechnical Engineer of Record.

3. Soft soil must be removed and replaced with clean fill placed and compacted in accordance with the *FILL AND COMPACTION* section of this report.

4. The base of all excavations in carbonate areas should be inspected for soft or unusually moist conditions. A visual inspection of the excavated surface, as well as probes of the soil at regular intervals, is recommended. Any soft or unusually moist soil should be further excavated and a determination of the extent of the problem be made. Remedial measures should then be undertaken as necessary. Swales, drainage ditches and/or basins are particularly vulnerable to sinkhole development during periods of heavy rainfall. The same is true of outlet locations for drainage pipes. EEI recommends lining these areas with natural clay or impermeable liners to minimize infiltration of water.

5. Excavation should be kept to a practical minimum in areas of known or suspected sinkhole or solution activity. In general, the closer excavations get to the rock surface, the greater the potential is for sinkhole development.

6. The proper stabilization of sinkholes or other areas exhibiting solution activity is critical and should be performed under the direction of experienced Geotechnical Engineers.

7. Watertight seals should be provided at all water bearing utility line connections. All roof drains should be watertight and should connect to the on-site stormwater management systems.

8. Site grades should provide positive drainage away from building areas.

9. Joints between asphalt paving and concrete curbing should be sealed to reduce water infiltration in these areas.

III. INTERPRETATION OF INFORMATION AND DATA

A. STRATIFICATION AND SUBSURFACE CONDITIONS

The samples of soil obtained during the field investigation were examined and visually classified by EEI, both in the field and in the laboratory. EEI has generalized the subsurface profile for the investigated area. EEI encountered an Existing FILL layer and at least two (2) naturally occurring soil strata beneath a surficial layer of asphalt, concrete, or sub-base stone. Surficial asphalt and sub-base stone were observed at test boring locations B-1, B-6, B-8, B-9, B10, B-12, B-13 and B-16. Asphalt without subbase stone was observed at test boring B-4 and concrete was observed at test boring B-5. Subbase stone, or crushed aggregate materials were encountered at the surface of all other test locations except at test borings B-11 and B-11A where existing FILL was observed at the surface.

Detailed descriptions and data regarding the subsurface conditions are shown on the *Test Pit Logs,* in the Appendix. The following subsections provide general descriptions of the materials encountered.

1. Existing Fill

The materials designated as Existing Fill are visually described as sandy silt and silty sand with variable amounts of gravel. The USCS Group Symbols verified by laboratory testing for representative samples of this material are *ML and SM*. The corresponding ASTM Group Names are *sandy silt and silty sand*. The Existing Fill was found at the surface of test borings B-11 and B-11A and beneath the surficial materials at all test locations except B-9, B-12, and B-16. The existing FILL extended to depths ranging from 2.0 to 10.5 feet below the existing grade.

The SPT values recorded during the sampling of this material range from 9 to 38 blows per foot of penetration. Based on this value, the relative density of the Existing Fill ranges from loose to dense. These materials were encountered in a moist state during the field investigation. Laboratory analysis of the existing FILL material showed natural moisture contents range from 12.9 to 18.4%.

2. Stratum I – Residual Soil

The materials designated as Stratum I consist of residual soil visually described as sandy silt, trace clay and gravel. The USCS Group Symbol verified by laboratory testing for representative samples of this material is *ML*. The corresponding ASTM Group Name is *sandy silt*. Stratum I soils were encountered at test borings B-9, B-11A, B-13, and B-16 below surficial materials or Existing Fill to depths ranging from 3.5 feet to 12.0 feet below existing grade.

The SPT values recorded during the sampling of the Stratum I soil range from 8 blows per foot of penetration to 24 blows per foot of penetration. Based on these values, the consistency of the Stratum I soil ranges from medium to very stiff. In general, the Stratum I soils were stiff. These materials were encountered in a moist state during the field investigation. Laboratory analyses of the Stratum I material showed natural moisture contents of 18.8 and 20.2%.

3. Stratum II – Decomposed/Saprolitic Limestone and Phyllite

The soils designated as Stratum II are visually described as decomposed phyllitic limestone in the form of sandy silt to silty sand with trace clay and gravel. The USCS Group Symbol verified by laboratory testing for representative samples of this material is *SM*. The corresponding ASTM Group Name is *silty sand*. The Stratum II soils were encountered in all test borings except B-11. The Stratum II soils extended to termination depths ranging from 20.0 to 30.0 feet below the existing ground surface at test locations B-6, B-9, B-11A, B-12, B-13 and B-16.

The SPT values recorded during the sampling of this soil range from 2 blows per foot of penetration to 64 blows per foot of penetration. Based on these values, the relative density of the Stratum II soil ranges from very loose to very dense. In general, these materials were medium dense near the upper stratum limits, however, loose and very loose conditions were encountered at test locations B-1, B-4, B-5, B-7, and B-8 at initial depths of 6.0, 16.0, 18.5, 6.0 and 9.0 feet, respectively. These materials were encountered in a moist to wet state during the field investigation. Laboratory analyses of the Stratum II material showed natural moisture contents to range from 10.9 to 25.2%.

4. Stratum III – Weathered Limestone

The soils designated as Stratum III are visually described as weathered limestone in the form of silty sand, gravelly sand, and sandy gravel. The USCS Group Symbol verified by laboratory testing for representative samples of this material is *SM*. The corresponding ASTM Group Name is *silty sand*. The Stratum III soils were encountered in test locations B-1, B-3, B-

4, B-5, B-7, B-10 and B-18 below Stratum II and extended to termination depths ranging from 13.0 to 25.0 feet below the existing ground surface at B-6, B-9, B-11A, B-12, B-13 and B-16.

The SPT values recorded during the sampling of this soil range from 4 blows per foot of penetration to 50 blows per four (4) inches of penetration. Higher SPT values are indicative of very dense weathered rock. In general, these materials were very dense. These materials were encountered in a dry to wet state during the field investigation. Laboratory analysis of the Stratum III material showed a natural moisture content to be 19.5%.

5. Bedrock

Bedrock, inferred herein as auger refusal on moderately to freshly weathered rock, was encountered in B-1 through B-5, B-7 and B-8 at depths ranging from 8.0 to 22.5 feet below existing grade. In addition to bedrock, very dense weathered rock as indicated by SPT-values greater than 50 blows per foot and/or difficult drilling was encountered across the site. Table 3 below summarizes the depths and elevations where very dense weathered rock and bedrock was encountered during the field investigation.

TABLE 3
DEPTH TO VERY DENSE WEATHERED ROCK AND BEDROCK

Boring Location	Surface Elevation[1.)] (ft)	Depth to Very Dense Weathered Rock [2.)3.)] (ft)	Elevation of Very Dense Weathered Rock [1.)3.)] (ft)	Depth to Bedrock[2.)](ft)	Elevation of Bedrock[1.)](ft)
B-1	388.0	11.5	376.5	15.0	373.0
B-2	387.0	-	-	8.0	379.0
B-3	387.0	12.5	374.5	13.0	374.0
B-4	387.0	20.5	366.5	22.5	364.5
B-5	387.0	20.0	367.0	20.5	366.5
B-6	400.0	-	-	-	-
B-7	387.0	12.5	374.5	13.5	373.5
B-8	387.0	-	-	19.0	368.0
B-9	400.0	-	-	-	-
B-10	398.0	20.5	377.5	-	-
B-11	411.0	-	-	-	-
B-11A	411.0	-	-	-	-
B-12	401.0	-	-	-	-
B-13	399.5	-	-	-	-

TABLE 3 DEPTH TO VERY DENSE WEATHERED ROCK AND BEDROCK					
Boring Location	Surface Elevation[1.)] (ft)	Depth to Very Dense Weathered Rock [2.)3.)] (ft)	Elevation of Very Dense Weathered Rock [1.)3.)] (ft)	Depth to Bedrock[2.)](ft)	Elevation of Bedrock[1.)](ft)
B-16	427.5	-	-	-	-
B-18	421.0	19.0	402.0	-	-

1.) The ground surface elevation at each boring location was interpolated from plans provided.
2.) The depth is relative to existing grade at the time of the investigation.
3.) Very dense weathered bedrock is defined as having an SPT N-value of at least 50 blows per foot and/or hard drilling.

IV. GEOTECHNICAL RECOMMENDATIONS

A. GEOTECHNICAL ANALYSES

EEI has completed geotechnical analyses in order to provide foundation design recommendations. The analyses are based on the conditions encountered in the field. EEI has evaluated the subsurface conditions and provides the following soil parameters utilized for foundation analyses in the following table.

TABLE 4 GEOTECHNICAL SOIL PROPERTIES				
Stratum	Existing FILL	Stratum I	Stratum II	Stratum III
Moist Unit Weight - γ_m (pcf)	120	115	120	120
Effective Stress Angle of Internal Friction - ϕ' (deg)	30	28	30	32
Cohesion – c (psf)	0	0	0	0

Geotechnical calculations and the following recommendations are based on the geotechnical subsurface investigation, assumed loads and annotated sketches provided to EEI by the client.

B. FOUNDATION SUPPORT RECOMMENDATIONS

Based upon the provided grading plans for the proposed construction, as well as assumed structural loads of 50 kips column loads and 2 kips per linear foot, EEI has determined that the materials encountered in the vicinity of the proposed addition are generally suitable for foundation and/or slab support. In order to protect foundation from frost penetration, spread

footings bottom of footing elevations (BFE) shall be placed a minimum of 3.0 feet below lowest adjacent exterior grade. Based on the results of test borings in the area of the proposed development, it is expected that foundations will bear in stiff/medium dense Existing FILL, Stratum I, Stratum II soils, or *structural fill placed and compacted over prepared Existing FILL, Stratum I or Stratum II subgrade soils*.

Following site preparation activities, the subgrade soils should be visually evaluated and/or proof-rolled. Soft or unstable soils can be scarified, dried in-place, and compacted. Alternatively, unstable areas can be undercut to firm residual soils and/or stabilized. The extent of the undercutting/stabilization and confirmation of a stable subgrade should be determined in the field by a representative of the Geotechnical Engineer of Record. Following verification of suitable bearing material, the over-excavation may be backfilled and replaced with *structural fill*, as outlined in the FILL and COMPACTION section, or lean concrete up to the originally proposed foundation bottom elevation. Alternatively, the foundations can bear on properly placed, and compacted structural fill with the footing bottoms situated below frost depth, or the foundation base can be lowered to an approved soil bearing elevation.

The following foundation system and soil bearing capacity recommendations, in addition to those discussed above, are provided by EEI for use in foundation design assuming that the procedures stated in this report are followed. A foundation system consisting of strip and spread footings is recommended for support of the proposed improvements contingent upon proper completion of the procedures recommended within this report.

1. EEI recommends that the foundations for the proposed structures be designed for an allowable bearing capacity of 3,000 pounds per square foot bearing on medium dense Existing FILL, medium stiff Stratum I soils, medium dense Stratum II soils, and/or properly placed, and compacted structural fill. **Foundations shall not bear on or above any soft/unstable soils.**
2. Strip and spread footings shall be a minimum of 18 and 36 inches wide, respectively, for shear considerations. However, it is noted that bearing conditions may require wider footing dimensions.
3. Under the prescribed allowable bearing capacity of 3,000 psf, total and differential settlements of new foundations are expected to be less than 1.00 and 0.50 inch, respectively. If the foundation loads exceed the values previously stated in this report, EEI should be informed to review and revise these recommendations as necessary.
4. The bottom of exterior footings and footings in unheated areas should be placed at least thirty-six (36) inches below the final exterior grade for protection from frost heave. Interior footings to be located within heated areas should be installed to a minimum depth of twenty-four (24) inches below the final slab-on-grade elevation.

5. All footing bottoms should be compacted, dry, and completely cleaned of soft/loose material or debris immediately prior to the placement of concrete.
6. The actual bearing conditions of the soil at the footing bottom elevation should be confirmed in the field during excavation by inspection under the supervision of a Professional Engineer qualified in Geotechnical Engineering.

C. FLOOR SLAB AND PAVEMENT SUPPORT

EEI recommends the floor slabs for the proposed structures are designed as a slab-on-grade system, and the subgrade should be prepared in accordance with the procedures described in this report. It is the opinion of EEI that the Existing FILL materials, Stratum I and Stratum II soils are generally capable of providing slab and pavement support. This recommendation assumes that all slab and pavement areas be proof-rolled and evaluated prior to the placement of the sub-base stone and again prior to asphalt/concrete placement.

Pavements and floor slabs may be supported on suitably medium dense Existing FILL, Stratum I, Stratum II, or structural fill soils placed and compacted over approved subgrade soils in accordance with the FILL AND COMPACTION section of this report. During SITE PREPARATION, removal of soft/loose soils and replacement with compacted structural fill or excavation, drying, aeration and replacement in a controlled manner should be anticipated. Following these procedures, the resultant product should be a uniform bearing surface for slab support that will provide adequate structural support and limit settlement. The earthwork procedures described herein should be monitored and inspected by a representative of the Geotechnical Engineer of Record. It is imperative that a stable subgrade be realized to ensure the durability and longevity of the slab and pavement sections.

Proof-rolling should be performed with a steel drum, vibratory roller having a minimum static weight of 10 tons. Excessively moist soil encountered at the slab and pavement subgrade will result in an unstable subgrade. Therefore, any excessively moist soil should be aerated, sufficiently dried, and densified in-place. The use of a geotextile within slab and paved areas is also recommended by EEI to extend the life of the slab and pavement. It is also assumed that periodic maintenance, such as patching and sealing, is performed at regular intervals. The proof-rolling effort is critical, and evaluation should be conducted under the supervision of the Geotechnical Engineer of Record.

Floor slabs shall be designed with a modulus of subgrade reaction value of 125 psi/in. EEI recommends the placement of a granular subbase beneath the floor slab to provide uniform support distribution between the subgrade soils and the base of the concrete slab. It is

recommended that a minimum of four (4) inches of crushed stone aggregate, such as AASHTO #57 or equivalent, be placed and compacted beneath all floor slab areas. The floor slabs should be suitably reinforced to control shrinkage cracks. Proper joints should be provided at the junction of the slabs and foundation system so that a small amount of independent movement can occur without causing damage.

D. SITE PREPARATION

Prior to foundation construction, any concrete, asphalt, subbase, mulch, and topsoil should be removed from the development area to expose the soils at the construction subgrade elevations. The subgrade should be proof-rolled and compacted to densify and verify the integrity of the subgrade bearing materials. EEI recommends that a smooth drum vibratory roller having a minimum static weight of 10 tons be utilized for this purpose. Any subgrade soils that are found to be predominantly fine-grained in the field should be proof-rolled with the roller set in “static” mode. Areas that cannot be accessed by this sized equipment should be densified and compacted by use of walk-behind or hand operated equipment. Proof-rolling and compaction procedures are an integral part of the site preparation process necessary to densify and verify the integrity of the existing soils. The proof-rolling operation should be observed and evaluated in the field by a representative of the Geotechnical Engineer of Record. Any soft zones of encountered during proof-rolling should be removed and replaced with structural fill as described in the *FILL AND COMPACTION* subsection of this report.

The site should be graded during construction to convey surface runoff away from active work areas. The work areas should be sealed by rolling daily to promote runoff. Careful grading and management of surface water runoff will help minimize disturbance of the subgrade. EEI recommends that all construction areas, including those that will be excavated to achieve the planned subgrade elevation, be proof-rolled immediately before the placement of any structural fill and/or the placement of subbase stone, and again before the installation of concrete or asphalt. Such preparations will allow soft and weak areas to be observed and remediated before construction.

E. GROUNDWATER CONTROL

As previously discussed, groundwater was encountered in many of the test borings at relatively shallow depths below the existing ground surface. Specifically, test boring B-10 encountered the shallowest subsurface water level relative to the planned bottom of footing. The FFE of the residences in the vicinity of test boring B-10 is at elevation 398.0 feet, so the

assumed BFE will be three feet lower, at elevation 395.0 feet. Groundwater was encountered in test boring B-10 at elevation 387.0, which is more than 2.0 feet below the assumed BFE. EEI typically recommends at least a 2-foot separation between the bottom of footing and top of groundwater. Consequently, groundwater is not expected to be encountered during construction of the proposed buildings but may be encountered within deeper utility excavations across the site. The dewatering system should be capable of dewatering excavations during construction activities. A backup system should be available if the primary system fails. It is recommended that excavations are kept dry a minimum of 2 feet below bearing elevations by the selected contractor using the most efficient means possible. Failure to do so may result in detrimental softening of the subgrade and require remediation.

Water produced during the dewatering operation should be handled in accordance with applicable statutes and regulations. Dewatering should be based on standard practices and on the flows encountered at the time of construction. The final number and positioning of pumps required to de-water the excavation should be made by the contractor, subject to review by the Engineer. Control measures (i.e. surface grading, etc.) may be required to prevent water from entering excavations.

Site construction activities performed during warm and dry summer months may reduce the scope of temporary groundwater control measures. The appropriate measures to be taken for groundwater control are the responsibilities of the contractor and should be determined prior to construction and verified at the time of excavation. Groundwater elevations in the project area may fluctuate with daily, seasonal, and climatic events. The contractor should be advised that they may conduct their own investigations to verify groundwater elevations prior to performing excavations on site.

F. EXCAVATIONS

Based on the proposed plans and the subsurface profiles, EEI expects that excavations will occur within the Existing Fill, Stratum I and Stratum II soils at the site. EEI expects that these materials should be capable of being excavated with conventional earth excavation equipment and techniques. If bedrock pinnacles typical of the underlying geologic formation are encountered at locations between the test borings conducted, excavations will require the use of a late-model, high power trackhoe in lieu of a standard backhoe.

Excavations must be sloped, benched, or shored to prevent collapse during soil excavation and during construction. Sloping, benching, or shoring of all construction excavation should be conducted in accordance with 29 CFR 1926, Subpart P. A competent person as

defined by the aforementioned regulation is required to confirm the stability of all excavations during construction. The actual excavation wall slopes, benching, or shoring should be determined in the field and should be based on the required depth of excavations and on the soil types encountered. Care should be taken during construction to protect existing foundations, pavements, walkways and utilities from undermining.

G. FILL AND COMPACTION

1. Onsite Fill Criteria

Fill material used to support and backfill foundations, pavements, as well as fill for retaining walls is considered structural fill. Based on field observations it appears that the existing FILL, Stratum I and Stratum II soils are generally suitable for reuse as a structural fill material in their current condition. Stratum I soil will be difficult for re-use as structural fill due to their fine-grained matrix and elevated moisture content. The laboratory analysis measured the moisture content of the Stratum I soil to be 18.8 and 20.2%. If maintained within suitable range of the optimum moisture content and approved by a representative of the Geotechnical Engineer of Record at the time of use, the Stratum I soil may be used as structural fill. Deleterious materials including organics, degradable demolition and building materials, frozen materials, metals, organics, frozen, and other materials should not be included in onsite fills.

2. Imported Fill Criteria

If any general structural fill is required to be **imported** to the site, it should meet the following criteria:

- Granular soils such as GW, GP, GM SW, SP or SM as classified by ASTM D2487 are preferred, however soils having soil classifications GC, SC, ML or CL may be acceptable provided the Geotechnical Engineer of Record approves the soil;
- the largest particles within the fill should be no greater than 3 inches in diameter;
- not include deleterious materials such as construction debris, wood, glass, ash, trash, refuse, roots and other organic matter or contain frozen clumps of soil, snow or ice;
- have moisture contents within 3 percent of the soil's optimum moisture content and
- meets the definition of clean fill according to PADEP Management of Fill Policy, Document Number 258-2182-773.

The above criteria are provided as a general guideline for soil materials imported to the site. Soil materials that become available for use as a structural fill should be submitted to the Geotechnical Engineer of Record for evaluation before they are imported to the site.

3. Compaction Criteria

Structural fill should be placed in horizontal lifts not exceeding 8 inches in loose thickness and compacted with a smooth drum vibratory roller with a minimum static weight of 10 tons. Structural fill should be placed in horizontal lifts of 6 inches loose thickness where compaction by hand-operated equipment is necessary. The optimum lift thickness and number of repetitions necessary to achieve the required percentage compaction values should be determined in the field with test passes of the chosen compaction equipment. Structural fill material should be placed at, or deviate nominally from, the optimum moisture content as determined in accordance with ASTM D698 (Standard Proctor) or ASTM D1557 (Modified Proctor) and compacted to a minimum of dry density as indicated in Table 5.

TABLE 5
COMPACTION CRITERIA

Fill Area	Percent of Maximum Dry Density ASTM D698 (Standard Proctor)	Percent of Maximum Dry Density ASTM D1557 (Modified Proctor)
Foundation Support, Slab-On-Grade	98	95
Pavements and Sidewalks	98	95
Basin Berms, Wall Backfill	98	95
Non-structural	92	90

H. Fill Placement and Monitoring

Construction fills on the order of 13.0 feet are expected to be placed in some areas of the site in order to meet the proposed project subgrades. For example, at testing boring location B-7, construction fill may exceed ten (10) feet to meet the proposed bottom of foundation elevation. To ensure the placement of a stable soil mass that can support the proposed structure and site loadings, structural fill placement should be monitored with the following procedures:

- Collection and testing of proposed fill materials in accordance with ASTM D2487 and ASTM D1557/ASTM D698
- monitoring of topsoil removal and proof rolling of subgrade soils
- visual observation of lift thickness
- compaction testing using a nuclear density gauge in accordance with ASTM D6938,
- visual observation of lift thickness
- overall evaluation of the stability of the soil mass during the fill placement operation

The structural fill monitoring should be performed by a qualified geotechnical inspector working under the supervision of a Professional Geotechnical Engineer.

Prior to placement of any structural fill, the work area should be stripped of topsoil to a depth as determined by the geotechnical inspector. After topsoil removal the subgrade soils should be proof rolled to evaluate the stability of these soils to support the structural fill placement. Proof rolling should be completed with a fully loaded tandem-axle dump truck or other sufficiently suitable construction equipment. Any soft, loose, or yielding soils, as determined by the geotechnical inspector, shall be either reworked or undercut until suitable soils are encountered. Reworking can consist of moisture conditioning (drying) and/or re-compaction until a suitable condition is achieved. Additionally, slopes greater than 4 horizontal to 1 vertical (4H:1V) should be benched into the existing slope to allow for bonding of Structural Fill material.

In addition to the structural fill monitoring activities during construction, EEI recommends the installation of settlement monuments (survey pins). Settlement monuments (survey pins) should be set and surveyed after fill placement operations of 5.0 feet or greater to verify that the settlement has ceased prior to installation of the building foundations or utilities as an additional measure to confirm that settlements have been substantially dissipated. EEI recommends beginning the construction fill process as early as possible so that stabilization of the soil mass may be achieved prior to construction of the final surfaces.

I. LATERAL EARTH PRESSURES

Retaining walls that are restrained from deflection should be designed for the at-rest (K_o) condition. Retaining walls that are free to deflect, such as landscaped walls, should be designed for the active (K_a) condition. Considered somewhat conservative, the earth pressure data for the on-site material was determined from the soil classification testing and visual classification of the soil samples and was compared to generally accepted and published values for the various properties. EEI recommends additional laboratory testing, namely a direct shear test (ASTM D3080), be conducted on representative soils if mechanically stabilized retaining walls are proposed for the site. The results of this test may provide more aggressive soil parameters to be used in retaining wall design, which may effectively reduce retaining wall cost.

EEI recommends that a drainage system be installed for walls constructed below grade. The presence of a drainage system will serve to minimize hydrostatic pressures caused by water trapped against the walls. If adequate drainage is not provided, the walls should be

designed to resist hydrostatic loads. Additionally, consideration should be given to any surcharge loads at the top of walls. The lateral earth pressures that may be used for designing below grade walls and for retaining walls are shown in the following table.

TABLE 6
SOIL PROPERTIES FOR COMPUTATION OF LATERAL LOADS

Stratum	Existing FILL	Stratum I	Stratum II	Stratum III
Effective Stress Angle of Internal Friction - ϕ'	30°	28°	30°	32°
Moist Unit Weight - γ_m	120 pcf	115 pcf	120 pcf	120 pcf
Rankine Coefficient of Active Earth Pressure - K_a	0.33	0.36	0.33	0.31
Rankine Coefficient of Passive Earth Pressure - K_p	3.00	2.77	3.00	3.25
Rankine Coefficient of At-Rest Earth Pressure - K_o	0.50	0.53	0.50	0.47
Coefficient of Sliding	0.40	0.37	0.40	0.44

J. BELOW GRADE SPACE DAMPPROOFING

Based on the findings of the geotechnical investigation, hydrostatic pressures due to groundwater are not anticipated to develop adjacent to any subsurface walls or beneath slabs in the proposed construction area, if below grade spaces are to be incorporated into the project designs. It is understood that a portion of the structure may be below grade as part of the final grading scheme. Final grading plans should be transmitted to EEI for review so that ramifications to this report may be reviewed. Consequently, in accordance with the International Building Code (IBC 2009) Section 1805, below grade walls and floors should at a minimum be damp-proofed. Damp-proofing for floors shall consist of not less than 6-mil (0.006 inch) polyethylene with joints lapped not less than 6 inches. Additionally, a base consisting of at least 4 inches of gravel or crushed stone containing not more than 10 percent of material that passes through a No. 4 (4.75mm) sieve should be placed under the lowest level floor. Damp-proofing materials for walls shall be installed on the exterior surface of the wall and shall extend from the top of the footing to above the ground level in accordance with IBC 2009 Section 1805.2.2.

K. UNDERPINNING, SHEETING AND SHORING

Underpinning, sheeting, and/or shoring of existing foundation elements may be required in areas where proposed foundations are constructed adjacent to, and below, existing footing bottom elevations. Should sheeting, shoring, underpinning, or bracing of adjacent structures be required, these systems should be designed by a professional engineer and constructed according to the design plans. EEI can be contacted to provide the design of such measures.

Construction of any proposed structures adjacent to existing structures may compromise the existing foundations; therefore, bracing, sheeting, and shoring, and/or underpinning may be required for those areas. If existing foundations are potentially undermined, permanent underpinning or shoring will be required. EEI recommends that underpinning and/or a permanent retainment system be installed in areas where excavations are within the zone of influence of the existing foundations. New foundations adjacent to the existing structures must be lowered to match the adjacent existing foundation system. Special inspections may be required during underpinning and shoring activities, if deemed necessary, in accordance with the International Building Code (IBC).

L. SITE SEISMIC CLASSIFICATION

According to the 2009 International Building Code IBC Section 1613.5.5 Site Classification for Seismic Design and the information obtained from the geotechnical field investigation, the average properties in the top 100 feet correspond to Site Class D. Therefore, Site Class D conditions should be applied for the seismic design of the proposed structures.

M. CONSTRUCTION QUALITY CONTROL

As documented within this report, the proposed construction will include earthwork procedures and foundation placement activities. The quality of these activities is an integral part of the development of this site and directly affects the validity of the recommendations presented in this report. Based on EEI's past experience, the most effective and economical earthwork inspection is obtained through the presence of a qualified representative of the Geotechnical Engineer of Record during site preparation, excavation of on-site materials, site development, proof-rolling, placement of structural fill, and installation of foundation elements. EEI recommends that these activities be examined, tested, and confirmed by a representative of the Geotechnical Engineer of Record.

N. LIMITATIONS

The conclusions and recommendations presented in this report are based on the subsurface data collected, details stated in this report, and the assumption that the subsurface conditions do not deviate from those disclosed by the data acquisition activities performed. Foundation loads were not provided to EEI. It is recommended that the final foundation plans be made available to EEI for review. Should any substantial change in the proposed plans occur, these should be brought to the attention of EEI so that the impact of the change on the recommendations presented herein may be evaluated.

The recommendations provided herein are for the design of the foundations and associated structures related to the proposed development at the site. Should sheeting, shoring, underpinning, or bracing of adjacent structures be required, EEI should be contacted so that proper design of such measures may be formulated.

The procedures followed during the subsurface exploration, and the analyses and conclusions contained herein, have followed generally accepted practices of geotechnical engineering. EEI provides no other warranties, either expressed or implied, as to the professional advice provided under the terms of EEI's agreement and included in this report. The conclusions and recommendations presented in this report are based on the assumption that recognized, proper construction practices will be followed throughout construction and that a Professional Engineer qualified in Geotechnical Engineering will be retained to oversee the inspection of site preparation, proof-rolling, foundation construction, and other critical earthwork operations. If structural loads or subsurface conditions substantially deviate during construction from those described in this report, EEI should be contacted promptly.

Unless specifically indicated to the contrary in this report, the scope of work for this project was limited only to investigations and evaluation of the geotechnical aspects of the site conditions, and does not include any considerations of potential site pollution, contamination, or other environmental issues. This report offers no facts or opinions related to potential pollution or contamination of the site.

EEI emphasizes that geotechnical analyses made in this report are for the proposed residential development at 1 Malin Road in East Whiteland Township, Chester County, Pennsylvania. EEI does not assume any responsibility for the use of this report in generating a foundation design for a site other than the one specifically addressed in this report.

Respectfully submitted,
EARTH ENGINEERING INCORPORATED

Mark Friedrichsen, E.I.T.
Project Manager

David P. McGuire, P.E.
Project Manager

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FIGURES AND DRAWINGS

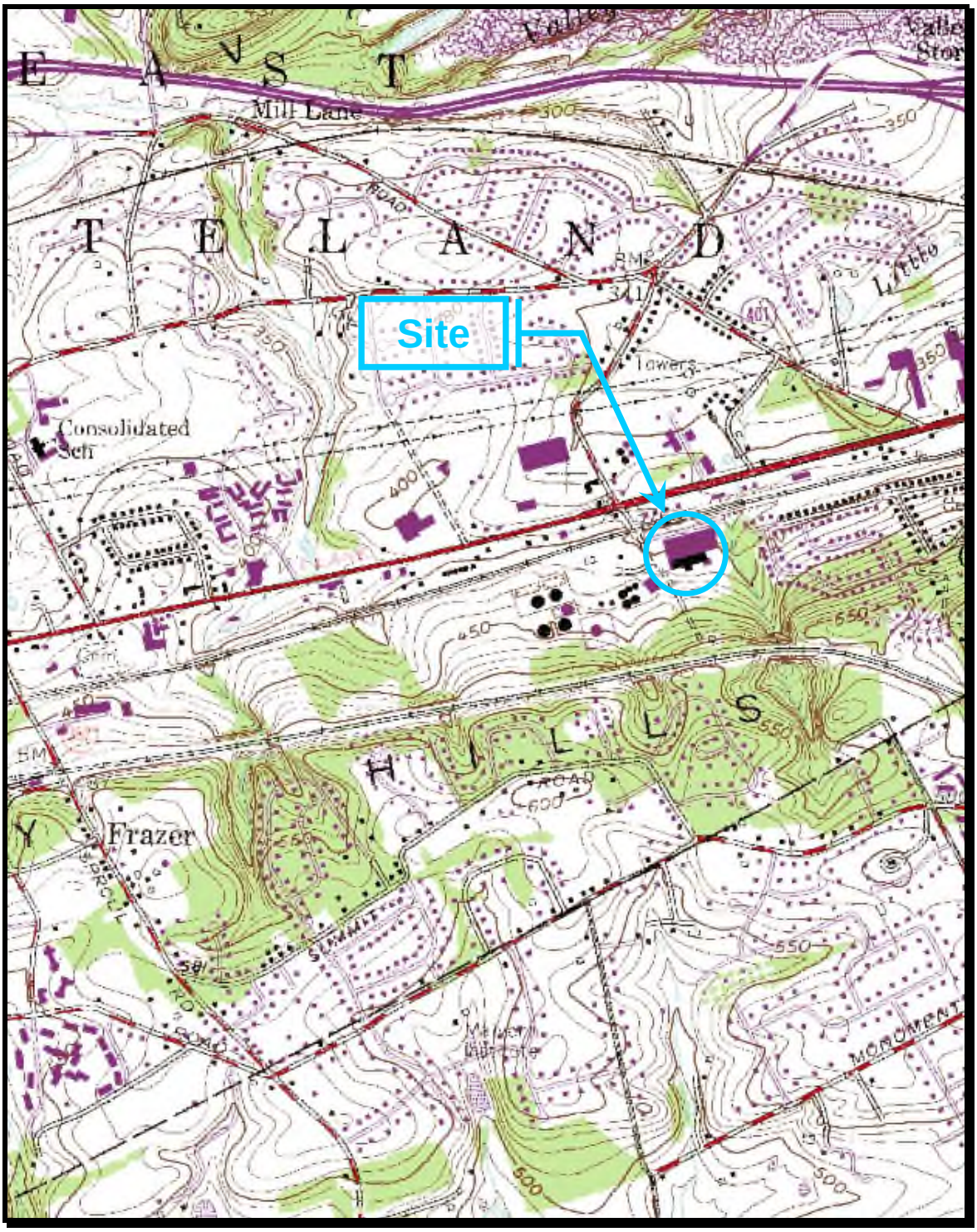


PLATE 1 – TOPOGRAPHIC MAP OF SITE

Reprinted from the United States Department of the Interior Geological Survey, Topographic Maps of Pennsylvania, Malvern, PA Quadrangle, Photorevised 1983.

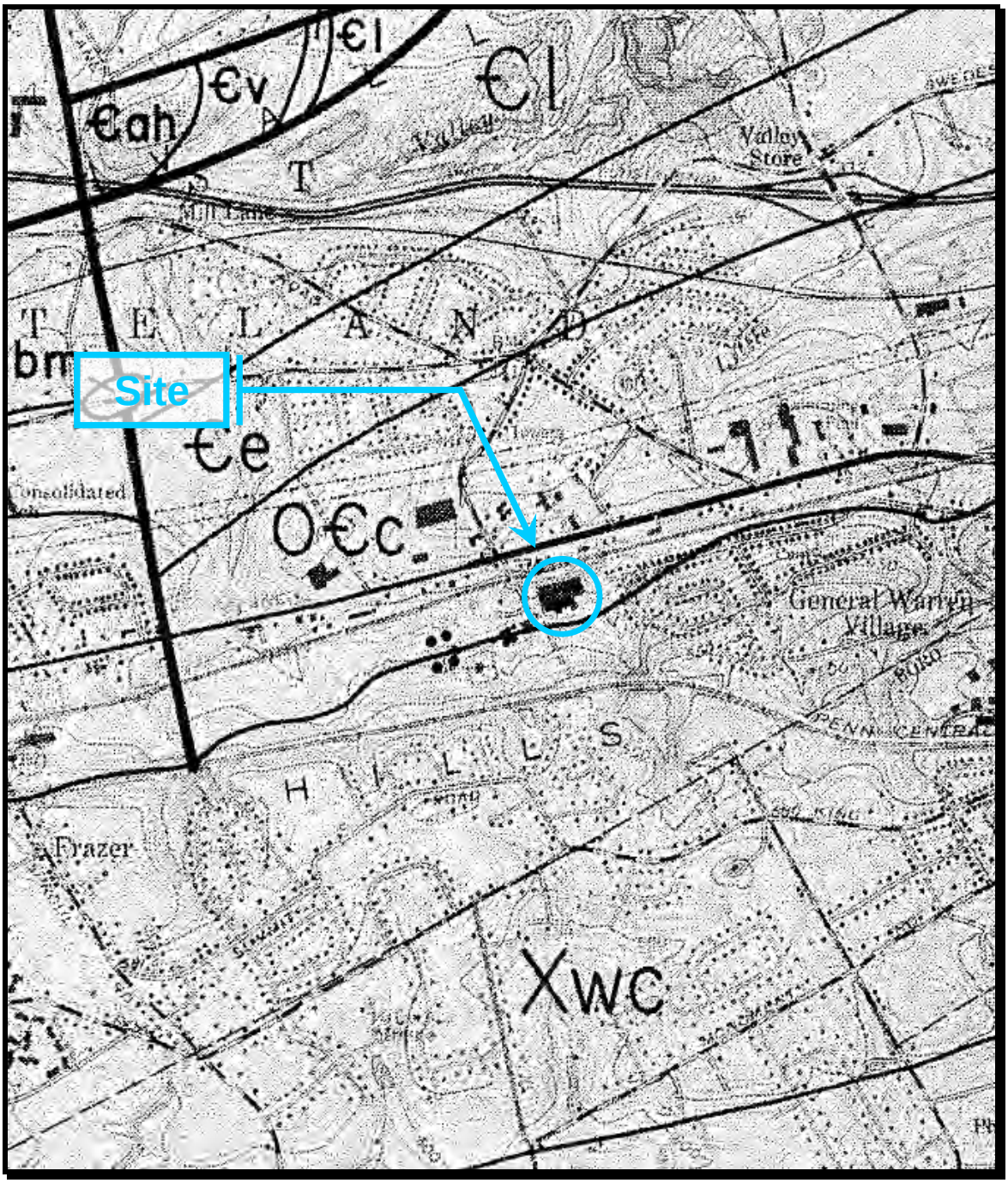


PLATE 2 - GEOLOGIC MAP OF SITE

Reprinted from the Pennsylvania Geological Survey, Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania, Malvern, PA Quadrangle, 1978.

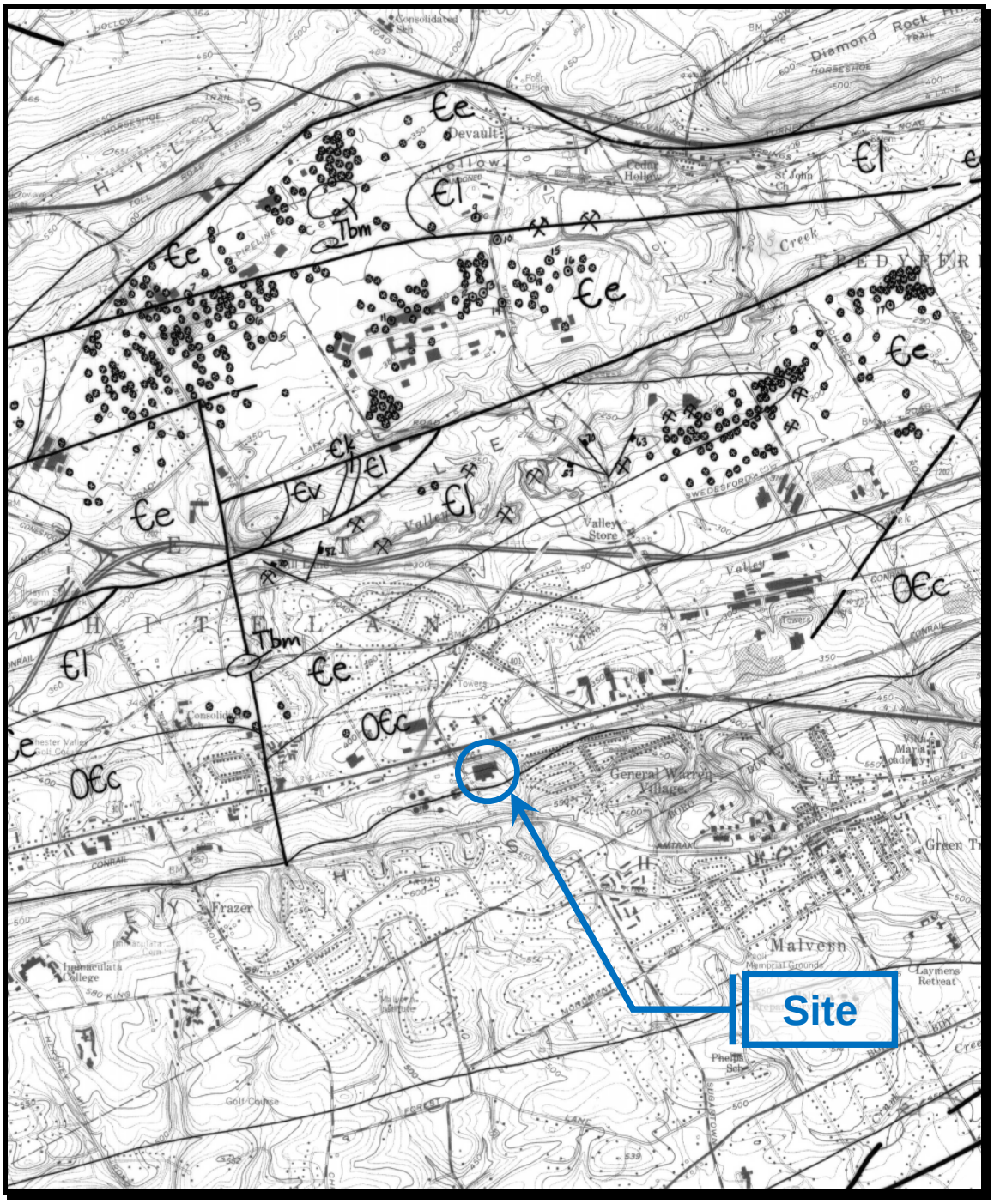
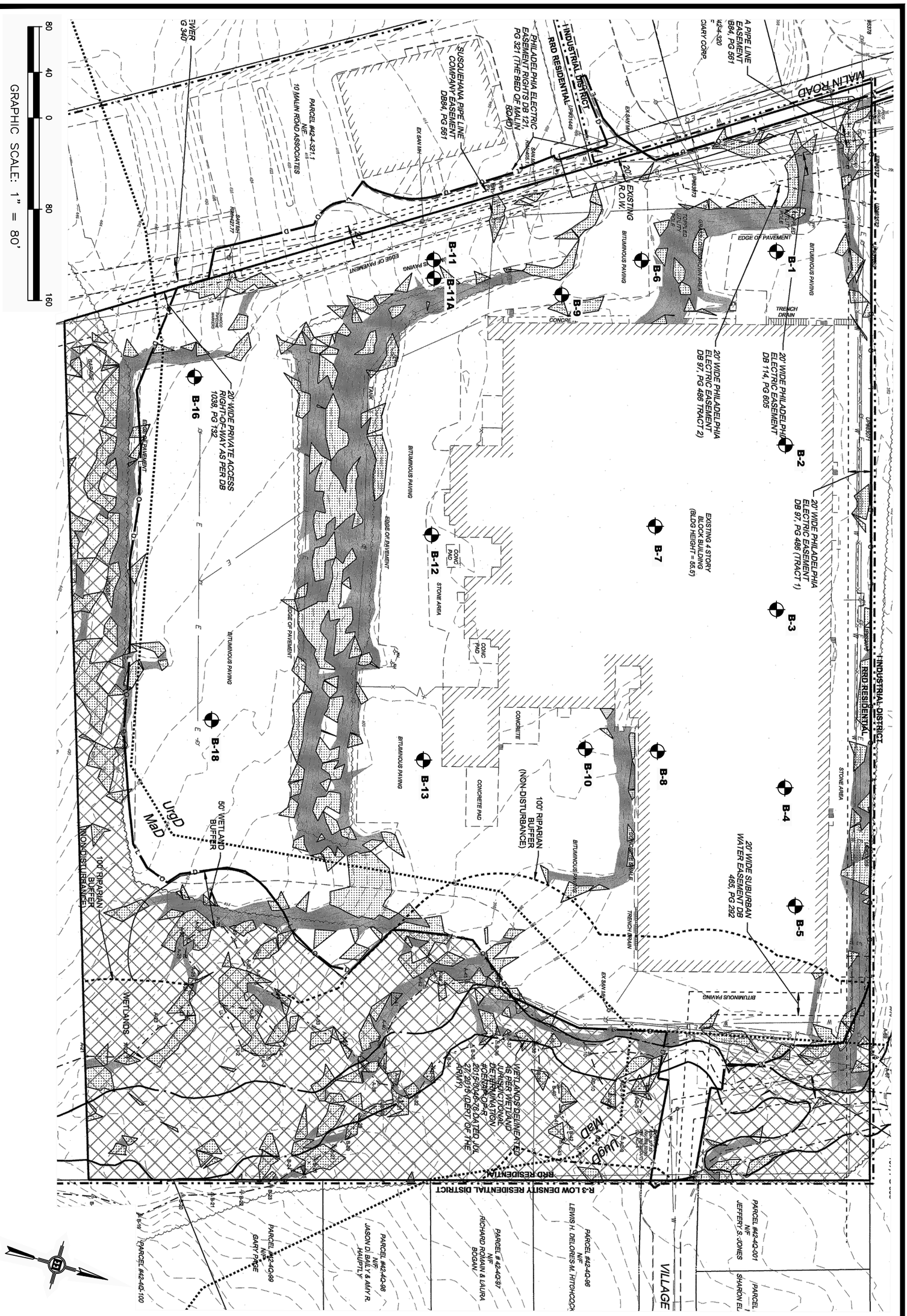


PLATE 3 – KARST-RELATED FEATURES GEOLOGIC MAP OF SITE

Reprinted from the Pennsylvania Geologic Survey Open-File Report: 9301, titled *Sinkholes and Karst-related Features of Chester County, Pennsylvania*, USGS Malvern, PA Quadrangle, prepared by W. E. Kochanov, 1993.



TESTING LOCATION PLAN

FOR

1 MALIN ROAD

EAST WHITELAND TOWNSHIP CHESTER COUNTY PENNSYLVANIA

Scale: 1" = 80'	Date: 04/01/2020	Drawn By: MTF	Checked By: DPM
Drawing Number: 32546.00-B-101		Approved By: PMM	

KEY:

TEST BORING LOCATION

BASE PLAN PROVIDED BY:

TAYLOR WISEMAN & TAYLOR

EARTH ENGINEERING INCORPORATED

Geotechnical Engineers & Geologists

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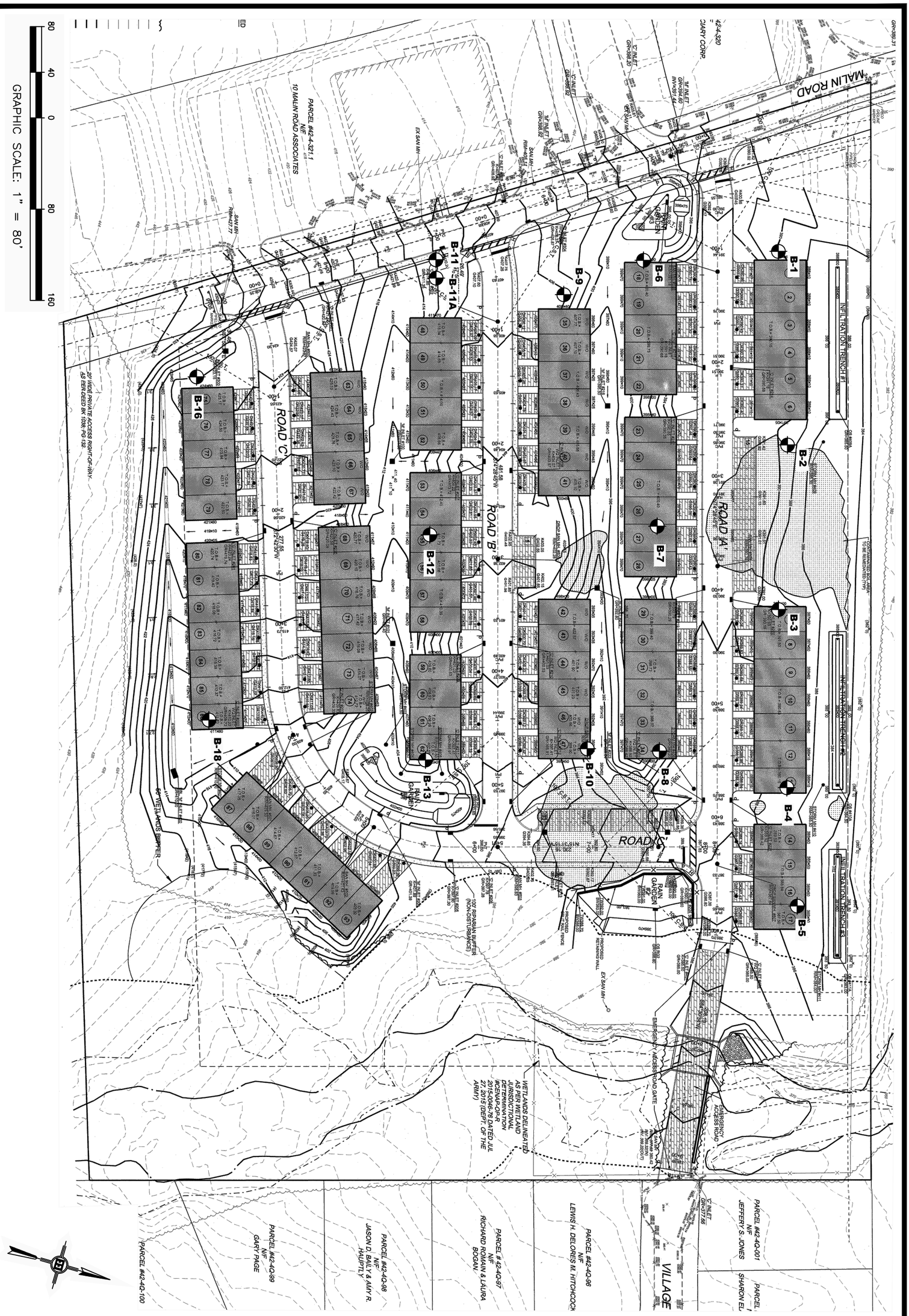

TESTING LOCATION PLAN

FOR

1 MALIN ROAD

EAST WHITELAND TOWNSHIP CHESTER COUNTY PENNSYLVANIA

Scale: 1" = 80'	Date: 04/01/2020	Drawn By: MTF	Checked By: DPM
Drawing Number: 32546.00-B-102		Approved By: PMM	

KEY:

TEST BORING LOCATION

BASE PLAN PROVIDED BY:

TAYLOR WISEMAN & TAYLOR

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Geotechnical Engineers & Geologists

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APPENDIX

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-1
SHEET	1 OF 1
DATE: START	2/28/20
END	2/28/20
SURFACE ELEV. (FT)	388.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 15.0' ; WATER: DEPTH: 5.0' TIME: 0.25 hrs. DATE: 2/28/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 5.0' TIME: 3.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								0.2 Asphalt (2") 387.8	
								0.7 Gravel (6") 387.3	
1.0								Silty sand; some gravel; orange brown, gray brown (FILL)	Easy drilling 0.0' - 11.5'
	S-1	5 10 14 18	1.2'	60 -	sm	m			Existing FILL possibly reworked site soils
3.0								3.5 384.5	
	S-2	12 8 6 6	0.5'	25 -	ml/sm	m		Silty sand; trace gravel; orange brown, gray brown	
5.0									
	S-3	5 5 4 4	1.3'	65 -	SM	M			
7.0									
	S-4	5 5 6 6	1.4'	70 -	SM	M			
9.0									
	S-5	5 5 5 6	1.3'	65 -	sm	w			Wet collapse at 10.0'
11.0								11.5 376.5	
								Silty sand; some gravel; dark gray (weathered limestone)	Moderate drilling 11.5' - 14.0'
									Pinnacle bedrock indicated by auger deflection at 11.5'
13.5									
	S-6	17 20 21	1.3'	87 -	sm/gm	w			Hard drilling 14.0' - 15.0'
15.0								15.0 373.0	
									Auger refusal and end of boring at 15.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-10
SHEET	1 OF 2
DATE: START	2/27/20
END	2/27/20
SURFACE ELEV. (FT)	398.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 25.0' ; WATER: DEPTH: 16.5' TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 13.0' TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								0.3 Asphalt (3") 397.7	
1.0								Subbase stone (9") 1.0 397.0	
	S-1	5 5 5 5	0.8'	40 -	ml/sm	m		Sandy silt to silty sand; trace gravel; gray brown, orange brown (FILL)	Easy drilling 0.0' - 9.0'
3.0									Existing FILL possibly reworked site soils
	S-2	4 4 5 5	1.6'	80 -	sm	m			
5.0									
	S-3	5 5 6 6	1.3'	65 -	ml	m			
7.0									
	S-4	5 5 5 5	1.3'	65 -	ml/sm	m			
9.0								9.0 389.0	
	S-5	5 6 6 8	1.2'	60 -	ml	m		Silty sand with gravel; gray brown (colluvium)	Easy drilling 9.0' - 19.5'
11.0									
13.5									
	S-6	8 9 9	1.0'	67 -	SM	M			
15.0									
								17.0 381.0	
									Soft/loose conditions encountered 17.0' - 19.5'
18.5									
	S-7	1 1 4	1.3'	65 -	sm/gm	w			Wet collapse at 18.5'
								19.5 378.5	
									Moderate drilling 19.5' - 20.5'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO. **B-10**
SHEET **2** OF **2**
DATE: START **2/27/20**
END **2/27/20**
SURFACE ELEV. (FT) **398.0**

PROJECT NAME **1 Malin Road**
PROJECT LOCATION **East Whiteland Township, Chester County, PA**
PROJECT NUMBER **32546.00**
INSPECTOR NAME **M. Friedrichsen**
EQUIPMENT USED **Mobile Drill B-57 powered cathead w/ safety hammer**
DRILLER NAME/COMPANY **W. Corcoran/Main Line Drilling Company, Inc.**
DRILLING METHODS **2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter**
AUGER: SIZE: **3.25" ID HSA** ; AUGER DEPTH: **25.0'** ; WATER: DEPTH: **16.5'** TIME: **0.25 hrs.** DATE: **2/27/2020**
CHECKED BY: **P. Neumann** ; DATE: **5/15/2020** DEPTH: **13.0'** TIME: **24.00 hrs.** DATE: **2/28/2020**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
20.5		14			sm/gm	w		20.5 / 377.5 Silty sand; trace gravel; orange brown (saprolitic limestone) *(continued)*	Hard drilling and augers deflecting 20.5' - 25.0'
								Sandy gravel; gray (weathered limestone)	
23.5									
	S-8	15 22 31	0.1'	7 -	sm	w			
25.0								25.0 / 373.0	End of boring at 25.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO. **B-11**
SHEET **1** OF **1**
DATE: START **2/27/20**
END **2/27/20**
SURFACE ELEV. (FT) **411.0**

PROJECT NAME **1 Malin Road**
PROJECT LOCATION **East Whiteland Township, Chester County, PA**
PROJECT NUMBER **32546.00**
INSPECTOR NAME **M. Friedrichsen**
EQUIPMENT USED **Mobile Drill B-57 powered cathead w/ safety hammer**
DRILLER NAME/COMPANY **W. Corcoran/Main Line Drilling Company, Inc.**
DRILLING METHODS **2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter**
AUGER: SIZE: **3.25" ID HSA** ; AUGER DEPTH: **4.0'** ; WATER: DEPTH: **dry** TIME: **0.25 hrs.** DATE: **2/27/2020**
CHECKED BY: **P. Neumann** ; DATE: **5/15/2020** DEPTH: **dry** TIME: **0.50 hrs.** DATE: **2/28/2020**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S-1	7 13 12 9	1.5'	75 / -	sm /	m		Silty sand; some gravel; orange brown (FILL)	Easy drilling 0.0' - 4.0'
2.0	S-2	6 5 5 5	1.0'	50 / -	sm/gm /	w			
4.0								4.0 / 407.0	Dry collapse at 3.5', wet sample S-2 due to probable perched water Obstruction encountered within FILL materials at 4.0' Offset 5' east; see B-11A

** D = DRY, M = MOIST, W = WET

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BORING LOG

BORING NO.	B-11A
SHEET	1 OF 1
DATE: START	2/27/20
END	2/27/20
SURFACE ELEV. (FT)	411.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 20.0' ; WATER: DEPTH: dry TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: dry TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
4.0							Silty sand; some gravel; orange brown (FILL) — 4.0 / 407.0	Boring continued from B-11
6.0	S-1	4 4 6 8	1.6'	80 -	ML	M	Sandy silt; trace to some gravel; little clay; red brown, orange brown — 7.5 / 403.5	Easy drilling 0.0' - 7.5'
8.0	S-2	9 9 9 9	1.5'	75 -	ml/sm	m		
10.0	S-3	9 9 9 9	1.1'	55 -	sm	m	Silty sand; trace gravel; gray brown, orange brown, tan (saprolitic phyllite)	Moderate drilling 7.5' - 20.0'
13.5								
15.0	S-4	9 10 11	0.0'	0 -	-	-		
18.5								
20.0	S-5	8 10 11	1.5'	100 -	sm	m	20.0 / 391.0	Dry collapse at 18.5' End of boring at 20.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-12
SHEET	1 OF 1
DATE: START	2/28/20
END	2/28/20
SURFACE ELEV. (FT)	401.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 20.0' ; WATER: DEPTH: 12.0' TIME: 0.25 hrs. DATE: 2/28/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 12.0' TIME: 5.50 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								0.5 Asphalt (6") 400.5	
								1.3 Gravel (10") 399.7	
1.5								Silty sand; trace to some gravel; orange brown, gray brown, brown (saprolitic phyllite)	Easy drilling 0.0' - 3.0'
3.5	S-1	5 5 7 9	1.2'	60 -	sm	m			Easy to moderate drilling 3.0' - 15.5'
5.5	S-2	10 10 9 9	0.7'	35 -	sm	m			
7.5	S-3	11 12 12 13	1.3'	65 -	sm	m			
9.5	S-4	11 11 12 12	1.3'	65 -	sm/sp	m			
11.5	S-5	11 12 13 12	1.4'	70 -	sm	m/w			
13.5									Wet collapse at 12.5'
15.0	S-6	9 11 11	1.5'	100 -	sm	w			
18.5									Moderate drilling 15.5' - 17.0' Easy drilling 17.0' - 20.0'
20.0	S-7	5 5 6	1.5'	100 -	sm/sp	w		20.0 381.0	End of boring at 20.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-13
SHEET	1 OF 1
DATE: START	2/27/20
END	2/27/20
SURFACE ELEV. (FT)	399.5

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 20.0' ; WATER: DEPTH: 10.3' TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 10.5' TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
							Asphalt (8") 0.7 / 398.8	
							Subbase stone (12") 1.7 / 397.8	Moderate drilling 0.0' - 1.7'
2.0							Sandy silt; trace to some gravel; orange brown, gray brown (FILL)	Existing FILL possibly reworked site soils
	S-1	9 10 10 11	1.3'	65 -	sm	m		Easy drilling 1.7' - 7.5'
4.0								
	S-2	8 7 7 8	1.3'	65 -	ml/sm	m/w		
6.0								
	S-3	7 8 16 17	1.5'	75 -	sm	m	6.5 / 393.0	
							Sandy silt; orange brown 7.5 / 392.0	Possible alluvial soils
8.0							Silty sand; trace gravel; gray brown, orange brown, dark brown, dark gray (saprolitic phyllite)	Moderate drilling 7.5' - 11.0'
	S-4	17 18 19 19	1.5'	75 -	sm/gm	d/m		
10.0								
								Easy drilling 11.0' - 20.0'
13.5								
	S-5	9 10 10	1.0'	67 -	sm	w		
15.0								
18.5								
	S-6	7 8 10	0.9'	60 -	sm	m		
20.0							20.0 / 379.5	End of boring at 20.0'

** D = DRY, M = MOIST, W = WET

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BORING LOG

BORING NO.	B-16
SHEET	1 OF 1
DATE: START	2/28/20
END	2/28/20
SURFACE ELEV. (FT)	427.5

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 20.0' ; WATER: DEPTH: dry TIME: 0.25 hrs. DATE: 2/28/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: dry TIME: 6.75 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
							0.2 / 427.3 Asphalt (2")	
							Gravel (10")	
1.0							1.0 / 426.5	
	S-1	4 4 4 4	0.8'	40 -	ml/sm	m	Sandy silt; some gravel; little clay; red brown, gray	Easy drilling 0.0' - 6.5'
3.0							3.5 / 424.0	
	S-2	4 4 5 5	1.3'	65 -	sm	m	Silty sand; trace to some gravel; yellow brown, gray brown (saprolitic phyllite)	
5.0								
	S-3	6 7 9 11	1.2'	60 -	sm	m		
7.0								Easy to moderate drilling 6.5' - 15.0'
	S-4	11 12 14 15	1.3'	65 -	sm	m		
9.0								
	S-5	16 16 15 16	1.0'	50 -	sm	m		
11.0								
13.5								
	S-6	16 17 20	1.0'	67 -	sm	m		Dry collapse at 14.0'
15.0								Moderate to hard drilling 15.0' - 20.0'
18.5								
	S-7	30 31 33	1.5'	100 -	sm/gm	m		
20.0							20.0 / 407.5	End of boring at 20.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-18
SHEET	1 OF 1
DATE: START	2/27/20
END	2/27/20
SURFACE ELEV. (FT)	421.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 19.3' ; WATER: DEPTH: dry TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: dry TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S-1	5 9 7 7	1.0'	50 / -	sm/gw /	m		0.5 / 420.5 Subbase stone (6")	
								Silty sand with gravel; gray brown (FILL)	Easy drilling 0.0' - 4.5'
2.0	S-2	6 6 7 7	1.3'	65 / -	SM /	M			
4.0	S-3	6 7 8 13	1.3'	65 / -	ml/sm /	m		4.5 / 416.5	
								Sandy silt to silty fine sand; trace to some gravel; orange brown (saprolitic phyllite)	Moderate drilling 4.5' - 12.0'
6.0	S-4	13 14 15 14	1.3'	65 / -	sm /	m			
8.0	S-5	13 13 12 12	0.5'	25 / -	gw /	d/m			
10.0								12.0 / 409.0	
								Silty sand to gravelly sand; gray brown (weathered limestone)	Moderate to hard drilling 12.0' - 19.3'
13.5									Dry collapse at 13.5'
	S-6	17 26 41	0.9'	60 / -	sm/gm /	d/m			
15.0									
18.5									
19.3	S-7	34 50/4"	0.8'	100	gw /	d		19.3 / 401.7	
									End of boring at 19.3'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-2
SHEET	1 OF 1
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 8.0' ; WATER: DEPTH: 5.5' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 5.0' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S-1	8 14 15 19	0.7'	35 -	gm	d/m		Gravel (8") 0.7 / 386.3	
								Silty sand; trace gravel; orange brown (FILL)	Easy to moderate drilling 0.0' - 3.5'
2.0	S-2	14 15 14 17	0.3'	15 -	sm	m		3.5 / 383.5	
4.0								Sandy silt to silty sand; trace to some gravel; gray brown, orange brown	Easy drilling 3.5' - 8.0'
	S-3	11 9 8 8	1.4'	70 -	ml/sm	m			
6.0	S-4	8 8 6 6	1.4'	70 -	sm	m/w			Wet collapse at 6.5'
8.0								8.0 / 379.0	Very hard drilling at 8.0'
									Auger refusal and end of boring at 8.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-3
SHEET	1 OF 1
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 13.0' ; WATER: DEPTH: 10.0' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 8.5' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
0.0	S-1	6 14 21 50/0"	1.2'	80 / -	sm	d/m	0.3 Gravel (4") — ELEVATION 386.7 Silty fine sand; trace gravel; gray brown (FILL)	Easy to moderate drilling 0.0' - 1.5'
1.5							2.0 — ELEVATION 385.0 Silty sand; trace to some gravel; little clay; gray brown, orange brown, tan	Obstruction encountered within FILL materials at 1.5' Easy to moderate drilling 2.0' - 7.5'
3.0	S-2	5 7 10 10	1.6'	80 / -	sm	m		
5.0	S-3	18 17 17 15	1.0'	50 / -	sm	m		
7.0	S-4	15 14 9 7	1.0'	50 / -	ml/sm	m		Easy drilling 7.5' - 12.5'
9.0	S-5	6 6 6 7	1.4'	70 / -	SM	M		Wet collapse at 10.5'
11.0							12.5 — ELEVATION 374.5 Sandy gravel; gray (weathered limestone) 13.0 — ELEVATION 374.0	Hard drilling 12.5' - 13.0" Auger refusal and end of boring at 13.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-4
SHEET	1 OF 2
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 22.5' ; WATER: DEPTH: 11.5' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 11.5' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION	REMARKS
							DEPTH / ELEVATION	
							0.2 Asphalt (2") — 386.8	Easy drilling 0.0' - 2.5'
							Sandy silt with gravel; trace asphalt; orange brown, gray brown (FILL)	
1.0	S-1	5 10 11 14	1.2'	60 / -	ML	M		
3.0	S-2	15 16 17 19	1.4'	70 / -	ML	M		Moderate drilling 2.5' - 15.0'
5.0	S-3	17 18 20 25	1.3'	65 / -	sm	m		
7.0	S-4	21 17 16 15	1.4'	70 / -	ml/sm	m		
							8.5 — 378.5	
							Silty fine sand; trace gravel; little clay; orange brown, gray brown (colluvium)	Possible topsoil layer (8.5' - 9.0'); trace grasses, fine roots
9.0	S-5	15 12 13 15	1.5'	75 / -	sm	m		
11.0								
							13.0 — 374.0	
							Silty sand; some gravel; gray brown	
13.5	S-6	14 13 15	0.7'	47 / -	sm	m/w		
15.0								Wet collapse at 10.5' Easy to moderate drilling 15.0' - 16.0' Easy drilling 16.0' - 20.0'
18.5	S-7	2 2 2	1.7'	85 / -	SM	M		

** D = DRY, M = MOIST, W = WET

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BORING LOG

BORING NO. **B-4**
SHEET **2** OF **2**
DATE: START **2/26/20**
END **2/26/20**
SURFACE ELEV. (FT) **387.0**

PROJECT NAME **1 Malin Road**
PROJECT LOCATION **East Whiteland Township, Chester County, PA**
PROJECT NUMBER **32546.00**
INSPECTOR NAME **M. Friedrichsen**
EQUIPMENT USED **Mobile Drill B-57 powered cathead w/ safety hammer**
DRILLER NAME/COMPANY **W. Corcoran/Main Line Drilling Company, Inc.**
DRILLING METHODS **2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter**
AUGER: SIZE: **3.25" ID HSA** ; AUGER DEPTH: **22.5'** ; WATER: DEPTH: **11.5'** TIME: **0.25 hrs.** DATE: **2/26/2020**
CHECKED BY: **P. Neumann** ; DATE: **5/15/2020** DEPTH: **11.5'** TIME: **24.00 hrs.** DATE: **2/27/2020**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
20.5		12			SM	M		20.5 Silty sand; some gravel; gray brown *(continued)* 366.5	Moderate drilling 20.0' - 20.5'
								Silty sand; trace gravel; dark gray, gray brown (saprolitic/weathered limestone)	Hard drilling and grinding 20.5' - 22.5''
								22.5 364.5	Auger refusal and end of boring at 22.5'

** D = DRY, M = MOIST, W = WET

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Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-5
SHEET	1 OF 2
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 20.5' ; WATER: DEPTH: 14.0' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 14.0' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								0.3 / 386.7 Concrete (4")	
1.0								Silty sand with gravel; trace concrete; orange brown, gray brown (FILL)	Easy drilling 0.0' - 4.5' Existing FILL possibly reworked site soils
3.0	S-1	4 5 5 6	1.3'	65 / -	ml /	m			
5.0	S-2	5 6 7 11	0.7'	35 / -	ml/sm /	m			
7.0	S-3	40 16 16 16	0.5'	25 / -	gw /	d/m			
9.0	S-4	12 12 12 12	1.0'	50 / -	SM /	M			
11.0	S-5	12 11 12 12	1.3'	65 / -	sm /	m		10.5 / 376.5 Silty fine sand; trace gravel; gray brown (colluvium)	Moderate drilling 4.5' - 18.5'
13.0	S-6	11 12 17 19	1.3'	65 / -	sm /	m			
13.5									
15.5	S-7	11 12 11 11	0.0'	0 / -	- /	-			
17.5	S-8	10 10 10 10	0.0'	0 / -	- /	-			Low recovery samples S-7, S-8; soil cuttings; silty fine sand; trace gravel; gray brown
18.5								18.5 / 368.5	
20.0	S-9	3 2 2	1.8'	120 / -	SM /	M		Silty sand; some gravel; gray brown, orange brown (saprolitic/weathered limestone)	Easy drilling 18.5' - 20.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. **B-5**
SHEET **2** OF **2**
DATE: START **2/26/20**
END **2/26/20**
SURFACE ELEV. (FT) **387.0**

PROJECT NAME **1 Malin Road**
PROJECT LOCATION **East Whiteland Township, Chester County, PA**
PROJECT NUMBER **32546.00**
INSPECTOR NAME **M. Friedrichsen**
EQUIPMENT USED **Mobile Drill B-57 powered cathead w/ safety hammer**
DRILLER NAME/COMPANY **W. Corcoran/Main Line Drilling Company, Inc.**
DRILLING METHODS **2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter**
AUGER: SIZE: **3.25" ID HSA** ; AUGER DEPTH: **20.5'** ; WATER: DEPTH: **14.0'** TIME: **0.25 hrs.** DATE: **2/26/2020**
CHECKED BY: **P. Neumann** ; DATE: **5/15/2020** DEPTH: **14.0'** TIME: **24.00 hrs.** DATE: **2/27/2020**
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
		50/0"						20.5 / 366.5	Hard drilling 20.0' - 20.5' Auger refusal and end of boring at 20.5'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

BORING NO.	B-6
SHEET	1 OF 2
DATE: START	2/27/20
END	2/27/20
SURFACE ELEV. (FT)	400.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 25.0' ; WATER: DEPTH: 6.0' TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 10.0' TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
							0.3 Asphalt (3") 399.7	
1.0							Subbase stone (9") 1.0 399.0	Possible perched water within subbase stone/FILL
	S-1	5 5 6 7	1.1'	55 -	ml/sm	m	Sandy silt; trace gravel; gray brown (FILL) 2.5 397.5	Easy drilling 0.0' - 25.0'
3.0	S-2	5 5 6 8	1.2'	60 -	ml/sm	m/w	Sandy silt to silty fine sand; trace gravel; red brown, orange brown	
5.0	S-3	7 7 7 7	1.0'	50 -	sm	m		
7.0	S-4	7 8 9 11	1.3'	65 -	sm	m		
9.0	S-5	10 10 9 9	1.2'	60 -	sm	m		
11.0								
13.5							13.5 386.5	
	S-6	6 7 8	1.1'	73 -	SM	M	Silty sand; trace gravel; orange brown, dark gray (saprolitic limestone)	
15.0								
18.5								Wet collapse at 16.5'
	S-7	5 6 8	1.3'	87 -	sm	m		
20.0								

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO. B-6
SHEET 2 OF 2
DATE: START 2/27/20
END 2/27/20
SURFACE ELEV. (FT) 400.0

PROJECT NAME 1 Malin Road
PROJECT LOCATION East Whiteland Township, Chester County, PA
PROJECT NUMBER 32546.00
INSPECTOR NAME M. Friedrichsen
EQUIPMENT USED Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 25.0' ; WATER: DEPTH: 6.0' TIME: 0.25 hrs. DATE: 2/27/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 10.0' TIME: 24.00 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								Silty sand; trace gravel; orange brown, dark gray (saprolitic limestone) *(continued)*	
23.5									
	S-8	11 9 8	1.5'	100 -	sm	m			
25.0								25.0 / 375.0	End of boring at 25.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-7
SHEET	1 OF 1
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 13.5' ; WATER: DEPTH: 2.0' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 0.0' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
0.0	S-1	21 11 10 10	0.9'	45 / -	sm/gm /	d/m		0.5 / 386.5 Gravel (6")	Chemical odors at surface and sample S-1
								Silty sand; trace to some gravel; orange brown, gray brown (FILL)	Easy drilling 0.0' - 12.5'
2.0	S-2	8 6 6 6	1.3'	65 / -	sm /	m/w		2.5 / 384.5 Silty sand; trace gravel; dark brown, dark gray, gray brown (saprolitic limestone)	Possible perched water within subbase stone/FILL
4.0	S-3	6 6 6 5	1.3'	65 / -	sm /	m			
6.0	S-4	3 2 2 3	0.9'	45 / -	SM /	M			
8.0	S-5	3 4 4 5	0.8'	40 / -	sm /	m			
10.0								12.5 / 374.5 Sandy gravel; gray (weathered limestone)	Hard drilling 12.5' - 13.5'
								13.5 / 373.5	Auger refusal and end of boring at 13.5'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-8
SHEET	1 OF 1
DATE: START	2/26/20
END	2/26/20
SURFACE ELEV. (FT)	387.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 19.0' ; WATER: DEPTH: 11.0' TIME: 0.25 hrs. DATE: 2/26/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 10.5' TIME: 24.00 hrs. DATE: 2/27/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	DESCRIPTION (DEPTH – ELEVATION)	REMARKS
0.0	S-1	20 28 5 5	0.3'	15 / -	gm /	d/m	0.2 – 386.8: Cold patch asphalt (2")	
							Gravel (10") 1.0 – 386.0	Easy to moderate drilling 0.0' - 7.5'
							Sandy silt; trace to some gravel; orange brown (FILL)	Existing FILL possibly reworked site soils
2.0	S-2	5 7 9 14	1.4'	70 / -	ML /	M		
4.0	S-3	11 14 17 17	1.5'	75 / -	sm /	m		
6.0	S-4	15 14 14 14	1.0'	50 / -	sm /	m	7.5 – 379.5: Sandy silt to silty fine sand; trace gravel; orange brown, gray brown	Easy drilling 7.5' - 19.0'
8.0	S-5	10 8 10 6	1.3'	65 / -	sm /	m/w	9.0 – 378.0: Silty sand; dark gray, gray brown (saprolitic limestone)	
10.0	S-6	5 3 3 5	1.2'	60 / -	sm /	m/w		
12.0								
13.5	S-7	2 1 1 2	1.5'	75 / -	SM /	M		
15.5	S-8	2 2 3 4	1.2'	60 / -	SM /	M		
17.5								
18.5								
19.0	S-9	2 50/0"	0.5'	100	sm /	w	19.0 – 368.0	Spoon refusal at 19.0'
								Auger refusal and end of boring at 19.0'

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
Geotechnical Engineers & Geologists

BORING LOG

BORING NO.	B-9
SHEET	1 OF 2
DATE: START	2/28/20
END	2/28/20
SURFACE ELEV. (FT)	400.0

PROJECT NAME: 1 Malin Road
PROJECT LOCATION: East Whiteland Township, Chester County, PA
PROJECT NUMBER: 32546.00
INSPECTOR NAME: M. Friedrichsen
EQUIPMENT USED: Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY: W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS: 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 30.0' ; WATER: DEPTH: 12.0' TIME: 0.25 hrs. DATE: 2/28/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 12.0' TIME: 0.50 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								0.3 Asphalt (3") — 399.7	
								Gravel (9") — 1.0 — 399.0	
1.0	S-1	5 8 5 9	1.2'	60 / -	sm	m		Sandy silt, little clay and silty fine sand; trace to some gravel; red brown, orange brown, gray brown, yellow brown	Easy drilling 0.0' - 30.0'
3.0	S-2	8 9 11 12	1.3'	65 / -	ml/sm	m			
5.0	S-3	10 10 10 9	1.3'	65 / -	ML	M			
7.0	S-4	6 5 5 6	1.0'	50 / -	sm	m/w			
9.0	S-5	6 6 7 8	1.5'	75 / -	ml/sm	m			
11.0								12.0 — 388.0	
								Silty sand; trace gravel; gray brown, dark gray brown (saprolitic limestone)	
13.5	S-6	6 6 7	1.3'	87 / -	SM	M			
15.0									
18.5	S-7	3 4 5	1.4'	93 / -	sm	m			
20.0									

** D = DRY, M = MOIST, W = WET

EARTH ENGINEERING INCORPORATED
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BORING LOG

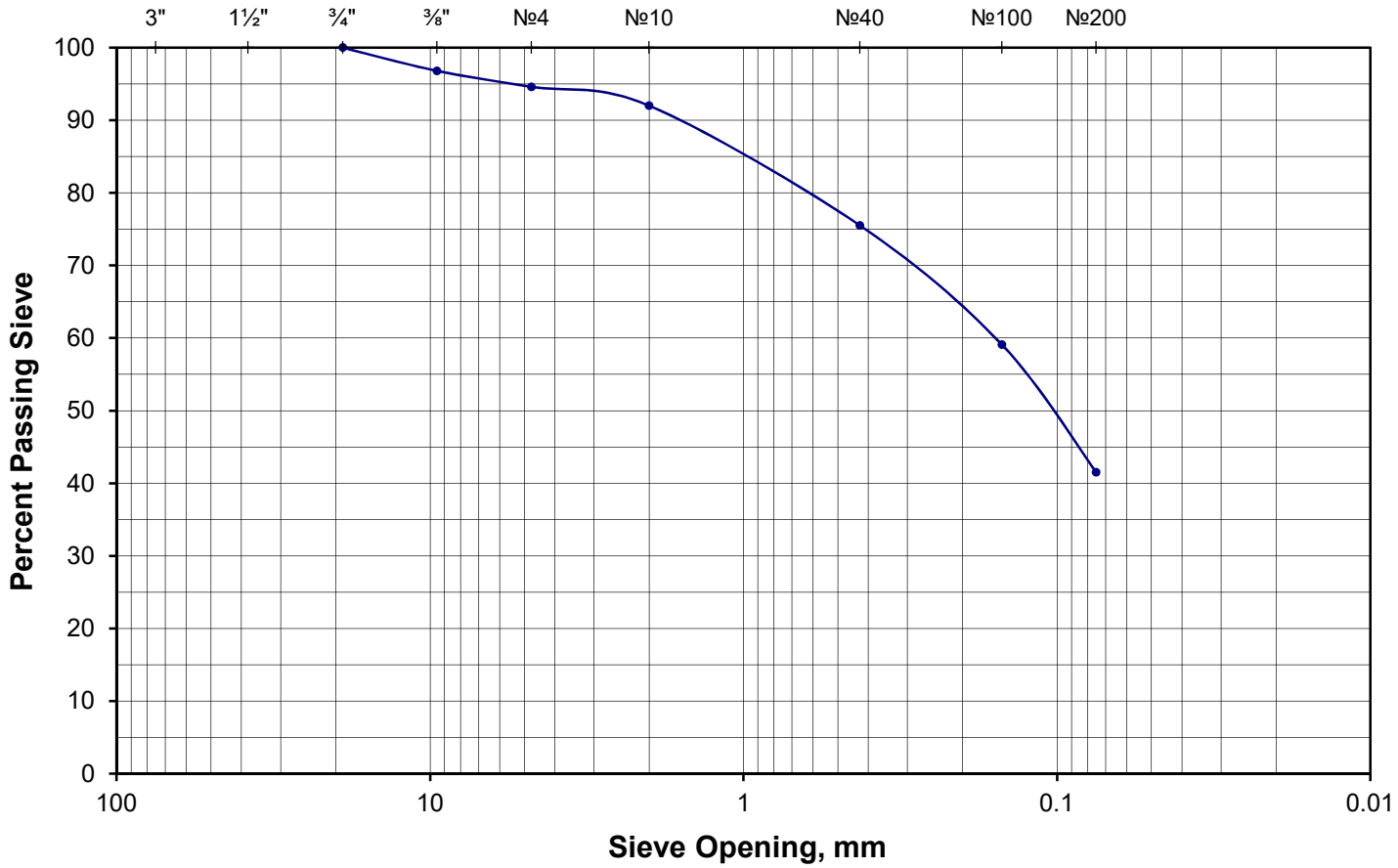
BORING NO. B-9
SHEET 2 OF 2
DATE: START 2/28/20
END 2/28/20
SURFACE ELEV. (FT) 400.0

PROJECT NAME 1 Malin Road
PROJECT LOCATION East Whiteland Township, Chester County, PA
PROJECT NUMBER 32546.00
INSPECTOR NAME M. Friedrichsen
EQUIPMENT USED Mobile Drill B-57 powered cathead w/ safety hammer
DRILLER NAME/COMPANY W. Corcoran/Main Line Drilling Company, Inc.
DRILLING METHODS 2" Continuous Split spoon Sampling 0.0' - 10.0'; 5' intervals thereafter
AUGER: SIZE: 3.25" ID HSA ; AUGER DEPTH: 30.0' ; WATER: DEPTH: 12.0' TIME: 0.25 hrs. DATE: 2/28/2020
CHECKED BY: P. Neumann ; DATE: 5/15/2020 DEPTH: 12.0' TIME: 0.50 hrs. DATE: 2/28/2020
NOT ENCOUNTERED ☐

DEPTH (FT)	SAMPLE NO./ TYPE/CORE RUN	BLOWS/0.5 FT. ON SAMPLER	RECOVERY (Ft.)	RECOVERY(%) / RQD (%)	USCS / AASHTO	H_2O CONTENT	GRAPHIC LOG	DESCRIPTION (DEPTH / ELEVATION)	REMARKS
								Silty sand; trace gravel; gray brown, dark gray brown (saprolitic limestone) *(continued)*	
23.5									
	S-8	3 3 4	1.3'	87 / -	sm /	m			
25.0									
28.5									
	S-9	4 6 10	1.4'	93 / -	sm /	m/w			
30.0								30.0 / 370.0	
									End of boring at 30.0'

** D = DRY, M = MOIST, W = WET

Particle Size Analysis of Soils



As-rec'd water content: 25.2 moist	**Odor:** NR			Particle Size			
% Gravel: 5.4	**Coarse:** 0.0	**Fine:** 5.4		US Standard Sieve Size		Diameter,	% Finer
% Sand: 53.1	**Coarse:** 2.6	**Medium:** 16.5	**Fine:** 34.0	GRAVEL	Coarse	3"	75
Gravel description: light gray-brown, and gray, subangular to subrounded with flat pieces						1½"	38.1
						¾"	19.0	100.0
Sand description: light gray-brown, with brown, subangular					Fine	⅜"	9.5	96.8
						№ 4	4.75	94.6
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	92.0
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	75.5
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	59.1
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	41.5
USCS Classification: SM, silty sand				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-1, S-3 (5-5-4-4) & S-4 (5-5-6-6)							
Depth: 5.0'- 7.0' & 7.0'- 9.0'							
Description: Brown silty sand							
Remarks:							

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Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 15, 2020***

Particle Size Analysis of Soils

As-rec'd water content: 18.5 moist		**Odor:** NR			Particle Size			
% Gravel: 14.4	**Coarse:** 0.0	**Fine:** 14.4			US Standard Sieve Size		Diameter,	% Finer
% Sand: 47.7	**Coarse:** 9.1	**Medium:** 15.6	**Fine:** 23.0		GRAVEL	Coarse	3"	75
Gravel description: brown, subangular							1½"	38.1
							¾"	19.0	100.0
Sand description: brown, subangular						Fine	⅜"	9.5	95.1
							№ 4	4.75	85.6
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	76.5
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	60.9
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	48.9
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	37.9
USCS Classification: SM, silty sand					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures									
Sample: B-3, S-5 (6-6-6-7)									
Depth: 9.0'- 11.0'									
Description: Orange-brown silty sand									
Remarks:									

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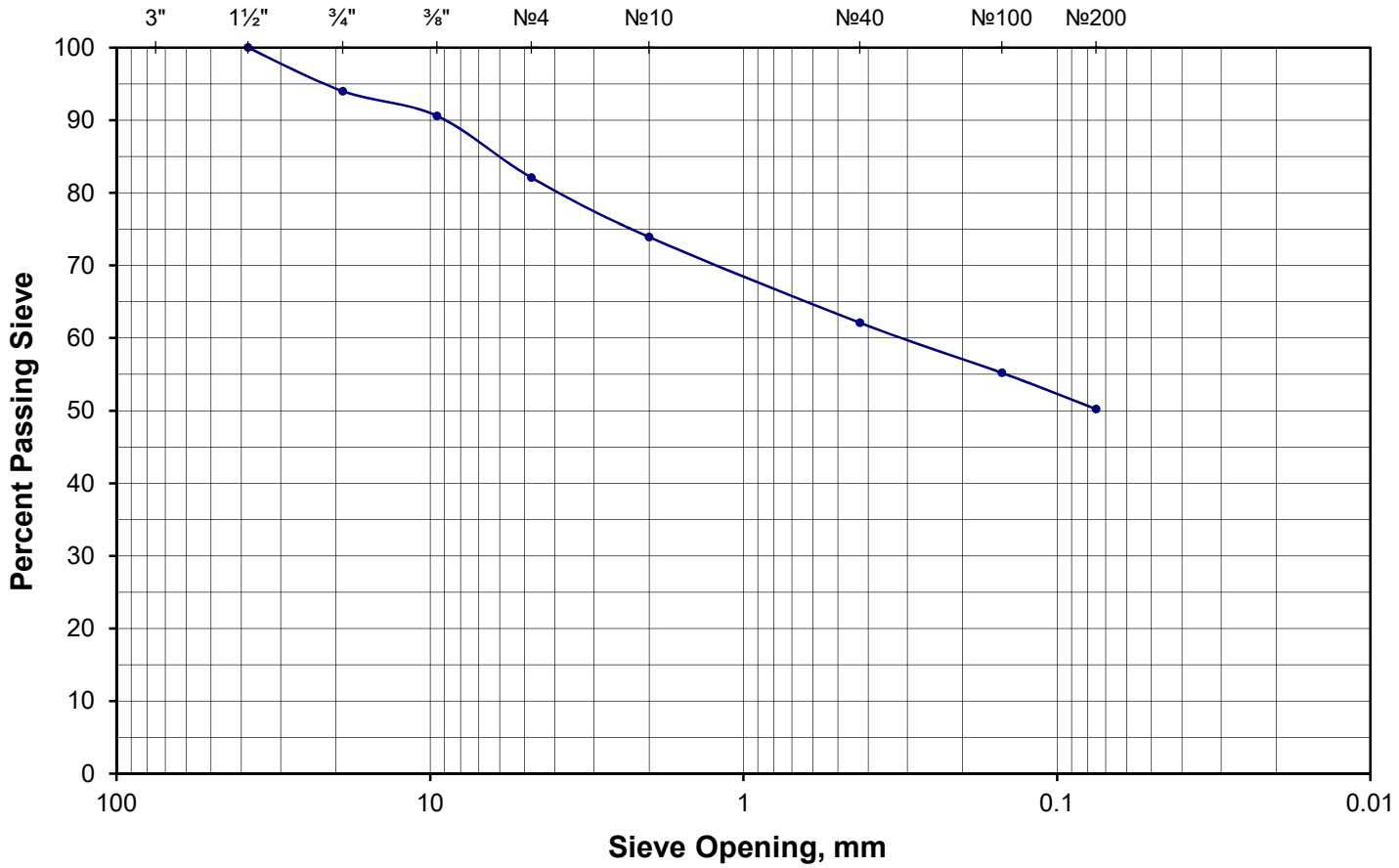
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 12.9 moist		**Odor:** NR			Particle Size			
% Gravel: 17.9	**Coarse:** 6.0	**Fine:** 11.9			US Standard Sieve Size		Diameter,	% Finer
% Sand: 31.9	**Coarse:** 8.2	**Medium:** 11.8	**Fine:** 11.9		GRAVEL	Coarse	3"	75
Gravel description: brown, subangular							1½"	38.1	100.0
							¾"	19.0	94.0
Sand description: brown, subangular						Fine	⅜"	9.5	90.6
							№ 4	4.75	82.1
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	73.9
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	62.1
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	55.2
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	50.2
USCS Classification: **ML, sandy silt with gravel**					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: **A-4**							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures									
Sample: B-4, S-1 (5-10-11-14) & S-2 (15-1-17-19)									
Depth: 1.0'- 3.0' & 3.0'- 5.0'									
Description: Orange-brown sandy silt with gravel									
Remarks:									

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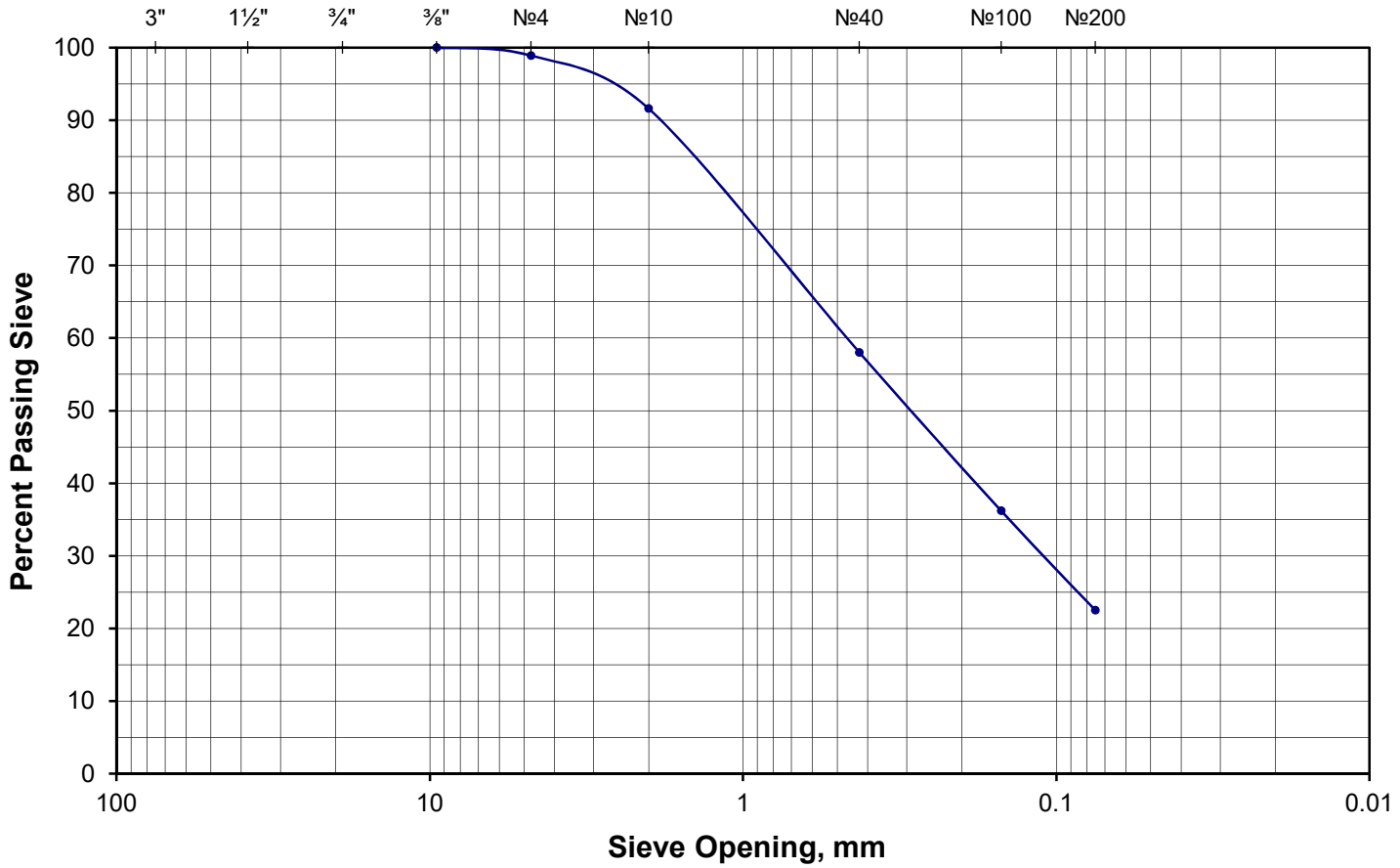
Lehigh Valley 610-967-4540

Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 17.3 moist		**Odor:** NR		Particle Size			
% Gravel: 1.1	**Coarse:** 0.0	**Fine:** 1.1		US Standard Sieve Size		Diameter,	% Finer
% Sand: 76.4	**Coarse:** 7.3	**Medium:** 33.6	**Fine:** 35.5	GRAVEL	Coarse	3"	75
Gravel description: brown, subangular						1½"	38.1
						¾"	19.0
Sand description: brown, subangular					Fine	⅜"	9.5	100.0
						№ 4	4.75	98.9
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	91.6
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	58.0
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	36.2
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	22.5
USCS Classification: SM, silty sand				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-2-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-4, S-7 (2-2-2-12)							
Depth: 18.5'- 20.5'							
Description: Brown to dark brown silty sand							
Remarks:							

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Geotechnical Engineers & Geologists

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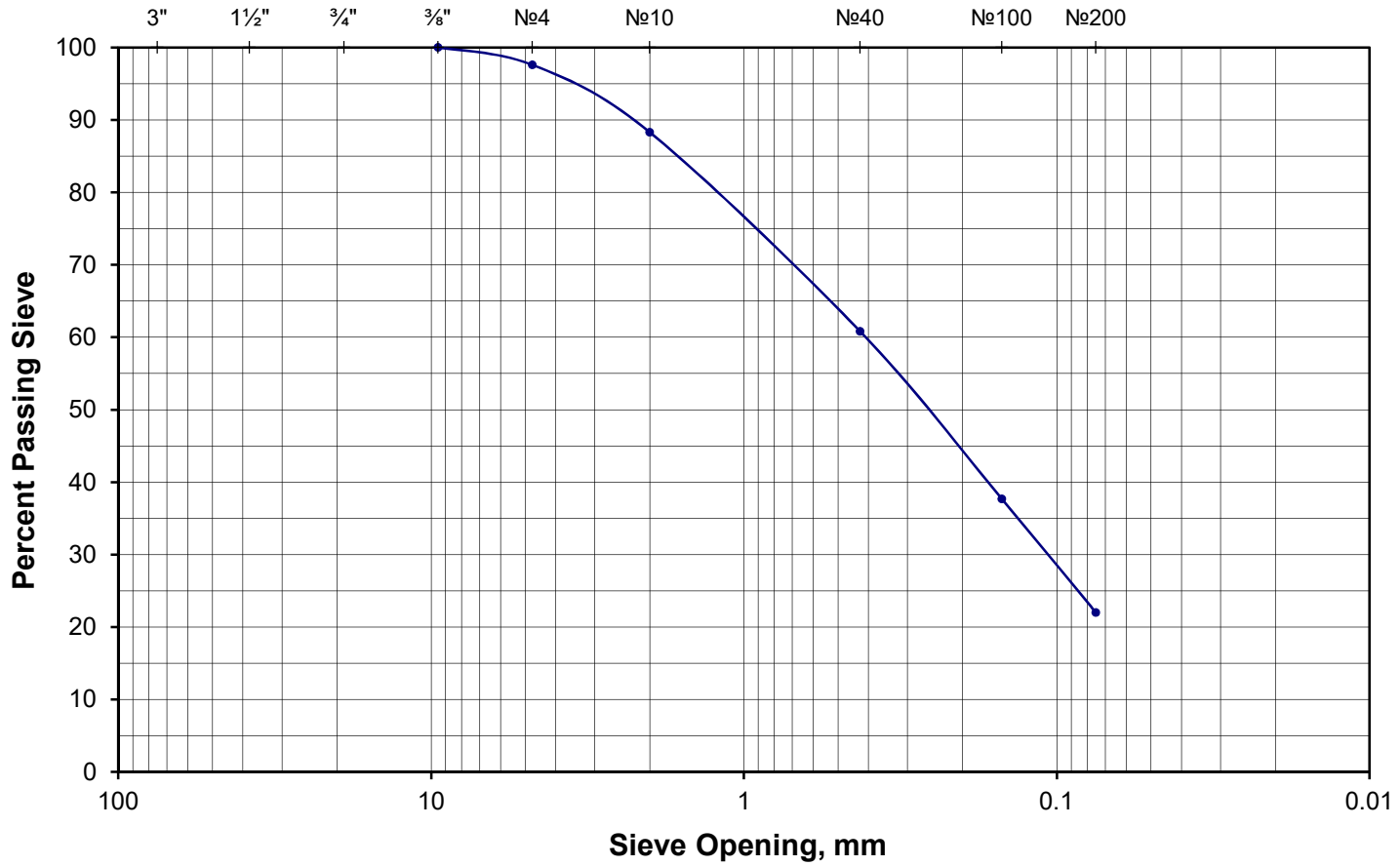
Central PA 717-697-5701
Lehigh Valley 610-967-4540

Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 19.5 moist		**Odor:** NR			Particle Size			
% Gravel: 2.4	**Coarse:** 0.0	**Fine:** 2.4			US Standard Sieve Size		Diameter,	% Finer
% Sand: 75.6	**Coarse:** 9.3	**Medium:** 27.5	**Fine:** 38.8		GRAVEL	Coarse	3"	75
Gravel description: brown, subangular							1½"	38.1
							¾"	19.0
Sand description: brown, subangular						Fine	⅜"	9.5	100.0
							№ 4	4.75	97.6
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	88.3
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	60.8
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	37.7
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	22.0
USCS Classification: SM, silty sand					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-2-4							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures					EARTH ENGINEERING INCORPORATED				
Sample: B-5, S-9 (3-2-2-50/0)									
Depth: 18.5'- 20.0'					*Geotechnical Engineers & Geologists*				
Description: Brown to dark brown silty sand					115 W Germantown Pk East Norriton, PA 19401 *tel* 610-277-0880 *fax* 610-277-0878				
Remarks:									

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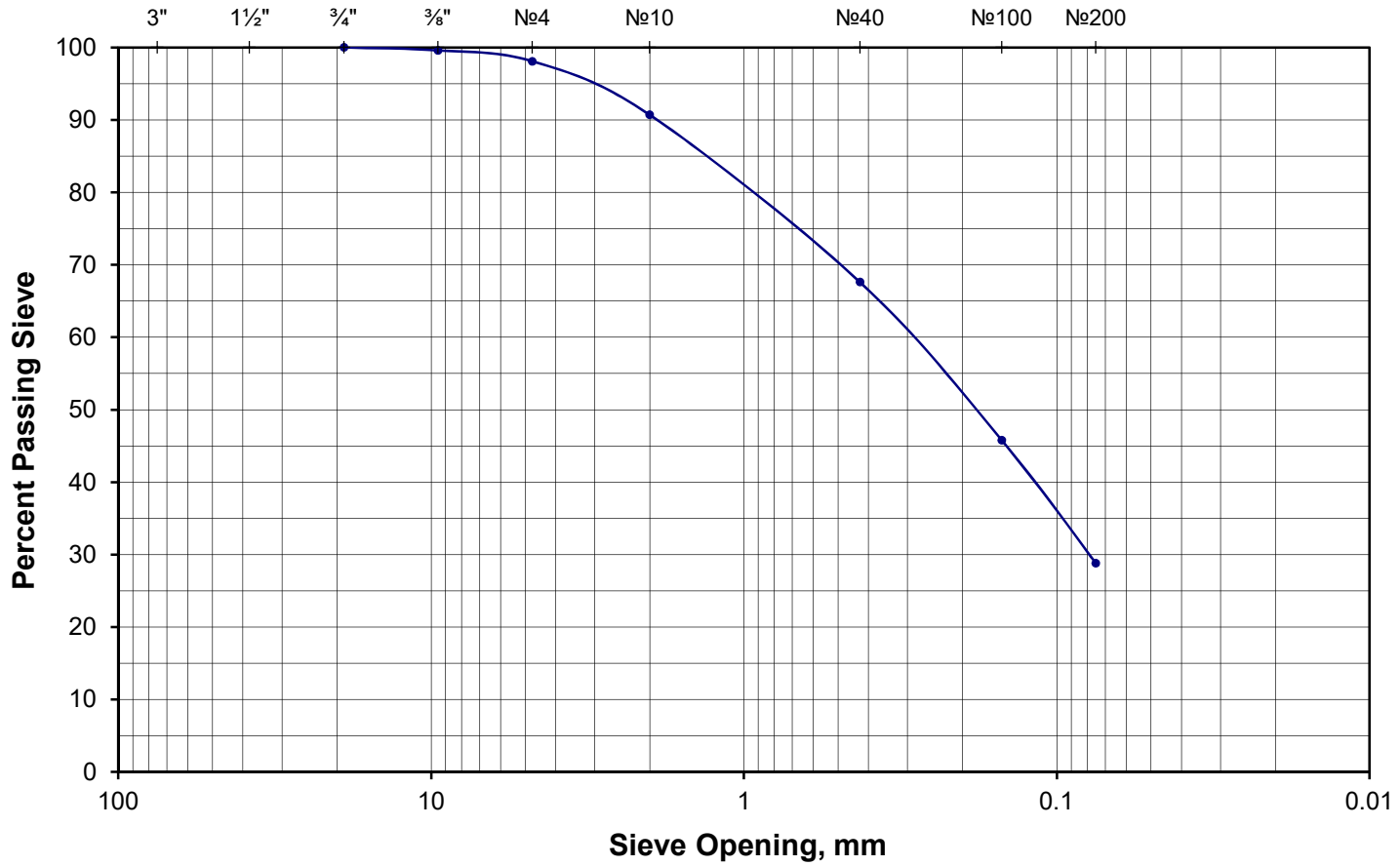
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 16.6 moist		**Odor:** NR			Particle Size			
% Gravel: 1.9	**Coarse:** 0.0	**Fine:** 1.9			US Standard Sieve Size		Diameter,	% Finer
% Sand: 69.3	**Coarse:** 7.4	**Medium:** 23.1	**Fine:** 38.8		GRAVEL	Coarse	3"	75
Gravel description: brown, subangular							1½"	38.1
							¾"	19.0	100.0
Sand description: brown, subangular						Fine	⅜"	9.5	99.6
							№ 4	4.75	98.1
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	90.7
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	67.6
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	45.8
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	28.8
USCS Classification: SM, silty sand					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-2-4							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures					EARTH ENGINEERING INCORPORATED				
Sample: B-6, S-6 (6-7-8)									
Depth: 13.5'- 15.0'					*Geotechnical Engineers & Geologists*				
Description: Brown silty sand					115 W Germantown Pk East Norriton, PA 19401 *tel* 610-277-0880 *fax* 610-277-0878				
Remarks:									

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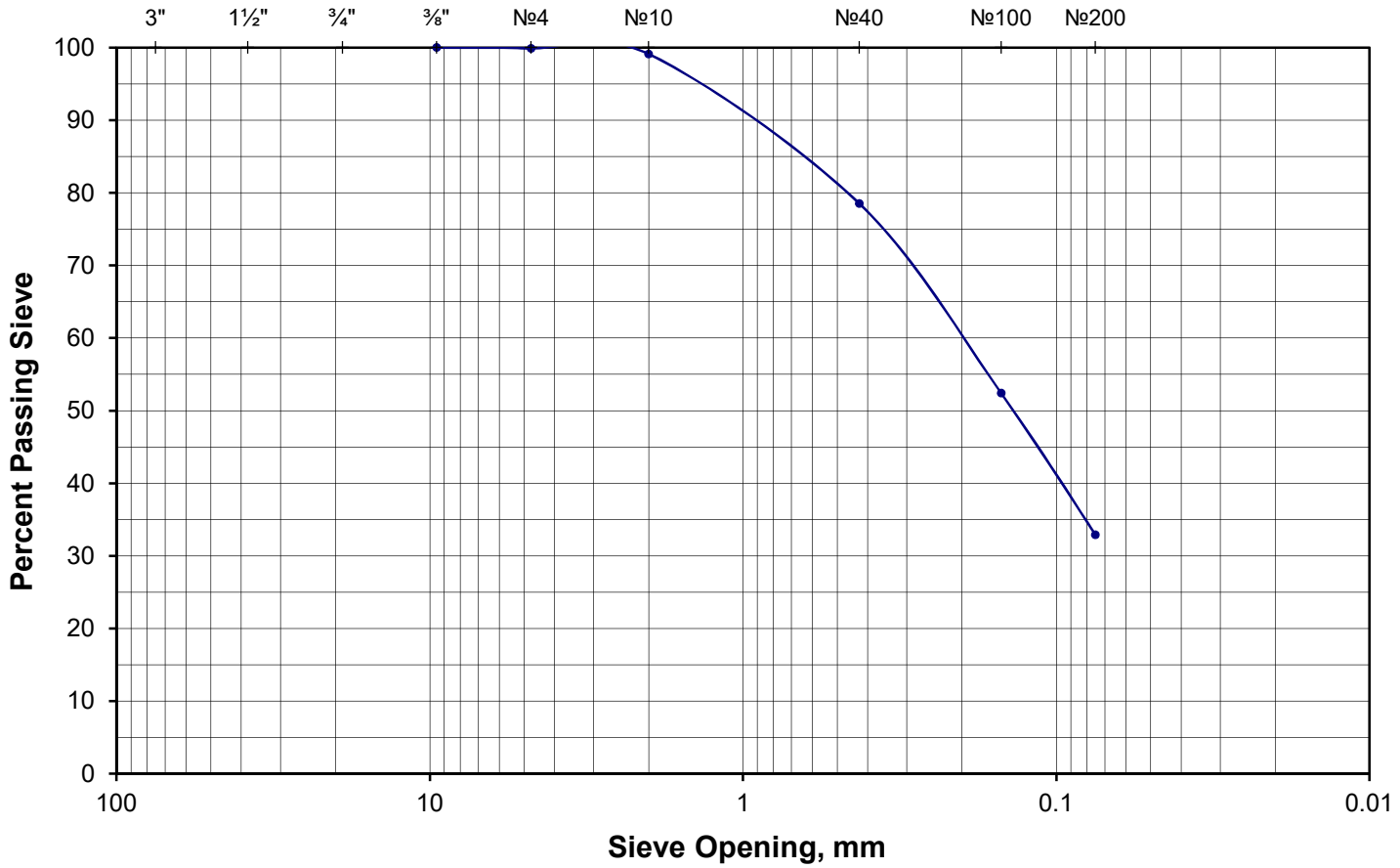
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 21.5 moist	**Odor:** NR			Particle Size			
% Gravel: 0.1	**Coarse:** 0.0	**Fine:** 0.1		US Standard Sieve Size		Diameter,	% Finer
% Sand: 67.0	**Coarse:** 0.8	**Medium:** 20.6	**Fine:** 45.6	GRAVEL	Coarse	3"	75
Gravel description: gray-brown, subangular						1½"	38.1
						¾"	19.0
Sand description: gray-brown, subangular					Fine	⅜"	9.5	100.0
						№ 4	4.75	99.9
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	99.1
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	78.5
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	52.4
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	32.9
USCS Classification: SM, silty sand				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-2-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-7, S-4 (3-2-2-3)							
Depth: 6.0'- 8.0'							
Description: Brown silty sand							
Remarks:							

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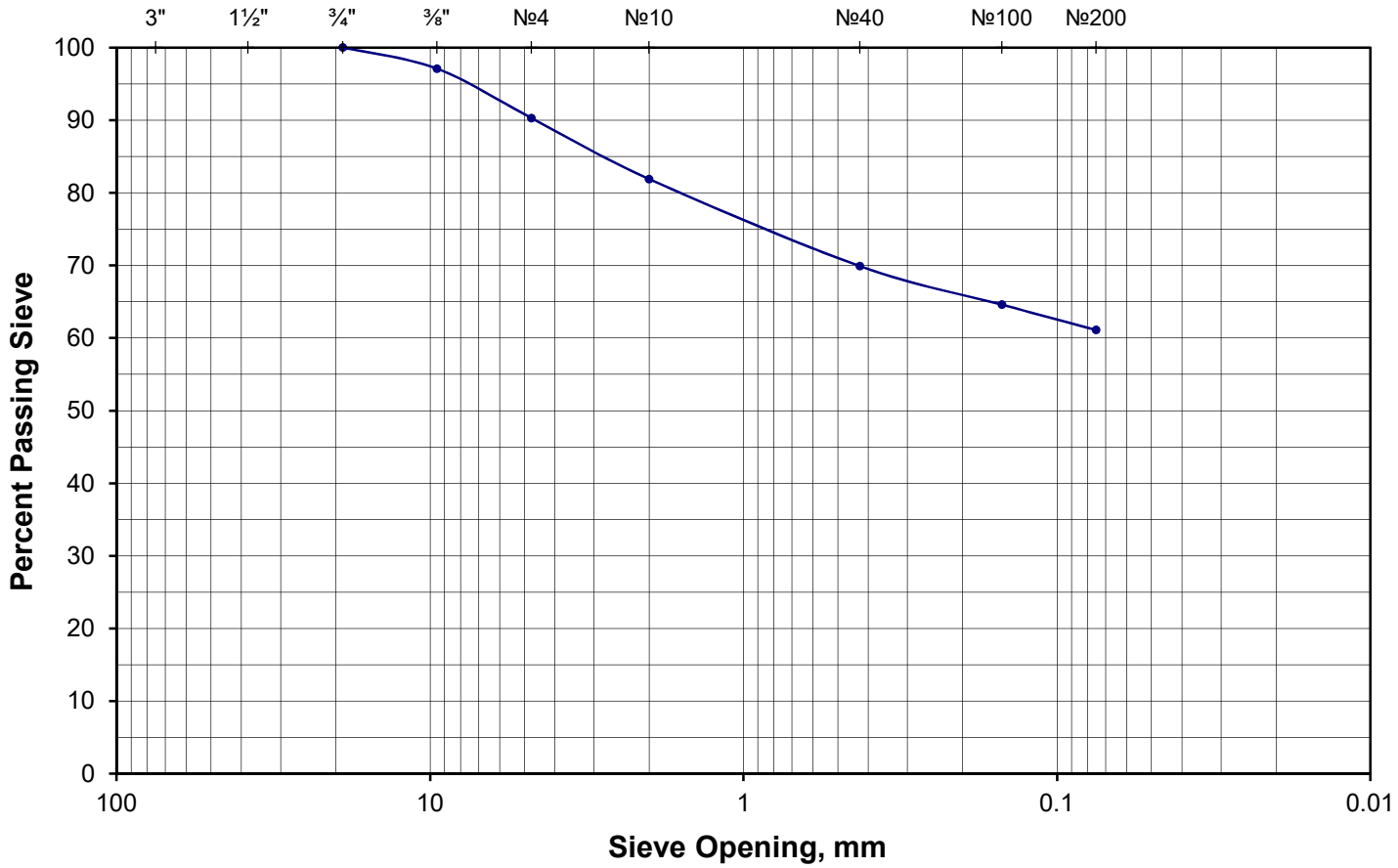
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 16.6 moist		**Odor:** NR			Particle Size			
% Gravel: 9.7	**Coarse:** 0.0	**Fine:** 9.7			US Standard Sieve Size		Diameter,	% Finer
% Sand: 29.2	**Coarse:** 8.4	**Medium:** 12.0	**Fine:** 8.8		GRAVEL	Coarse	3"	75
Gravel description: gray-brown, subangular							1½"	38.1
							¾"	19.0	100.0
Sand description: gray-brown, subangular						Fine	⅜"	9.5	97.1
							№ 4	4.75	90.3
Consistency: firm	**Hardness:** NR				SAND	Coarse	№ 10	2.00	81.9
Cementation: NR	**Dry Strength:** NR					Medium	№ 40	0.425	69.9
Structure: homogeneous	**Dilatency:** NR					Fine	№ 100	0.150	64.6
Reaction to HCl: NR	**Toughness:** NR						№ 200	0.075	61.1
USCS Classification: ML, sandy silt					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures									
Sample: B-8, S-2 (5-7-9-14)									
Depth: 2.0'- 4.0'									
Description: Gray-brown sandy silt									
Remarks:									

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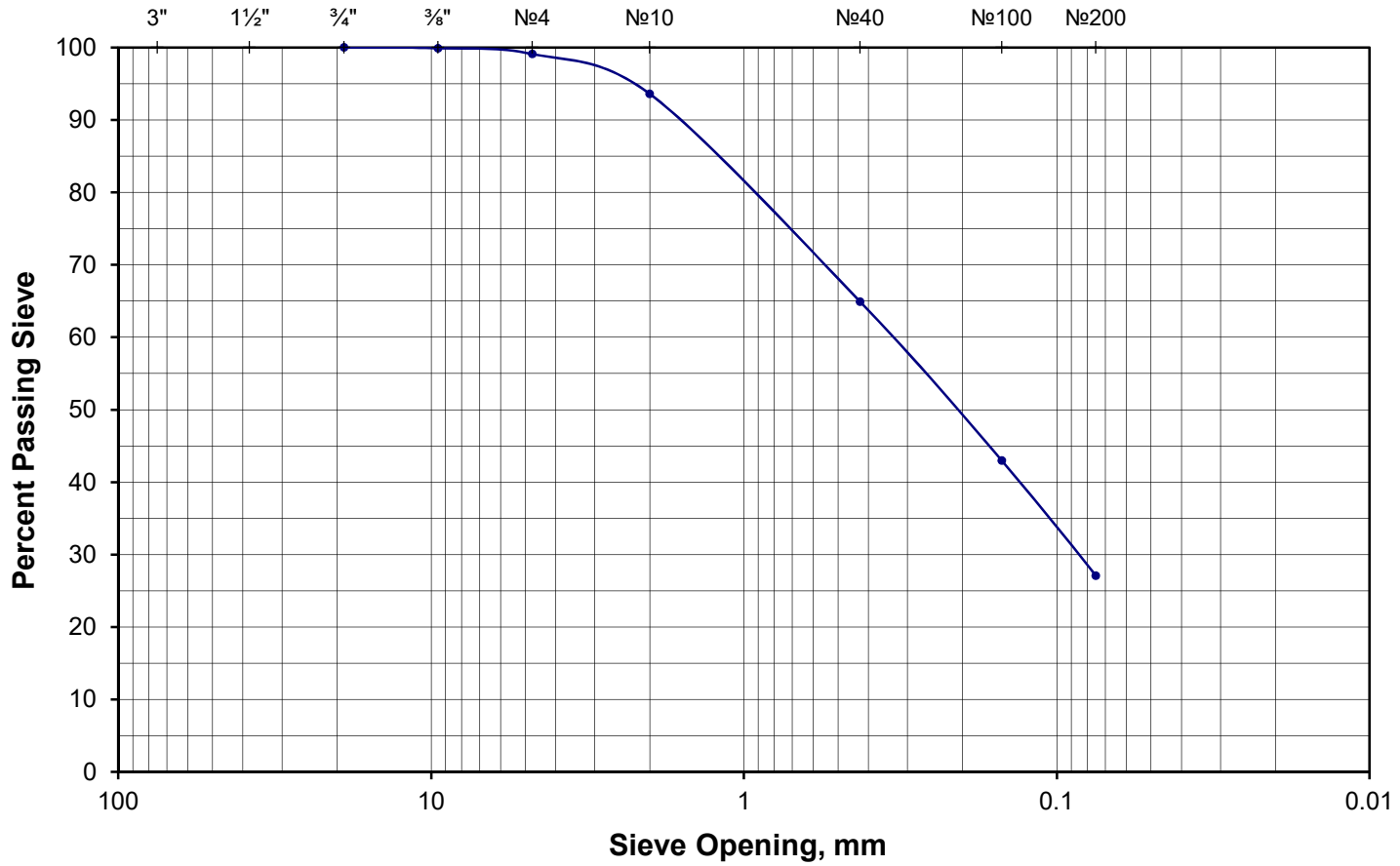
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 16.2 moist		**Odor:** NR		Particle Size			
% Gravel: 0.9	**Coarse:** 0.0	**Fine:** 0.9		US Standard Sieve Size		Diameter,	% Finer
% Sand: 72.0	**Coarse:** 5.5	**Medium:** 28.7	**Fine:** 37.8	GRAVEL	Coarse	3"	75
Gravel description: gray and orange-brown to brown, subangular with flat pieces						1½"	38.1
						¾"	19.0	100.0
Sand description: gray-brown, subangular					Fine	⅜"	9.5	99.9
						№ 4	4.75	99.1
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	93.6
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	64.9
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	43.0
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	27.1
USCS Classification: SM, silty sand				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-2-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-8, S-7 (2-1-1-2) & S-8 (2-2-3-4)							
Depth: 13.5- 15.5' & 15.5' - 17.5'							
Description: Dark brown silty sand							
Remarks:							

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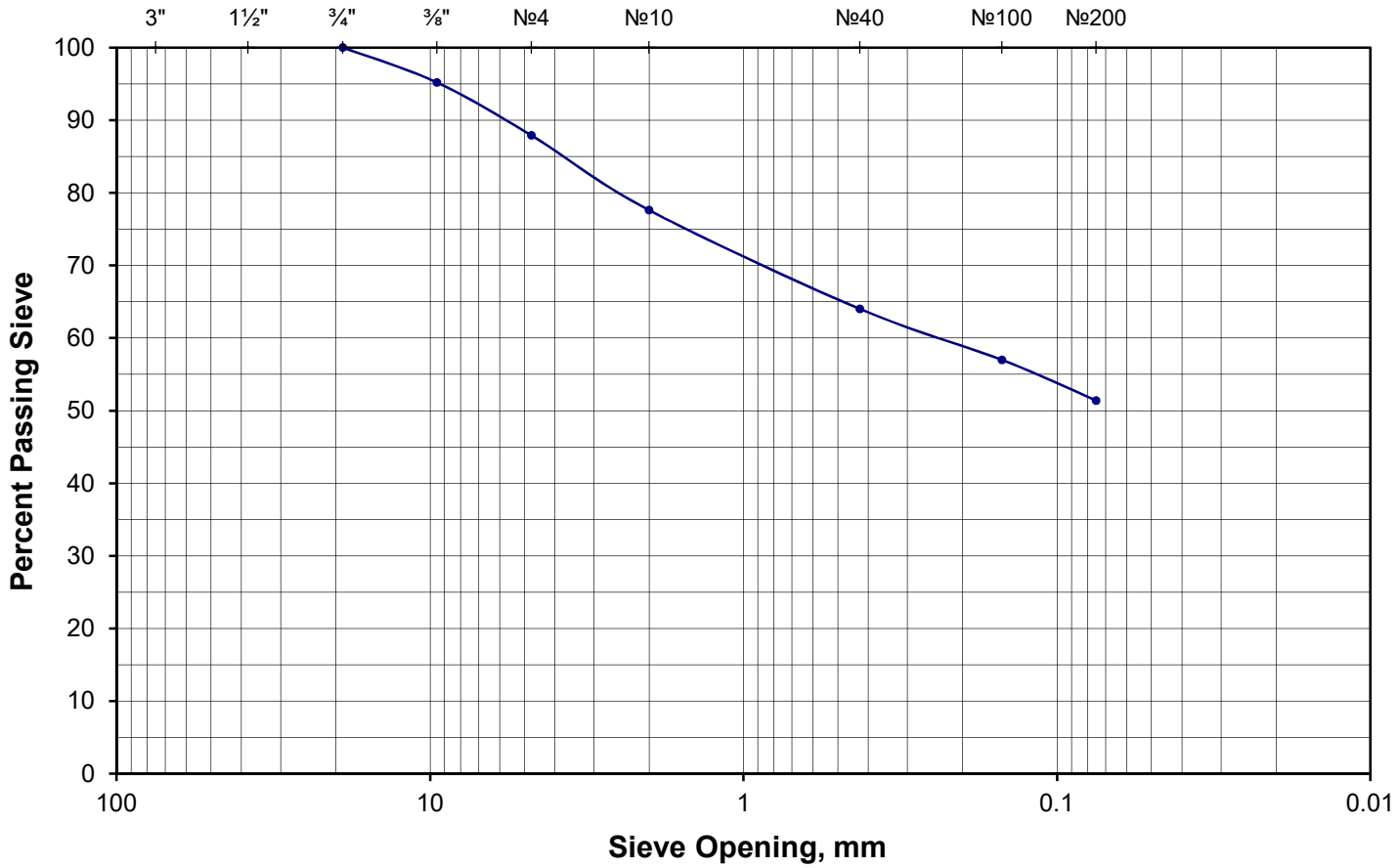
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 18.8 moist		**Odor:** NR		Particle Size			
% Gravel: 12.1	**Coarse:** 0.0	**Fine:** 12.1		US Standard Sieve Size		Diameter,	% Finer
% Sand: 36.5	**Coarse:** 10.3	**Medium:** 13.6	**Fine:** 12.6	GRAVEL	Coarse	3"	75
Gravel description: pale red-brown, subangular to subrounded						1½"	38.1
						¾"	19.0	100.0
Sand description: pale red-brown, subangular					Fine	⅜"	9.5	95.2
						№ 4	4.75	87.9
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	77.6
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	64.0
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	57.0
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	51.4
USCS Classification: ML, sandy silt				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-9, S-3 (10-10-10-9)							
Depth: 5.0'- 7.0'							
Description: Red-brown sandy silt							
Remarks:							

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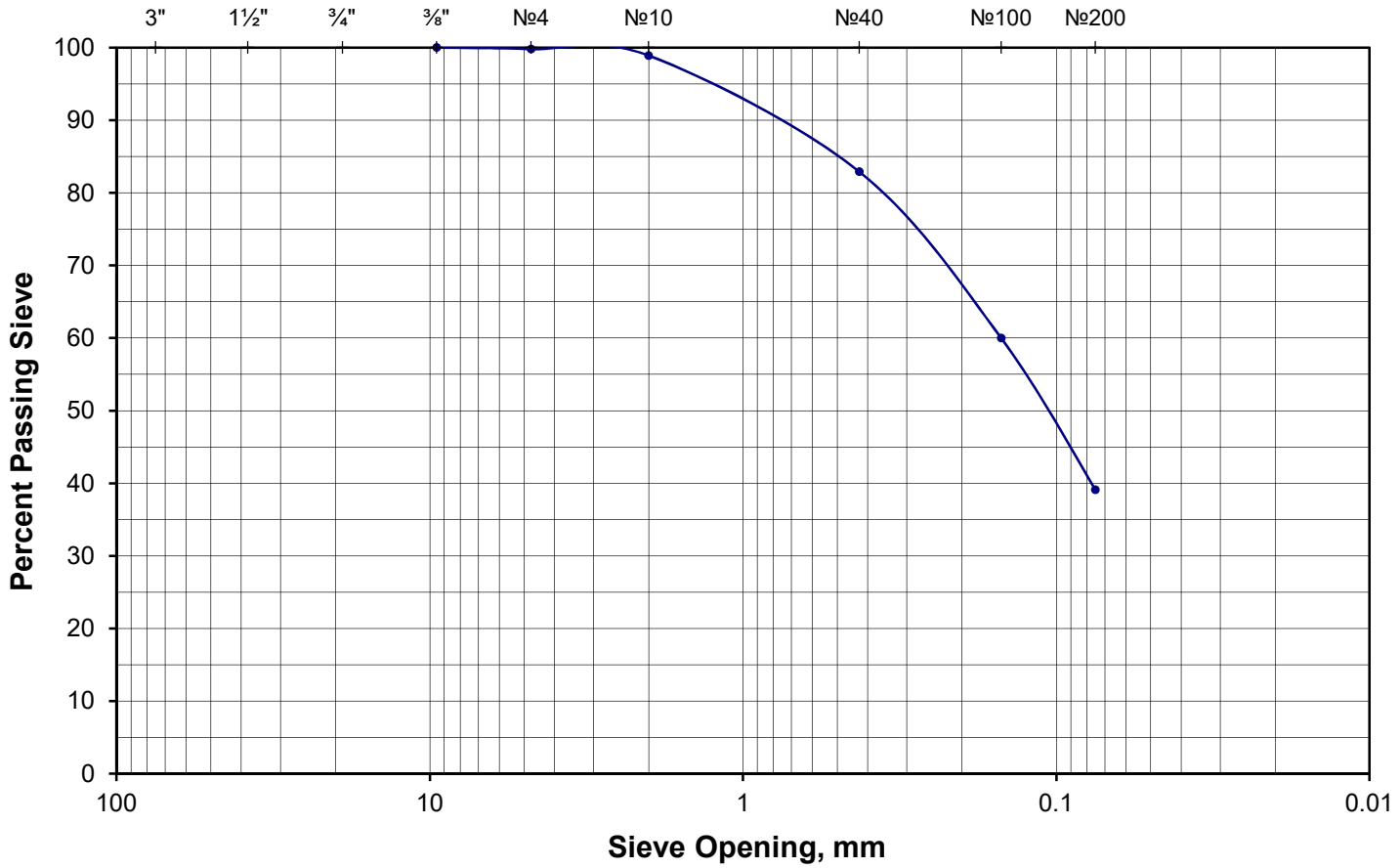
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 15, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 19.7 moist	**Odor:** NR		
% Gravel: 0.2	**Coarse:** 0.0	**Fine:** 0.2	
% Sand: 60.7	**Coarse:** 0.9	**Medium:** 16.0	**Fine:** 43.8
Gravel description: light brown and gray, subangular to subrounded with flat pieces			
Sand description: gray-brown, subangular			
Consistency: firm	**Hardness:** NR		
Cementation: NR	**Dry Strength:** NR		
Structure: homogeneous	**Dilatency:** NR		
Reaction to HCl: NR	**Toughness:** NR		
USCS Classification: **SM, silty sand**			
AASHTO Classification: **A-4**			

Particle Size				
US Standard Sieve Size			Diameter,	% Finer
GRAVEL	Coarse	3"	75	
		1½"	38.1	
		¾"	19.0	
	Fine	⅜"	9.5	100.0
		№ 4	4.75	99.8
SAND	Coarse	№ 10	2.00	98.9
	Medium	№ 40	0.425	82.9
	Fine	№ 100	0.150	60.0
		№ 200	0.075	39.1
Hydrometer Analysis		Clay Size	0.005	NR
		Colloids	0.001	NR

G_s: NR	C_u: N/A	C_c: N/A
LL: NP	**PL:** NP	**PI:** NP

Project: 32546.00 - Malin Road Development - Inv.

Client: MLP Ventures

Sample: B-9, S-6 (6-6-7)

Depth: 13.5'- 15.0'

Description: Brown silty sand

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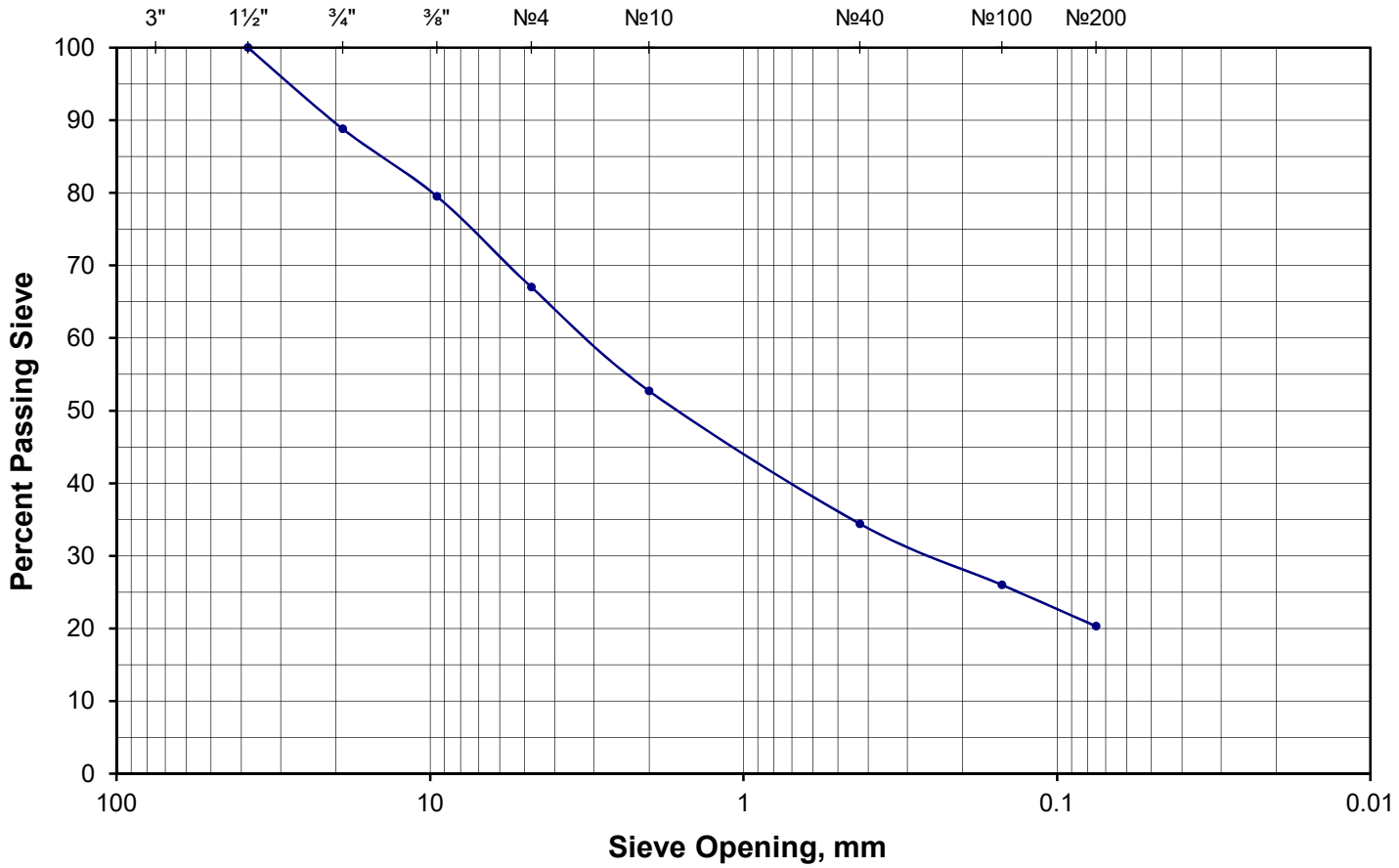
Remarks:

Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 16, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 10.9 moist	**Odor:** NR			Particle Size			
% Gravel: 33.0	**Coarse:** 11.2	**Fine:** 21.8		US Standard Sieve Size		Diameter,	% Finer
% Sand: 46.7	**Coarse:** 14.3	**Medium:** 18.3	**Fine:** 14.1	GRAVEL	Coarse	3"	75
Gravel description: gray to gray-brown, subangular with flat pieces						1½"	38.1	100.0
						¾"	19.0	88.8
Sand description: gray-brown, subangular					Fine	⅜"	9.5	79.5
						№ 4	4.75	67.0
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	52.7
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	34.4
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	26.0
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	20.3
USCS Classification: **SM, silty sand with gravel**				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: **A-1-b**						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures				EARTH ENGINEERING INCORPORATED				
Sample: B-10, S-6 (8-9-9)								
Depth: 13.5- 15.5'				*Geotechnical Engineers & Geologists*				
Description: Brown to orange-brown silty sand with gravel				115 W Germantown Pk East Norriton, PA 19401 *tel* 610-277-0880 *fax* 610-277-0878				
Remarks:								

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Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 15, 2020***

Particle Size Analysis of Soils

As-rec'd water content: 20.2 moist		**Odor:** NR		Particle Size			
% Gravel: 12.7	**Coarse:** 0.0	**Fine:** 12.7		US Standard Sieve Size		Diameter,	% Finer
% Sand: 35.1	**Coarse:** 9.8	**Medium:** 13.1	**Fine:** 12.2	GRAVEL	Coarse	3"	75
Gravel description: pale red-brown, with gray, subangular						1½"	38.1
						¾"	19.0	100.0
Sand description: pale red-brown, with gray, subangular					Fine	⅜"	9.5	96.3
						№ 4	4.75	87.3
Consistency: firm	**Hardness:** NR			SAND	Coarse	№ 10	2.00	77.5
Cementation: NR	**Dry Strength:** NR				Medium	№ 40	0.425	64.4
Structure: homogeneous	**Dilatency:** NR				Fine	№ 100	0.150	57.6
Reaction to HCl: NR	**Toughness:** NR					№ 200	0.075	52.2
USCS Classification: ML, sandy silt				Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4						Colloids	0.001	NR
				G_s: NR	C_u: N/A	C_c: N/A	
Project: 32546.00 - Malin Road Development - Inv.				**LL:** NP	**PL:** NP	**PI:** NP	
Client: MLP Ventures							
Sample: B-11A, S-1 (4-4-6-8)							
Depth: 4.0'- 6.0'							
Description: Red-brown sandy silt							
Remarks:							

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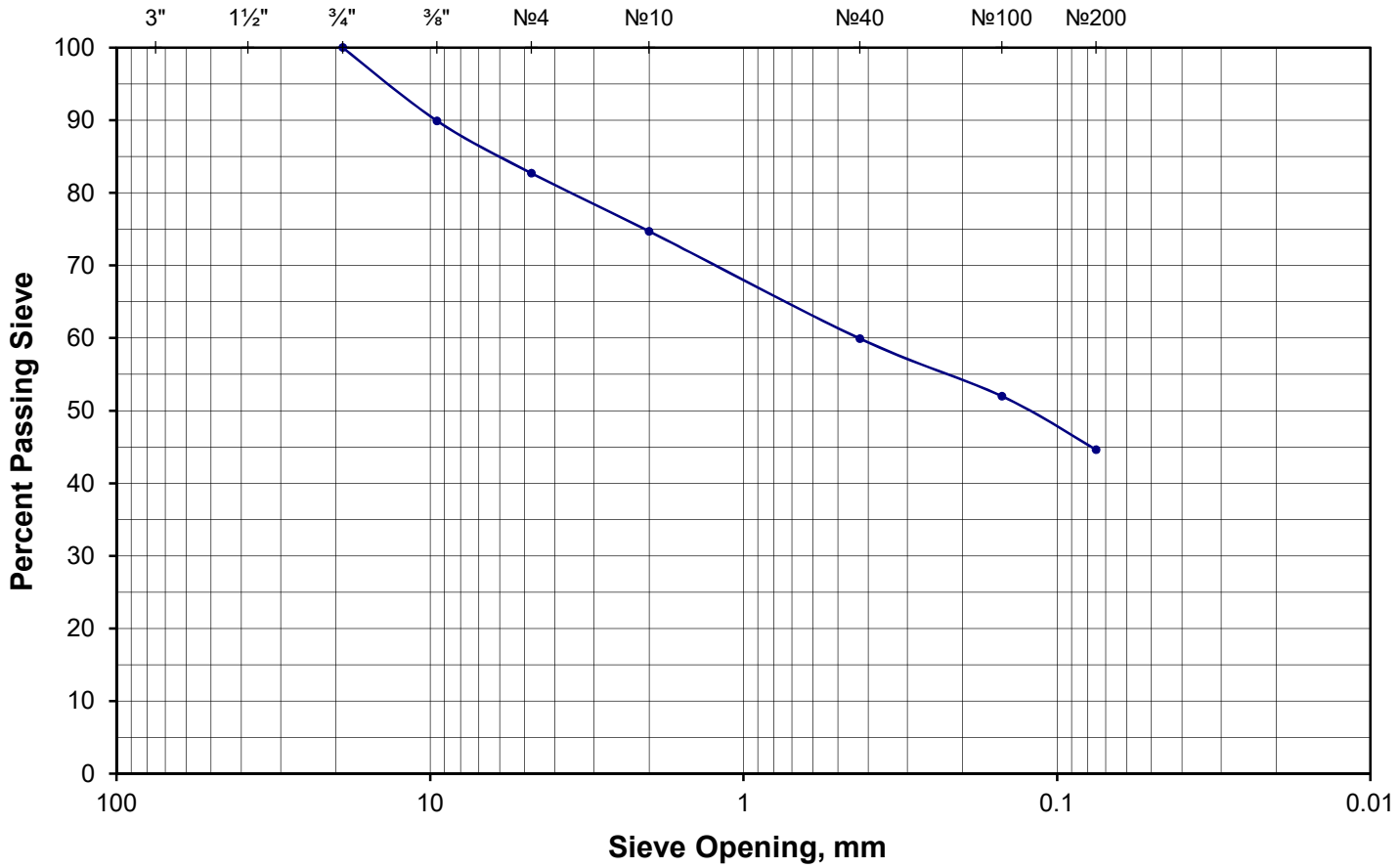
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 15, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 18.4 moist		**Odor:** NR			Particle Size			
% Gravel: 17.3	**Coarse:** 0.0	**Fine:** 17.3			US Standard Sieve Size		Diameter,	% Finer
% Sand: 38.1	**Coarse:** 8.0	**Medium:** 14.8	**Fine:** 15.3		GRAVEL	Coarse	3"	75
Gravel description: light gray-brown, with brown, subangular							1½"	38.1
							¾"	19.0	100.0
Sand description: light gray-brown, with brown, subangular						Fine	⅜"	9.5	89.9
							№ 4	4.75	82.7
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	74.7
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	59.9
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	52.0
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	44.6
USCS Classification: **SM, silty sand with gravel**					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: **A-4**							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures					EARTH ENGINEERING INCORPORATED				
Sample: B-18, S-2 (6-6-7-7)									
Depth: 2.0'- 4.0'					*Geotechnical Engineers & Geologists*				
Description: Brown silty sand with gravel					115 W Germantown Pk East Norriton, PA 19401 *tel* 610-277-0880 *fax* 610-277-0878				
Remarks:									

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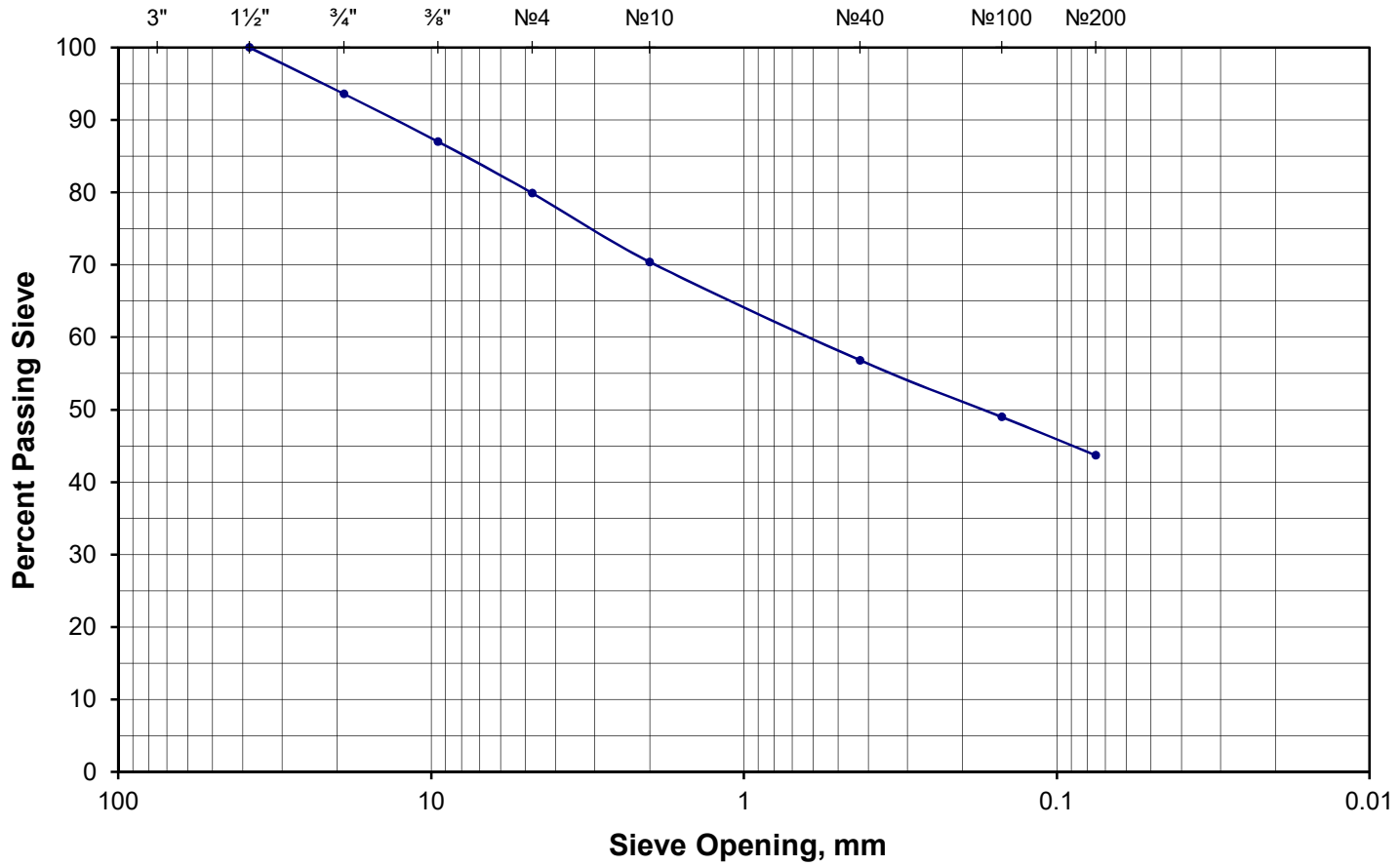
Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 15, 2020***

Particle Size Analysis of Soils



As-rec'd water content: 14.7 moist		**Odor:** NR			Particle Size			
% Gravel: 20.1	**Coarse:** 6.4	**Fine:** 13.7			US Standard Sieve Size		Diameter,	% Finer
% Sand: 36.2	**Coarse:** 9.5	**Medium:** 13.6	**Fine:** 13.1		GRAVEL	Coarse	3"	75
Gravel description: brown, subangular							1½"	38.1	100.0
							¾"	19.0	93.6
Sand description: brown, subangular						Fine	⅜"	9.5	87.0
							№ 4	4.75	79.9
Consistency: firm		**Hardness:** NR			SAND	Coarse	№ 10	2.00	70.4
Cementation: NR		**Dry Strength:** NR				Medium	№ 40	0.425	56.8
Structure: homogeneous		**Dilatency:** NR				Fine	№ 100	0.150	49.0
Reaction to HCl: NR		**Toughness:** NR					№ 200	0.075	43.7
USCS Classification: SM, silty sand with gravel					Hydrometer Analysis		Clay Size	0.005	NR
AASHTO Classification: A-4							Colloids	0.001	NR
					G_s: NR	C_u: N/A	C_c: N/A		
Project: 32546.00 - Malin Road Development - Inv.					**LL:** NP	**PL:** NP	**PI:** NP		
Client: MLP Ventures									
Sample: B-5, S-4 (12-12-12-12)									
Depth: 7.0'- 9.0'									
Description: Brown to orange brown silty sand with gravel									
Remarks:									

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Classification of Soils, ASTM D 2487-17 / D 2488-09a ***April 14, 2020***