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GEOTECHNICAL ENGINEERING INVESTIGATION

PROPOSED PARKING LOT IMPROVEMENTS
VA MEDICAL CENTER COLD SPRING ROAD FACILITY
INDIANAPOLIS, INDIANA

CARDNO ATC PROJECT NO. 170GC00002

DECEMBER 2, 2014

PREPARED FOR:

AMERICAN STRUCTUREPOINT, INC.
7260 SHADELAND STATION
INDIANAPOLIS, INDIANA 46256

ATTENTION: MR. DAVID KUEHNEN, P.E.
PROJECT MANAGER CIVIL GROUP

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December 2, 2014

Mr. David Kuehnen, P.E.
American Structurepoint, Inc.
7260 Shadeland Station
Indianapolis, Indiana 46256

Re: **Geotechnical Engineering Investigation**
Proposed Parking Lot Improvements
VA Medical Center Cold Spring Road Facility
Indianapolis, Indiana
Cardno ATC Project No. 170GC00002

Dear Mr. Kuehnen:

Submitted herewith is the report of our geotechnical engineering investigation for the referenced project. This study was authorized in accordance with your Subconsultant Agreement for Professional Services dated April 23, 2013 and our Proposal No. PE-14-0597, Revised dated September 6, 2014.

This report contains the results of our field and laboratory testing program, an engineering interpretation of this data with respect to the available project characteristics and recommendations to aid design and construction of the parking lot and other earth-connected phases of this project. We wish to remind you that we will store the samples for 30 days after which time they will be discarded unless you request otherwise.

We appreciate 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 either of the undersigned.

Sincerely,

David McIlwaine, P.E.
Project Engineer
for Cardno ATC

SHAWN M. MARCUM
REGISTERED
No. 10302398
STATE OF INDIANA
PROFESSIONAL ENGINEER

Shawn M. Marcum, P.E.
Senior Project Engineer
for Cardno ATC

Table of Contents

1 PURPOSE AND SCOPE

The purpose of this study was to determine the general subsurface conditions at the project site by drilling eight soil test borings and to evaluate this data with respect to foundation concept and design for the proposed parking lot improvements. Also included is an evaluation of the site with respect to potential construction problems and recommendations dealing with earthwork and quality control during construction.

2 PROJECT CHARACTERISTICS

American Structurepoint, Inc. is preparing plans for parking lot improvements within two areas at the VA Medical Center Cold Spring Road Facility on the northwest side of Indianapolis, Indiana. The general location of the project site is shown on the Vicinity Map (Figure 1 in the Appendix), which is taken from a map made prior to the current level of development in the surrounding area. The proposed southwest construction site is currently mostly used as a surface parking lot with a wooded area on the west portion. The proposed northeast construction site is currently mostly occupied by asphalt and crushed limestone parking areas and driveways. Throughout both sites there are existing buildings that will remain. The southwest site has a gradual slope down from the west to the east, ranging from El 742 near Cold Spring Road to El 734 in the central portion of the site. The northeast site ranges from about El 737 in the central portion to El 729 in the far northern portion of the site.

It is our understanding that approximately no more than 1 ft of cut or fill will be required in the proposed pavement improvement areas to establish finish grade. At this time, no special measures for the purpose of stormwater infiltration are planned. The general layout of the project site is shown on the Boring Plan (Figure 2 in the Appendix).

3 GENERAL SUBSURFACE CONDITIONS

The general subsurface conditions were investigated by drilling eight test borings to a depth of 10 ft at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). The subsurface conditions disclosed by the field investigation are summarized in the following paragraphs. Detailed descriptions of the subsurface conditions encountered in each test boring are presented on the "Test Boring Logs" in the Appendix. The letters in parentheses following the soil descriptions are the soil classifications in general accordance with the Unified Soil Classification System. It should be noted that the stratification lines shown on the soil boring logs represent approximate transitions between material types. In-situ stratum changes could occur gradually or at slightly different depths.

At the surface, Borings B-1 and B-3 encountered topsoil with a thickness ranging from 0.3 to 0.5 ft. Borings B-2, B-5, B-6, B-7 and B-8 revealed crushed limestone with thicknesses ranging from 0.3 to 1.0 ft and Boring B-4 revealed asphalt pavement over aggregate base with a total pavement thickness of 0.8 ft. Underlying these surface materials, Borings B-1, B-3, B-4, B-5 and B-6 encountered silty clay or sandy silty clay fill materials containing various amounts of sand, gravel, wood fragments and roots to a depth of 3 ft below the existing ground surface. Underlying the fill or surface materials, the test borings typically encountered medium stiff to stiff silty clay (CL), sandy silty clay (CL) and/or loose to medium dense sand (SP, SP-SM, SP-SC) containing various amounts of gravel to the termination depth of 10 ft below the existing ground surface. Boring B-4 revealed soft silty clay (CL) from a depth of 6 ft to the termination depth. The consistencies of the cohesive soils and densities of the granular soils as described above and on the boring logs were estimated based on the results of the standard penetration test (ASTM D-1586).

No free ground water was noted during or at completion of drilling in any of the borings. However, it must be noted that fluctuations in the level of the ground water will occur due to variations in rainfall and other factors.

4 DESIGN RECOMMENDATIONS

The following design recommendations have been developed on the basis of the previously described project characteristics (Section 2.0) and subsurface conditions (Section 3.0). If there is any change in these project criteria, including project location on the site, a review should be made by this office.

4.1 Pavement

Based upon grading information provided and seasonal conditions, it is likely that the pavement subgrade in some areas will be wet, soft or yielding at the time of construction. It may be possible to stabilize the subgrade soils in areas that are found to be excessively wet, soft or yielding at the time of construction, by discing, aerating and recompacting. However, if it is not possible to improve the subgrade soils in this manner because of weather conditions, scheduling or other conditions (which is often the case) it is recommended that the subgrade soils be improved or modified using either chemical stabilization (i.e., quicklime or a suitable lime by-product such as lime kiln dust), mechanical stabilization (i.e., a geogrid with additional crushed limestone placed over the subgrade), or removal of the unsuitable soils and replacement with crushed limestone and/or suitable fill soils determined to be appropriate by the geotechnical engineer. The best method for stabilizing the pavement subgrade should be determined in the field at the time of construction based upon the actual field conditions in conjunction with the specific soil type encountered at the locations requiring stabilization, the size of the areas requiring stabilization and the construction schedule.

Based on our experience with soils of the type underlying this site, the natural subgrade soils at this site may yield and become unstable under construction traffic, particularly if the construction will be done during seasons when heavy precipitation and cooler temperatures typically occur (such as late fall, winter and spring). The extent to which yielding subgrades may be a problem is difficult to predict beforehand since it is dependent upon several factors including seasonal conditions, precipitation, cut depths, sequencing and schedule of earthwork, surface and subsurface drainage measures, the weight and traffic patterns of construction equipment, etc. In general, yielding subgrade problems are more prominent in cut areas (where saturated or nearly saturated silty and clayey soils are exposed by the excavation) or where little or no fill is to be placed. Based on our experience on other projects near this site with similar soil conditions, it appears likely that modification or stabilization of subgrade soils will be required in some areas at this site. Depending on these factors, it may be possible to stabilize some yielding subgrade soils by discing, aerating and then recompacting the soils; however, this is often unsuccessful, particularly in the late fall, winter and spring construction seasons since the weather conditions may not permit drying to occur.

In order to cope with constructability problems and to avoid schedule delays associated with these types of soil conditions, it would be prudent to develop a contingency plan for subgrade stabilization so that it can be implemented, where deemed necessary by the geotechnical engineer at the time of construction based on the specific field conditions encountered. It should be anticipated (as a minimum) that stabilization of the subgrade could be required in all cut areas or areas that will be at-grade. Furthermore, depending upon the time and conditions when the earthwork is performed, it may be necessary to use chemical modification of the fill soils in order for the fill to be properly placed and compacted. For soil conditions such as those at this site, lime stabilization (i.e., quicklime and lime kiln dust) is often the most cost effective subgrade stabilization method particularly when large areas require stabilization. The lime stabilization is typically performed in a single lift and should be performed by a specialty contractor who has the necessary equipment and experience in the application of lime stabilization methods. There may be areas where the soil conditions are not compatible with lime stabilization or the size of the areas requiring stabilization do not justify the use of lime stabilization. In such areas, mechanical subgrade stabilization using a biaxial geogrid in conjunction with additional crushed limestone is considered appropriate for stabilization. It is important that the geotechnical consultant provide continuous inspection during the earthwork operations to identify areas where special stabilization will be required while limiting the stabilization to only those areas where it is necessary.

The pavement subgrade surface should be uniformly sloped to facilitate drainage through the granular base and to avoid any ponding of water beneath the pavement. The storm water catch basins in pavement areas should be designed to allow water to drain from the aggregate base into the catch basins. At a minimum, subsurface trench drains should be included that extend out at least 20 ft from the catchbasins in at least four directions.

The following report sections outline recommendations for asphalt and concrete pavements for automobile parking areas and truck zones. It is important to note that the recommendations for the automobile parking areas are based on the assumption that these areas will not be subject to any heavy truck traffic. Therefore, in areas where truck traffic cannot be controlled (i.e., driveways), it is suggested that the thicker pavement section be utilized. Since these recommendations are based on estimated traffic loading conditions, it is recommended that they be verified when the actual anticipated traffic conditions become available.

4.1.1 Asphalt Pavement

Based on a CBR value of 3 (resilient modulus value equivalent to approximately 4,500 lbs/sq.in.), a design period of 15 years, estimated traffic for this type of facility and the conditions encountered at the site, the following asphalt pavement sections are recommended:

Automobile Parking Areas	3 in. of asphaltic concrete over 6 in. of aggregate base.
Driveway Areas and Truck Zones	5 in. of asphaltic concrete over 10 in. of aggregate base.

The base should be a well-graded crushed stone with a maximum of 10 percent (by weight) finer than the No. 200 sieve such as coarse aggregate size No. 53 in accordance with Indiana Department of Transportation-INDOT-Standard Specifications ("commercial grade" No. 53 crushed stone should not be used as pavement base material). The asphaltic concrete pavement should be constructed in accordance with the INDOT Standard Specifications Section 402-Hot Mix Asphalt, HMA, Pavement.

It should be expected that normal maintenance compatible with asphalt pavement and the design period selected will be required during the life of the pavement. Furthermore, overlaying the pavement surface may be desirable at an intermediate time period to extend the life of the pavement and improve serviceability.

4.1.2 Concrete Pavement

Concrete pavement thicknesses were determined from methods developed by the Portland Cement Association (PCA), the American Association of State Highway and Transportation Officials (AASHTO) and the American Concrete Institute (ACI). These methods assume that the subgrade is firm, well-compacted and non-pumping and that all joints are properly designed, located and sealed to minimize moisture seepage into the subgrade. It is also important to insure proper concrete curing practices will be employed and traffic will not be allowed until the concrete has had sufficient time to cure.

For design calculation purposes, the compressive strength of the concrete was assumed to be 4,000 lbs/sq.in. (or a modulus of rupture of about 600 lbs/sq.in.). The modulus of subgrade reaction of the soil (k_{30}) was estimated to be 125 lbs/cu.in.

Based on the above information, the following concrete pavement sections are recommended:

Automobile Parking Areas	5 in. of concrete over 4 in. granular base.
Driveway Areas and Truck Zones	8 in. of concrete over 4 in. granular base.

The performance of the concrete paving section is highly dependent on controlling the pumping of the subgrade soils. Although no wet surface soils were noted at the time of this study, it is important that surface drainage be controlled to prevent water from ponding in pavement areas.

4.2 Site Grading and Drainage

Proper surface drainage should be provided at the site to minimize any increase in moisture content of the foundation soils. The grade near existing structures should be sloped away from the structures to prevent ponding of water.

5 GENERAL CONSTRUCTION PROCEDURES AND RECOMMENDATIONS

Since this investigation identified actual subsurface conditions only at the test boring locations, it was necessary for our geotechnical engineers to extrapolate these conditions in order to characterize the entire project site. Even under the best of circumstances, the conditions encountered during construction can be expected to vary somewhat from the test boring results and may, in the extreme case, differ to the extent that modifications to the pavement recommendations become necessary. Therefore, we recommend that Cardno ATC be retained as geotechnical consultant through the earth-related phases of this project to correlate actual soil conditions with test boring data, identify variations, conduct additional tests that may be needed and recommend solutions to earth-related problems that may develop.

5.1 Site Preparation

All areas that will support new pavements should be properly prepared. The exposed subgrade should be carefully observed by the geotechnical engineer or a qualified soils technician working under the direction of the geotechnical engineer-of-record by probing and testing as needed. Any soils that have been softened or frozen, wet, loose or otherwise undesirable materials should be removed. The exposed subgrade should furthermore be evaluated by proofrolling with suitable equipment to check for pockets of soft material hidden beneath a thin crust of better soil. Any unsuitable materials thus exposed should be removed and replaced with well-compacted, engineered fill as outlined in Section 5.2, or stabilized in-place as described in Section 4.1.

In order to attain a suitable foundation for placing the pavement subgrade in cut and at-grade areas, the foundation soils in some areas may require some modification (e.g., chemical or mechanical modification) or improvement to reduce the excess moisture content. Some areas requiring modification may be too small for chemical modification to be practical. In these cases, the subgrade can be improved by removing the unstable subgrade soils and replacing them with crushed limestone. The actual depth of removal will need to be determined based on specific field conditions at each location at the time of construction. It is not possible to accurately determine beforehand the amount of subgrade modification or improvement that may be required since this is dependent upon seasonal conditions, construction equipment and methods and the specific soil type encountered at the subgrade level. It is suggested that an undistributed quantity of subgrade improvement equal to approximately 25 percent of the subgrade area be included in the contract to be used where determined to be necessary to provide a suitable foundation for the pavement.

Care should be exercised during the grading operations at the site. Due to the nature of the near surface soils, the traffic of construction equipment may create pumping and general deterioration of the shallower soils, especially if excess surface water is present. The grading, therefore, should be done during a dry season, if at all possible.

5.2 Fill Compaction

All engineered fill should be compacted to a dry density of at least 100 percent of the standard Proctor maximum dry density (ASTM D-698). The compaction should be accomplished by placing the fill in about 8 in. (or less) loose lifts and mechanically compacting each lift to at least the specified minimum dry density. Field density tests should be performed on each lift as necessary to insure that adequate moisture conditioning and compaction is being achieved.

Compaction of any fill by flooding is not considered acceptable. This method will generally not achieve the desired compaction and the large quantities of water will tend to soften the foundation soils.

5.3 Construction Dewatering

No serious dewatering problems are anticipated. At the time of our investigation, the ground water level appeared to be below the anticipated excavation depths. However, depending on the seasonal conditions, some seepage into shallow excavations may be experienced. Seepage of water into excavations may also be experienced due to “perched” water that may be encountered in aggregate base below the asphalt or that may be encountered within old miscellaneous fill materials, abandoned utilities, utility trenches, etc. It is anticipated that such seepage into shallow excavations can be handled by conventional dewatering methods such as by pumping from sumps.

6 FIELD INVESTIGATION

Eight test borings were drilled at the approximate locations shown on the Boring Plan (Figure 2 in the Appendix). The borings were extended to a depth of 10 ft below the existing grade. Split-barrel samples were obtained by the Standard Penetration Test procedures (ASTM D-1586) at 2.5 ft intervals.

Logs of all borings, which show visual descriptions of all soil strata encountered using the Unified Soil Classification System, have been included in numerical order in the Appendix. Ground water observations, sampling information and other pertinent field data and observations are also included. In addition, a "Field Classification System for Soil Exploration" document defining the terms and symbols used on the logs and explaining the Standard Penetration Test procedure is provided immediately following the boring logs.

7 LABORATORY INVESTIGATION

The disturbed samples were inspected and classified in accordance with the Unified Soil Classification System and the boring logs were edited as necessary. To aid in classifying the soils and to determine general soil characteristics, natural moisture content tests, an Atterberg limits test and calibrated hand penetrometer ("pocket penetrometer") tests were performed on selected samples. The results of these tests are included on the Test Boring Logs in the Appendix.

8 LIMITATIONS OF STUDY

An inherent limitation of any geotechnical engineering study is that conclusions must be drawn on the basis of data collected at a limited number of discrete locations. The recommendations provided in this report were developed from the information obtained from the test borings that depict subsurface conditions only at these specific locations and at the particular time designated on the logs. Soil conditions at other locations may differ from conditions occurring at these boring locations. The nature and extent of variations between the borings may not become evident until the course of construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report after performing on-site observations during the excavation period and noting the characteristics of any variation.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either express or implied. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on the field exploration and laboratory test data presented in this report.

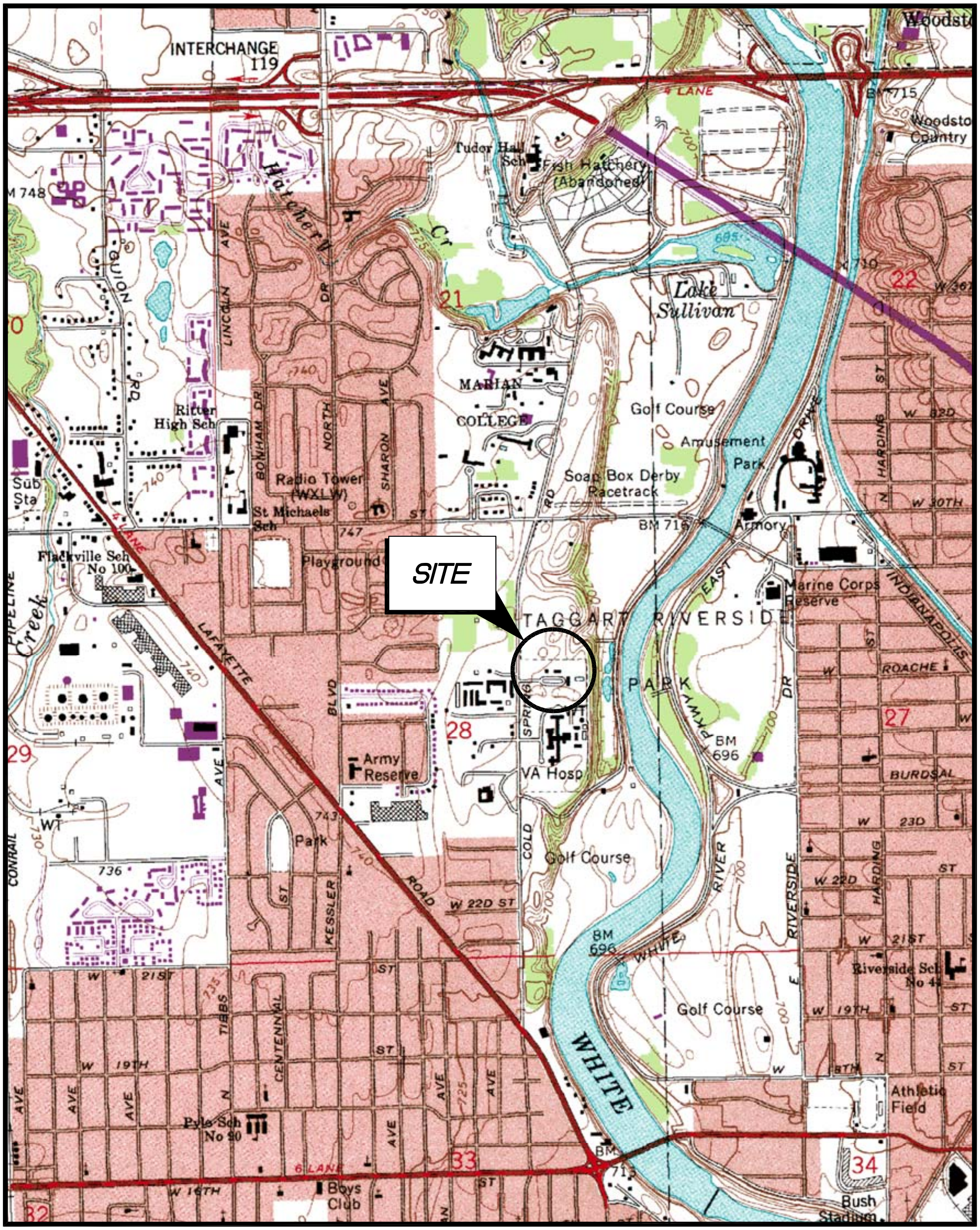
The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, ground water or surface water within or beyond the site studied.

Cardno ATC assumes no responsibility for any construction procedures, temporary excavations (including utility trenches), temporary dewatering or site safety during or after construction. The contractor will be solely responsible for all construction procedures, construction means and methods, construction sequencing and for safety measures during construction. All applicable federal, state and local laws and regulations regarding construction safety must be followed, including current Occupational Safety and Health Administration (OSHA) Regulations including OSHA 29 CFR Part 1926 "Safety and Health Regulations for Construction", Subpart P "Excavations", and/or successor regulations. The Contractor is solely responsible for designing and constructing stable, temporary excavations and should brace, shore, slope, or bench the sides of the excavations as necessary to maintain stability of the excavation sides and bottom.

Appendix

Figure 1:	Vicinity Map
Figure 2:	Boring Plan

Test Boring Logs (8)
"Field Classification System for Soil Exploration"
"Important Information About Your Geotechnical Engineering Report"



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VICINITY MAP

PROPOSED PARKING LOT IMPROVEMENTS
VA MEDICAL CENTER – COLD SPRING ROAD FACILITY
INDIANAPOLIS, INDIANA

Project Number: 170GC00002		Drn. By: SP
Drawing File: 00481~500A		Ckd. By: DM
Date: 11/14	Scale: 1" = 2000'	App'd By:
Cardno ATC		Figure: 1

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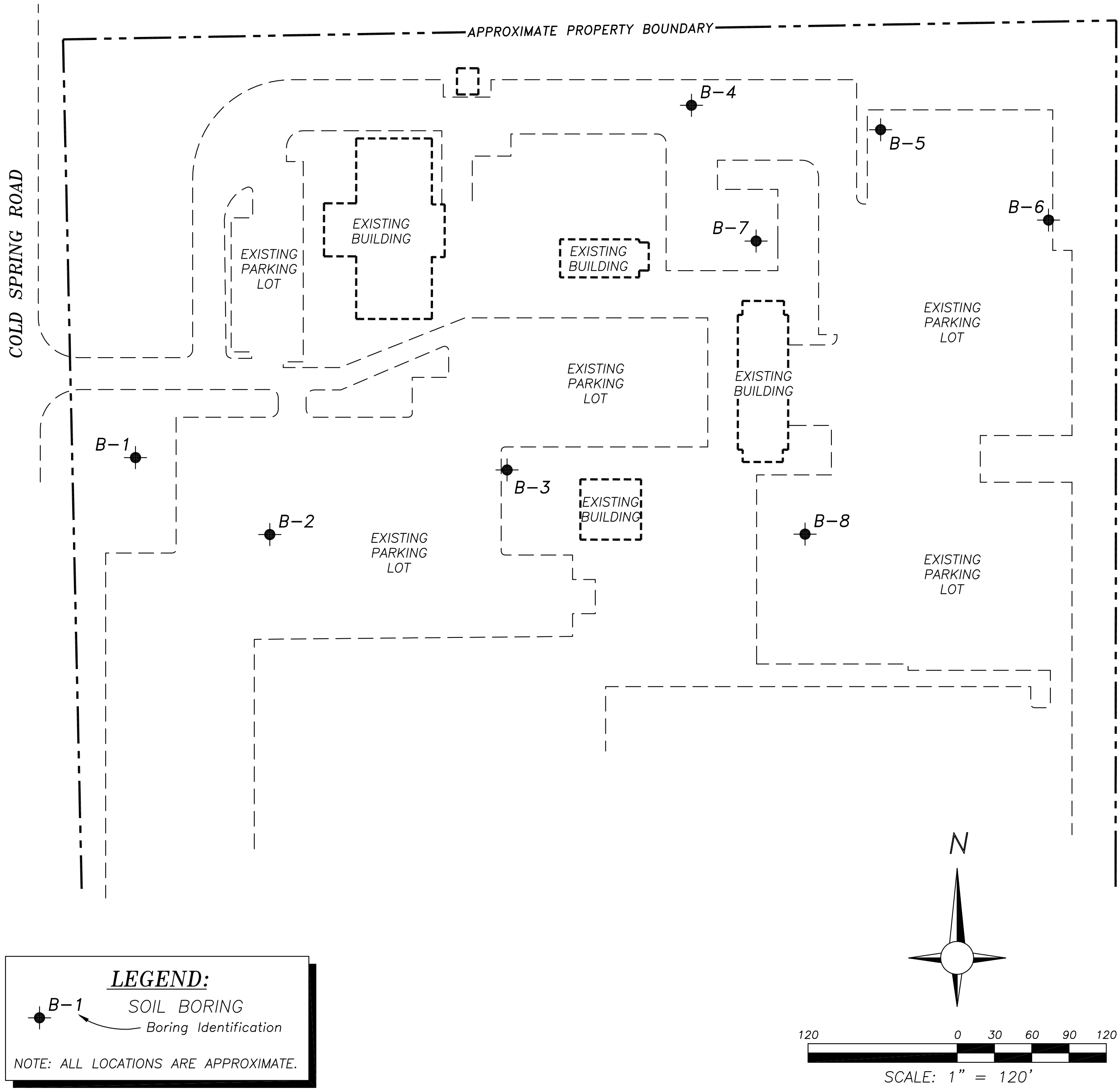

BORING PLAN

PROPOSED PARKING LOT IMPROVEMENTS
VA MEDICAL CENTER – COLD SPRING ROAD FACILITY
INDIANAPOLIS, INDIANA

Project Number: 170GC00002		Drn. By: SP
Drawing File: 00481~500A		Ckd. By: DM
Date: 11/14	Scale: AS SHOWN	App'd By:
Cardno ATC		Figure: 2

H:\2014\AMERICAN STURCTUREPOINT\GEO\VA MEDICAL CENTER – COLD SPRING FACILITY (170GC00002)\00481~500A.DWG, BPLAN

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TEST BORING LOG

CLIENT **American Structurepoint, Inc.**
PROJECT NAME **Proposed Parking Lot Improvements**
PROJECT LOCATION **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

BORING # **B-1**
JOB # **170GC00002**

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION 741)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Topsoil	740.5	0.5									Ground surface elevation estimated from topographic map provided by client.
Brown, slightly moist silty clay with little sand, trace gravel, wood fragments and roots (FILL)				1	SS			7-9-11	16.1		
Brown, slightly moist, loose to medium dense SAND (SP-SM) with silt and trace gravel	738.0	3.0		2	SS		Cave	6-5-5			
			5								Borehole plugged with concrete at completion.
				3	SS			7-6-5			
				4	SS			5-5-6			
Bottom of Test Boring at 10.0 ft	731.0	10.0	10								

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After **--** hours **--** ft.
Cave Depth **4.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **American Structurepoint, Inc.**
BORING # **B-2**
PROJECT NAME **Proposed Parking Lot Improvements**
JOB # **170GC00002**
PROJECT LOCATION **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 735	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
5 in. Crushed Limestone	734.6	0.4									Ground surface elevation estimated from topographic map provided by client.
Brown, moist, medium stiff SILTY CLAY (CL) with trace sand				1	SS			2-2-4	18.5	3.0	
Brown, moist, medium stiff SILTY CLAY (CL) with little sand	732.0	3.0		2	SS			3-3-5	18.6	2.0	
Brown, moist, medium stiff to stiff SANDY SILTY CLAY (CL)	729.5	5.5	5								Borehole plugged with concrete at completion.
				3	SS			4-4-4	11.8	2.0	
							Cave (7.5 ft)				
				4	SS			3-4-7		2.25	
Bottom of Test Boring at 10.0 ft	725.0	10.0	10								

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **7.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **American Structurepoint, Inc.**
BORING #: **B-3**
PROJECT NAME: **Proposed Parking Lot Improvements**
JOB #: **170GC00002**
PROJECT LOCATION: **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 736	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Topsoil	735.7	0.3									Ground surface elevation estimated from topographic map provided by client.
Light brown, slightly moist sandy silty clay with little gravel (FILL)				1	SS			8-6-7	9.0		
	733.0	3.0									
Brown, slightly moist, very stiff to stiff SILTY CLAY (CL) with little sand and trace gravel				2	SS			10-11-12	12.9	4.5+	
			5								Borehole plugged with concrete at completion.
				3	SS		Cave	7-6-5			
	728.0	8.0									
Brown, slightly moist, loose SAND (SP-SM) with little silt and trace gravel				4	SS			3-5-5			
	726.0	10.0	10								
Bottom of Test Boring at 10.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
● Noted on Drilling Tools **None** ft.
▽ At Completion **None** ft.
▼ After **--** hours **--** ft.
Cave Depth **7.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT	**American Structurepoint, Inc.**	BORING #	**B-4**
PROJECT NAME	**Proposed Parking Lot Improvements**	JOB #	**170GC00002**
PROJECT LOCATION	**VA Medical Center Cold Spring Road Facility** **Indianapolis, Indiana**		

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION (SURFACE ELEVATION 734)	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Asphalt over 6 in. Aggregate Base	733.2	0.8								Ground surface elevation estimated from topographic map provided by client.
Brown, moist silty clay with trace sand and gravel (FILL)	731.0	3.0		1	SS		3-4-4	19.1	2.0	
Brown, moist, medium stiff to soft SILTY CLAY (CL) with little sand and trace gravel				2	SS		2-3-3			
			5							Borehole plugged with concrete at completion.
				3	SS		3-3-2	24.8		
						Cave depth				
	724.0	10.0		4	SS		2-2-3			
Bottom of Test Boring at 10.0 ft			10							

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **8.0** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

Cardno ATC

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TEST BORING LOG

CLIENT **American Structurepoint, Inc.**

BORING # **B-5**

PROJECT NAME **Proposed Parking Lot Improvements**

JOB # **170GC00002**

PROJECT LOCATION **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 734	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
6 in. Crushed Limestone	733.5	0.5									Ground surface elevation estimated from topographic map provided by client.
Dark brown, moist silty clay with little sand (FILL)				1	SS			3-4-4	18.5		
	731.0	3.0									
Brown, moist, medium stiff SANDY SILTY CLAY (CL) with trace gravel				2	SS			3-4-4	18.6	3.0	
			5								Borehole plugged with concrete at completion.
				3	SS			5-4-4			
	727.0	7.0									
Brown, slightly moist, loose SAND (SP-SC) with trace clay and little gravel											
	726.0	8.0					Cave depth				
Brown, moist, medium stiff SANDY SILTY CLAY (CL) with trace gravel				4	SS			4-4-3			
	724.0	10.0	10								
Bottom of Test Boring at 10.0 ft											

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Depth to Groundwater
- Noted on Drilling Tools **None** ft.
- At Completion **None** ft.
- After **--** hours **--** ft.
- Cave Depth **8.0** ft.

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- CA - Casing Advancer
- MD - Mud Drilling
- HA - Hand Auger

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TEST BORING LOG

CLIENT: **American Structurepoint, Inc.**
BORING #: **B-6**
PROJECT NAME: **Proposed Parking Lot Improvements**
JOB #: **170GC00002**
PROJECT LOCATION: **VA Medical Center Cold Spring Road Facility, Indianapolis, Indiana**

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION — SURFACE ELEVATION 736

Soil Classification	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
12 in. Crushed Limestone	735.0	1.0								Ground surface elevation estimated from topographic map provided by client.
Brown, slightly moist silty clay with wood fragments (FILL)	733.0	3.0		1	SS		10-11-10	14.4		
Brown, slightly moist, stiff SANDY SILTY CLAY (CL) with trace gravel	730.0	6.0	5	2	SS		6-7-4	11.8	4.5+	Borehole plugged with concrete at completion.
Brown, slightly moist, medium dense SAND (SP-SM) with little silt and trace gravel	726.0	10.0	10	3	SS	Cave	7-8-7			
				4	SS		7-7-6			
Bottom of Test Boring at 10.0 ft										

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **6.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT **American Structurepoint, Inc.**
PROJECT NAME **Proposed Parking Lot Improvements**
PROJECT LOCATION **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

BORING # **B-7**
JOB # **170GC00002**

DRILLING and SAMPLING INFORMATION

Date Started	**11/19/14**	Hammer Wt.	**140** lbs.
Date Completed	**11/19/14**	Hammer Drop	**30** in.
Drill Foreman	**Amer. Drilling**	Spoon Sampler OD	**2.0** in.
Inspector	**D. McIlwaine**	Rock Core Dia.	**--** in.
Boring Method	**HSA**	Shelby Tube OD	**--** in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 736	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics / Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
4 in. Crushed Limestone	735.7	0.3									Ground surface elevation estimated from topographic map provided by client.
Brown, moist, medium stiff SILTY CLAY (CL) with trace sand				1	SS			3-3-5	16.5		
	733.0	3.0									
Brown, slightly moist, medium dense SAND (SP-SM) with little silt and trace gravel				2	SS			7-7-10			
			5								Borehole plugged with concrete at completion.
				3	SS		Cave	17-13-15			
				4	SS			13-10-11			
	726.0	10.0	10								
Bottom of Test Boring at 10.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools **None** ft.
At Completion **None** ft.
After **--** hours **--** ft.
Cave Depth **6.5** ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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TEST BORING LOG

CLIENT: **American Structurepoint, Inc.** BORING #: **B-8**
PROJECT NAME: **Proposed Parking Lot Improvements** JOB #: **170GC00002**
PROJECT LOCATION: **VA Medical Center Cold Spring Road Facility**
Indianapolis, Indiana

DRILLING and SAMPLING INFORMATION

Date Started	11/19/14	Hammer Wt.	140 lbs.
Date Completed	11/19/14	Hammer Drop	30 in.
Drill Foreman	Amer. Drilling	Spoon Sampler OD	2.0 in.
Inspector	D. McIlwaine	Rock Core Dia.	-- in.
Boring Method	HSA	Shelby Tube OD	-- in.

TEST DATA

SOIL CLASSIFICATION SURFACE ELEVATION 734	Stratum Elevation	Stratum Depth, ft	Depth Scale, ft	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Groundwater	Standard Penetration Test, Blows per 6 in. Increments	Moisture Content, %	Pocket Penetrometer PP-tsf	Remarks
7 in. Crushed Limestone	733.4	0.6									Ground surface elevation estimated from topographic map provided by client.
Brown, moist, medium stiff SILTY CLAY (CL) with little sand				1	SS			4-4-5	19.4	1.5	Sample No. 1: Liquid Limit = 29 Plastic Limit = 17 Plasticity Index = 12
	730.0	4.0		2	SS			4-5-6			
Brown, slightly moist, medium dense SAND (SP) with little gravel			5								Borehole plugged with concrete at completion.
	728.5	5.5									
Brown, moist, very stiff SILTY CLAY (CL) with some sand and trace gravel				3	SS			7-10-7	14.8		
	726.0	8.0					Cave (7.5)				
Brown, slightly moist, medium dense SAND (SP-SM) with trace silt and gravel				4	SS			9-11-11			
	724.0	10.0	10								
Bottom of Test Boring at 10.0 ft											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Depth to Groundwater
Noted on Drilling Tools: None ft.
At Completion: None ft.
After -- hours: -- ft.
Cave Depth: 7.5 ft.

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
CA - Casing Advancer
MD - Mud Drilling
HA - Hand Auger

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 Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

Particle Size Identification

Boulders	-	8 inch diameter or more	
Cobbles	-	3 to 8 inch diameter	
Gravel	-	Coarse	- 1 to 3 inch
		Medium	- ½ to 1 inch
		Fine	- ¼ to ½ inch
Sand	-	Coarse	2.00mm to ¼ inch (dia. of pencil lead)
		Medium	0.42 to 2.00mm (dia. of broom straw)
		Fine	0.074 to 0.42mm (dia. of human hair)
Silt			0.074 to 0.002mm (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 - 4
Slight	5 - 7
Medium	8 - 22
High to Very High	over 22

Classification on the logs are made by visual inspection of samples.

Standard Penetration Test — Driving a 2.0" O.D. 1-3/8" I.D. sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary for ATC to drive the spoon 6 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 inches of penetration on the drill log (Example — 6-8-9). The standard penetration test result can be obtained by adding the last two figures (i.e., 8 + 9 = 17 blows/ft). (ASTM D-1586-11).

Strata 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.

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

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

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

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

Read the Full Report

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

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

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

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

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

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

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

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
The Best People on Earth

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