advanced engineering services

REPORT OF SUBSURFACE EXPLORATION

New Residential Subdivision

NWC of Arizona Street and 61st Avenue

Hobart, Lake County, Indiana

AES Project No. 2020-1105G

Prepared For

Mr. Phillip Gralik, PE

City of Hobart - City Engineer

414 Main Street

Hobart, Indiana 46342

November 10, 2020

Advanced Engineering Services (AES) Inc.
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November 10, 2020

Mr. Phillip Gralik, PE
City of Hobart - City Engineer
414 Main Street
Hobart, Indiana 46342

Re: Report of Subsurface Exploration
Proposed Residential Subdivision
NWC of Arizona Street and 61st Avenue
Hobart, Lake County, Indiana
AES Project No. 2020-1105G

Dear Mr. Gralik:

Advanced Engineering Services (AES) is pleased to submit herewith a report of a subsurface exploration for the proposed residential subdivision at the referenced location in Hobart, Indiana. This study was performed in accordance with AES Proposal No. 2020-258G dated October 1, 2020, which was authorized by the honorable Mayor Mr. Brian K. Snedecor of City of Hobart on October 8, 2020.

This report contains field and laboratory test results, an engineering interpretation of the data with respect to the available project characteristics and our recommendations to aid design and construction of the proposed improvements and other earth-related phases of this project. This study only addresses the new roadways and related infrastructures for the new development. No geotechnical design recommendations for the proposed buildings or any other structures are included in the scope of work.

AES appreciates the opportunity to be of service to you on this project. If we can be of any further assistance, or if you have any questions regarding this report, please do not hesitate to contact us at your convenience.

Respectfully submitted,
Advanced Engineering Services (AES) Inc.

Jose A. Vargas
Project Manager
jav@adv-engrs.com

AKHTAR ZAMAN REGISTERED No. 10001091 STATE OF INDIANA PROFESSIONAL ENGINEER

Akhtar (Art) Zaman, P.E
Principal Engineer
anz@adv-engrs.com

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Purpose and Scope 1
1.2 Site and Project Description 1
2.0 FIELD AND LABORATORY EXPLORATIONS 2
2.1 Field Exploration 2
2.2 Laboratory Explorations 2
3.0 GENERAL SUBSURFACE CONDITIONS 3
3.1 General 3
3.2 Subsurface Soil and Groundwater Profile 3
3.3 Groundwater Profile 3
4.0 GEOTECHNICAL RECOMMENDATIONS 4
4.1 General 4
4.2 Site Preparation 4
4.3 Excavation and Slope Stability 5
4.4 Discussion for Detention Ponds 6
4.5 Recommendations for Storm Sewers 6
4.6 Pavement Subgrade Recommendations 7
4.7 Corrosion Protection 8
4.8 Engineered Fill 8
4.9 Groundwater Control 9
5.0 LIMITATIONS OF STUDY 10

APPENDIX

Boring Location Plan

Test Boring Logs and Laboratory Test Results

Field Classification System for Soil Exploration

1.0 INTRODUCTION

This report presents the results of a subsurface exploration for the new residential subdivision planned at the northwest corner of the intersection of Arizona Street and 61st Avenue in Hobart, Lake County, Indiana. This study was performed in accordance with AES Proposal No. 2020-258G dated October 1, 2020.

1.1 Purpose and Scope

The purpose of the study was to: obtain subsurface soil and groundwater information present at the site based on test borings, evaluate the suitability of the encountered materials to support the proposed construction, provide recommendations based on the field and laboratory tests for the design of the proposed improvements and earth-related phases of the project.

The scope of this exploration includes: a limited site reconnaissance, field soil borings, field and laboratory testing and an engineering evaluation of the encountered subsurface conditions based on the soil borings.

Please note that our recommendations are prepared solely based on the results of the field test borings and in accordance with generally accepted geotechnical engineering principles and practices. It is important to understand that the subsurface soil conditions at other locations may be different and hence no warranties are expressed or implied in this report. We are not responsible for independent conclusions, opinions or recommendations made by others.

1.2 Site and Project Description

City of Hobart is planning a new residential subdivision at the northwest corner of the intersection of Arizona Street and 61st Avenue in Hobart, Indiana. The project site is currently vacant and partly wooded parcel covering a total of about 60 acres in plan area. While no topographic drawing was available, the area appears to be relatively flat to gently rolling. It appears that the site was previously utilized predominantly for agricultural purposes.

While no detailed information is available at the time of the proposal, we understand that the proposed development will include single-family residences and town homes with driveways. In addition, available drawings suggest that there will be vegetated detention and bio-swales for the project. Although no details drawings are available, we assume that the proposed storm sewers will consist of pipes no larger than about 24-inch to 48-inch in diameter with inverts no deeper than about 6 to 7 ft below the existing grade.

This study only addresses the roadways and related infrastructure for the development. As requested, a total of eight (8) soil borings along the proposed driveways of the proposed development were completed during this study. No geotechnical design for the proposed buildings or any other structures is considered in this exploration.

2.0 FIELD AND LABORATORY EXPLORATIONS

2.1 Field Exploration

As requested, the field exploration program consisted of eight (8) test borings at the approximate locations shown on the Boring Location Plan in the Appendix. Borings B-1 through B-8 were drilled to a depth of 15 ft below the existing grade.

All test locations were established at the site based on the available drawings, accessibility and by estimating distances from existing site features. Since these measurements are not precise, the boring locations shown on the attached Boring Location Plan should be considered approximate. Ground elevations reported on the logs were estimated from Google Earth.

All soil borings were completed using an all-terrain vehicle (ATV)-mounted CME-550 drill-rig. Conventional hollow-stem augers were used to advance the boreholes through the soil. Standard Penetration Tests (SPT) were performed in accordance with applicable ASTM standards. Representative split-spoon samples were obtained at selected intervals. The SPT (N) value corresponding to each split-spoon sample provides general information about the strength and consistency of the naturally occurring materials. The Soil Classification Sheet provided in Appendix explains the SPT test procedure in brief.

Groundwater observations were made during and immediately after completion of the drilling operations. SPT values and groundwater observations are noted on the respective Test Boring Logs. All holes were backfilled with auger cuttings after the drilling.

2.2 Laboratory Explorations

Samples from the field were placed in sealed containers and brought to the laboratory for further analysis. The laboratory program included a supplementary visual classification on all samples and the field logs were edited accordingly. Moisture and organic contents, pH and unconfined compressive strength tests were completed on selected soil samples and the results are included in the appendix.

The Test Boring Logs in the Appendix describe visual classifications of all soil strata encountered using the Unified Soil Classification System (USCS). Soil classification explaining terms and symbols used on the logs is provided in the Appendix. Please note that we will store the samples for sixty days after which they will be discarded unless you request otherwise.

3.0 GENERAL SUBSURFACE CONDITIONS

3.1 General

The subsurface materials encountered and groundwater observations at each boring are described in detail on the Test Boring Logs provided in Appendix. It should be noted that stratification lines shown on the boring logs represent approximate transitions between material types. In-situ strata changes could occur gradually or at slightly different levels. Also, it should be noted that the boring logs depict conditions at the soil boring locations only and the subsurface conditions at other locations may vary. Some conditions, such as groundwater conditions, could change with time.

3.2 Subsurface Soil and Groundwater Profile

All borings encountered approximately 8 inches to 14 inches of dark brown sandy clay mixed with topsoil at the existing ground surface. This is likely the result of tilling activities at the site. All soil borings then revealed brown to gray silt with clay (ML/CL), sandy clay (CL), lean clay (CL) with isolated interbedded sandy silt (ML) or sand to the termination depth of 15 ft below the existing surface grade. Borings B-4 and B-5 noted trace organics to depths of about 8 ft and 4 ft, respectively.

Based on the field Standard Penetration Test (SPT) values, the natural granular soils were very loose to loose and the cohesive soils were generally medium stiff to stiff with very soft to soft soil especially in Borings B-4 and B-5. Moisture contents of the native soils varied between teens to twenties with few in the thirties.

The following table summarizes the pH tests performed on select samples:

Table-3.1: Summary of pH Test Results

Boring Nos.	Depth ft	Visual Classification	pH
B-2	6 – 7.5	Brown Silt with Clay	7.9
B-4	3.5 – 5	Brown Sandy Clay	8.3
B-7	3.5 – 5	Brown Silt with Clay	8.1

3.3 Groundwater Profile

Groundwater observations were made during and immediately after the drilling operations. Perched groundwater was encountered only in Borings B-5 and B-8 at depths of about 9.5 ft and 4 ft, respectively, during drilling.

Please note that short-term groundwater observations do not provide accurate groundwater information and groundwater conditions may change due to precipitation and other hydro-geologic factors. Perched water trapped in granular zones is common in clayey soils and may be encountered at shallow depths during construction.

4.0 GEOTECHNICAL RECOMMENDATIONS

4.1 General

Based upon our analysis of the soil conditions revealed by the test borings and the available project information, the following recommendations were developed. Please note that if the project characteristics are changed from those assumed herein, our recommendations must be reviewed to see whether any modifications are needed.

The subsurface exploration identified actual subsurface conditions only at the test boring locations. It was necessary to extrapolate these conditions in order to characterize the entire project site. For this reason, the subsurface conditions encountered during construction may vary somewhat from the test boring results and may in the extreme case, differ to the extent that modifications to the recommendations become necessary. Therefore, we recommend that AES be retained as the geotechnical consultant throughout the earth-related phases of the project to correlate actual soil conditions with the test boring data, identify variations, conduct additional tests that may be needed and recommend solutions to earth-related problems that may develop during construction.

4.2 Site Preparation

Proper subgrade preparation is essential for long-term performance of any construction project. Please note that improper earthwork may deteriorate an otherwise suitable subgrade. This is especially important for this site has silty/clayey subgrade throughout the proposed development area. The time period between late spring and early fall are typically favorable for earthwork in the project area. Earthwork activities undertaken during late fall and winter often encounter substantial difficulties associated with snow, rain and cold temperatures.

All existing vegetation, topsoil, highly organic soils (over 5%), frozen, wet, soft, loose or otherwise unsuitable material should be removed from the proposed structural (roadway) areas. The mass grading should be performed in a manner consistent with good erosion and sediment control practice. Adequate drainage must be provided at the site to minimize any increase in moisture content of the subgrade soils. Maintaining positive site drainage is an important part of successful earthwork operations and long-term performance. The contractor should maintain the construction area in a well-drained condition both during and after construction. Improper site drainage during grading can increase the need for remedial treatment of saturated soils. Disturbed areas should be sealed off with rubber tired or smooth drum roller at the end of each day and prior to anticipated inclement weather to minimize infiltration of water.

After rough grade has been established in cut areas and prior to placement of new fill, the exposed subgrade should be carefully observed by an AES representative by probing or other methods of testing. The exposed subgrade should furthermore be observed by proof-rolling with a tandem-axle dump truck loaded with at least 20 tons or similar. The purpose of the proof-rolling is to locate soft or unstable soils present at the surface or beneath a thin crust of relatively stronger soil. The proof-roll should cover the entire area in two perpendicular directions. If an area is too small, then it must be observed by an AES representative, to establish its suitability. All unsuitable materials revealed during the evaluation should be replaced or stabilized appropriately.

Soil boring revealed wet silty soils near the anticipated bearing elevation of the proposed sewers. Saturated silty soils tend to become "quick" and loose its strength once the confinements are removed. Hence, some additional stabilization may be necessary depending on the site condition during construction and the contractor must be prepared to handle such unstable materials during the excavations.

The soil borings suggest that the subgrade soil consists of predominantly silty and clayey soils. Depending on the weather conditions, these soils may become soft or unstable under construction traffic particularly if the construction is performed immediately after precipitation or during colder temperatures. The extent to which this may be a problem is difficult to determine beforehand since it is dependent upon several factors including cut and fill depths, weather conditions, drainage provisions, variations in soil conditions across the site, sequencing and scheduling of the earthwork and construction traffic, etc. Construction traffic must be controlled to minimize disturbance and deterioration of the subgrade.

In general, yielding subgrade problems are more prominent in cut areas (where saturated or nearly saturated clayey soils are exposed by the excavation) or where little or no fill is placed. Depending on these factors, it may be possible to stabilize some yielding subgrade soils by disking, aerating and then re-compacting the soils. However, this is often unsuccessful, particularly when the weather conditions do not permit drying of wet soil. In such case, it may be necessary to undercut and replace with coarse aggregate with geo-grid or to use chemical modification (such as lime, fly-ash, cement, etc.). An AES representative should be present during the earthwork to identify areas where special stabilization may be necessary and verify that these recommendations are implemented during construction.

4.3 Excavation and Slope Stability

There should not be any significant difficulty in excavating soils at this site with conventional equipment. Unless specified otherwise, all permanent cut slopes should be no steeper than 3 horizontal to 1 vertical. All temporary excavations should be properly laid back or braced in accordance with Occupational Safety and Health Administration (OSHA) requirements. Flatter cut slopes may be required where there is water seepage or the foundation soils are particularly poor.

Sheeting or trench-boxes may be needed in order to protect the excavations from caving. Slope failure may occur with an increase in loading from machinery and excavated soil and decrease in support resulting from removal of soil. Excavated material should not be stockpiled immediately adjacent to the top of the cut nor should equipment be allowed to operate too closely to the excavations.

Where new fill is placed against existing slopes, the new fill must be benched into the existing slope, as per ISS. This will facilitate a good bonding between the existing soil and the new fill and to prevent the development of a zone of weak soil at the interface. Benches should be at least 10 ft wide into the existing slopes that are steeper than 4 (horizontal) to 1 (vertical). If spatial constraints will not permit an open cut, bracing will be required for any excavation deeper that 5 ft.

Care must be exercised when excavating near the existing streets, underground utilities, etc., to protect the integrity of the existing facilities. Bracing may be required if it becomes necessary to excavate below and in close proximity to such facilities. All temporary bracing for deep excavations should be designed and installed by an experienced specialty contractor.

4.4 Discussion for Detention Ponds

Available drawings suggest that there will be a detention and bio-swales for the project. Based on the soil borings, silty and clayey soils are generally expected at the pond bottoms. However, saturated silty soil was noted in a few borings and must be considered during the design. It is recommended that at least 2 to 3 ft of compacted clay liner be installed at the bottom and sides of the ponds in order to maintain water pool in the detention ponds. While detail design of the liner is beyond the scope of this study, we recommend clayey soils (CL) with hydraulic conductivity less than about 10^{-5} to 10^{-7} cm/sec be placed and compacted as engineered fill discussed in Section 4.8 of this report.

4.5 Recommendations for Storm Sewers

We understand that the project will require storm-sewers for the proposed development. Although no detailed information was available, the sewers will presumably be no larger than 24 inches to 48 inches diameter pipes with inverts no deeper than about 6 ft to 7 ft below the current grade. The subsurface soil noted in the soil borings appear to be generally suitable to support the proposed storm sewers. All existing very soft, highly organic (over 5%) and otherwise unsuitable materials should be removed from the proposed sewer subgrade. All utility excavations should be observed by an AES representative to verify that all unsuitable material is removed.

Groundwater was noted in two test borings and the contractor must be prepared to handle any groundwater during excavations. All excavations should be performed as per OSHA guidelines. Sheeting or boxes should be used in order to stabilize the excavations especially the excavation extend into granular soils. In addition, saturated silty soils tend to become "quick" and loose its strength once the confinements are removed. Hence, some additional stabilization may be necessary depending on the site condition during construction and the contractor must be prepared to handle such unstable materials during the excavations.

Once the sewer subgrade appears satisfactory, approved bedding materials should be placed before placing the pipes. The bedding material around the structures should in accordance with Section 211 of the Indiana Department of Transportation (INDOT) Standard Specifications (ISS). Hand-or remote-guided vibratory compactors are recommended for compacting the bedding material and backfill on either side of the structure.

The first few lifts of backfill over the structure should also be compacted with small vibratory compactors to assure proper compaction is achieved and to prevent damage from heavier and higher energy compactors. Compaction equipment should run parallel to the axis of the structures, starting at the extremity and progressing toward the structures.

Compaction with heavy equipment should not begin until a minimum of two to three lifts have been placed, hand compacted and tested. The remaining structural fill may then be placed and compacted as an engineered fill discussed in Section 4.8 of this report.

We recommend that the joints of the pipes be wrapped with a geotextile drainage fabric to prevent soils from "piping" into the pipe through the joints. A filter fabric such as Mirafi 180 N or equivalent should be placed over each joint, extending at least 12 inches beyond the joint. The fabric should completely encircle each pipe joint and overlapped as per manufacturer's recommendations.

Utility trenches that are left open, backfilled without proper compaction or backfilled with open-graded stone, may become water collection points and allow infiltration into the surrounding soil. This condition may destabilize the subgrade around the trenches such that undercutting and repair may be needed. We recommend using controlled soil fill or dense-graded base stone (such as INDOT Coarse Aggregate No. 53 or similar) to backfill utility excavations to minimize the potential for water collection points. It is advantageous to use dense graded coarse aggregate as it can be more easily compacted. Clayey soil may be used for backfill after the pipes have been adequately covered with bedding materials. In addition, weep-holes should be provided in drop inlets and catch basins to prevent water from ponding.

Sewer pipes may experience heavy thrust forces, especially where there is a significant change in horizontal or vertical alignment. This force may cause separation at the pipe joints and undermine the underlying soil. In order to resist the thrust at horizontal and vertical elbows, pipe sections should be supported on concrete thrust blocks (as needed), which should be designed to withstand the horizontal and vertical forces, generated as a result of change of alignment.

4.6 Pavement Subgrade Recommendations

We understand that a new paved driveway will be constructed for the proposed development. The anticipated subgrade soils revealed by the test borings appear to be generally suitable to support the proposed pavement, provided they are prepared as discussed in Section 4.1 of this report. Please note that improper earthwork may deteriorate an otherwise suitable subgrade especially in silty and clayey soils, as noted in the test borings.

In the new pavement areas, all existing vegetation, highly organic (over 5%) and otherwise unsuitable materials should be removed and replaced with suitable granular material prior to the placement of new fill, aggregate base. It should be noted that the existing subgrade may deteriorate and become unstable if they are left exposed to moisture. Once the subgrade elevation is reached, it should be proof-rolled as discussed in Section 4.1 of this report. Any unsuitable materials revealed by the proof-roll should be replaced or adequately stabilized, as discussed earlier. An AES representative should be present to verify that the subgrade is prepared properly as prescribed in this report.

The pavement surface should be sloped to facilitate positive drainage and prevent surface water ponding on the pavement. Edges of the pavement should provide a means of water outlet by extending the aggregate base through side ditches or drain pipes. The subgrade surface should be uniformly sloped to facilitate drainage through the granular base and to avoid any ponding of water beneath the pavement. Subsurface drains without filter fabric are recommended, if needed. Please note that inadequate surface and subsurface drainage often results in premature pavement failure.

In the absence of any California Bearing Ratio (CBR) tests, we recommend a CBR value of 3 for the pavement design. The aggregate base materials should be well-graded granular materials conforming to INDOT Coarse Aggregate No. 53 in accordance with the Indiana Department of Transportation (INDOT) Standard Specifications. The asphaltic concrete pavement should be constructed in accordance with the INDOT Standard Specifications Section 401-Hot Mix Asphalt, HMA, Pavement.

4.7 Corrosion Protection

The soil samples tested for pH during the laboratory tests indicate that the soils at the site have a low potential for causing corrosion. However, the scope of this study did not include a thorough evaluation of the corrosion potential and a corrosion expert should be consulted.

4.8 Engineered Fill

Once the subgrade has been properly prepared, fill may be placed in order to attain desired final grades. In general, any non-organic, naturally occurring, non-expansive soils can be used for structural fill. Although the native soils encountered in the test borings appears to be suitable as engineered fills, some of the clayey soils may become wet depending on the time of the year and may be difficult.

It is recommended that only sand and gravel or preferably crushed limestone (INDOT 53 gradation or similar) be used in the aggregate base in the pavement areas. The proposed soil fill materials should consist of soil with the following characteristics:

- Organic content less than 5% by dry weight of soil,
- Liquid Limit less than 50 and Plasticity Index less than 30,
- Free of large rock fragments (no particles larger than 3 inches in diameter), debris, roots, rubble, wood or any other deleterious materials,
- The amount retained on a ¾ inch sieve should be less than 30%,
- The maximum dry density (ASTM D-698) should be at least 100 pcf,
- The soil fill should meet the requirements of the Unified Soil Classification System (USCS) (ASTM D-2487) as either CL, CL-ML, SM, SC, SP, SW, SP-SM, SC-SM, SP-SC, SW-SM, SW-SC, GW, GW-GM or GW-GC,
- The use of an essentially one-size material should not be permitted.

All engineered fill with fines should be placed in about 8 to 10 inches loose horizontal lifts and compacted to at least 95% of the maximum dry density determined by the standard Proctor test (ASTM D-698). The soils should be placed and compacted at moisture contents within 3% of the optimum moisture content as determined by the specified Proctor test. Suitable equipment for either aerating or adding water should be available as the soil moisture and weather conditions dictate. In general, smooth-wheel vibratory rollers or skid-plates are suitable for compacting non-cohesive gravel and sand fill type soils.

It is recommended that AES should perform continuous review of the soils related phases of this project. Otherwise, AES can assume no responsibility for construction compliance with the design concepts, specifications, or our recommendations. As part of this review, field density tests should be performed as frequently as necessary to assist in the evaluation of the fill with respect to the above recommendations.

4.9 Groundwater Control

Groundwater was noted in two soil borings as shallow as about 4 ft below existing grade and may rise. Hence, the contractor must be prepared to dewater during construction. Minor water may be pumped from an excavation terminating in clayey soils. However, water should not be pumped directly from an excavation terminating in saturated sandy soil. Typically, well-points or cased-wells installed outside the excavation limits are necessary to lower groundwater in saturated sandy soils. We recommend that water be lowered at least 2 ft below the lowest excavation point.

Discharge from dewatering (if any) should be closely monitored during dewatering. Should excessive fine particles like silty soils are noted with discharged water, the dewatering operation must be halted until unsatisfactory condition is remedied. An experienced dewatering contractor should be employed to design and install dewatering system, if necessary. Any dewatering should be performed with caution as improper dewatering may deteriorate the subgrade as well as nearby structures.

5.0 LIMITATIONS OF STUDY

Differing Site Conditions

Geotechnical engineering recommendations were developed based on the information obtained from the test borings. Please note that soil test borings only depict the subsurface soil and groundwater conditions at the specific locations and time at which they were made. The soil conditions at other locations at the site may differ from those occurring at the soil boring locations. Groundwater condition may change over time. If deviations from the noted subsurface conditions are encountered during construction, please notify us immediately for recommendations.

Not Final Design

This report and the recommendations included in the report are not a final design, but rather as a basis for the final design to be completed by others (architect, civil or structural engineers, etc.). It is the client's responsibility to ensure that the recommendations are properly integrated into the design, and that the geotechnical engineer is provided the opportunity for design input and comment, as needed. We recommend that this firm be retained to review the final construction documents to confirm that the proposed project design sufficiently reflects the recommendations presented in the report. We also suggest that our firm be represented at pre-bid and/or pre-construction meetings regarding this project to offer any needed clarification of the geotechnical information to all involved.

Changes in Plans

The recommendations presented herein are based on the preliminary design details furnished by the client and/or as assumed herein. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary.

Construction Issues

Although general constructability issues have been considered in this report, the means, methods, techniques, sequences and operations of construction, safety procedure, and all items incidental thereto and consequences of, are the responsibility of parties to the project other than AES. Please contact us if additional guidance is needed.

Report Interpretation

AES is not responsible for the conclusions, opinions, or recommendations made by others based upon the data included herein. It is the client's responsibility to seek any guidance and clarifications from the geotechnical engineer needed for proper interpretation of this report.

Environmental Considerations

The scope of our services does not include any environmental assessment or exploration for the presence or absence of hazardous or toxic materials in the soil, surface or groundwater, water within or beyond the site studied. Unless complete environmental information regarding the site is already available, an environmental assessment is recommended prior to the development of this site.

Standard of Care

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This statement is made in lieu of all other warranties either expressed or implied.

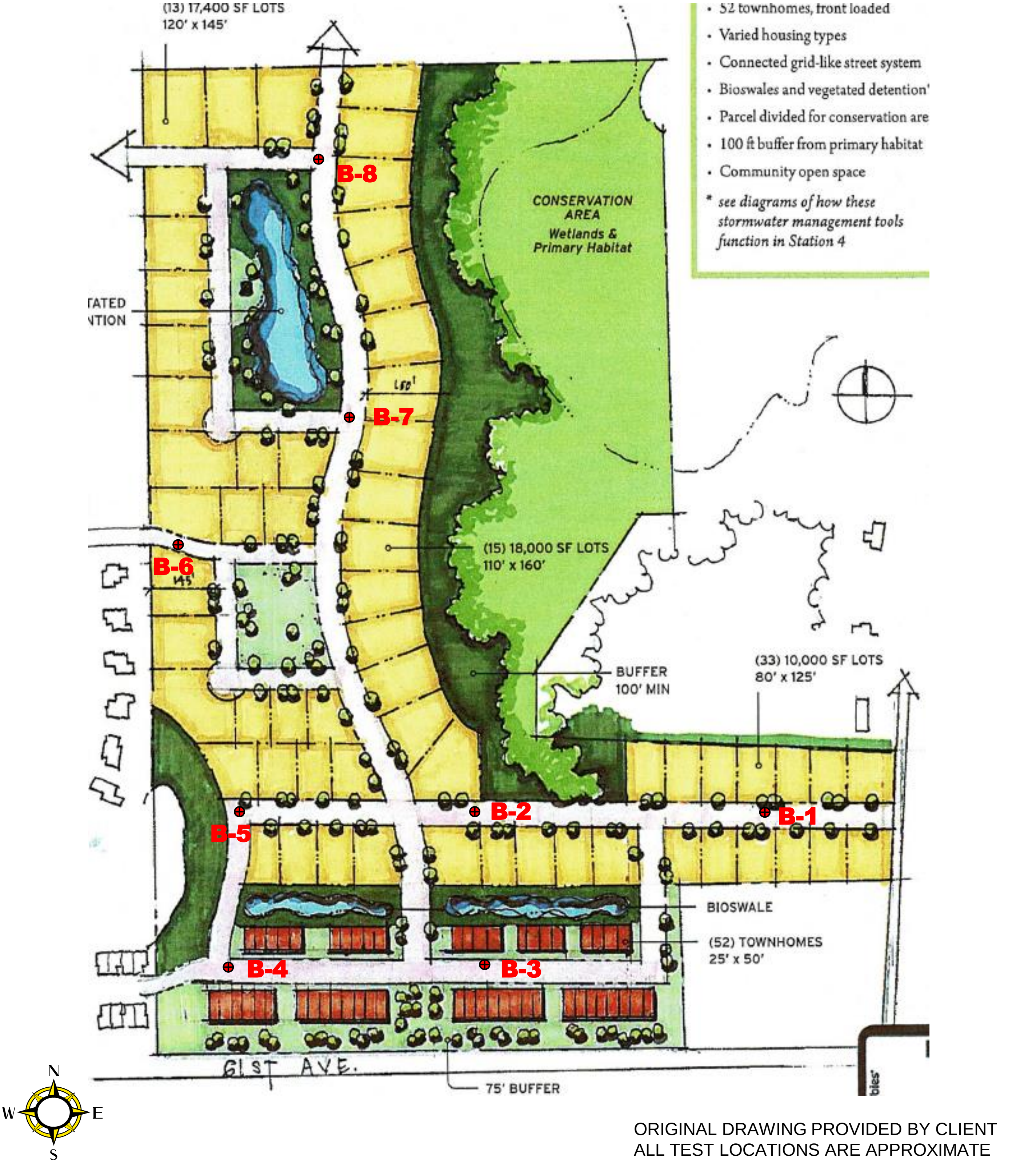
APPENDIX

BORING LOCATION PLAN

TEST BORING LOGS

LABORATORY TEST RESULTS

FIELD CLASSIFICATION SYSTEM



ORIGINAL DRAWING PROVIDED BY CLIENT
ALL TEST LOCATIONS ARE APPROXIMATE

BORING LOCATION PLAN	PROJECT NUMBER: 2020-1105G	DRAWN BY: JV
PROPOSED RESIDENTIAL SUBDIVISION NWC OF 61ST AVENUE AND ARIZONA STREET HOBART, INDIANA CLIENT: CITY OF HOBART	DATE: 11-09-20 SCALE: NONE	APPROVED: AZ
	aes advanced engineering services	Figure: 1

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-1

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 631 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(ML/CL) Brown Silt with Clay, Trace Sand, Gravel, Moist, Medium Stiff to Stiff	SS 1		4-7-7 (14)	2.5		17.4				
2.5												
			SS 2		3-6-8 (14)	4.5		20.8				
5.0												
			SS 3		4-5-5 (10)	2.25		24.7				
7.5												
		(ML) Brown Silt, Trace Sand, Clay, Moist, Loose	SS 4		3-4-5 (9)	1.75		24.6				
10.0												
		(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff	SS 5		2-4-4 (8)	2.75		23.6				
12.5												
		(SP) Brown Poorly Graded Sand, Trace Gravel, Moist, Medium Dense	SS 6		9-12-16 (28)							
15.0												

Bottom of borehole at 15.0 feet.

advanced engineering services

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-2

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 632 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(ML/CL) Brown Silt with Clay, Trace Sand, Gravel, Moist, Medium Stiff to Very Stiff	SS 1		6-10-13 (23)	1.0		17.4				
2.5			SS 2		5-13-16 (29)	1.25		16.5				
5.0			SS 3		5-7-9 (16)	0.75		18.9				
7.5			SS 4		2-4-6 (10)	2.75		23.0				
10.0		(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff	SS 5		3-4-6 (10)	2.0		21.6				
12.5			SS 6		2-3-4 (7)	1.5		22.7				
15.0												

Bottom of borehole at 15.0 feet.

REC GRAPHICS BH COLUMN - GINT STD US LAB AES.GDT - 11/9/20 14:01 - H:\2020\1105G HOBART RES SUB\HOBART RESIDENTIAL SUBDIVISION.GPJ

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-3

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 627 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(ML/CL) Brown Silt with Clay, Trace Sand, Gravel, Moist, Medium Stiff	SS 1		3-3-5 (8)	2.5		23.7				
2.5												
			SS 2		2-4-4 (8)	2.75		24.8				
5.0												
			SS 3		2-4-4 (8)	1.5		25.1				
7.5												
			SS 4		2-3-4 (7)	1.75		26.8				
10.0												
		(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff to Stiff	SS 5		3-4-5 (9)	1.5		24.0				
12.5												
			SS 6		3-3-9 (12)	1.0		24.5				
15.0												

Bottom of borehole at 15.0 feet.

BORING NUMBER B-4

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 629 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Clay with Topsoil										
		(CL) Brown Sandy Clay, Trace Organics, Gravel, Silt, Moist, Very Soft to Medium Stiff SS#1: Organic-3.3%	SS 1		3-3-4 (7)			26.0				
2.5		SS#2: Organic-3.9%	SS 2		2-3-2 (5)			35.5				
5.0			SS 3		2-1-2 (3)			28.7				
7.5			SS 4		2-3-4 (7)	2.5		24.8				
10.0		(CL) Gray Lean Clay, Trace Silt, Moist, Soft to Medium Stiff	SS 5		2-5-4 (9)	2.0		22.2				
12.5			SS 6		2-2-2 (4)	0.5		26.9				
15.0												

Bottom of borehole at 15.0 feet.

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-5

CLIENT City of Hobart

PROJECT NAME New Residential Subdivision

PROJECT NUMBER 2020-1105G

PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana

DATE STARTED 10/27/20 **COMPLETED** 10/27/20

GROUND ELEVATION 629 ft **HOLE SIZE** 4 inches

DRILLING CONTRACTOR GTC

GROUND WATER LEVELS:

DRILLING METHOD HSA

∇ **AT TIME OF DRILLING** 9.50 ft / Elev 619.50 ft

LOGGED BY JV **CHECKED BY** AZ

AT END OF DRILLING --- None

NOTES Ground Elevation Estimated from Google Earth.

AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(CL) Brown to Gray Sandy Clay, Trace Organics, Gravel, Silt, Moist, Very Soft to Stiff SS#1: Organic-2.3%	SS 1		2-3-3 (6)			23.2				
2.5												
		SS#2: Organic-2.1%	SS 2		2-2-3 (5)	1.75		23.9				
5.0												
		SS#3: Organic-2.0%	SS 3		2-1-1 (2)	0.25		37.2				
7.5												
			SS 4		3-4-7 (11)	3.25		24.5				
10.0		∇ Thin Wet Silt Seam at about 9.5 ft.										
		(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff										
			SS 5		3-3-7 (10)	2.25		23.0				
12.5												
			SS 6		3-3-5 (8)	1.0		21.7				
15.0												

Bottom of borehole at 15.0 feet.

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-6

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 628 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(CL) Brown to Gray Sandy Clay, Trace Gravel, Silt, Moist, Soft to Medium Stiff										
			SS 1		3-4-5 (9)	2.25		24.7				
2.5												
			SS 2		2-4-4 (8)	3.0		24.7				
5.0												
			SS 3		2-2-3 (5)	1.5		25.3				
7.5												
			SS 4		2-5-5 (10)	3.25		23.7				
		(CL) Gray Sandy Clay, Trace Silt, Moist, Medium Stiff										
10.0												
			SS 5		3-3-5 (8)	2.5		21.8				
12.5												
			SS 6		1-4-3 (7)	1.75		25.9				
15.0												

Bottom of borehole at 15.0 feet.

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-7

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 627 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING --- None
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0		Dark Brown Sandy Clay with Topsoil										
		(ML/CL) Brown to Gray Silt with Clay, Trace Sand, Gravel, Moist, Medium Stiff to Stiff	SS 1		3-5-5 (10)	3.5		17.2				
2.5												
			SS 2		3-7-8 (15)	4.0		19.6				
5.0												
			SS 3		3-4-5 (9)	3.5		23.5				
7.5												
			SS 4		2-5-7 (12)	2.25		25.9				
10.0		(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff										
			SS 5		3-4-3 (7)	1.75		21.2				
12.5												
			SS 6		3-3-3 (6)	1.0		22.4				
15.0												

Bottom of borehole at 15.0 feet.

REC GRAPHICS BH COLUMN - GINT STD US LAB AES.GDT - 11/9/20 14:01 - H:\2020\1105G HOBART RES SUB\HOBART RESIDENTIAL SUBDIVISION.GPJ

Advanced Engineering Services Inc.
7439 Calumet Avenue
Hammond, IN 46324
Telephone: 219 933 7888

BORING NUMBER B-8

CLIENT City of Hobart
PROJECT NAME New Residential Subdivision
PROJECT NUMBER 2020-1105G
PROJECT LOCATION NWC of Arizona St. and 61st Ave., Hobart, Indiana
DATE STARTED 10/27/20 **COMPLETED** 10/27/20
GROUND ELEVATION 626 ft **HOLE SIZE** 4 inches
DRILLING CONTRACTOR GTC
GROUND WATER LEVELS:
DRILLING METHOD HSA
∇ **AT TIME OF DRILLING** 4.00 ft / Elev 622.00 ft
LOGGED BY JV **CHECKED BY** AZ
AT END OF DRILLING --- None
NOTES Ground Elevation Estimated from Google Earth.
AFTER DRILLING --- None

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY %	STD. PEN. TEST SPT (N VALUE)	HAND PEN. (TSF)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNCONF. COMP STRENGTH (TSF)
0.0	Dark Brown Sandy Clay with Topsoil										
	(CL) Brown Sandy Clay, Trace Gravel, Silt, Moist, Soft to Medium Stiff	SS 1		2-4-5 (9)	2.5		23.1				
2.5											
	∇ (ML) Brown to Gray Sandy Silt, Trace Clay, Moist to Wet, Very Loose to Loose	SS 2		2-2-3 (5)	1.75		22.0				
5.0											
		SS 3		2-1-2 (3)			26.9				
7.5											
		SS 4		2-3-6 (9)	1.25		24.1				
10.0											
	(CL) Gray Lean Clay, Trace Silt, Moist, Medium Stiff	SS 5		2-3-4 (7)	1.75		20.0				
12.5											
		SS 6		3-3-3 (6)	1.0		23.6				
15.0											

Bottom of borehole at 15.0 feet.

FIELD CLASSIFICATION SYSTEM FOR SOIL EXPLORATION

NON-COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density	
Very Loose	5 blows/ft or less
Loose	6 to 10 blows/ft
Medium Dense	11 to 30 blows/ft
Dense	31 to 50 blows/ft
Very Dense	51 blows/ft or more

Relative Proportions

Descriptive	Percent
Trace	1 to 10
Little	11 to 20
Some	21 to 35
And	36 to 50

Particle Size Identification

Boulders	12 inch diameter or more	
Cobbles	12 to 3 inch diameter	
Gravel	Coarse	3 to 3/4 inch
	Fine	3/4 inch to 4.75mm (No. 4)
Sand	Course	4.75mm to 2mm (No. 10) (dia. Of pencil lead)
	Medium	2.00mm to 0.425mm (No.40) (Dia. of broom straw)
	Fine	0.425mm to 0.075mm (No.200) (dia. of human hair)
Silt/Clay		0.075mm or Smaller (cannot see particles)

COHESIVE SOILS
(Clay, Silt and combinations)

Consistency	
Very Soft	3 blows/ft or less
Soft	4 to 5 blows/ft
Medium Stiff	6 to 10 blows/ft
Stiff	11 to 15 blows/ft
very Stiff	16 to 30 blows/ft
Hard	31 blows/ft or more

Plasticity

Degree of Plasticity	Plasticity Index
None to slight	0 to 4
Slight	5 to 7
Medium	8 to 22
High to Very High	over 22

Classification on logs are made by visual inspection of samples.

Standard Penetration Test (SPT)- Driving a 2.0" O.D. 1-3/8" I.D. sampler a distance of 1ft into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary for ATC to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the test are recorded for each 6.0 inches of penetration on the drill log (Example-6/8/9). The standard penetration test result can be obtgained by adding the last two figures (i.e., 8+9=17 blows/ft). (ASTM D-1586-08).

Stara Changes - In the column "Soil Descriptions" on the drill log the horizontal lines represent strata changes. A solid line (____) represents an actually observed change. A dashed line (_ _ _ _) represents an estimated change.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topographjy, etc,, may cause changes in the water levels indicated on the logs.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS