Geotechnical Engineering Report

Lovettsville Park
Lovettsville, Virginia

May 2, 2018

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May 2, 2018

Mr. Robert E. Balinger
Loudoun County
Department of Transportation & Capital Infrastructure
101 Blue Seal Dr., SE, Suite 102
PO Box 7500
Leesburg, VA 20177-7500

Subject: Geotechnical Engineering Report
Lovettsville Park (Our JD185069)
Lovettsville, Loudoun County, Virginia

Dear Mr. Balinger:

GeoConcepts Engineering, Inc. (GeoConcepts) is pleased to present the following geotechnical engineering report prepared for Lovettsville Park in Lovettsville, Loudoun County, Virginia.

We appreciate the opportunity to serve as your geotechnical consultant on this project. Please do not hesitate to contact me if you have any questions or want to meet to discuss the findings and recommendations contained in the report.

Sincerely,

GEOCONCEPTS ENGINEERING, INC.

Amy Strobel, PG
Senior Associate
AStrobel@GeoConcepts-eng.com

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Table of Contents

1.0 Scope of Services

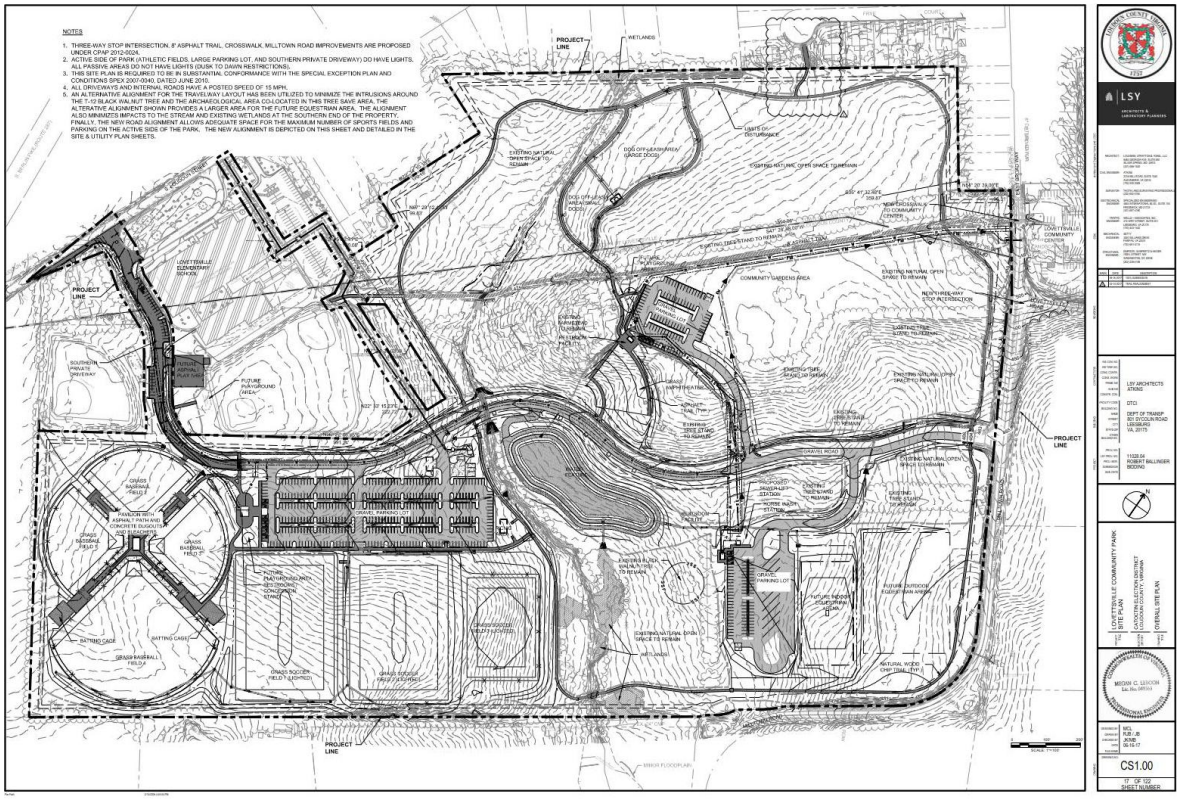
This geotechnical engineering report presents the results of the field investigation, soil laboratory testing, and engineering analysis of the geotechnical data. This report specifically addresses the following:

- An evaluation of subsurface conditions within the area of the proposed site development, including results of agronomic soil testing and recommendations.
- Earthwork recommendations for construction of loadbearing fills, including an assessment of on-site soils to be excavated for re-use as fill.
- Recommendations regarding rock excavation for the athletic fields.
- Recommendations regarding construction of the stormwater management pond, including embankment and outlet works foundation support, embankment fill construction, and internal seepage devices.

Services not specifically identified in the contract for this project are not included in the scope of services.

2.0 Site Description and Proposed Construction

The site is located at 57 East Broad Way in Lovettsville, Virginia. The site consists of undeveloped open fields and wooded areas. The elevation at the site ranges from approximately elevation (EL) 450 to EL 500, sloping down towards the middle of the site to an existing stream.



Based on plans provided to us by Loudoun County dated December 2017, the proposed construction consists of athletic fields, equestrian area, amphitheater, roadways, parking lots, multiple walking trails, and a wet pond. Specifically, this report addresses the construction of the proposed athletic fields and the wet pond near the center of the site.

3.0 Subsurface Conditions

Subsurface conditions were investigated by drilling a total of five Standard Penetration Test (SPT) borings in the proposed site development area. The SPT borings were completed by Northern Virginia Drilling of Manassas, Virginia under our observation on March 30, 2017 utilizing 2-¼ inch inside diameter hollow stem auger with automatic hammer. The sampler was advanced by driving the spoon into undisturbed soil under the impact of a 140-lbf hammer free-falling from 30 inches height per ASTM D1586-11. The borings were staked by a GeoConcepts representative in advance of our work. Test boring logs and a subsurface investigation plan are presented in Appendix A of this report.

3.1 Geology

The site lies within the Blue Ridge Physiographic Province of Virginia. The Blue Ridge Province is a generally mountainous upland extending from northeast to southwest, lying between the Piedmont Physiographic Province to the east and the Great Valley section of the Valley and Ridge Province to the west. The Blue Ridge Province is unusual in that it is defined based on the nature of the rocks underlying it, rather than any characteristic topography (in many places the eastern edge of the Blue Ridge Province is indistinguishable topographically from the adjacent western Piedmont Province). The Blue Ridge Mountains, also sometimes referred to as the "Blue Ridge Front", form a prominent escarpment visible for many miles to the east, marking the erosion resistant central rocks of the Province. The elevation of the peaks along the crest of the Blue Ridge range from less than 2,000 feet in the northeast, to over 5,000 feet above sea level in the southwest, reaching a maximum elevation at Mount Rogers (EL 5,729), the highest point in Virginia.

The Blue Ridge province contains some of the oldest rocks in Virginia, dating to 1.8 billion years before present. These ancient rocks are folded upwards in an eroded "anticlinorium", the flanks of which are surrounded by younger rocks ranging from 1 billion to 400 million years before present. The entire region was formed during the mountain-building event called the "Appalachian Orogeny" a result of the collision of the North American and African tectonic plates at the end of the Paleozoic geologic era, approximately 265 million years ago.

According to local geologic maps, the site is mapped in the Garnet monzogranite of the Middle Proterozoic geologic period, including a lens of Alluvium and fine colluvial debris from the Holocene geologic period. Our subsurface investigation agrees favorably with the published geology.

3.2 Published Soils

A review of the USGS Web Soil Survey and Loudoun County soils maps indicates a portion of the site development will be built on Class III and IV soils. Specifically, Soil Mapping Units 17B, 10B, and 38B are located on the site. According to the Loudoun County Interpretive Guide to the Use of Soils Maps, the Class III and IV soils may have low soil/bearing strength, seasonal high water tables, and high shrink/swell characteristics. However, soil laboratory testing completed for the on-site soils did not indicate a large amount of high plasticity soils. The groundwater conditions are discussed in Section 3.4 of this report. The Loudoun County soils mapping is shown on Figure 7 in Appendix A of this report, and is presented below in Table 3.2-1.

Table 3.2-1: Soil Type Characteristics by Mapping Unit

Mapping Unit	Soil Group	Slope (percent)	Hydrologic Soil Class	Drainage	Published Depth to Water Table	Published Depth to Restrictive Feature	Soil Class
10B	Mongle silt loam	0 to 7	B/D	Somewhat poorly drained	About 10 to 24 inches	More than 80 inches	IV

Mapping Unit	Soil Group	Slope (percent)	Hydrologic Soil Class	Drainage	Published Depth to Water Table	Published Depth to Restrictive Feature	Soil Class
17B	Middleburg silt loam	2 to 7	A	Well drained	More than 80 inches	More than 80 inches	III
20C	Purcellville and Tankerville soils	7 to 15	B	Well drained	More than 80 inches	20 to 40 inches to paralithic bedrock; 40 to 55 inches to lithic bedrock	II
22B	Purcellville-Swampoodle complex	2 to 7	C/D	Somewhat poorly drained	About 10 to 24 inches	More than 80 inches	II
23B	Purcellville silt loam	2 to 7	B	Well drained	More than 80 inches	More than 80 inches	I
28B	Eubanks loam	2 to 7	A	Well drained	More than 80 inches	More than 80 inches	I
38B	Swampoodle silt loam	2 to 7	C/D	Somewhat poorly drained	About 10 to 24 inches	More than 80 inches	IV

3.3 Stratification

The subsurface materials encountered have been stratified for purposes of our discussions herein. These stratum designations do not imply that the materials encountered are continuous across the site. Stratum designations have been established to characterize similar subsurface conditions based on material gradations and parent geology. Per GeoConcepts' convention, Stratum A is reserved for existing fill soils. Existing fill soils were not encountered in the soil borings completed at the site. Accordingly, Stratum A was not used in this report. The generalized subsurface materials encountered in the test borings completed at the site have been assigned to the following strata:

Stratum B1 (Residual Fine)	firm to very stiff, SANDY LEAN CLAY (CL), SANDY SILT (ML), SILT (ML), moist, brown, red-brown
Stratum B2 (Residual Coarse)	loose to very dense, SILTY SAND (SM), CLAYEY SAND (SC), moist, brown, orange-brown
Stratum B3 (Weathered Rock)	very dense, SILTY SAND (SM), with gravel, moist, brown

The two letter designations included in the strata descriptions presented above and on the test boring logs represent the Unified Soil Classification System (USCS) group symbol and group name for the samples based on laboratory testing per ASTM D2487 and visual classifications per ASTM D2488. It should be noted that visual classifications per ASTM D2488 may not match classifications determined by laboratory testing per ASTM D2487.

3.4 Groundwater

Groundwater level observations were made in the location of the proposed wet pond. A summary of the water level readings rounded off to the nearest 0.5 feet elevation is presented below in Table 3.4-1.

Table 3.4-1: Groundwater Readings

Test Boring No.	Depth to Groundwater (ft.)	Groundwater Elevation (ft.)
B-3	1.0	EL 458.0
B-4	4.5	EL 455.5
B-5	9.5	EL 452.5

As shown in the table above, groundwater was encountered at depths of about 1 to 9.5 feet below the existing ground surface, or at about EL 458.0 to EL 452.5. The groundwater observations presented herein are considered to be an indication of the groundwater levels at the dates and times indicated. Where more impervious silty and clayey soils are encountered, the amount of water seepage into the borings is limited, and it is generally not possible to establish the location of the groundwater table through short term water level observations. Accordingly, the groundwater information presented herein should be used with caution. Also, fluctuations in groundwater levels should be expected with seasons of the year, construction activity, changes to surface grades, precipitation, or other similar factors.

3.5 Soil Laboratory Test Results

Selected soil samples obtained from the field investigation were tested for grain size distribution, Atterberg limits, and natural moisture contents. A summary of soil laboratory test results is presented below in Table 3.5-1, and the results of natural moisture content tests are presented on the test boring logs in Appendix A.

Table 3.5-1: Summary of Soil Laboratory Test Results

Test Boring No.	Depth (ft)	Sample Type	Stratum	Description of Soil Specimen	Sieve Results		Atterberg Limits			Natural Moisture Content (%)
					Percent Retained #4 Sieve	Percent Passing #200 Sieve	LL	PL	PI	
B-2	18.5-20.0	Jar	B2	SILTY SAND (SM)	8.3	29.9	NP	NP	NP	7.7
B-3	0.0-2.0	Jar	B1	LEAN CLAY (CL) WITH SAND	0.8	71.1	45	22	23	23.2
B-4	5.0-6.5	Jar	B2	SILTY SAND (SM)	0.0	38.2	29	23	6	10.5

Notes:
1. Soil tests are in accordance with applicable ASTM standards
2. Soil classification symbols are in accordance with Unified Soil Classification System
3. Visual identification of samples is in accordance with ASTM D2488
4. Key to abbreviations: LL = liquid limit; PL = plastic limit; PI = plasticity index; NP = nonplastic

3.5.1 Agronomic Testing

A total of 10 soil samples were collected at various locations across the site for agronomic testing. Samples were taken from the ground surface to a maximum depth of 6 inches. Sample locations are presented on Figure 7 in Appendix A. Agronomic laboratory test results including organic matter content, pH, estimated nitrogen release, cation exchange capacity, and percent base saturations are presented in Appendix B.

Based on information provided to us by Atkins Global via email on March 21, 2018, we understand that the proposed seed mix for the baseball fields should include proven tall fescue cultivars chosen from the latest recommendations from Virginia Tech, in the following mixtures: 80-90% turf type tall fescue with at least three cultivars in equal percentages, and 10-20% Perennial Ryegrass. Soil fertility recommendations for

the on-site soils to be used for the athletic fields with the proposed seed mix are included with the test results in Appendix B.

3.6 Seismic Refraction Survey

A seismic refraction survey was conducted at the site to assist in determining the depth to rock in the areas of the proposed athletic field cut areas. The survey was completed using a DAQlink III with Optim Vibrascope 240 Programming and twelve 10-Hz geophones. The survey consisted of five lines, designated as lines L-1 to L-5, measured 150 feet in length, for a total of approximately 750 linear feet of seismic survey data. It should be noted that the geophones were placed from 20 to 30 feet along each line. Multiple shot locations (location of energy introduction) were conducted along each line including 20 feet offset from the beginning and end of each line as indicated on the scale on the seismic refraction line figures. The seismic survey lines are plotted as Figures 2 through 6, and the locations of the seismic survey lines are shown on Figure 7, all in Appendix A of this report.

The primary objective of the survey is to establish a rippability profile of the subsurface strata within the proposed alignment. The subsurface information interpreted from the seismic survey is used for design and construction planning by relating modeled/calculated seismic velocities to relative ease of rippability. In general, P-wave seismic velocity is indirectly related to density and directly related to changes in the compressive strength of materials through established excavation and blasting industry tables, including the Caterpillar Handbook. By using published reference tables, a P-wave seismic velocity of approximately 5,900 ft/sec was chosen for the lower limit of marginal rippability for weathered granite rock underlying the site. Based on published data, all materials with a modeled seismic velocity below 5,900 ft/sec should be able to be removed with ease using the industry standard Caterpillar D-8 ripper or 330 hydraulic backhoe. Materials with modeled seismic velocities between 5,900 and 6,900 ft/sec should be able to be removed with difficulty using a Caterpillar D-8 ripper or 330 hydraulic backhoe. The lower (5,900 ft/sec) and upper (6,900 ft/sec) limits of rippability are indicated on Figures 2 to 6. Materials with modeled seismic velocities greater than 5,900 ft/sec may need to be removed using rock excavation methods as described in Section 4.2 of this report.

4.0 Engineering Analysis

Recommendations regarding earthwork, rock excavation, and the stormwater management pond are presented herein.

4.1 Earthwork

Fill will be required for the proposed site grading. The areas to be filled should be cleared and grubbed prior to placing fill. Soft or loose natural soils, organic material, and rubble should be stripped to approved subgrades as determined by the geotechnical engineer. Topsoil depths presented on the boring logs should not be considered as stripping depths, as topsoil depths may vary widely across the site, particularly in wooded or previously cultivated areas. Stripping depths will probably extend to greater depths than the topsoil depths indicated herein due to the presence of minor amounts of organics, roots, and other surficial materials that will require removal as a part of the stripping operations. In addition, seasonal soil moisture variations can affect stripping depths. In general, less stripping may occur during summer months when drier weather conditions can be expected. The depth of required stripping should be determined prior to construction by the excavation contractor using test pits, probes, or other means that the contractor wishes to employ, and this determination should be the responsibility of the excavation contractor. All subgrades should be proofrolled with a minimum 20 ton, loaded dump truck or suitable rubber tire construction equipment approved by the geotechnical engineer, prior to the placement of new fill.

Fill material should be placed in lifts not exceeding 8 inches loose thickness, with fill materials compacted by hand operated tampers or light compaction equipment placed in maximum 4-inch thick loose lifts. Fill should be compacted at +/- 2% of the optimum moisture content to at least 95 percent of the maximum dry density per VTM-1.

Materials used for compacted fill should consist of soils classifying ML, SC, SM, SP, SW, GC, GM, GP, or GW per ASTM D2487. It is expected that portions of soils excavated at the site will be suitable for re-use as fill based on classification. However, drying of excavated soils by spreading and aerating may be necessary to obtain proper compaction. This may not be practical during the wet period of the year. Accordingly, earthwork operations should be planned for early spring through late fall, when drier weather conditions can be expected. Individual borrow areas, both from on-site and off-site sources, should be sampled and tested to verify classification of materials prior to their use as fill.

The weathered rock of Stratum B3 may also be suitable for re-use as fill. With limited exposure and manipulation, the weathered rock will eventually breakdown into smaller size particles. If the weathered rock is placed in a fill without sufficient fines to fill void spaces adjacent to larger size particles, degradation of the larger disintegrated rock particles may result in collapse of the individual void spaces, and subsequent undesirable settlement. In order to prevent the improper placement of weathered rock materials due to the non-durable nature of this material, we recommend that the weathered rock be placed as a soil fill and not as rock fill. This will require that sufficient mechanical effort be used to breakdown and crush the disintegrated rock into particles not larger than 8 inches in mean diameter, with approximately 50 percent materials passing the US Standard No. 40 sieve. These criteria should be able to be met by compacting with a CAT 815 sheepsfoot roller or similar sized equipment, in lifts not exceeding 8 inches in thickness prior to compaction.

Fill materials should not be placed on frozen or frost-heaved soils, and/or soils that have been recently subjected to precipitation. All frozen or frost-heaved soils should be removed prior to continuation of fill operations. Borrow fill materials should not contain frozen materials at the time of placement.

Compaction equipment that is compatible with the soil type used for fill should be selected. Theoretically, any equipment type can be used as long as the required density is achieved; however, sheepsfoot roller equipment are best suited for fine-grained soils and vibratory smooth drum rollers are best suited for granular soils. Ideally, a smooth drum roller should be used for sealing the surface soils at the end of the day or prior to upcoming rain events. All areas receiving fill should be graded to facilitate positive drainage of any water associated with precipitation and surface run-off.

4.2 Rock Excavation

The majority of excavations to reach proposed grades should generally be feasible using normal earth moving equipment; however, rock excavation methods such as hoe-ramming or blasting may be required for some of the site development. The elevations where rock excavation methods may be required for removal of bedrock at the test boring and seismic refraction line locations are estimated below in Table 4.2-1, and are based on materials equal to or harder than an SPT resistance of 50/3", or materials with a seismic velocity greater than 6,900 ft/sec.

Table 4.2-1: Estimated Elevation Where Rock Excavation Methods May be Required

Test Boring No. or Seismic Line No.	Estimated Depth Below Existing Grades Where Rock Excavation Methods May Be Required (feet)	Estimated Elevation Where Rock Excavation Methods May be Required (EL)
B-1	Below 20	Below 479
B-2	Below 20	Below 475
B-3	8.0	451
B-4	6.5	453
B-5	13.0	449

Test Boring No. or Seismic Line No.	Estimated Depth Below Existing Grades Where Rock Excavation Methods May Be Required (feet)	Estimated Elevation Where Rock Excavation Methods May be Required (EL)
L-1	35.0	463
L-2	30.0	471
L-3	15.0	483
L-4	17.0	474
L-5	12.0	487

The elevations given above are based upon the use of normal earth excavation equipment including up to a Caterpillar 330 hydraulic backhoe or equivalent, for mass excavation. Project specifications should include the following as a definition of rock excavation for mass excavation: "Rock is defined as any material which cannot be dislodged by a Caterpillar 330 hydraulic backhoe without the use of hoe-ramming or blasting. This classification does not include material such as loose rock, concrete or other materials that can be removed by means other than hoe-ramming or blasting, but which for reasons of economy in excavating, the contractor chooses to remove by hoe-ramming or blasting." Variations in rock conditions should be expected from the elevations presented in the table above, since the rock surface can vary over the site. Also, the extent of rock excavation will depend on Contractor's methods, rock jointing, and rock foliation/bedding.

4.3 Stormwater Management Pond

A stormwater management (SWM) wet pond will be constructed as part of this site development. The pond embankment will generally be constructed in cut into the natural soils, with a pond bottom at EL 450.0, and a permanent water surface elevation at EL 456.0. Groundwater level observations were made in test borings B-3, B-4, and B-5 completed at the proposed wet pond location. Groundwater was encountered at depths of about 1 to 9.5 feet below the existing ground surface, or at about EL 458 to EL 452.5.

According to Chapter 11 of the VDOT Drainage Manual, SWM pond embankment and pond subgrade materials should be classified as A-4 or finer soils per the AASHTO soil classification system. Subgrade materials for the pond bottom will most likely consist of weathered rock to bedrock, while the side slopes will vary from sandy soils to weathered rock. Accordingly, we recommend a relatively impervious, minimum 1.5-feet thick clay liner be placed in the proposed pond bottom that extends up to the 100-year water surface elevation. Materials used for construction of the pond liner should consist of clay soils classifying CH or CL per ASTM D2487, with a minimum of 75 percent fines passing the No. 200 sieve and a minimum plasticity index of 15. Clay materials should not contain sod, brush, roots, or other perishable materials. Rock particles larger than 3 inches should be removed prior to compaction of the clay. The clay material should have a permeability less than $1x10^{-6}$ cm/sec per ASTM D5084.

Please note that the soil test boring in the area of the pond indicated the presence of bedrock at EL 451, or 1 foot above the proposed pond bottom. Consideration should be made to move the pond bottom up to elevation EL452, if possible, to avoid rock excavation when installing the liner. If this is not possible, a reduced clay liner thickness of 8 inches may be considered on the pond bottom to limit the amount of rock excavation required. However, it should be understood that reducing the thickness of the liner on the pond bottom increases the risk of excessive seepage over time. Excessive seepage may make it difficult to maintain pond water levels.

Foundation surfaces should be graded to remove surface irregularities and should be scarified or loosened to a minimum depth of 3 inches. The moisture content of the loosened material should be controlled as specified for the clay liner, and the surface materials of the foundation should be compacted and bonded

with the first layer of the clay liner as specified for subsequent layers of clay liner. If the surface of any layer becomes too hard and smooth for proper bond with the succeeding layer, it should be scarified to a depth of not less than 2 inches before the next layer is placed.

Clay fill materials should be placed at a moisture content at least 1 percent above optimum for compaction purposes, but at a moisture content that can still achieve compaction, typically no more than 5 percent above optimum moisture. The fill materials should be compacted with a sheepsfoot roller, to at least 95 percent of the maximum dry density per VTM-1. Fill should be placed in horizontal lifts, and fill placed along slopes steeper than 5H:1V should be benched into the existing slope. The thickness of each lift before compaction should not exceed the smaller of 6 inches or the length of the teeth of the sheepsfoot compactor used.

Drying of the clay liner will cause desiccation to form cracks that may compromise the integrity of the liner. Therefore, after the completion of liner construction, the pond should be filled with water immediately. If the pond cannot be filled immediately, the liner should be moistened as necessary to prevent desiccation. If desiccation occurs prior to filling the pond, the desiccated areas should be scarified and re-completed to meet the criteria recommended herein.

The outlet works for the wet pond are assumed to consist of precast concrete risers and outlet pipe. An allowable soil bearing pressure of 2,500 psf is recommended for riser foundations when founded on the natural soils below any soft surficial soils. To minimize the potential for excess seepage along the exterior of the outlet pipes, we recommend that a concrete cradle be placed below the outlet pipe. The cradle should be at least 6 inches thick, with the pipe embedded into the cradle a depth of 0.5 times the pipe diameter. The cradle should be placed directly on top of undisturbed natural soils and should extend up to a level equal to or above the spring line of the pipe.

5.0 General Limitations

Recommendations contained in this report are based upon the data obtained from the relatively limited number of test borings. This report does not reflect conditions that may occur between the points investigated, or between sampling intervals in test borings. The nature and extent of variations between test borings and sampling intervals may not become evident until the course of construction. Therefore, it is essential that on-site observations of subgrade conditions be performed during the construction period to determine if re-evaluation of the recommendations in this report must be made. It is critical to the successful completion of this project that GeoConcepts be retained during construction to observe the implementation of the recommendations provided herein.

This report has been prepared to aid in the evaluation of the site and to assist your office and the design professionals in the design of this project. It is intended for use with regard to the specific project as described herein. Changes in proposed construction, grading plans, etc. should be brought to our attention so that we may determine any effect on the recommendations presented herein.

An allowance should be established for additional costs that may be required for foundation and earthwork construction as recommended in this report. Additional costs may be incurred for various reasons including wet fill materials, soft subgrade conditions, unexpected groundwater problems, rock excavation, etc.

This report should be made available to bidders prior to submitting their proposals to supply them with facts relative to the subsurface conditions revealed by our investigation and the results of analyses and studies that have been performed for this project. In addition, this report should be given to the successful contractor and subcontractors for their information only.

We recommend the project specifications contain the following statement: “A geotechnical engineering report has been prepared for this project by GeoConcepts Engineering, Inc. This report is for informational purposes only and should not be considered part of the contract documents. The opinions expressed in

this report are those of the geotechnical engineer and represent their interpretation of the subsoil conditions, tests and results of analyses that they performed. Should the data contained in this report not be adequate for the contractor's purposes, the contractor may make their own investigations, tests and analyses prior to bidding."

This report was prepared in accordance with generally accepted geotechnical engineering practices. No warranties, expressed or implied, are made as to the professional services included in this report.

We appreciate the opportunity to be of service for this project. Please contact the undersigned if you require clarification of any aspect of this report.

Sincerely,

GEOCONCEPTS ENGINEERING, INC.

Amy E. Strobel, PG
Senior Associate

Paul Burkart, PE
Senior Principal

DN/WR/MC/AES/PEB/shm
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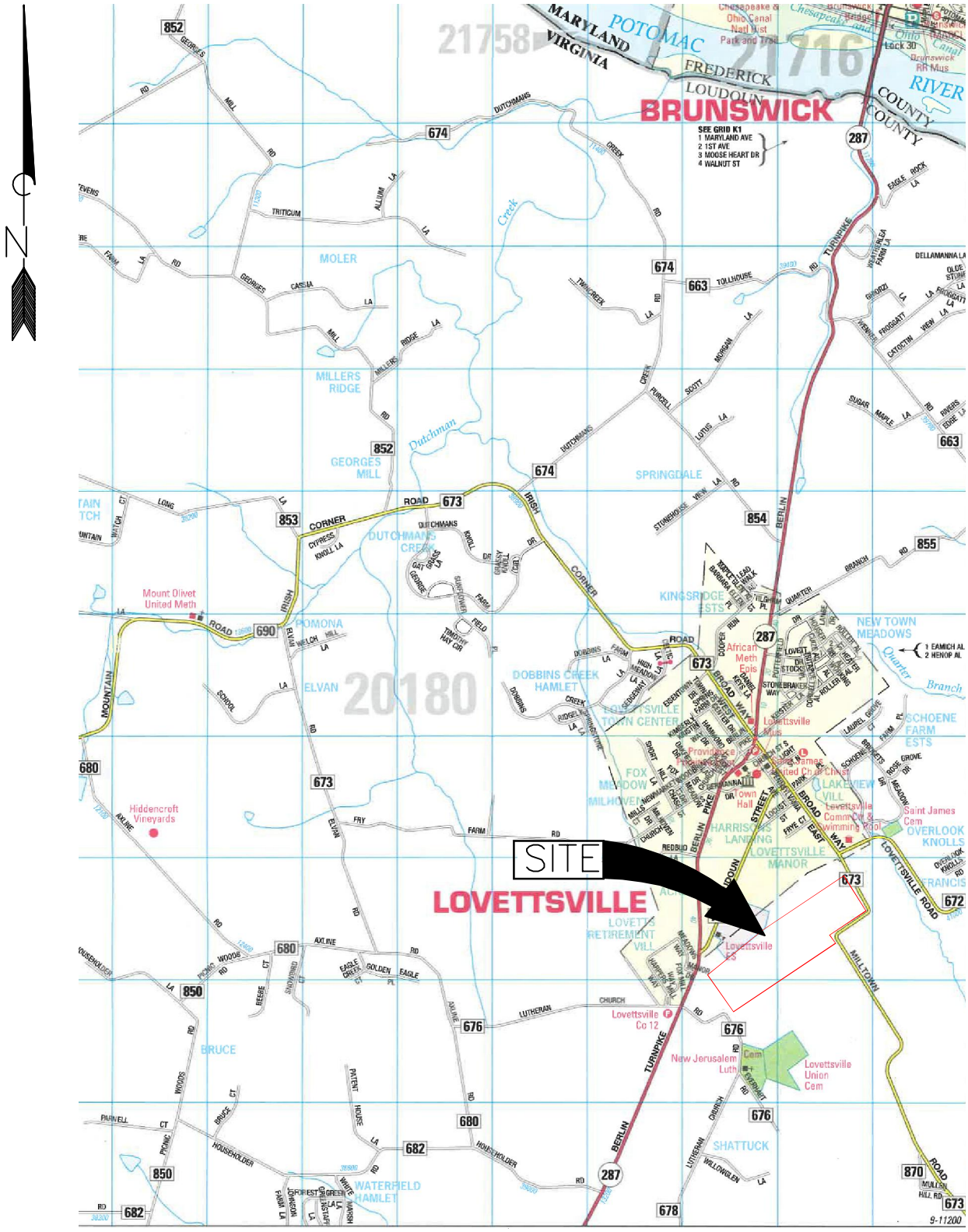

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LOVETTSVILLE PARK
57 EAST BROAD WAY, LOVETTSVILLE, VIRGINIA

SITE VICINITY MAP			Scale: N.T.S.	Fig. 1
Date: APRIL 2018	Drawn By: A.K.M.	Checked By: P.E.B.	Project No.: JD185069	

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Appendix A
Subsurface Investigation

Subsurface Investigation Procedures (1 page)

Identification of Soil (1 page)

Test Boring Notes (1 page)

Test Boring Logs (5 pages)

Seismic Refraction Lines, Figures 2 to 6 (5 pages)

Subsurface Investigation Plan, Figure 7 (1 page)

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Subsurface Investigation Procedures

1. Test Borings – Hollow Stem Augers

The borings are advanced by turning an auger with a center opening of 2-¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods, after removal of the plug. Usually, no water is introduced into the boring using this procedure.

2. Standard Penetration Tests

Standard penetration tests are performed by driving a 1-⅜ inch I.D. sampling spoon with a 140-pound hammer falling 30 inches, according to ASTM D1586. After an initial 6 inches penetration to assure the sampling spoon is in undisturbed material, the number of blows required to drive the sampler an additional 12 inches is generally taken as the N value. In the event 30 or more blows are required to drive the sampling spoon the initial 6-inch interval, the sampling spoon is driven to a total penetration resistance of 100 blows or 18 inches, whichever occurs first.

3. Groundwater Observation Wells

A water observation well was installed in test borings B-3, B-4, and B-5. The well was installed by inserting a 1-¼ inch plastic perforated pipe through the 2-¼ inch center opening of the auger and backfilling with sand filter material as the auger was withdrawn. The pipe was capped for protection from rainfall, runoff, and foreign objects. Readings were taken as shown on the test boring logs.

4. Test Boring and Seismic Survey Stakeout

The test boring and seismic survey stakeout was provided by GeoConcepts personnel using available site plans. Ground surface elevations were estimated from topographic information contained on the site plan provided to us and should be considered approximate. If the risk related to using approximate boring locations and elevations is unacceptable, we recommend an as-drilled survey of boring locations and elevations be completed by a licensed surveyor.

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Identification of Soil

I. DEFINITION OF SOIL GROUP NAMES

		ASTM D2487	Symbol	Group Name
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines	*GW*	WELL GRADED GRAVEL
			GP	POORLY GRADED GRAVEL
		Gravels with Fines More than 12% fines	*GM*	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines	*SW*	WELL GRADED SAND
			SP	POORLY GRADED SAND
		Sands with fines More than 12% fines	*SM*	SILTY SAND
			SC	CLAYEY SAND
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid Limit less than 50	Inorganic	*CL*	LEAN CLAY
			ML	SILT
		Organic	*OL*	ORGANIC CLAY
				ORGANIC SILT
	Silts and Clays Liquid Limit 50 or more	Inorganic	*CH*	FAT CLAY
			MH	ELASTIC SILT
		Organic	*OH*	ORGANIC CLAY
				ORGANIC SILT
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor		*PT*	PEAT

II. DEFINITION OF MINOR COMPONENT PROPORTIONS

Minor Component	Approximate Percentage of Fraction by Weight
Gravelly, Sandy (adjective)	30% or more coarse grained
Sand, Gravel	15% to 29% coarse grained
Silt, Clay	5% to 12% fine grained

III. GLOSSARY OF MISCELLANEOUS TERMS

SYMBOLS	Unified Soil Classification Symbols are shown above as group symbols. Use “A” Line Chart for laboratory identification. Dual symbols are used for borderline classification.
BOULDERS & COBBLES	Boulders are considered pieces of rock larger than 12 inches, while cobbles range from 3 to 12 inches.
WEATHERED ROCK	Residual rock material with a standard penetration test (SPT) resistance of at least 50 blows per 6 inches.
ROCK/SPOON REFUSAL	Rock material with a standard penetration test (SPT) resistance of 50 blows for 1 inch.
ROCK FRAGMENTS	Angular pieces of rock which have separated from original vein or strata and are present in a soil matrix. Only used in residual soils
QUARTZ	A hard silicate mineral often found in residual soils. Only used when describing residual soils.
CEMENTED SAND	Usually localized rock-like deposits within a soil stratum composed of sand grains cemented by calcium carbonate, iron oxide, or other minerals. Commonly encountered in Coastal Plain sediments, primarily in the Potomac Group sands (Kps).
MICACEOUS	A term used to describe soil that “glitters” or is shiny. Most commonly encountered in fine-grained soils.
ORGANIC MATERIALS	Topsoil - Surface soils that support plant life and contain organic matter.
(Excluding Peat)	Lignite - Hard, brittle decomposed organic matter with low fixed carbon content (a low grade of coal).
FILL	Man-made deposit containing soil, rock, and other foreign matter.
CONTAINS	This is used when a soil contains a secondary component that does not apply to a USCS classification.
WITH	This is used when a residual soil contains a secondary component that is included in the USCS classification.
PROBABLE FILL	Soils which contain no visually detected foreign matter but which are suspect with regard to origin.
LAYERS	½ to 12 inch seam of minor soil component.
COLOR	Two most predominant colors present should be described.
MOISTURE CONDITIONS	Wet, moist, or dry to indicate visual appearance of specimen.
GRAIN SIZE	Fine-medium-coarse

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Test Boring Notes

1. Classification of soil is by visual inspection and is in accordance with the Unified Soil Classification System.

2. Estimated groundwater levels are indicated on the logs. These are only estimates from available data and may vary with precipitation, porosity of soil, site topography, etc.

3. Sampling data presents standard penetrations for 6-inch intervals or as indicated with graphic representations adjacent to the sampling data.

4. The energy applied to the split-spoon sampler using the automatic hammer is about 33 percent greater than the applied energy using the standard safety hammer. The hammer blows shown on the boring logs are uncorrected for the higher energy.

5. The logs and related information depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at the test locations. Also, the passage of time may result in a change in the subsurface conditions at the test locations.

6. The stratification lines represent the approximate boundary between soil types as determined in the sampling operation. Some variation may be expected vertically between samples taken. The soil profile, groundwater level observations and penetration resistances presented on the logs have been made with reasonable care and accuracy and must be considered only an approximate representation of subsurface conditions to be encountered at the particular location.

7. Weathered rock is defined as residual earth material with a penetration resistance between 50 blows per 6 inches and refusal. Spoon refusal at the surface of rock, boulders, or obstructions is defined as a penetration resistance of 50 blows for 1 inch penetration or less. Auger refusal is taken as the depth at which further penetration of the auger is not possible without risking significant damage to the drilling equipment.

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Ashburn, VA 20147
703-726-8030
703-726-8032 fax

PROJECT:	LOGGED BY:	BORING NUMBER:
Lovettsville Park	**D. Nixon**	**B-1**
LOCATION:	DRILLING CONTRACTOR:	SHEET 1 OF 1
Lovettsville, Loudoun County, Virginia	**Northern Virginia Drilling**	
OWNER/CLIENT:	DRILLER:	DATES DRILLED:
Loudoun Co. Dept. of Transportation & Capital Infrastructure	**J. Labas**	**3/30/18**
PROJECT NUMBER: / GROUND SURFACE ELEVATION (ft.):	DRILLING METHOD:	DRILL RIG:
JD185069 / **499.0 ±**	**2.25 ID HSA; Automatic Hammer**	**Track Diedrich D50**

ELEV. (ft.)	DEPTH (ft.)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL: SPT BLOW COUNTS	SOIL: REC (in)	SOIL: STANDARD PENETRATION TEST RESISTANCE (BPF)
499.0					Topsoil = 2 in.			
498.8					*Residual*, brown, fine, SANDY LEAN CLAY, firm, moist, **CL**	1+2+4+4	18	
496.5			B1		*Residual*, brown, fine, SANDY SILT, very stiff, moist, **ML**	4+6+11	18	
494.0	5		B2		*Residual*, orange-brown, fine to medium, SILTY SAND, loose, moist, **SM**	3+3+4	18	
490.5			B1		*Residual*, brown, fine, SANDY SILT, very stiff, moist, **ML**	4+7+10	18	
485.5	10		B3		*Weathered rock*, light brown, fine to medium, SILTY SAND, very dense, moist, **SM**	16+29+50/4	18	>>
480.5	15				Brown	30+42+50/5	18	>>
479.0	20				Bottom of Borehole at 20.0 ft.			
	25							

STANDARD PENETRATION TEST RESISTANCE (BPF): 20 40 60 80

GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION — CAVED: 15.0 ft. ELEV. 484.0

SAMPLE TYPES:

SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

BOREHOLE/TEST PIT LOVETTSVILLE PARK LOGS.GPJ GEOCONCEPTS 20170216.GDT 4/23/18

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Ashburn, VA 20147
703-726-8030
703-726-8032 fax

PROJECT:	LOGGED BY:	BORING NUMBER:
Lovettsville Park	D. Nixon	B-2
LOCATION:	DRILLING CONTRACTOR:	SHEET 1 OF 1
Lovettsville, Loudoun County, Virginia	Northern Virginia Drilling	
OWNER/CLIENT:	DRILLER:	DATES DRILLED:
Loudoun Co. Dept. of Transportation & Capital Infrastructure	J. Labas	3/30/18
PROJECT NUMBER: / GROUND SURFACE ELEVATION (ft.):	DRILLING METHOD:	DRILL RIG:
JD185069 / 495.0 ±	2.25 ID HSA; Automatic Hammer	Track Diedrich D50

ELEV. (ft.)	DEPTH (ft.)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL: SPT BLOW COUNTS	SOIL: REC (in)	SOIL: STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	SOIL: MC (%)
495.0					Topsoil = 3 in.				
494.8			B1		*Residual*, red-brown, LEAN CLAY, firm, moist, **CL**	1+2+4+4	18		
492.5					*Residual*, light brown, fine to coarse, SILTY SAND, medium dense, moist, **SM**	3+6+7	18		
490.0	5				Brown and white, dense	5+8+15	18		
486.5					*Residual*, light brown and white, medium to coarse, POORLY GRADED SAND, contains quartz, dense, moist, **SP**	6+9+17	18		
	10		B2						
481.5					*Residual*, brown, fine, SILTY SAND, dense, moist, **SM**	7+10+13	16		
	15								
476.5					Very dense	25+33+49	18		7.7
475.0	20				Bottom of Borehole at 20.0 ft.				
	25								

GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION — CAVED: 13.5 ft. ELEV. 481.5

SAMPLE TYPES:

SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

BOREHOLE/TEST PIT LOVETTSVILLE PARK LOGS.GPJ GEOCONCEPTS 20170216.GDT 4/23/18

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Ashburn, VA 20147
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PROJECT:	LOGGED BY:	BORING NUMBER:
Lovettsville Park	D. Nixon	B-3
LOCATION:	DRILLING CONTRACTOR:	SHEET 1 OF 1
Lovettsville, Loudoun County, Virginia	Northern Virginia Drilling	
OWNER/CLIENT:	DRILLER:	DATES DRILLED:
Loudoun Co. Dept. of Transportation & Capital Infrastructure	J. Labas	3/30/18
PROJECT NUMBER: / GROUND SURFACE ELEVATION (ft.):	DRILLING METHOD:	DRILL RIG:
JD185069 / 459.0 ±	2.25 ID HSA; Automatic Hammer	Track Diedrich D50

ELEV. (ft.)	DEPTH (ft.)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL: SPT BLOW COUNTS	REC (in)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	MC (%)
459.0	0				Topsoil = 2 in.				
458.8					*Residual*, brown, fine, LEAN CLAY WITH SAND, firm, moist, **CL**	1+1+3+4	18		23.2
456.5			B1		Brown, stiff	2+3+4	18		
454.0	5				*Residual*, brown, fine to medium, CLAYEY SAND, medium dense, moist, **SC**	3+5+7	18		18.5
			B2			50/0	0	>>	
451.0					Auger and Spoon Refusal at 8.0 ft.				
	10								
	15								
	20								
	25								

GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION — CAVED: 7.0 ft. ELEV. 452.0

▼ 3/31/2018 — 1.0 ft. ELEV. 458.0

SAMPLE TYPES:

☒ SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

BOREHOLE/TEST PIT LOVETTSVILLE PARK LOGS.GPJ GEOCONCEPTS 20170216.GDT 4/23/18

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PROJECT:	LOGGED BY:	BORING NUMBER:
Lovettsville Park	D. Nixon	B-4
LOCATION:	DRILLING CONTRACTOR:	SHEET 1 OF 1
Lovettsville, Loudoun County, Virginia	Northern Virginia Drilling	
OWNER/CLIENT:	DRILLER:	DATES DRILLED:
Loudoun Co. Dept. of Transportation & Capital Infrastructure	J. Labas	3/30/18
PROJECT NUMBER: / GROUND SURFACE ELEVATION (ft.):	DRILLING METHOD:	DRILL RIG:
JD185069 / 460.0 ±	2.25 ID HSA; Automatic Hammer	Track Diedrich D50

ELEV. (ft.)	DEPTH (ft.)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL: SPT BLOW COUNTS	REC (in)	STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	MC (%)
460.0	0				Topsoil = 2 in.				
459.8			B1		*Residual*, brown, LEAN CLAY, firm, moist, **CL**	1+1+3+5	18		26.8
457.5					*Residual*, brown gray, fine to coarse, CLAYEY SAND, dense, moist, **SC**	7+10+16	18		
455.0	5		B2		*Residual*, brown, fine to medium, SILTY SAND, very dense, moist, **SM**	6+15+29	18		10.5
453.5					Auger and Spoon Refusal at 6.5 ft.	50/0	0	>>	
	10								
	15								
	20								
	25								

GROUND WATER LEVELS:

NOT ENCOUNTERED DURING DRILLING

NOT ENCOUNTERED UPON COMPLETION — CAVED: 3.0 ft. ELEV. 457.0

▼ 3/31/2018 — 4.5 ft. ELEV. 455.5

SAMPLE TYPES:

☒ SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

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PROJECT:	LOGGED BY:	BORING NUMBER:
Lovettsville Park	**D. Nixon**	**B-5**
LOCATION:	DRILLING CONTRACTOR:	SHEET 1 OF 1
Lovettsville, Loudoun County, Virginia	**Northern Virginia Drilling**	
OWNER/CLIENT:	DRILLER:	DATES DRILLED:
Loudoun Co. Dept. of Transportation & Capital Infrastructure	**J. Labas**	**3/30/18**
PROJECT NUMBER: / GROUND SURFACE ELEVATION (ft.):	DRILLING METHOD:	DRILL RIG:
JD185069 / **462.0 ±**	**2.25 ID HSA; Automatic Hammer**	**Track Diedrich D50**

ELEV. (ft.)	DEPTH (ft.)	SAMPLE TYPE	STRATUM	GRAPHIC	MATERIAL DESCRIPTION	SOIL: SPT BLOW COUNTS	SOIL: REC (in)	SOIL: STANDARD PENETRATION TEST RESISTANCE (BPF) 20 40 60 80	SOIL: MC (%)
462.0					Topsoil = 2 in.				
461.8					*Residual*, brown, SILT, contains organics, firm, moist, **ML**	1+2+4+7	16		
459.5					*Residual*, brown, fine to medium, SANDY SILT, very stiff, moist, **ML**	3+5+11	16		23.4
	5		B1			3+7+15	18		
453.5					*Residual*, brown, fine to medium, SILTY SAND, very dense, moist, **SM**	11+28+39	16		
	10		B2						
448.5					*Weathered rock*, brown, fine to coarse, SILTY SAND, with gravel, very dense, moist, **SM**	47+50/2	2	>>	
	15		B3						
446.0					Auger and Spoon Refusal at 16.0 ft.	50/0	0	>>	
	20								
	25								

GROUND WATER LEVELS:

ENCOUNTERED:	13.0	ft.	ELEV.	449.0			
UPON COMPLETION:	4.0	ft.	ELEV.	458.0	CAVED: 13.0 ft.	ELEV.	449.0
3/31/2018	9.5	ft.	ELEV.	452.5			

SAMPLE TYPES: SPT

REMARKS:

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARIES. THE TRANSITION MAY BE GRADUAL.

BOREHOLE/TEST PIT LOVETTSVILLE PARK LOGS.GPJ GEOCONCEPTS 20170216.GDT 4/23/18

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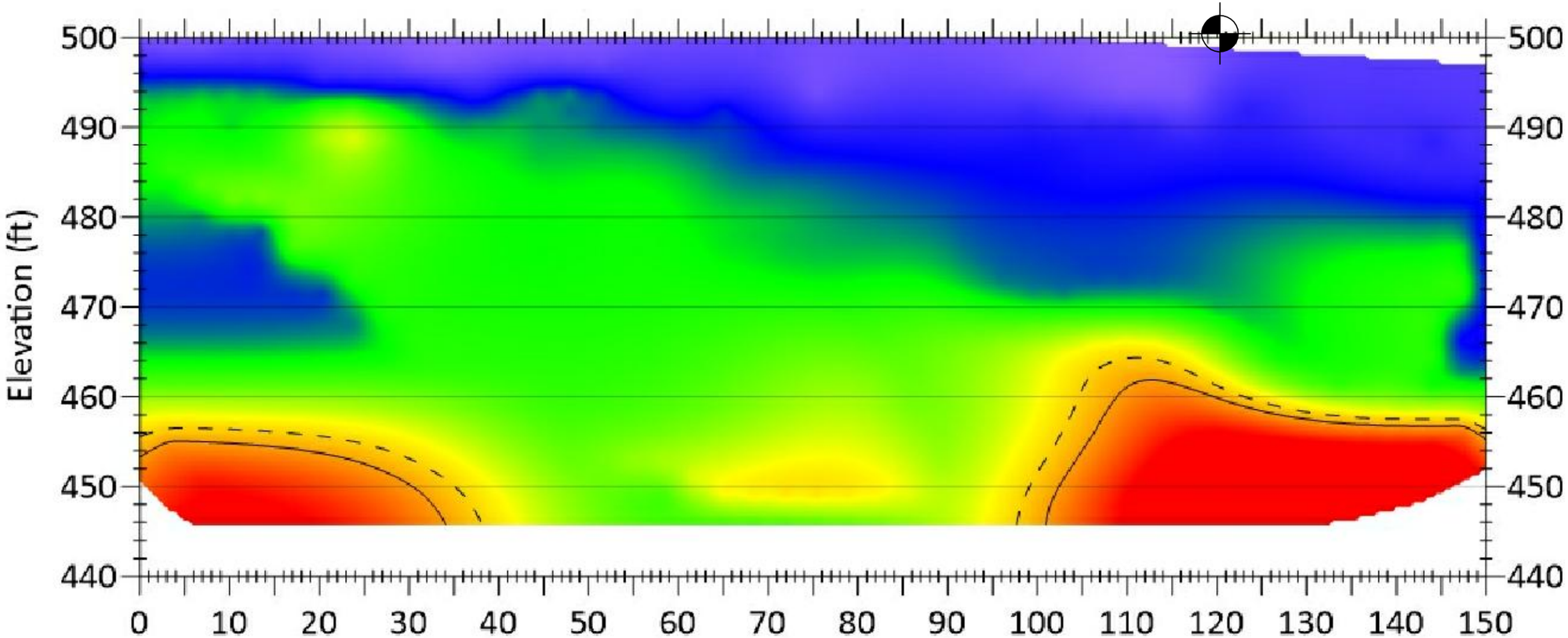
LINE 1

SOUTH

NORTH

B-2



5,900 ft/s

6,900 ft/s

B-1 APPROXIMATE BORING LOCATION

NOTES;

1) PROFILE ORIENTED AS NOTED ON FIGURE
2) TERRAIN TOPOGRAPHY ESTIMATED FROM SITE PLAN PROVIDED BY LOUDOUN COUNTY DATED DECEMBER 2017

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LOVETTSVILLE PARK
LOVETTSVILLE, LOUDOUN COUNTY, VIRGINIA

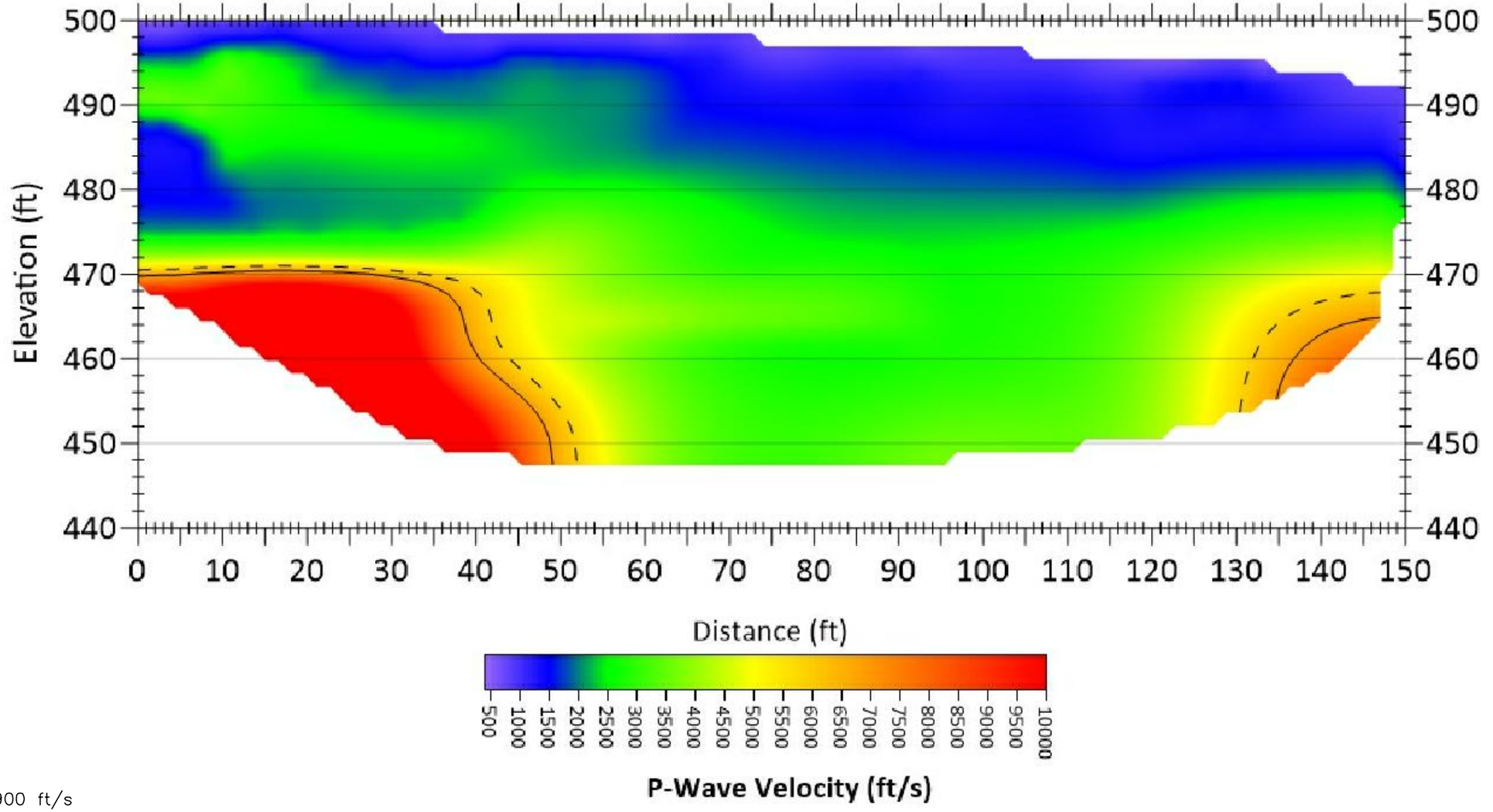
SEISMIC REFRACTION LINE L-1

Scale:	Fig.
AS SHOWN	2

Date:	Drawn By:	Checked By:	Project No.:
APRIL 2018	D.J.N.	P.E.B.	JD185069

n:\projects\2018\jd185069\working files\diagrams-drawings-figures\surfer plots in cad\seismic line drawings\seismic lines imagery

LINE 2



5,900 ft/s

6,900 ft/s

NOTES;
1) PROFILE ORIENTED AS NOTED ON FIGURE
2) TERRAIN TOPOGRAPHY ESTIMATED FROM SITE PLAN PROVIDED BY LOUDOUN COUNTY DATED DECEMBER 2017

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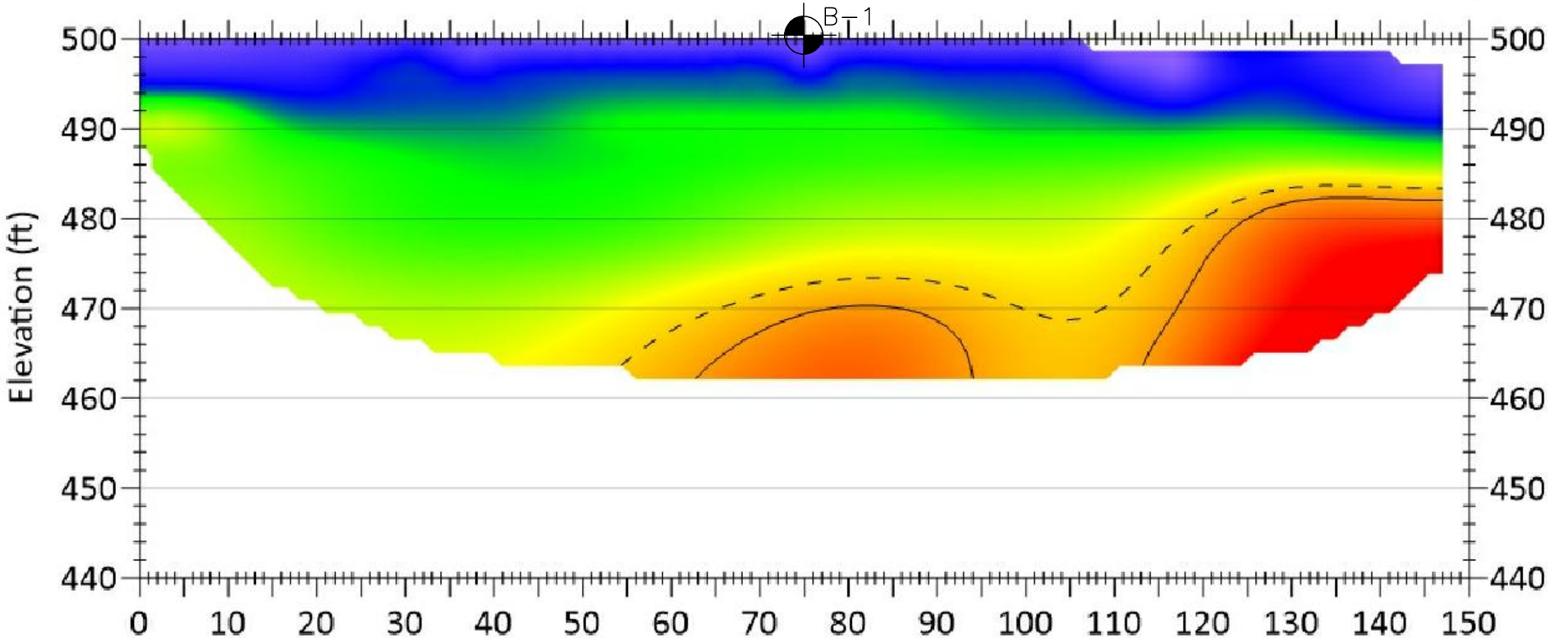
LOVETTSVILLE PARK
LOVETTSVILLE, LOUDOUN COUNTY, VIRGINIA

SEISMIC REFRACTION LINE L-2			Scale: AS SHOWN	Fig. 3
Date: APRIL 2018	Drawn By: D.J.N.	Checked By: P.E.B.	Project No.: JD185069	

LINE 3

SOUTH

NORTH



5,900 ft/s

6,900 ft/s

B-1 APPROXIMATE BORING LOCATION

NOTES;

1) PROFILE ORIENTED AS NOTED ON FIGURE
2) TERRAIN TOPOGRAPHY ESTIMATED FROM SITE PLAN PROVIDED BY LOUDOUN COUNTY DATED DECEMBER 2017

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LOVETTSVILLE PARK
LOVETTSVILLE, LOUDOUN COUNTY, VIRGINIA

SEISMIC REFRACTION LINE L-3

Scale:	Fig.
AS SHOWN	4

Date:	Drawn By:	Checked By:	Project No.:
APRIL 2018	D.J.N.	P.E.B.	JD185069

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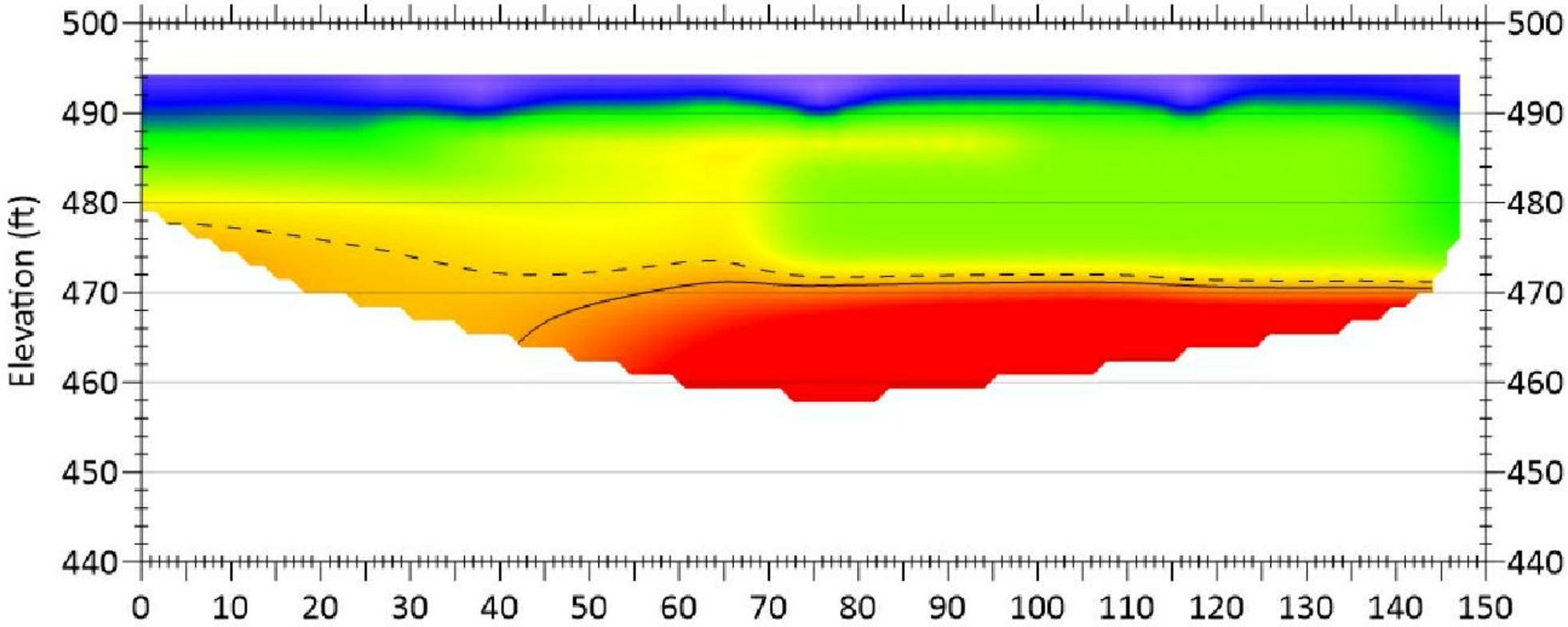
LINE 4



5,900 ft/s

6,900 ft/s

NOTES;
1) PROFILE ORIENTED AS NOTED ON FIGURE
2) TERRAIN TOPOGRAPHY ESTIMATED FROM SITE PLAN PROVIDED BY LOUDOUN COUNTY DATED DECEMBER 2017

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Ashburn, Virginia 20147 (703) 726-8032 fax

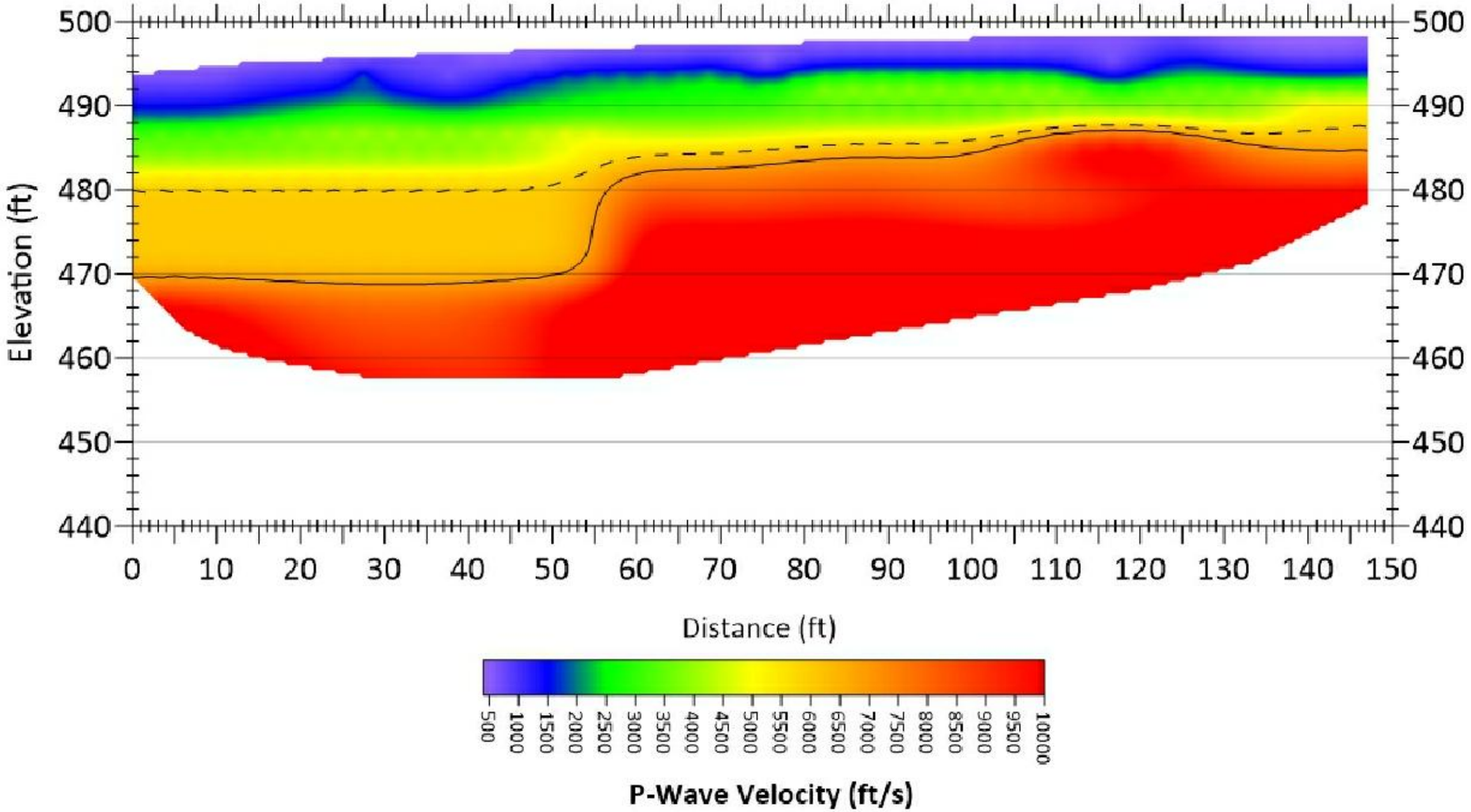
LOVETTSVILLE PARK
LOVETTSVILLE, LOUDOUN COUNTY, VIRGINIA

SEISMIC REFRACTION LINE L-4			Scale: AS SHOWN	Fig. 5
Date: APRIL 2018	Drawn By: D.J.N.	Checked By: P.E.B.	Project No.: JD185069	

SOUTH

LINE 5

NORTH



5,900 ft/s

6,900 ft/s

NOTES;

1) PROFILE ORIENTED AS NOTED ON FIGURE
2) TERRAIN TOPOGRAPHY ESTIMATED FROM SITE PLAN PROVIDED BY LOUDOUN COUNTY DATED DECEMBER 2017

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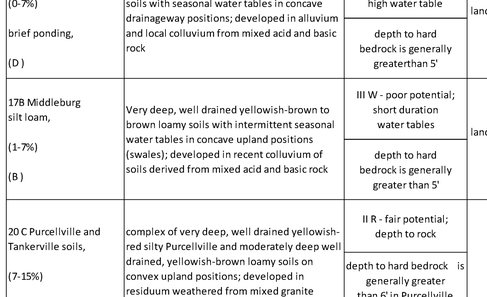
Ashburn, Virginia 20147 (703) 726-8032 fax

LOVETTSVILLE PARK
LOVETTSVILLE, LOUDOUN COUNTY, VIRGINIA

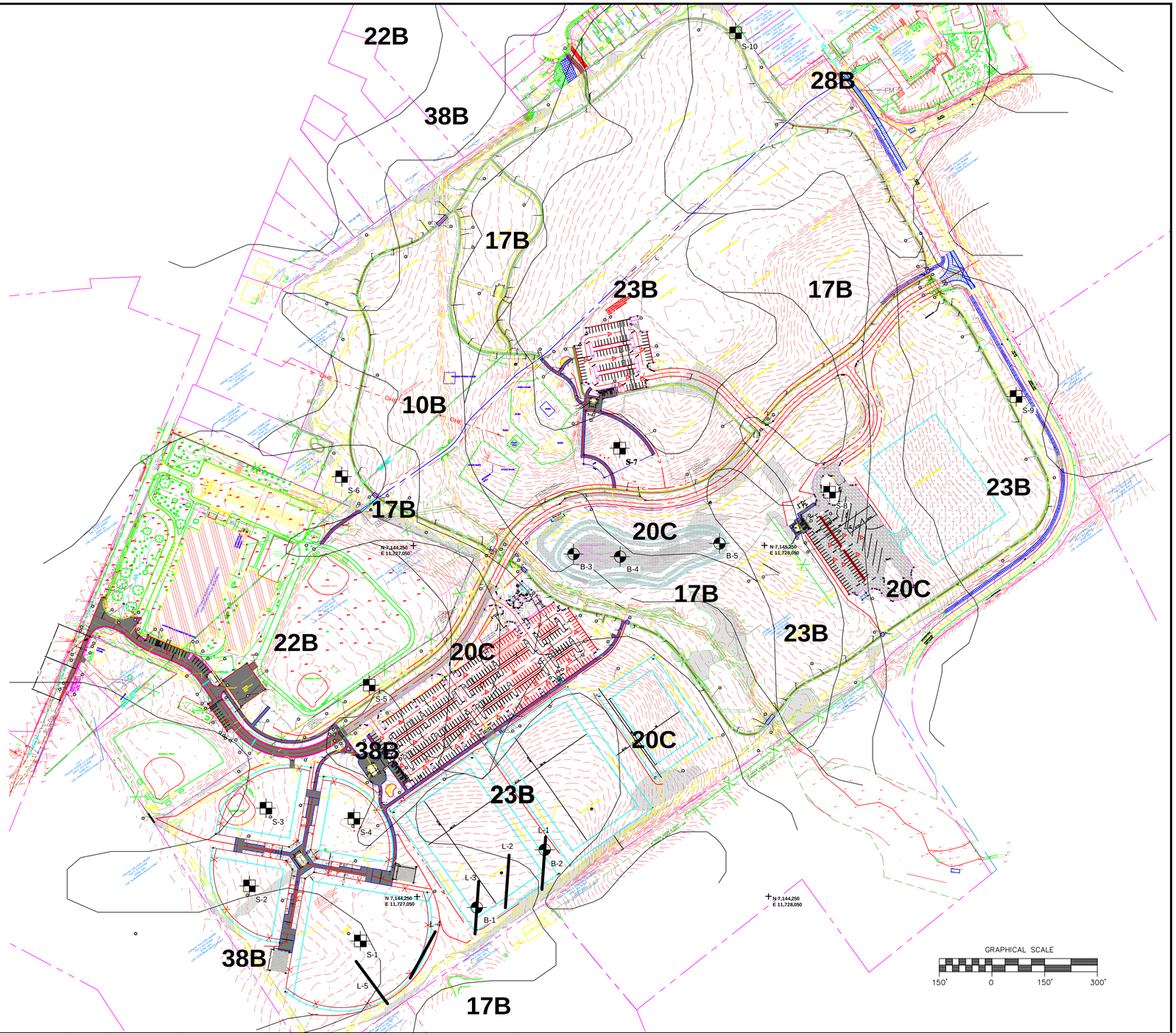
SEISMIC REFRACTION LINE L-5			Scale: AS SHOWN	Fig. 6
Date: APRIL 2018	Drawn By: D.J.N.	Checked By: P.E.B.	Project No.: JD185069	

Mapping Unit Number, Name, Slope, Flooding Potential, and Hydrologic Group	Soil Characteristics	Mapping Unit Potential Subclasses For Selected Uses		
		General Development Central Water and Sewer/ Depth to Rock	Conventional Septic Tank Drain Fields	Agricultural Forestry and Horticultural/ USDA Land use capabiltiy class
10B Mongle silt loam, (0-7%) brief ponding, (D)	VVery deep, somewhat poorly drained brown and mottled brown and gray loamy to silty soils with seasonal water tables in concave drainageway positions; developed in alluvium and local colluvium from mixed acid and basic rock	IV W - very poor potential; prolonged high water table	IV - very poor: landscape position and prolonged high water table	IV - grassland agriculture
		depth to hard bedrock is generally greaterthan 5'		4W
17B Middleburg silt loam, (1-7%) (B)	Very deep, well drained yellowish-brown to brown loamy soils with intermittent seasonal water tables in concave upland positions (swales); developed in recent colluvium of soils derived from mixed acid and basic rock	III W - poor potential; short duration water tables	IV - very poor: landscape position and short duration water tables	I - prime farmland
		depth to hard bedrock is generally greater than 5'		2E
20 C Purcellville and Tankerville soils, (7-15%) (B)	complex of very deep, well drained yellowish-red silty Purcellville and moderately deep well drained, yellowish-brown loamy soils on convex upland positions; developed in residuum weathered from mixed granite gneiss and metadiabase rock	II R - fair potential; depth to rock	II - fair potential: depth to rock	II - secondary cropland
		depth to hard bedrock is generally greater than 6' in Purcellville and greater than 30" in Tankerville		3E, 4S
22B Purcellville-Swampoodle complex, (2-7%) (B)	complex of very deep, well drained yellowish-red silty Purcellville and very deep moderately well drained, strong brown and mottled strong brown and gray silty Swampoodle soils in broad, nearly level to concave upland positions; developed in residuum weathered from mixed granite gneiss and metadiabase rock	II WP - fair potential; seasonal water table	II - poor potential; seasonal water table, slow permeability	II - secondary cropland
		depth to hard bedrock is generally greater than 5'		2E, 4W
23B Purcellville silt loam, (2-7%) (B)	very deep, well drained yellowish-red silty to loamy soil on undulating and gently sloping uplands; developed in residuum weathered from mixed granite gneiss and metadiabase rock	I - good potential	I- good potential	I - prime farmland
		depth to hard bedrock is generally greater than 6'		2E
28B Eubanks loam, (2-7%) (B)	very deep, well drained reddish-yellow to red loamy soil on undulating and gently sloping uplands; developed in residuum weathered from mixed gneiss, metadiabase and other metamorphosed grantic rocks	I - good potential	I- good potential	I - prime farmland
		depth to hard bedrock is generally greater than 6'		2E
38B Swampoodle silt loam, (1-7%) (C)	very deep, moderately well drained, strong brown and mottled strong brown and gray silty soils with seasonal water tables in broad, nearly level to concave upland positions; developed in residuum derived from mixed acid and basic rock	IV WP - very poor potential; seasonal high water table and areas of shrink-swell clays	IV - very poor; landscape position and prolonged high water table	IV - grassland agriculture
		depth to hard bedrock is generally greater than 5'		4W



SITE VICINITY MAP
SCALE 1" =2000'
MAP COORDINATE SYSTEM
US STATE PLANE
VA NORTH
DATUM = NAVD888

NOTE: BASE PLAN PROVIDED BY LOUDOUN COUNTY OF VIRGINIA DATED DECEMBER 2017.



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Ashburn, Virginia 20147 (703) 726-8032 fax

L E G E N D

- B-1 — APPROXIMATE TEST BORING LOCATION
- S-1 — APPROXIMATE AGRONOMIC SAMPLE LOCATION
- L-1 — APPROXIMATE SEISMIC SURVEY LINE

NO.	DATE	REVISION

LOVETTSVILLE PARK

57 EAST BROAD WAY, LOVETTSVILLE, VIRGINIA

SUBSURFACE INVESTIGATION PLAN

PROJECT NO.: JD185069
SCALE: AS SHOWN
DATE: MAY 1, 2018
DRAWN BY: A.K.M.
CHECKED BY: P.E.B.

Fig. 7

N:\Projects\2018\JD185069\Working Files\Diagrams--Drawings--Figures\Subsurface Investigation Plan 5-1-18.dwg

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Appendix B
Soil Laboratory Test Results

Liquid and Plastic Limit, and Grain Size Analysis Test Data (6 pages)

Agronomic Test Data and Recommendations (5 pages)

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Ashburn, Virginia 20147
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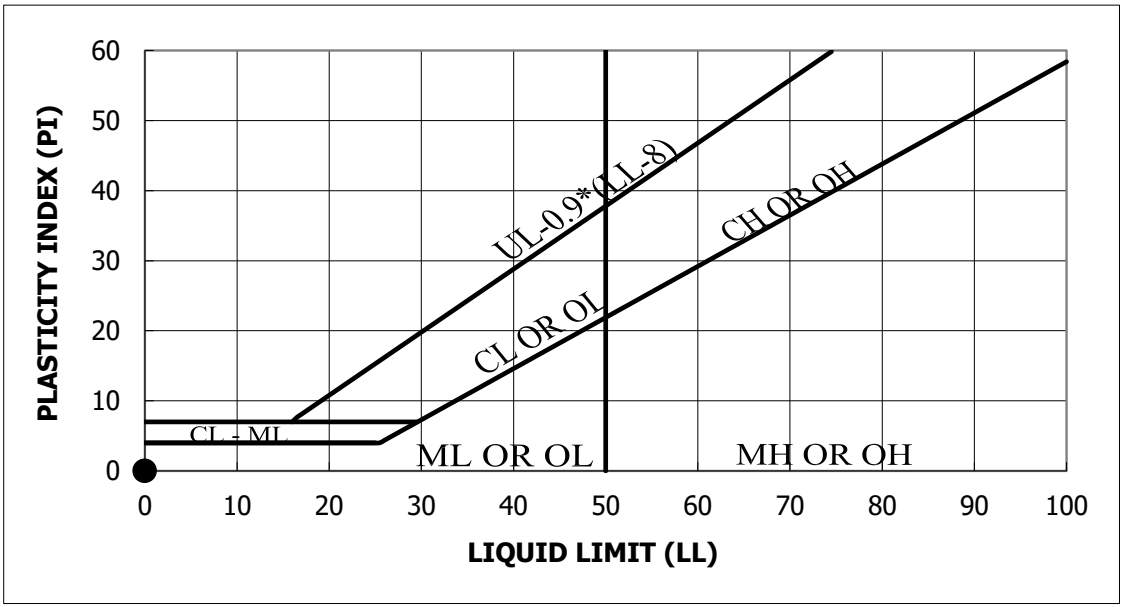
LIQUID AND PLASTIC LIMIT - ASTM D4318			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-2	**Depth (Feet)**	18.5-20.0
Lab Order No.	4302-1	**Date**	04.10.2018



Material Description	LL	PL	PI	% Passing		USCS	w (%)
				#4	#200		
SILTY SAND	NP	NP	NP	91.7	29.9	SM	7.7
Color	Brown		AASHTO Classification			A-2-4	

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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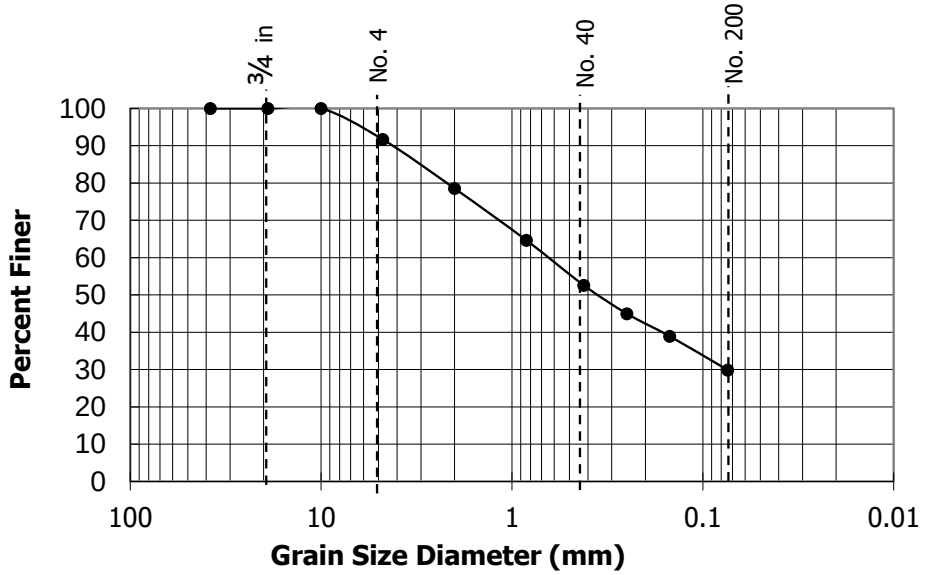
GRAIN SIZE ANALYSIS - ASTM D422			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-2	**Depth (Feet)**	18.5-20.0
Lab Order No.	4302-1	**Date**	04.10.2018



SIEVE	% Passing
1 ½ "	**100**
3/4"	**100**
3/8"	**100**
#4	**92**
#10	**79**
#20	**65**
#40	**53**
#60	**45**
#100	**39**
#200	**30**
Pan	**--**

USCS Group Symbol	**SM**
USCS Group Name	**SILTY SAND**
Cu	**---**
Cc	**---**
LL	**NP**
PI	**NP**
Gravel	**8.3**
Sand	**61.8**
Fines	**29.9**
AASHTO Classification	**A-2-4**
Color	**Brown**

Test Method: ASTM D 422

Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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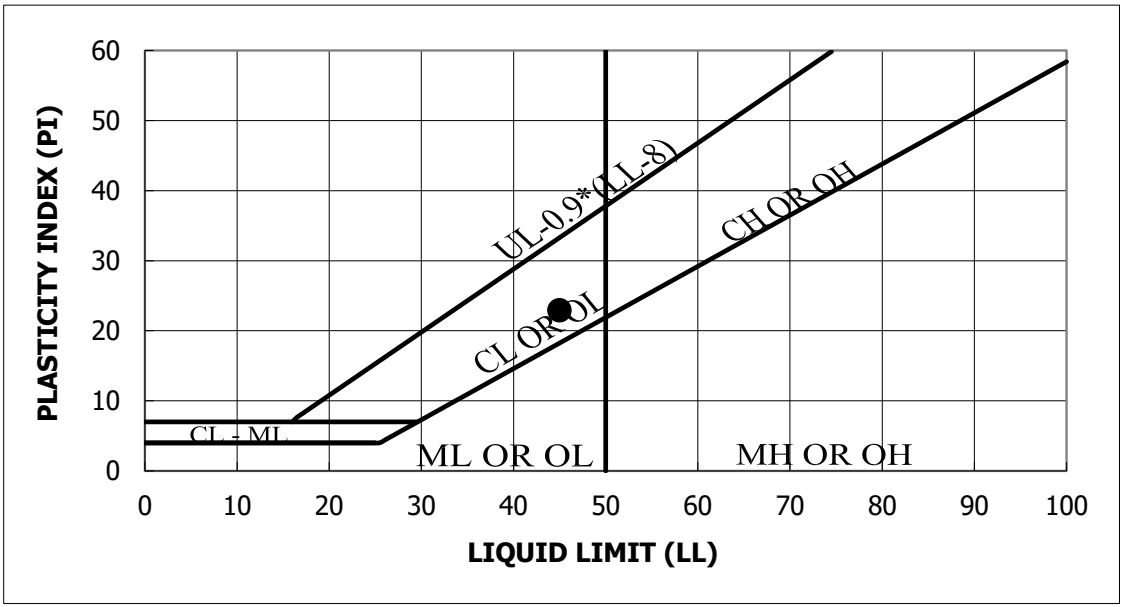
LIQUID AND PLASTIC LIMIT - ASTM D4318			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-3	**Depth (Feet)**	0.0-2.0
Lab Order No.	4302-2	**Date**	04.10.2018



Material Description	LL	PL	PI	% Passing		USCS	w (%)
				#4	#200		
Lean Clay with sand	45	22	23	99.2	71.1	CL	23.2
Color	Brown		AASHTO Classification			A-7-6	

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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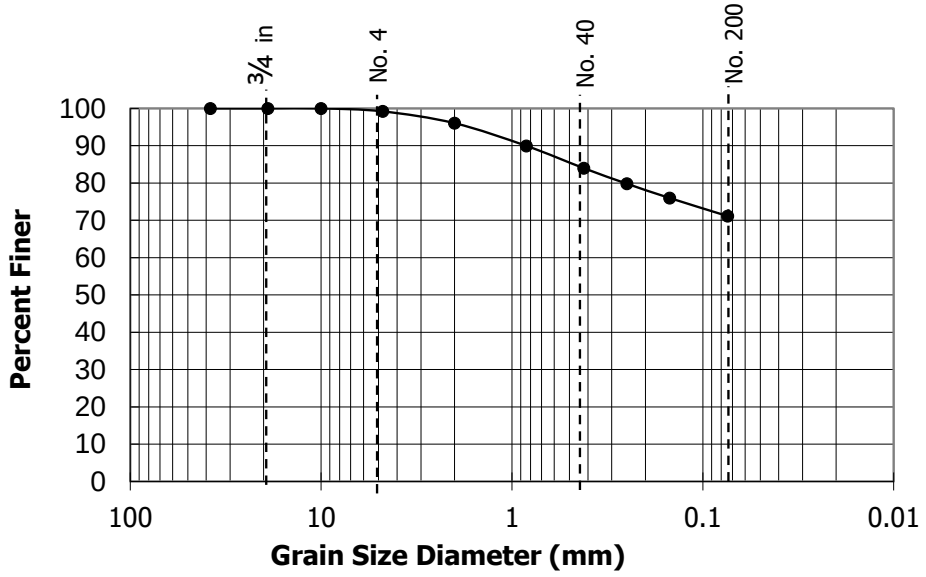
GRAIN SIZE ANALYSIS - ASTM D422			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-3	**Depth (Feet)**	0.0-2.0
Lab Order No.	4302-2	**Date**	04.10.2018



SIEVE	% Passing
1 ½ "	**100**
3/4"	**100**
3/8"	**100**
#4	**99**
#10	**96**
#20	**90**
#40	**84**
#60	**80**
#100	**76**
#200	**71**
Pan	**--**

USCS Group Symbol	**CL**
USCS Group Name	**Lean Clay with sand**
Cu	**---**
Cc	**---**
LL	**45**
PI	**23**
Gravel	**0.8**
Sand	**28.1**
Fines	**71.1**
AASHTO Classification	**A-7-6**
Color	**Brown**

Test Method: ASTM D 422

Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

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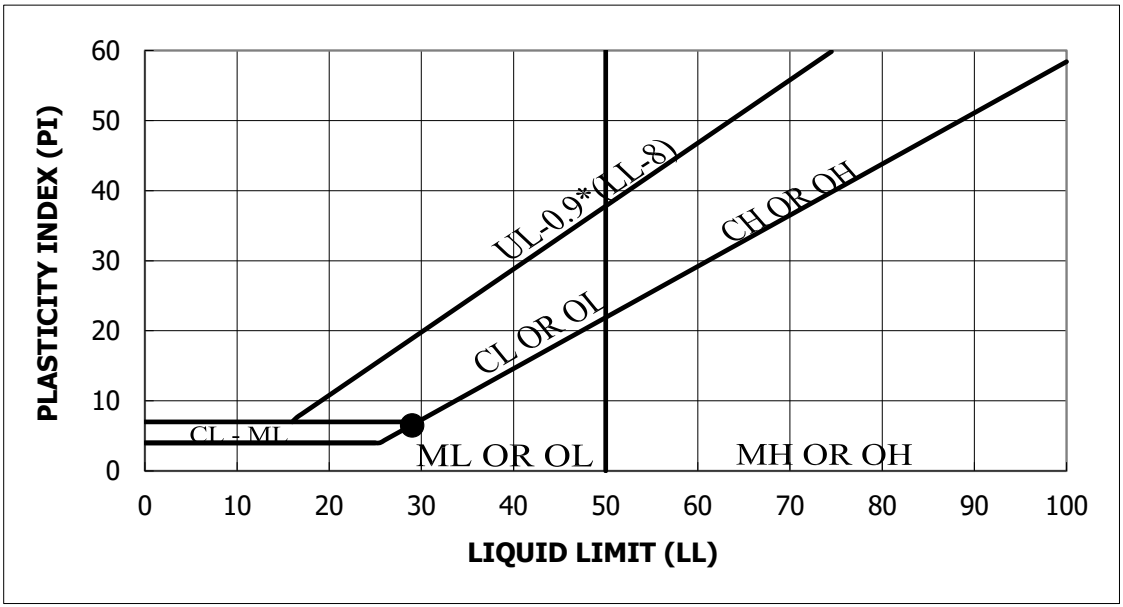
LIQUID AND PLASTIC LIMIT - ASTM D4318			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-4	**Depth (Feet)**	5.0-6.5
Lab Order No.	4302-5	**Date**	04.10.2018



Material Description	LL	PL	PI	% Passing		USCS	w (%)
				#4	#200		
SILTY SAND	29	23	6	100.0	38.2	SM	10.5
Color	Brown		AASHTO Classification			A-4	

Test Method: ASTM D 4318
Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by Lindsay Bartz

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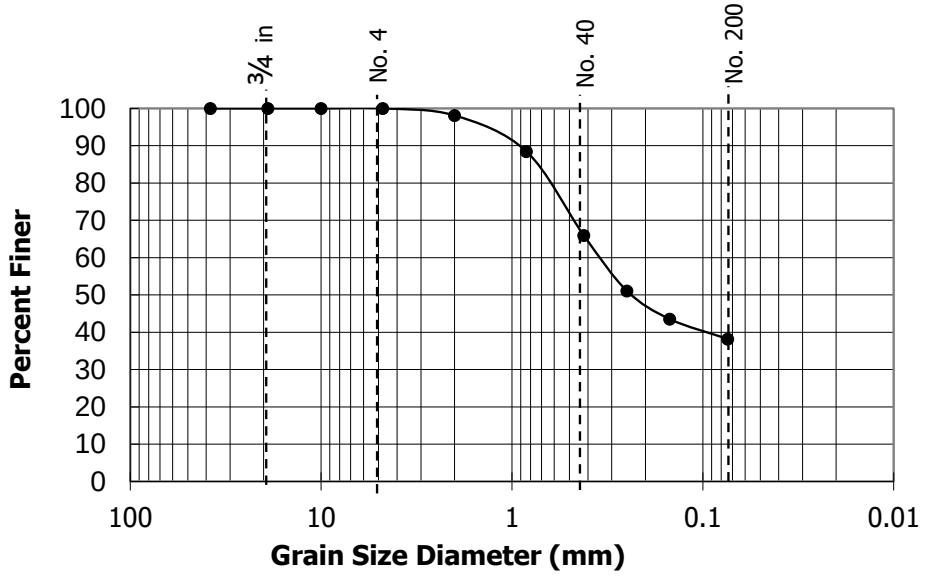
GRAIN SIZE ANALYSIS - ASTM D422			
Project No.	JD185069	**Project Name**	Lovettsville Park
Sample ID	B-4	**Depth (Feet)**	5.0-6.5
Lab Order No.	4302-5	**Date**	04.10.2018



SIEVE	% Passing
1 ½ "	**100**
3/4"	**100**
3/8"	**100**
#4	**100**
#10	**98**
#20	**88**
#40	**66**
#60	**51**
#100	**44**
#200	**38**
Pan	**--**

USCS Group Symbol	**SM**
USCS Group Name	**SILTY SAND**
Cu	**---**
Cc	**---**
LL	**29**
PI	**6**
Gravel	**0.0**
Sand	**61.8**
Fines	**38.2**
AASHTO Classification	**A-4**
Color	**Brown**

Test Method: ASTM D 422

Soil Classification by ASTM D2487 and AASHTO M 145

Reviewed by: Lindsay Bartz

Report Number: 18-093-0516
Account Number: 74328

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Grower: Lovettesville Park
JD185069

SOIL ANALYSIS REPORT

Analytical Method(s): Mehlich 3 SMP Buffer pH Loss On Ignition Water pH

Date Received: 04/03/2018 **Date Of Analysis:** 04/04/2018 **Date Of Report:** 04/04/2018

Sample ID / Field ID	Lab Number	OM % Rate	W/V Soil Class	ENR lbs/A	Phosphorus M3 ppm Rate	Phosphorus ppm Rate	Phosphorus ppm Rate	Potassium K ppm Rate	Magnesium Mg ppm Rate	Calcium Ca ppm Rate	Sodium Na ppm Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	C.E.C meq/100g
S-1	10172	3.0 M		101	10 VL			33 VL	93 M	977 H	16 VL	6.4		0.6	6.4
S-2	10173	2.2 L		87	5 VL			32 VL	59 L	759 H	18 VL	6.3		0.5	4.9
S-3	10174	3.3 M		105	4 VL			33 VL	118 M	1102 H	16 VL	6.0	6.81	1.2	7.8
S-4	10175	2.8 M		97	6 VL			36 VL	120 H	880 M	12 VL	6.0	6.83	1.0	6.5
S-5	10176	2.9 M		99	4 VL			35 VL	96 M	792 M	15 VL	5.8	6.81	1.2	6.1

Sample ID / Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3 N ppm Rate	Sulfur S ppm Rate	Zinc Zn ppm Rate	Manganese Mn ppm Rate	Iron Fe ppm Rate	Copper Cu ppm Rate	Boron B ppm Rate	Soluble Salts SS ms/cm Rate		
S-1	1.3	12.1	76.3	1.1	9.4		11 L	1.0 VL	48 H	141 VH	0.7 L	0.3 VL			
S-2	1.7	10.0	77.4	1.6	10.2		19 M	0.8 VL	44 H	127 VH	0.6 L	0.3 VL			
S-3	1.1	12.6	70.6	0.9	15.4		16 M	0.7 VL	65 VH	111 VH	0.8 L	0.3 VL			
S-4	1.4	15.4	67.7	0.8	15.4		12 L	1.0 VL	135 VH	110 VH	0.8 L	0.3 VL			
S-5	1.5	13.1	64.9	1.1	19.7		11 L	0.7 VL	35 H	124 VH	0.7 L	0.3 VL			

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Pauric McGroary

Pauric McGroary

Report Number: 18-093-0516
Account Number: 74328

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Ashburn VA 20147

Grower: Lovettesville Park
JD185069

Date Received: 04/03/2018
Date Of Report: 04/04/2018

SOIL FERTILITY RECOMMENDATIONS

Sample ID Field ID	Intended Crop	Yield Goal	Lime Tons/A	Nitrogen N lb/A	Phosphate P_2O_5 lb/A	Potash K_2O lb/A	Magnesium Mg lb/A	Sulfur S lb/A	Zinc Zn lb/A	Manganese Mn lb/A	Iron Fe lb/A	Copper Cu lb/A	Boron B lb/A
S-1	Athletic Field	0	0.0	3.5	4.0	6.0	0	0.56	0	0	0	0	0
S-2	Athletic Field	0	0.0	3.5	5.0	6.0	0.11	0.36	0	0	0	0	0
S-3	Athletic Field	0	0.0	3.5	5.0	6.0	0	0.43	0	0	0	0	0
S-4	Athletic Field	0	0.0	3.5	4.5	6.0	0	0.53	0	0	0	0	0
S-5	Athletic Field	0	0.0	3.5	5.0	6.0	0	0.56	0	0	0	0	0

Comments:

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

Pauric McGroary

Report Number: 18-093-0516

Account Number: 74328

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Grower: Lovettesville Park
JD185069

Sample(s) : S-2 Crop: Athletic Field

Apply required magnesium with magnesium oxide, Epsom Salts, K-Mag or Sul-PO-Mag.

Sample(s) : S-2,S-3,S-4,S-5 Crop: Athletic Field

For a more in depth explanation of the soil test and recommendations, go to our website www.aleastern.com and select the "Lawn and Garden" tab at the top of home page. Under the "How to Understand a Soil Test Report" header you will find the link to the article "Soil Test Report & Fertilizer Recommendation Explained".

The amount of fertilizer recommended in the first page is the total amount needed for the entire growing season. Split into 3-4 applications to keep the atheletic field green and prevent fertilizer loss. Custom blend is best to meet exactly the requirement, if this is impossible, the above specific fertilizer application is a general guideline, if the specified grades can not be found, replace with fertilizer having similar N:P:K ratio. The best time to apply fertilizer for cool season grass (bluegrass, fescue, ryegrass) is in the Fall when grass is growing. For Mid-Atlantic region the time is from late August to November. For Northeast region the time is from mid August to October. Fall application should start as soon as the day time high temperature is below 80-85F, apply with the interval of one month. If you start late in the Fall, apply the remaining in the Fall of next year. Spring application can start as soon as the grass starts to grow in April. In the case of exceptional warm Spring, or the grass look pale, the application can be made earlier.

Sample(s) : S-3,S-4,S-5 Crop: Athletic Field

Apply the amount of lime recommended in first page to raise pH

Sample(s) : S-3,S-5 Crop: Athletic Field

Apply dolomitic lime to raise pH and improve the magnesium level.

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

Pauric McGroary

Report Number: 18-093-0516
Account Number: 74328

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Ashburn VA 20147

Grower: Lovettesville Park
JD185069

SOIL ANALYSIS REPORT

Analytical Method(s): Mehlich 3 SMP Buffer pH Loss On Ignition Water pH

Date Received: 04/03/2018 **Date Of Analysis:** 04/04/2018 **Date Of Report:** 04/04/2018

Sample ID / Field ID	Lab Number	OM % Rate	W/V Soil Class	ENR lbs/A	Phosphorus M3 ppm Rate	Phosphorus ppm Rate	Phosphorus ppm Rate	Potassium K ppm Rate	Magnesium Mg ppm Rate	Calcium Ca ppm Rate	Sodium Na ppm Rate	pH Soil pH	pH Buffer Index	Acidity H meq/100g	C.E.C meq/100g
S-6	10178	3.8 M		116	7 VL			39 VL	110 M	949 M	18 VL	5.8	6.79	1.4	7.2
S-7	10179	3.9 M		114	76 H			406 VH	154 M	1245 M	16 VL	6.2		1.2	9.8
S-8	10180	3.7 M		117	14 L			104 M	70 M	502 L	15 VL	5.2	6.75	1.8	5.2
S-9	10181	3.5 M		110	11 VL			100 M	130 H	789 M	15 VL	5.6	6.77	1.6	6.9
S-10	10182	3.0 M		102	8 VL			93 M	109 H	692 M	15 VL	5.7	6.81	1.2	5.9

Sample ID / Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3 N ppm Rate	Sulfur S ppm Rate	Zinc Zn ppm Rate	Manganese Mn ppm Rate	Iron Fe ppm Rate	Copper Cu ppm Rate	Boron B ppm Rate	Soluble Salts SS ms/cm Rate		
S-6	1.4	12.7	65.9	1.1	19.4		12 L	1.7 L	66 VH	108 VH	1.0 M	0.3 VL			
S-7	10.6	13.1	63.5	0.7	12.2		16 M	7.1 H	32 H	270 VH	3.5 VH	0.7 M			
S-8	5.1	11.2	48.3	1.3	34.6		22 M	1.4 L	90 VH	133 VH	1.0 M	0.3 VL			
S-9	3.7	15.7	57.2	0.9	23.2		13 L	1.0 VL	172 VH	133 VH	1.1 M	0.3 VL			
S-10	4.0	15.4	58.6	1.1	20.3		15 L	1.5 L	57 VH	93 VH	1.2 M	0.2 VL			

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation of symbols: % (percent), ppm (parts per million), lbs/A (pounds per acre), ms/cm (milli-mhos per centimeter), meq/100g (milli-equivalent per 100 grams). Conversions: ppm x 2 = lbs/A, Soluble Salts ms/cm x 640 = ppm.

This report applies to sample(s) tested. Samples are retained a maximum of thirty days after testing.

Analysis prepared by: Waypoint Analytical Virginia, Inc.

by: Pauric McGroary

Pauric McGroary

Report Number: 18-093-0516
Account Number: 74328

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Grower: Lovettesville Park
JD185069

Date Received: 04/03/2018
Date Of Report: 04/04/2018

SOIL FERTILITY RECOMMENDATIONS

Sample ID Field ID	Intended Crop	Yield Goal	Lime Tons/A	Nitrogen N lb/A	Phosphate P_2O_5 lb/A	Potash K_2O lb/A	Magnesium Mg lb/A	Sulfur S lb/A	Zinc Zn lb/A	Manganese Mn lb/A	Iron Fe lb/A	Copper Cu lb/A	Boron B lb/A
S-6	Athletic Field	0	0.0	3.5	4.5	6.0	0	0.53	0	0	0	0	0
S-7	Athletic Field	0	0.0	3.5	0.5	0	0	0.43	0	0	0	0	0
S-8	Athletic Field	0	0.0	3.5	3.5	4.0	0	0.28	0	0	0	0	0
S-9	Athletic Field	0	0.0	3.5	4.0	5.0	0	0.51	0	0	0	0	0
S-10	Athletic Field	0	0.0	3.5	4.5	5.0	0	0.46	0	0	0	0	0

Comments:

Sample(s) : S-7,S-8,S-9,S-10 Crop: Athletic Field

For a more in depth explanation of the soil test and recommendations, go to our website www.aleastern.com and select the "Lawn and Garden" tab at the top of home page. Under the "How to Understand a Soil Test Report" header you will find the link to the article "Soil Test Report & Fertilizer Recommendation Explained".

The amount of fertilizer recommended in the first page is the total amount needed for the entire growing season. Split into 3-4 applications to keep the atheletic field green and prevent fertilizer loss. Custom blend is best to meet exactly the requirement, if this is impossible, the above specific fertilizer application is a general guideline, if the specified grades can not be found, replace with fertilizer having similar N:P:K ratio. The best time to apply fertilizer for cool season grass (bluegrass, fescue, ryegrass) is in the Fall when grass is growing. For Mid-Atlantic region the time is from late August to November. For Northeast region the time is from mid August to October. Fall application should start as soon as the day time high temperature is below 80-85F, apply with the interval of one month. If you start late in the Fall, apply the remaining in the Fall of next year. Spring application can start as soon as the grass starts to grow in April. In the case of exceptional warm Spring, or the grass look pale, the application can be made earlier.

Sample(s) : S-8 Crop: Athletic Field

Apply dolomitic lime to raise pH and improve the magnesium level.

Sample(s) : S-8,S-9,S-10 Crop: Athletic Field

Apply the amount of lime recommended in first page to raise pH

"The recommendations are based on research data and experience, but NO GUARANTEE or WARRANTY expressed or implied, concerning crop performance is made."

Pauric McGroary