Geotechnical Engineering Report

New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
April 24, 2012
Terracon Project No. 03125095

Prepared for:
Med-Arch LLC
Tulsa, Oklahoma

Prepared by:
Terracon Consultants, Inc.
Oklahoma City, Oklahoma

April 24, 2012

Terracon

Med-Arch LLC
1401 South Denver, Suite C
Tulsa, Oklahoma 74119

Attn: Mr. Jack Kelley
P: (918) 695 9809
E: jack@med-arch.com

Re: Geotechnical Engineering Report
New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Terracon Project No. 03125095

Dear Mr. Kelley:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. These services were performed in general accordance with our proposal number P03110154 dated March 8, 2012. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, below-grade walls, and pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.
Cert. Of Auth. #CA-4531 exp. 6/30/13

Diana Vargas-Suaza, E.I.
Senior Staff Geotechnical Engineer

REGISTERED PROFESSIONAL ENGINEER
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Copies to: Addressee (3 via mail, 1 via email)

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EXECUTIVE SUMMARY

Geotechnical Engineering Services have been performed for the proposed new parking garage at the V.A Medical Center located at 921 N.E. 13th Street in Oklahoma City, Oklahoma. Terracon's geotechnical scope of work included the advancement of three test borings to approximate depths of 31 to 35.5 feet below existing site grades.

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

- Beneath the pavement, the borings generally encountered lean clay with varying amounts of sand and sands with varying amounts of silt and clay to depths of about 2 to 14 feet. The overburden soils were underlain by highly weathered shale and sandstone and weathered shale or sandstone extending to the boring termination depths. A layer of shaley lean to fat clay was encountered in borings B-1, B-4, B-6 and B-7 from depths of about 6 to 7 feet extending to depths of about 9.5 to 14 feet. Groundwater was encountered at depths of about 8.5 to 34 feet in borings B-2, B-3 and B-5 at the time of the field exploration.

- The materials encountered beneath the pavement floor level generally exhibit low plasticity. These materials are considered adequate for providing direct support for the bottom floor pavement provided the recommended proofrolling and moisture/density control are incorporated into subgrade preparation and fill placement.

- Based on the subsurface conditions encountered, a maximum net allowable bearing pressure of 80,000 psf could be used for drilled piers if they bear at least 4 feet or two pier diameters, whichever is greater, into approved weathered sandstone, or shale and extend at least three pier diameters beneath the grade beams. The weathered sandstone and weathered shale were encountered at depths of about 4.5 to 14.5 feet at the time of field exploration.

- Based on the grading information provided, we anticipate that excavations for the parking garage will extend into weathered shale or weathered sandstone. Rock formations that have standard penetration test results of 4 or more inches per 50 blows can usually be excavated with heavy excavation equipment equipped with ripping teeth.

- In boring B-3, groundwater was encountered at a depth of about 8.5 feet at the time of this investigation. Because groundwater was encountered in boring B-3 above the

planned finish floor of EL. 1237, we recommend installing a groundwater collection system beneath the lowest level for the entire structure, to collect and dispose of the groundwater.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled General Comments should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
NEW PARKING GARAGE
V.A. MEDICAL CENTER
921 N.E. 13TH STREET
OKLAHOMA CITY, OKLAHOMA

Terracon Project No. 03125095
April 24, 2011

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed new parking garage at the V.A Medical Center located at 921 N.E. 13th Street in Oklahoma City, Oklahoma. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- foundation design and construction
- pavement recommendations
- construction excavations
- groundwater conditions
- seismic considerations
- lateral earth pressures

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Appendix A, Exhibit A-1
Structures	The project will include the construction of a five-story parking garage.
Maximum loads	Columns: 600 kips (assumed) Walls: 15 klf (assumed)
Maximum allowable settlement	1-inch (assumed)

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The project will be at the V.A. Medical Center located at 921 N.E. 13th Street in Oklahoma City, Oklahoma.

ITEM	DESCRIPTION
Grading	Based on the bottom floor pavement elevation of 1237 feet provided by the client, we anticipate up to 13 feet of cut and 4 feet of fill will be necessary for this site.
Current ground cover	Approximately 4 to 7 inches of portland cement concrete pavement or asphaltic concrete pavement.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Details for each of the borings can be found on the boring logs included in Appendix A of this report. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Stratum 1	2 to 3.5	Fill consisting of silty sand or lean clay with varying amounts of sand	N/A
Stratum 2	3.5 to 14	Silty or clayey sand	Medium dense to dense
Stratum 3		Lean to fat clay and shaley lean clay	Stiff to hard
Stratum 4[1]	9.5 to14.5	Highly weathered silty sandstone/highly weathered shale	Poorly cemented to cemented/soft
Stratum 5	Below the boring termination depths	Weathered sandstone/weathered shale	Well cemented/soft to hard

[1] Highly weathered silty sandstone and/or highly weathered shale were encountered in borings B-3, B-5 and B-8

Laboratory tests were conducted on selected soil samples and the test results are presented on the boring logs in Appendix A.

3.2 Groundwater

The borings were monitored while drilling and immediately after completing the drilling activities for the presence and level of groundwater. Boring B-3 was also monitored approximately 24 hours after drilling for the presence and level of groundwater. At these times, groundwater was observed at the following depths:

Boring Number	Depth to Groundwater while Drilling (feet)	Depth to Groundwater Immediately after Drilling (feet)	Depth to Groundwater 24 Hours after Drilling (feet)
B-1	Dry	Dry	---
B-2	33.5	34	---
B-3	8.5	33	11
B-4	Dry	Dry	---
B-5	23.5	Dry	---
B-6	Dry	Dry	---
B-7	Dry	Dry	---
B-8	Dry	---	---

To obtain more accurate groundwater level information, longer observations in a monitoring well or piezometer that is sealed from the influence of surface water would be needed. Fluctuations in groundwater levels can occur due to seasonal variations in the amount of rainfall, runoff, altered natural drainage paths, and other factors not evident at the time the borings were advanced. Consequently, the designer and contractor should be aware of this possibility while designing and constructing this project.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The borings generally encountered fill materials consisting of sands and clays to depths of about 2 to 3.5 feet underlain by stiff to hard clays and medium dense to dense sands underlain by highly weathered to weathered shale and sandstone below depths ranging from approximately 3.5 to 14 feet. The highly weathered bedrock was underlain by weathered shale and/or weathered shale. Based on the subsurface conditions encountered in the borings, the planned grade changes, and the anticipated foundation loads, we recommend supporting the parking garage on drilled pier foundations bearing within the weathered shale or sandstone bedrock encountered at depths of about 4.5 to 14.5 feet.

In boring B-3, groundwater was encountered at a depth of about 8.5 feet at the time of this investigation. Because groundwater was encountered in boring B-3 above the planned finish bottom floor pavement of EL. 1237, we recommend installing a groundwater collection system beneath the lowest level of the structure, to collect and dispose of the groundwater.

Based on the grading information provided, we anticipate that excavations for the parking garage will extend into weathered shale or weathered sandstone. Rock formations that have standard penetration test results of 4 or more inches per 50 blows can usually be excavated with heavy excavation equipment equipped with ripping teeth.

The materials encountered beneath the basement lowest level generally exhibit low plasticity. These materials are not expected to experience significant volume changes with variations in subgrade moisture content. Therefore, these materials are considered adequate for providing direct support for bottom floor pavement provided the recommended proofrolling and moisture/density control are incorporated into subgrade preparation and fill placement.

Existing fill materials were encountered to depths of approximately 2 to 3.5 feet in borings B-1, B-2, B-3, B-4, and B-8. We are not aware that compaction testing was performed during placement of the fill. The depth, composition and compaction of the existing fill materials can vary greatly over relatively small lateral and vertical distances. Because of the potential variability of fill, it will not be possible to accurately predict the amount of fill that may need to be removed and replaced to develop suitable support for the proposed improvements until site grading is underway. The depth and composition of the fill, observed at the discrete boring locations, should only be used for estimating purposes. We encourage the owner to secure a base bid for removing and replacing a specified quantity of the existing fill. The owner should also secure unit rates for adding or deducting quantities from the base bid that includes costs for exporting unsuitable materials and importing approved replacement materials, if required.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendix A), engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

The following presents recommendations for subgrade preparation and placement and compaction of engineered fill on the project. The recommendations presented for design and construction of earth supported elements are contingent upon following the recommendations outlined in this section. Grading for the structure should incorporate the

limits of the proposed structure plus a minimum pad blow-up of five feet beyond proposed perimeter walls and any exterior columns.

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing materials, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Subgrade Preparation

After completing any required cuts, but before placing any fill, we recommend the site be proofrolled under the observation of Terracon personnel with a loaded, tandem-axle dump truck weighing at least 25 tons to locate any zones that are soft or unstable. The proofrolling should involve overlapping passes in mutually perpendicular directions. Where rutting or pumping is observed during proofrolling, the unstable soils should be overexcavated and replaced with an approved cohesive soil fill as described herein if it cannot be adequately compacted in-place. In areas where weathered sandstone or shale is encountered, proofrolling will not be required.

We expect the subgrade soils beneath the existing pavements to have accumulated moisture ever the life of the pavements. Therefore, it is possible that wet or unstable areas will be encountered during proofrolling. The amount of unstable soil cannot be determined at this time.

Weather conditions will influence site preparation procedures. If soil moisture contents are high, which could be the case if construction begins following a wet period, drying of exposed soils may be required to develop a stable base on which to place fill. Scarifying and aerating the soil may be sufficient to reduce the moisture content during warm, dry weather, but this will be less effective during periods of cool or wet weather. Removing and replacing or chemically treating wet soils with fly ash or kiln dust should be expected if site preparation is conducted during cool and/or wet conditions.

After proofrolling and correcting any unstable subgrade, we recommend all exposed subgrade soils be scarified to a depth of 8 inches. The scarified soil should be moisture conditioned and compacted following the recommendations for engineered fill provided in the Compaction Requirements section of this report. In areas where weathered sandstone and shale is exposed, it will not be necessary to scarify and compact the weathered sandstone and shale.

4.2.2 Excavations

Excavations deeper than 4 feet should meet all OSHA and other applicable safety regulations. Based on the groundwater conditions encountered during our subsurface exploration and the grading information provided, excavations for the bottom floor level may encounter groundwater. Therefore, we anticipate dewatering will be required during the construction of the floor level. We also recommend installing a groundwater collection system beneath the lowest level of the parking garage to collect and dispose of the water. As a minimum, a 12-inch thickness of crushed aggregate (meeting requirements of ODOT 1999 Standard Specifications for Highway Construction, Section 703.01, Type A) is recommended beneath the bottom floor pavement to help discharge the groundwater. The crushed aggregate should be compacted to at least 95 percent of its maximum dry density as determined by the standard Proctor test method (ASTM D 698).

Based on the bottom floor level elevation provided (1237 ft), we anticipate that excavations for the parking garage will extend into weathered shale or weathered sandstone. Rock formations that have standard penetration test results of 4 or more inches per 50 blows can usually be excavated with heavy excavation equipment equipped with ripping teeth. Rock formations that have standard penetration test results of 3 inches or less per 50 blows usually requires either pneumatic equipment or blasting to remove. However, variations in hardness of rock can occur with depth and distance from the borings.

4.2.3 Fill Materials and Placement

All fill required to develop the design subgrade elevation should be an approved material that is free of organic matter and debris as outlined in the following table.

Fill Type[1, 2]	Acceptable Location for Placement
Cohesive low volume change soils with LL ≤40 and 5≤PI≤15	Pavement areas, and behind below-grade walls

[1] Prior to any filling operations, samples of the proposed borrow and on-site materials should be obtained for Atterberg Limits and moisture-density testing. The tests will provide a basis for acceptance of the material and evaluation of fill compaction by in-place density testing. A qualified soil technician should perform sufficient in-place density tests during the filling operations to evaluate that proper levels of compaction, including dry unit weight and moisture content, are being attained.

[2] Some of the on-site soils appear suitable for use as low volume change soil. However, this should be verified during construction by further testing.

4.2.4 Compaction Requirements

The recommended compaction and moisture content criteria for engineered fill materials are as follows:

Item	Description
Fill Lift Thickness	9 inches or less in loose thickness
Compaction Requirements	At least 95% of material's maximum dry density as determined by the standard Proctor test method (ASTM D 698)
Moisture Content	Workable moisture content that is at or above the material's optimum value as determined by the standard Proctor test method (ASTM D 698) prior to compaction

Engineered fill should be placed and compacted in horizontal lifts, using equipment and procedures that will produce recommended moisture contents and densities throughout the lift.

4.3 Foundations

4.3.1 Drilled Piers

Geotechnical engineering recommendations for foundation systems are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.

DESCRIPTION	VALUE
Foundation Type	Drilled pier foundation system
Bearing Material[1]	Extend through the overburden soils and highly weathered shale and sandstone and bear in the weathered sandstone, or weathered shale that was encountered at depths of approximately 4.5 to 14.5 feet
Net Allowable Bearing Pressure[2]	80,000 psf - 4 feet penetration or two pier diameters, whichever is greater, into approved weathered sandstone, or shale and extend at least three pier diameters beneath the grade beams
Maximum Allowable Skin Friction[3]	3,000 psf within weathered shale and/or weathered sandstone
Allowable Passive Pressure[4]	■ Overburden soils: 150 pcf/ft. ■ Highly weathered sandstone or shale: 8,000 psf ■ Weathered sandstone or shale: 15,000 psf
Downward Drag	Ignore
Minimum Shaft Diameter[5]	24 inches
Void Space beneath Grade Beams	Not required
Estimated Total Settlement	1/2 inch
Estimated Differential Settlement	Negligible

DESCRIPTION	VALUE

[1] Due to variations in the depth to and quality of weathered shale and weathered sandstone across the site, the geotechnical engineer or his representative should be present during pier drilling to verify that suitable bearing material is adequately penetrated.

[2] This is the pressure at the base of the foundation in excess of the adjacent overburden pressure. The allowable bearing pressure has a safety factor of approximately 3.

[3] Skin friction may be used to resist both upward and downward axial forces. The allowable skin friction has a safety factor of approximately 2.

[4] The allowable passive pressures have a safety factor of approximately 2. Ignore passive pressure in frost zone. The soil/rock parameters for use in the LPILE computer program can be provided upon request.

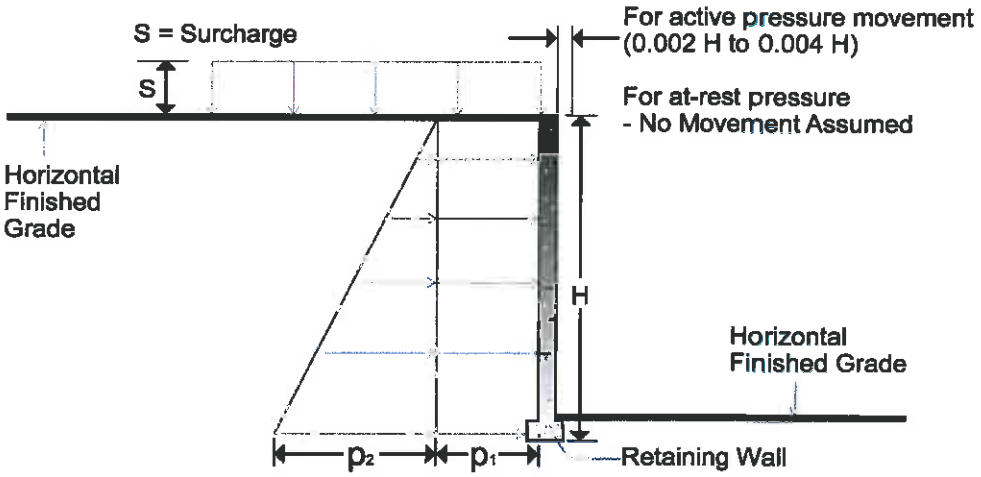
[5] Sufficient steel reinforcement should be provided to provide adequate structural integrity.

The drilling contractor should anticipate the need for a heavy-duty rig equipped with a rock bit to penetrate the weathered sandstone or weathered shale. It is anticipated that temporary casing will be needed to prevent caving of the excavation sides in the sand layer; however, the final determination should be made at the time of construction.

Groundwater was encountered in some of the borings at depths ranging from approximately 8.5 to 34 feet at the time of this investigation; therefore, we expect dewatering will be needed to facilitate drilled pier construction. The need for dewatering will depend on the pier length and actual groundwater conditions at the time of construction. Prior to placing concrete, water or sloughed material should be removed from the base of the drilled piers. If water is encountered and it cannot be removed, the concrete should be pumped from the bottom of the pier excavation to the top, displacing the water to the surface. To facilitate pier construction, concrete should be on-site and ready for placement as pier excavations are completed. In no event should a pier excavation be allowed to remain open overnight.

4.4 Lateral Earth Pressures

Walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall rotation. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.



EARTH PRESSURE COEFFICIENTS

Earth Pressure Condition	Coefficient for Backfill Type	Equivalent Fluid Pressure (pcf)	Surcharge Pressure, P_1 (psf)	Earth Pressure, P_2 (psf)
Active (K_a)	Granular - 0.33	40	(0.33)S	(40)H
	Lean Clay[1] - 0.42	50	(0.42)S	(50)H
At-Rest (K_o)	Granular - 0.46	55	(0.46)S	(55)H
	Lean Clay[1] - 0.58	70	(0.58)S	(70)H
Passive (K_p)	Granular - 3.0	360	---	---
	Lean Clay[1] - 2.4	288	---	---

[1] Cohesive low volume change soils with LL≤40 and PI≤15.

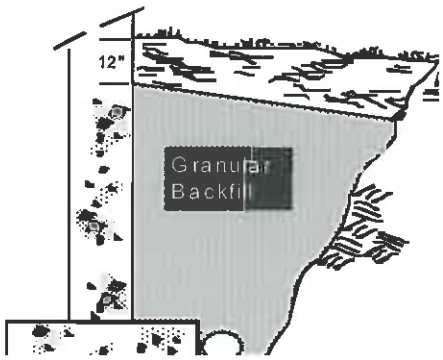
Conditions applicable to the above table include:

- For active earth pressure, wall must rotate about base, with top lateral movements 0.002Z to 0.004Z, where Z is wall height.
- For passive earth pressure, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure.
- In-situ soil backfill weight a maximum of 120 pcf.
- Horizontal backfill, compacted to at least 95 percent of the material's standard Proctor maximum dry density.
- Loading from heavy compaction equipment not included.
- No groundwater acting on wall.
- No safety factor included.
- Ignore passive pressure in frost zone.

Backfill placed against the walls should consist of granular soils or cohesive low volume change soils (LL≤40 and PI≤15). For the granular values to be valid, the granular backfill must extend out and up from the base of the wall at an angle of at least 45 and 60 degrees from vertical for the at-rest and passive cases, respectively. Additionally, the granular backfill must extend out from the base of the wall at an angle of at least 30 degrees from vertical for the active case. To calculate the resistance to sliding, an ultimate friction coefficient of 0.35 should be used between the foundation and the underlying soils.

We recommend installing an exterior perimeter drain system along below-grade walls. The exterior perimeter drains should be installed at the foundation level as shown on the adjacent figure and described in the following notes.

- Granular backfill should be clean, free-draining sand or crushed stone.
- Perforated pipe should be rigid PVC, sized to transport the expected water.
- Perforated pipe should be surrounded by at least 4 inches of ASTM C 33 No. 57 stone or equivalent with the stone and pipe encased in an approved filter fabric to restrict the migration of fines into the drain system.
- Exterior ground surface should consist of a 12-inch compacted clay cap.



If exterior perimeter drains will not be installed, then combined hydrostatic and lateral earth pressures should be calculated for lean clay backfill using an equivalent fluid weighing 90 and 100 pcf for active and at-rest conditions, respectively. For granular backfill, an equivalent fluid weighing 85 and 90 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of below-grade walls to prevent lateral pressures more than those provided.

4.5 Seismic Considerations

DESCRIPTION	VALUE
2006 International Building Code Site Classification (IBC)	C

Note: In general accordance with the *2009 International Building Code,* Table 1613.5.2. The 2009 International Building Code (IBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. Borings extended to a maximum depth of 34 feet. This seismic site class definition considers that weathered shale or weathered sandstone continues below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

4.6 Pavements

Traffic patterns and anticipated loading conditions were not provided to us at the time of this report. Therefore, we have assumed that traffic loads will consist primarily of automobile traffic and occasional trash removal trucks. Two pavement section categories have been provided. The light duty parking and drive area category is for areas expected to receive only car traffic. The heavy duty parking and drive area category assumes two trash removal or delivery trucks per day in addition to car traffic. If the truck traffic loading expected is different than our assumptions, we should be provided the traffic information and allowed to review these pavement sections. The owner/user should consider placing signs at entryways to deter heavy trucks from light duty pavement areas.

	Light Duty Parking and Drive	Heavy Duty Parking and Drive
Section I		
Portland Cement Concrete[1] (3,500 psi, Air Entrained)	5.0" Concrete 12.0" Type "A" aggregate base[2]	6.0" Concrete 12.0" Type "A" aggregate base[2]

[1] All materials should meet the ODOT Standard Specifications for Highway Construction.

[2] As a minimum, a 12-inch thickness of crushed aggregate (meeting requirements of ODOT 1999 Standard Specifications for Highway Construction, Section 703.01, Type A) is recommended beneath the floor pavement to help discharge the groundwater. The crushed aggregate should be compacted to at least 95 percent of its maximum dry density as determined by the standard Proctor test method (ASTM D 698).

Notes: Reinforced concrete pads should be provided in front of and beneath trash receptacles. The trash removal trucks should be parked on the rigid concrete pavement when the trash receptacles are lifted. The concrete pads should be a minimum of 7 inches thick and properly reinforced.

These pavement sections are considered minimal sections based upon the expected traffic and the existing subgrade conditions. However, they are expected to function with periodic maintenance and overlays if good drainage is provided and maintained.

Pavement materials should not be placed when the surface is wet. Surface drainage should be provided away from the edge of paved areas to minimize lateral moisture transmission into the subgrade.

Preventative maintenance should generally consist of both localized maintenance (e.g. crack sealing and patching) and global maintenance (e.g. surface sealing). It should be planned and provided for through an on-going pavement management program to enhance future pavement performance and preserve the pavement investment.

4.7 Construction Excavations

Based on the groundwater conditions encountered at the time of this investigation, excavations below depths of approximately 8.5 feet will likely encounter groundwater. Therefore, we anticipate dewatering will be required during construction.

The subgrade soil conditions should be evaluated during the excavation process and the stability of the soils determined at that time by the contractors' Competent Person. Slope inclinations flatter than the OSHA maximum values may have to be used.

As a safety measure, it is recommended that all vehicles and soil piles be kept to a minimum lateral distance from the crest of the slope equal to no less than the slope height. The exposed slope face should be protected against the elements.

The soils to be penetrated by the proposed excavations may vary significantly across the site. The contractor should verify that similar conditions exist throughout the proposed area of excavation. If different subsurface conditions are encountered at the time of construction, the actual conditions should be evaluated to determine any excavation modifications necessary to maintain safe conditions.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design documents so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after

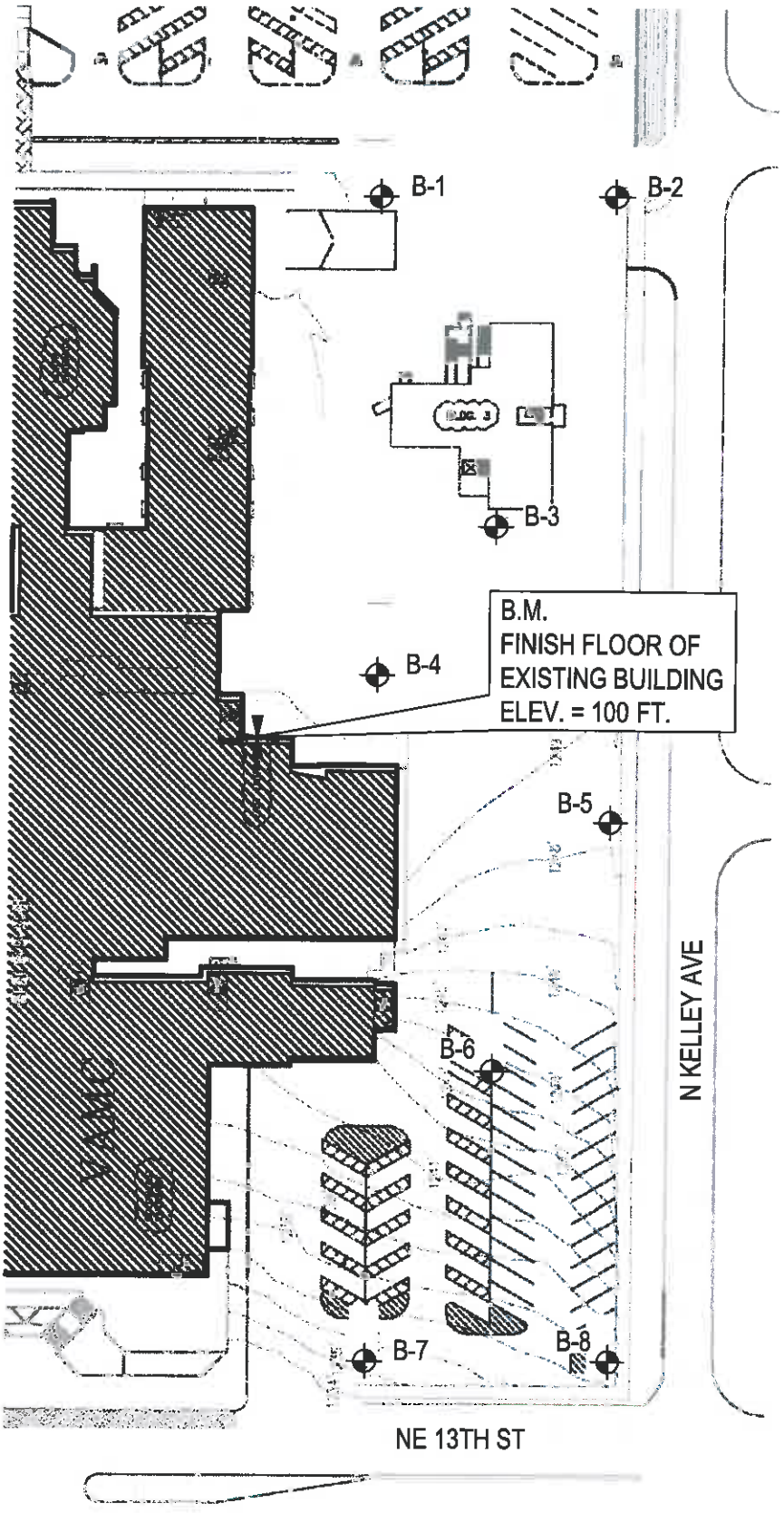
construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



LEGEND

BORING LOCATION

DIAGRAM IS FOR GENERAL LOCATION ONLY,
AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr: DCVS	Project No. 03125095
Drawn By: DWT	Scale: NTS
Checked By: DCVS	File No. 03125095 (A1)
Approved By: JWB	Date: 04/17/2012

Terracon
Consulting Engineers and Scientists
5301 BEVERLY DRIVE OKLAHOMA CITY, OKLAHOMA 73105
PH. (405) 525-0453 FAX. (405) 557-0549

BORING LOCATION PLAN

NEW PARKING GARAGE
V.A. MEDICAL CENTER
921 NE 13TH STREET
OKLAHOMA CITY, OKLAHOMA

EXHIBIT

A-1

Field Exploration Description

A total of eight test borings were drilled at the site on March 24, April 7 and April 9, 2012. The borings were drilled to depths ranging from approximately 31 to 34 feet below the ground surface at the approximate locations shown on the attached Boring Location Plan, Exhibit A-1.

Terracon personnel located the borings in the field by taping distances from the references shown on the attached boring location plan. The surface elevations at the boring locations were determined using differential leveling procedures. These elevations were referenced to the finish floor of the existing building located approximately as shown on the boring location plan and assuming an elevation of 100 feet. Based on this benchmark, the ground surface elevations at the boring locations ranged from 88.5 to 104 feet. The elevations shown on the logs have been rounded to the nearest 0.5 foot. The boring locations and elevations should be considered accurate only to the degree implied by the methods used to define them.

An all-terrain, rotary drill rig equipped with continuous flight augers was used to advance the boreholes. Representative samples were obtained by the split-barrel sampling procedure.

The split-barrel sampling procedure uses a standard 2-inch O.D. split-barrel sampling spoon that is driven into the bottom of the boring with a 140-pound drive hammer falling 30 inches. The number of blows required to advance the sampling spoon the last 12 inches, or less, of a typical 18-inch sampling interval or portion thereof, is recorded as the standard penetration resistance value, N. The N value is used to estimate the in-situ relative density of cohesionless soils and, to a lesser degree of accuracy, the consistency of cohesive soils and the hardness of sedimentary bedrock. The sampling depths, penetration distances, and the N values are reported on the boring logs. The samples were tagged for identification, sealed to reduce moisture loss and returned to the laboratory for further examination, testing and classification.

An automatic Standard Penetration Test (SPT) drive hammer was used to advance the split-barrel sampler. The automatic drive hammer achieves a greater mechanical efficiency when compared to a conventional safety drive hammer operated with a cathead and rope. We considered this higher efficiency in our interpretation and analysis of the subsurface information provided with this report.

Field logs were prepared as part of the drilling operations. These boring logs included visual classifications of the materials encountered during drilling and the field personnel's interpretation of the subsurface conditions between samples. The final boring logs included with this report may include modifications based on observations and tests of the samples in the laboratory.

As required by the Oklahoma Water Resources Board, any borings deeper than 20 feet, or borings that encounter groundwater or contaminated materials must be grouted or plugged in

accordance with Oklahoma State statutes. One boring log must also be submitted to the Oklahoma Water Resources Board for each 10 acres of project site area. Terracon grouted the borings and submitted a log in order to comply with the Oklahoma Water Resources Board requirements.

LOG OF BORING NO. B-1

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 101.0 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
Approx. 4" Portland Cement Concrete Pavement				PA						
FILL-SILTY SAND reddish-brown	2.5 / 98.5	CL	1	SS	6	14	15			
SHALEY LEAN CLAY with sand, reddish-brown hard	3.5 / 97.5			PA						
		SM	2	SS	10	45	18			
SILTY SAND reddish-brown medium dense	6 / 95			PA						
	5	CL CH	3	SS	18	34	16			
				PA						
SHALEY LEAN TO FAT CLAY reddish-brown, hard		CL CH	4	SS	16	51	14			
	10			PA						
	14 / 87		5	SS		44/6" 50/4"	14			
+WEATHERED SHALE red, moderately hard	15			HS						
	20			PM						
	21 / 80		6	SS	1	50/1"	14			
+WEATHERED SANDSTONE reddish-brown, well cemented				RB						
	25			PM						
	26 / 75		7	SS	6	50/6"	16			
+WEATHERED SHALE red, soft				RB						

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE W.D.	▼ NONE	A.B.
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-9-12		
BORING COMPLETED	4-9-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 98 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-1

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street, Oklahoma City, Oklahoma**

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR -#200 U.S. STANDARD SIEVE
		30			PM						
	+WEATHERED SHALE red, soft			8	SS	4	50/4"	17			
	(moderately hard below 31')				RB						
	35.5	35		9	SS		50/3"	10			
	BOTTOM OF BORING 65.5										

+Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE W.D.	NONE A.B.	
WL			
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-9-12		
BORING COMPLETED	4-9-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-2

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 104.0 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
Vegetation & Topsoil				PA						
FILL-CLAYEY SAND brown and reddish-brown			1	SS	18	6	16			-#200=35%
2.5				PA						
CLAYEY SAND reddish-brown medium dense			2	SS	10	21/6" 50/3"	13			
4.5 99.5	5			PA						
+WEATHERED SILTY SANDSTONE brown, cemented			3	SS	3	50/3"	8			
				PA						
(light gray below 6')			4	SS	2	50/2"	15			
	10			PA						
(well cemented below 8.5')										
13.5 90.5			5	SS	9	20/6" 50/6"	11			
	15			PA						
+WEATHERED SHALE red, soft to moderately hard			6	SS	9	27/6" 50/3"	11			
	20			PA						
(hard at 24')			7	SS	8	35/6" 50/2"	10			
	25			PA						

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 33.5	W.D.	▼ 34.0	A.B.
WL	▼		▼	
WL	Grouted 4' To 14'			

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-2

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
				8	SS	7	35/6" 50/3"	13			
		30			PA						
	+WEATHERED SHALE red, soft to moderately hard										
	34 ▽ 70			9	SS	6	50/6"	12			
	BOTTOM OF BORING +Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 33.5	W.D.	▼ 34.0	A.B.
WL	▼		▼	
WL	Grouted 4' To 14'			

Terracon

BORING STARTED			4-7-12
BORING COMPLETED			4-7-12
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 89 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-3

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 103.0 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
			PA						
		1	SS	18	18	13			
			PA						
		2	SS	6	50/6"	9			-#200=20%
5			PA						
		3	SS	4	50/4"	13			
			PA						
		4	SS	18	44	14			
10			PA						
		5	SS	17	41/6" 50/5"	14			
15			PA						
		6	SS	12	28/6" 50/6"	10			
20			PA						
		7	SS	2	50/2"	7			
25			PA						

Approx. 6" Asphaltic Concrete Pavement

2 — **FILL-SILTY SAND** — red — 101

3.5 — **FAT CLAY** — red — 99.5

+HIGHLY WEATHERED SILTY SANDSTONE
light gray and reddish-brown
poorly cemented

(light gray, cemented below 6')

8.5 — ▽ 94.5

+HIGHLY WEATHERED SHALE
red, soft

14.5 — 88.5

+WEATHERED SHALE
red, soft

23.5 — 79.5

+WEATHERED SANDY SHALE
red, hard

(soft at 28.5')

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 8.5	W.D.	▼ 33.0	A.B.
WL	▼		▼ 11.0	+ 24Hr
WL	Grouted 4' To 14'			

Terracon

BORING STARTED	3-24-12		
BORING COMPLETED	3-24-12		
RIG	907E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-3

CLIENT **Med-Arch LLC.**

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

ENGINEER/ARCHITECT

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
				8	SS	2	30/6" 50/2"	13			
		30			PA						
	+WEATHERED SANDY SHALE red, hard			9	SS	2	50/2"	8			
	33.5 ▼ 69.5										
	BOTTOM OF BORING										
	+Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 8.5	W.D.	▼ 33.0	A.B.
WL	▼		▼ 11.0	+ 24Hr
WL	Grouted 4' To 14'			

Terracon

BORING STARTED			3-24-12
BORING COMPLETED			3-24-12
RIG	907E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-4

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 103.0 ft

DEPTH, ft.	GRAPHIC LOG	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
		Approx. 5" Asphaltic Pavement Over 3" Aggregate Base			PA						
		FILL-LEAN CLAY	CL	1	SS	18	8	17			LL=39 PL=14 PI=25
2.5		red, mottled olive 100.5			PA						
		SILTY SAND trace clay and sandstone fragments, reddish-brown medium dense	SM	2	SS	18	17	11			
5					PA						
		(dense below 6')	SM	3	SS	18	33	16			
7		96			PA						
		SHALEY LEAN TO FAT CLAY red, hard	CL CH	4	SS	18	49	14			
10					PA						
14		89		5	SS	18	35/6" 50/6"	13			
15					PA						
		+WEATHERED SANDY SHALE red, soft		6	SS	5	50/5"	9			
20		(light gray below 18.5')			PA						
23.5		79.5		7	SS	3	50/3"	7			
25					PA						
		+WEATHERED SHALE red, moderately hard									

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE W.D.	▼ NONE	A.B.
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	3-24-12		
BORING COMPLETED	3-24-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-4

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
				8	SS	3	50"/3"	8			
		30			PA						
	+WEATHERED SHALE red, moderately hard										
	34 69			9	SS	4	50"/4"	10			
	BOTTOM OF BORING +Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE W.D.	▼ NONE	A.B.
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	3-24-12		
BORING COMPLETED	3-24-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-5

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
	Approx. Surface Elev.: 101.5 ft										
	Approx. 6" Asphaltic Pavement				PA						
	SILTY SAND light gray dense		SM	1	SS	17	31/6" 50/5"	14			-#200=15%
	2 — 99.5				PA						
	+HIGHLY WEATHERED SILTY SANDSTONE light gray, cemented			2	SS	3	50/3"	12			
		5			PA						
	6 — 95.5			3	SS	18	70	13			
	+HIGHLY WEATHERED SHALE red, soft				PA						
	9.5 — 92			4	SS	16	31/6" 50/4"	13			
	+WEATHERED SHALE red, soft	10			PA						
				5	SS	15	35/6" 50/3"	13			
		15			PA						
	18.5 — 83			6	SS	6	50/6"	9			
	+WEATHERED SHALE with sandstone seams, red and light gray, soft	20			PA						
	(hard below 23')			7	SS	2	50/2"	10			
	(soft below 28.5')	25			PA						

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23.5	W.D. ▼ NONE	A.B.
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	3-24-12		
BORING COMPLETED	3-24-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-5

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
				8	SS	12	35/6" 50/6"	11			
	+WEATHERED SHALE with sandstone seams, red and light gray, soft	30			PA						
	(moderately hard below 33')			9	SS	3	50/3"	9			
	34 67.5 BOTTOM OF BORING										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 23.5 W.D.	▼ NONE A.B.	
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	3-24-12		
BORING COMPLETED	3-24-12		
RIG	970E	FOREMAN	RS
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-6

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 96.5 ft

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
	Approx. 6 1/2" Asphaltic Concrete Pavement				PA						
	LEAN CLAY red, stiff		CL	1	SS	18	8	16			LL=44 PL=15 PI=29
					PA						
	(very stiff below 4')		CL	2	SS	18	19	15			
		5			PA						
			CL CH	3	SS	18	56	14			
					PA						
	SHALEY LEAN TO FAT CLAY red, hard		CL CH	4	SS	15	35/6" 50/5"	12			
		10			PA						
				5	SS	11	25/6" 50/5"	10			
		15			PA						
	+WEATHERED SHALE red, soft			6	SS	15	25/6" 50/6"	13			
		20			PA						
				7	SS	5	50/5"	11			
		25			PA						

6 — 90.5

9.5 — 87

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE W.D.	▼ NONE A.B.	
WL	▼	▼	
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-6

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
				8	SS	4	50/4"	9			
	+WEATHERED SHALE red, soft	30			PA						
	32.5 64										
	33.5 **+WEATHERED SILTY SANDSTONE** red, well cemented 63			9	SS	2	50/2"	7			
	BOTTOM OF BORING										

+Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NONE	W.D.	▼ NONE	A.B.
WL	▼		▼	
WL	Grouted 4' To 14'			

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-7

CLIENT **Med-Arch LLC.**

SITE **921 N.E. 13th Street, Oklahoma City, Oklahoma**

ENGINEER/ARCHITECT

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 88.5 ft

DEPTH, ft.	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS AND/OR -#200 U.S. STANDARD SIEVE
	Approx. 6 1/2" Asphaltic Concrete Pavement			PA						
	LEAN CLAY	CL	1	SS	12	8	16			
2.5	reddish-brown, stiff	86		PA						
4	**LEAN TO FAT CLAY**	84.5								
	reddish-brown, very stiff	CL CH	2	SS	18	16	17			
5				PA						
6	**SANDY LEAN CLAY**	82.5								
	light greenish-gray, very stiff	CL CH	3	SS	18	32	14			LL=48 PL=18 PI=30
				PA						
	SHALEY LEAN TO FAT CLAY red, hard	CL CH	4	SS	18	51	12			
10				PA						
13		75.5								
			5	SS	4	50/4"	9			
15				PA						
	+WEATHERED SHALE red, moderately hard		6	SS	5	50/5"	11			
20	(soft below 18.5')			PA						
			7	SS	6	50/6"	10			
25				PA						
28.5		60								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE W.D.	NONE	A.B.
WL			
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-7

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
	+WEATHERED SILTY SANDSTONE red, cemented			8	SS	4	50/4"	6			
		30			PA						
	(well cemented below 32.5')										
	33.5			9	SS	2	50/2"	5			
	BOTTOM OF BORING	55									
	+Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE W.D.	NONE	A.B.
WL			
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-8

CLIENT **Med-Arch LLC.**

SITE **921 N.E. 13th Street, Oklahoma City, Oklahoma**

ENGINEER/ARCHITECT

PROJECT **VA Medical Center Parking Garage**

Approx. Surface Elev.: 91.0 ft

DEPTH, ft.	GRAPHIC LOG	DESCRIPTION	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
		Approx. 7" Asphaltic Concrete pavement			PA						
		FILL-SANDY LEAN CLAY brown and red		1	SS	18	6	18			
					PA						
3.5		87.5									
		LEAN TO FAT CLAY red, stiff	CL CH	2	SS	8	11	18			LL=46 PL=15 PI=31
5					PA						
			CL CH	3	SS	18	38	15			
		(hard below 6')			PA						
8.5		82.5									
				4	SS	18	61	14			
10		**+HIGHLY WEATHERED SHALE** red, soft			PA						
14.5		76.5									
				5	SS	16	35/6" 50/4"	14			
15					HS						
					RB						
					PM						
20		**+WEATHERED SHALE** red, moderately hard		6	SS	2	50/3"	10			
					RB						
					PM						
25				7	SS	2	50/2"	11			
					RB						
26		65									
		+WEATHERED SANDSTONE red, well cemented									

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	W.D.	
WL			
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

LOG OF BORING NO. B-8

CLIENT **Med-Arch LLC.**

ENGINEER/ARCHITECT

SITE **921 N.E. 13th Street**
Oklahoma City, Oklahoma

PROJECT **VA Medical Center Parking Garage**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS ATTERBERG LIMITS AND/OR #200 U.S. STANDARD SIEVE
	+WEATHERED SANDSTONE red, well cemented	30			PM						
	31 60										
	+Classification estimated from disturbed samples. Core sample and petrographic analysis may reveal other rock types.										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	W.D.	
WL			
WL	Grouted 4' To 14'		

Terracon

BORING STARTED	4-7-12		
BORING COMPLETED	4-7-12		
RIG	387E	FOREMAN	RE
APPROVED	DVS	JOB #	03125095

BOREHOLE 99 03125095.GPJ TERRACON.GDT 4/25/12

Pressuremeter Testing

In-situ pressuremeter tests were performed in the weathered bedrock encountered in borings B-1 and B-8. The purpose of the pressuremeter test is to obtain in-situ data on the strength and compressibility of the sedimentary rock which often allows a less conservative evaluation of the bearing strata. Pressuremeter test results are included in Exhibit A-5 of this report in the form of pressure versus volume curves. A tabulated summary of the test results is also presented in Table I attached in Exhibit A-5.

The pressuremeter consists of a cylindrical-shaped probe, a pressure source and metering gauges. The test is performed by lowering the probe into the borehole to a desired test level. The probe is expanded by gas pressure against the soil or rock at the sides of the borehole. Gauges permit simultaneous measurement of the applied pressure and corresponding volume change of the probe. A plot of applied pressure versus probe volume has a characteristic shape from which parameters to evaluate soil and rock strength and compressibility are determined.

The primary parameters determined from the pressuremeter test are the creep pressure, Pf, which is the upper limit of the pseudo-elastic (straight line) portion of the pressure versus volume curve; the limit pressure, PL, which is the failure pressure of the material being tested; and the deformation modulus, Em, which is the slope of the pressure versus deformation curve in the pseudo-elastic range. The PL values are a measure of strength and used to evaluate allowable bearing pressures. The Em values are a measure of compressibility and are used to evaluate settlements.

The capacity of the pressuremeter equipment used for this project is 1,450 psi (approximately 208 ksf). A review of the attached table of pressuremeter test data shows P_L values ranging from 119 to in excess of 284 ksf and E_m values ranging from 2,700 to 15,800 ksf within the weathered shale/sandstone bedrock.

TABLE I

PRESSUREMETER TEST RESULTS

NEW PARKING GARAGE
V.A. MEDICAL CENTER
921 N.E. 13TH STREET
OKLAHOMA CITY, OKLAHOMA

Terracon Project No. 03125095

Boring No.	Depth (Ft.)	P_o (ksf)	P_f (ksf)	P_L (ksf)	E_m (ksf)
B-1	19.0 - 21.0	5.0	115	195	3,160
	24.0 - 26.0	6.0	94	156	3,125
	29.0 - 31.0	6.0	84	119	3,400
B-8	19.0 - 21.0	6.0	73	127	2,700
	24.0 - 26.0	6.0	167	283	3,000
	29.0 - 31.0	6.0	>168	>284	15,800

Notes: Assumed Poisson's Ratio = 0.33 and P_L/P_f=1.7

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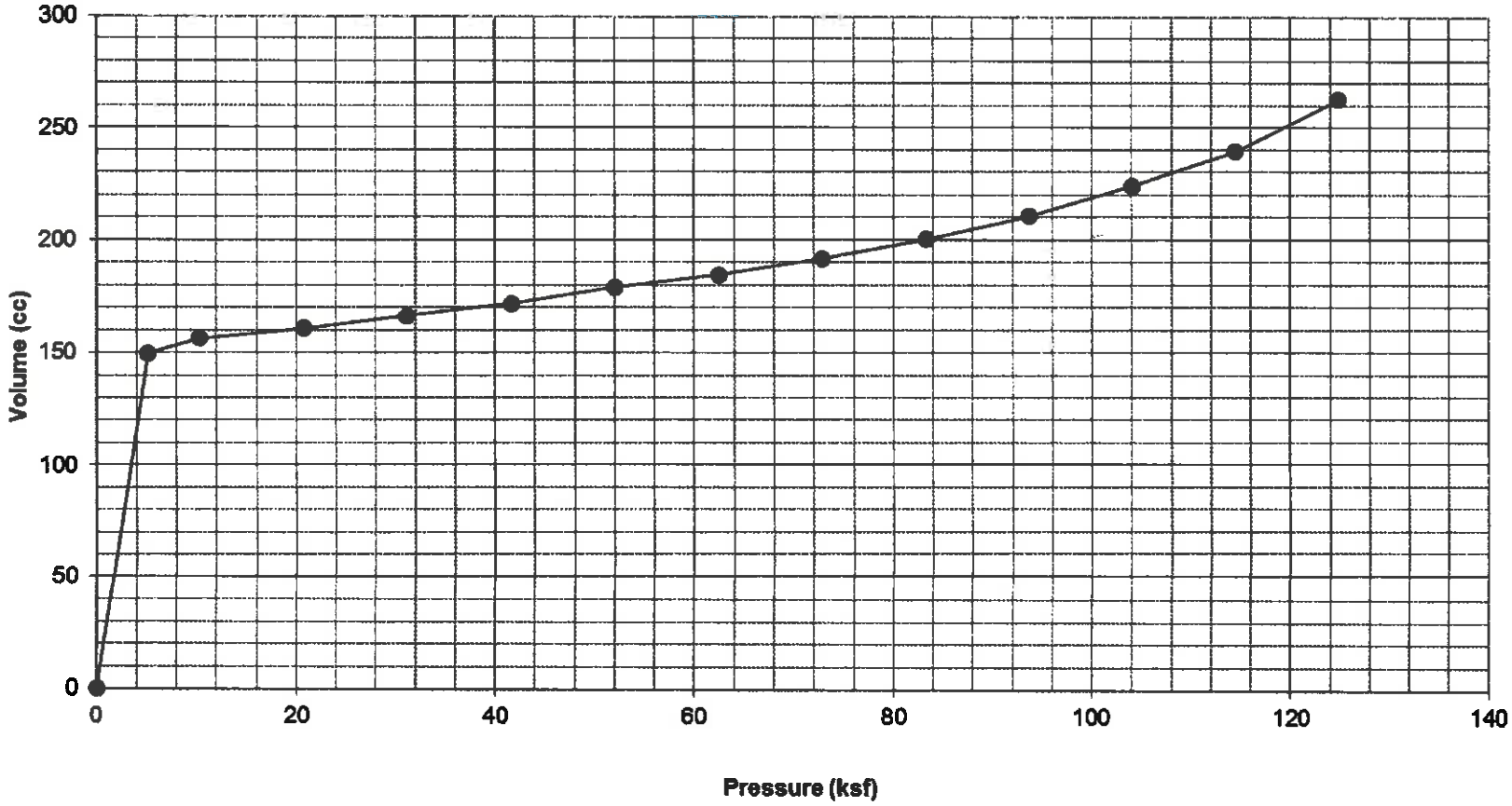
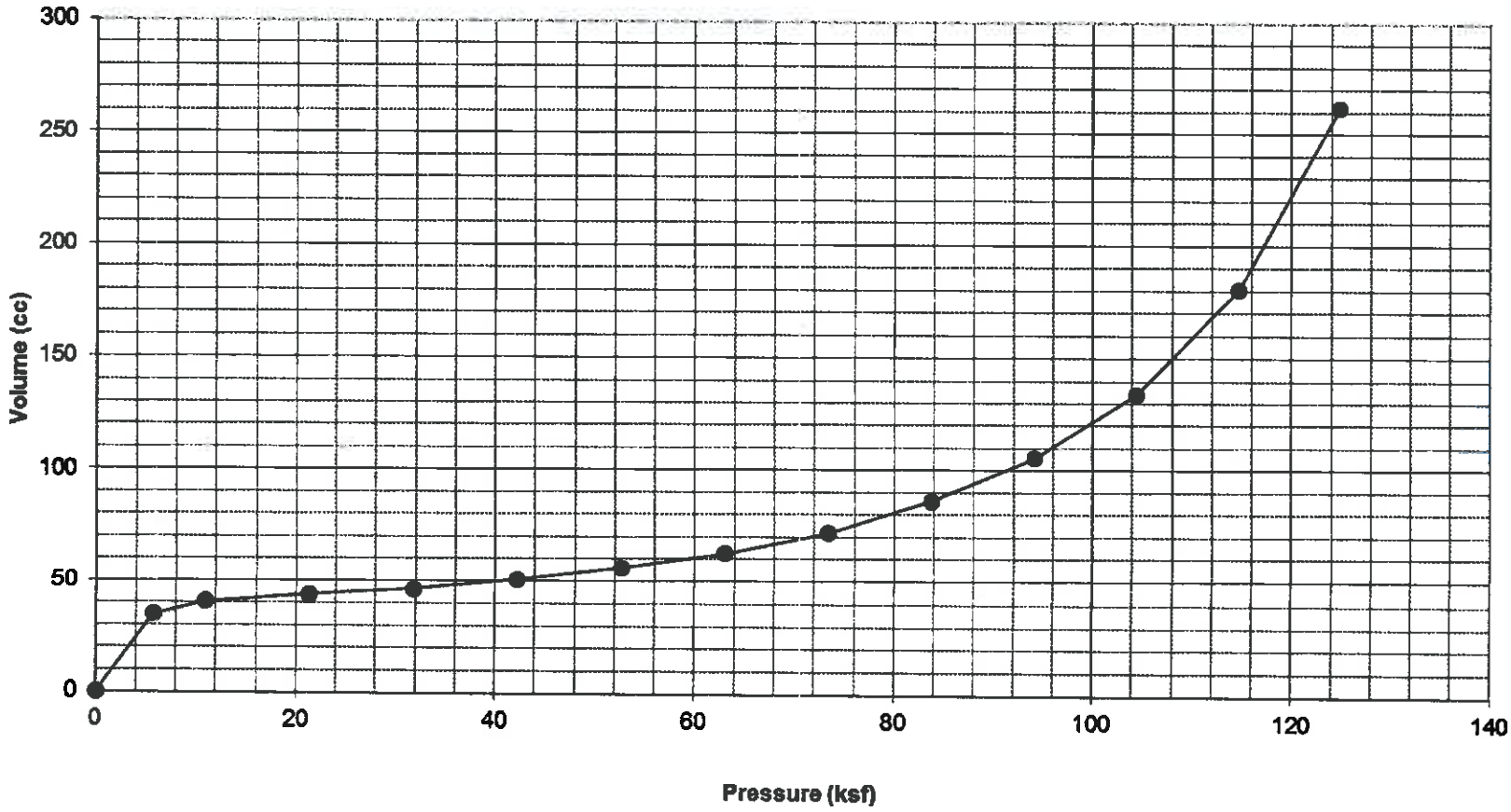
New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-1: 19'-21'
Terracon Project No. 03125095

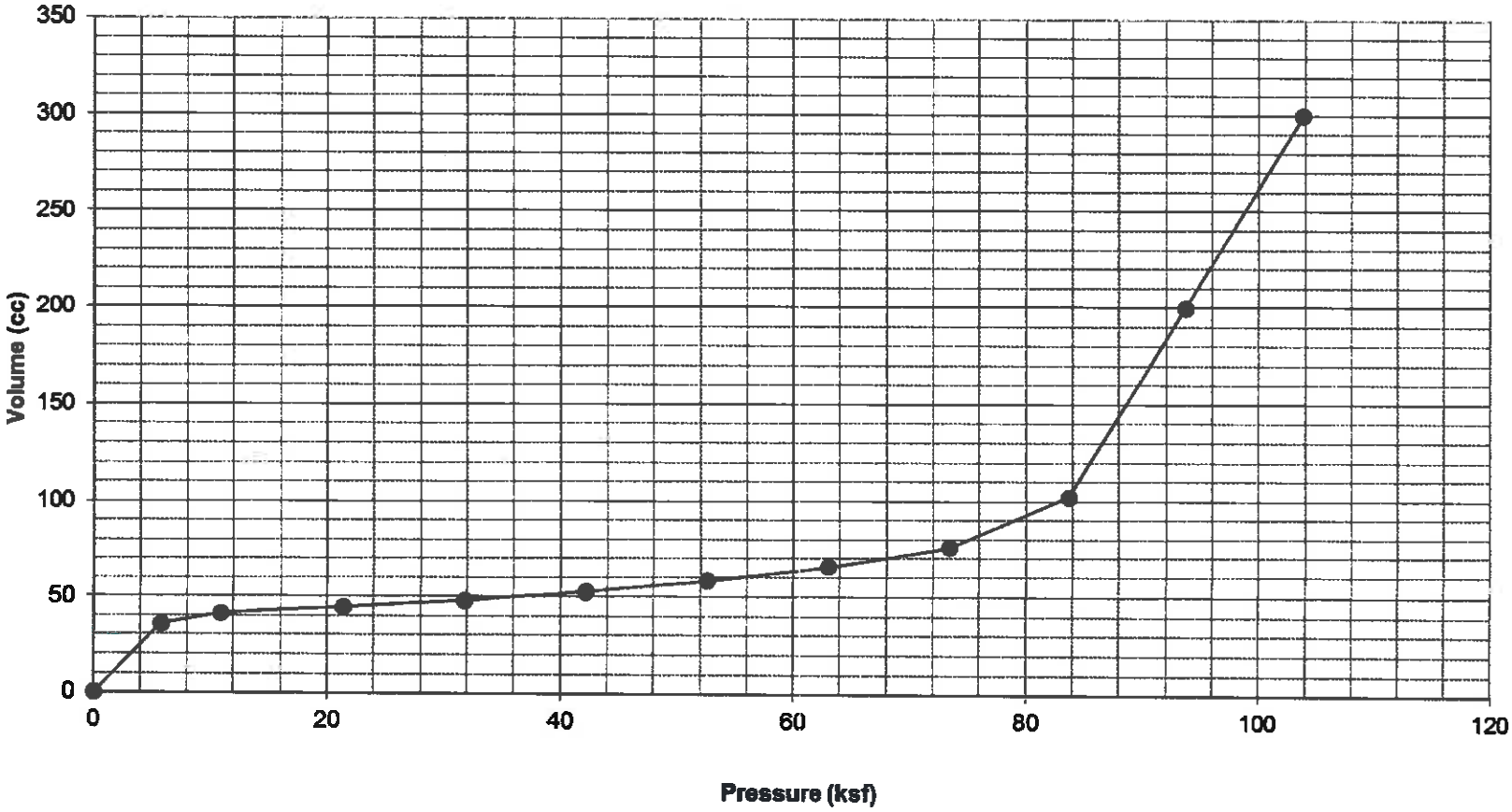


Terracon

New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-1: 24'-26'
Terracon Project No. 03125095

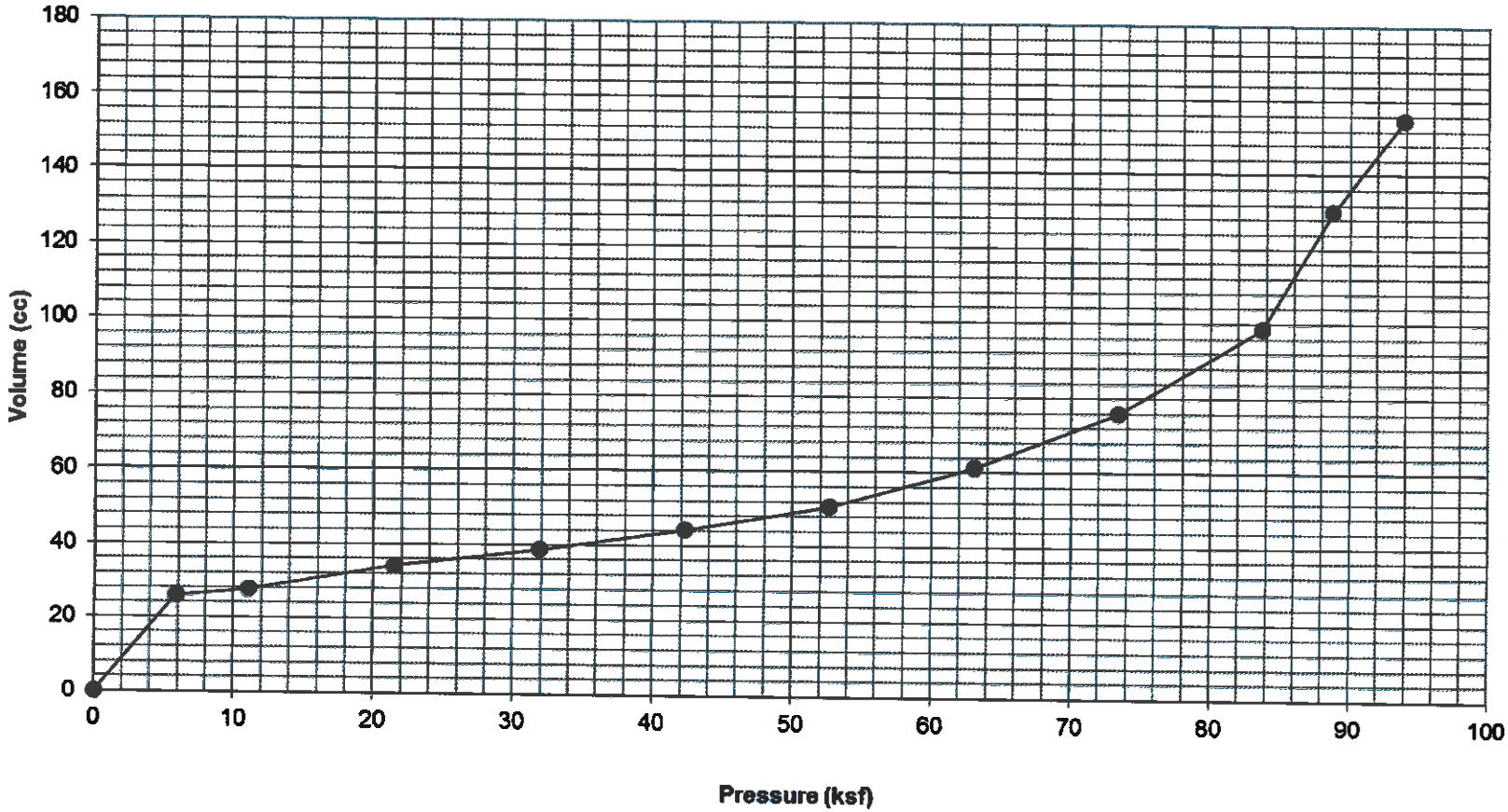


New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-1: 29'-31'
Terracon Project No. 03125095

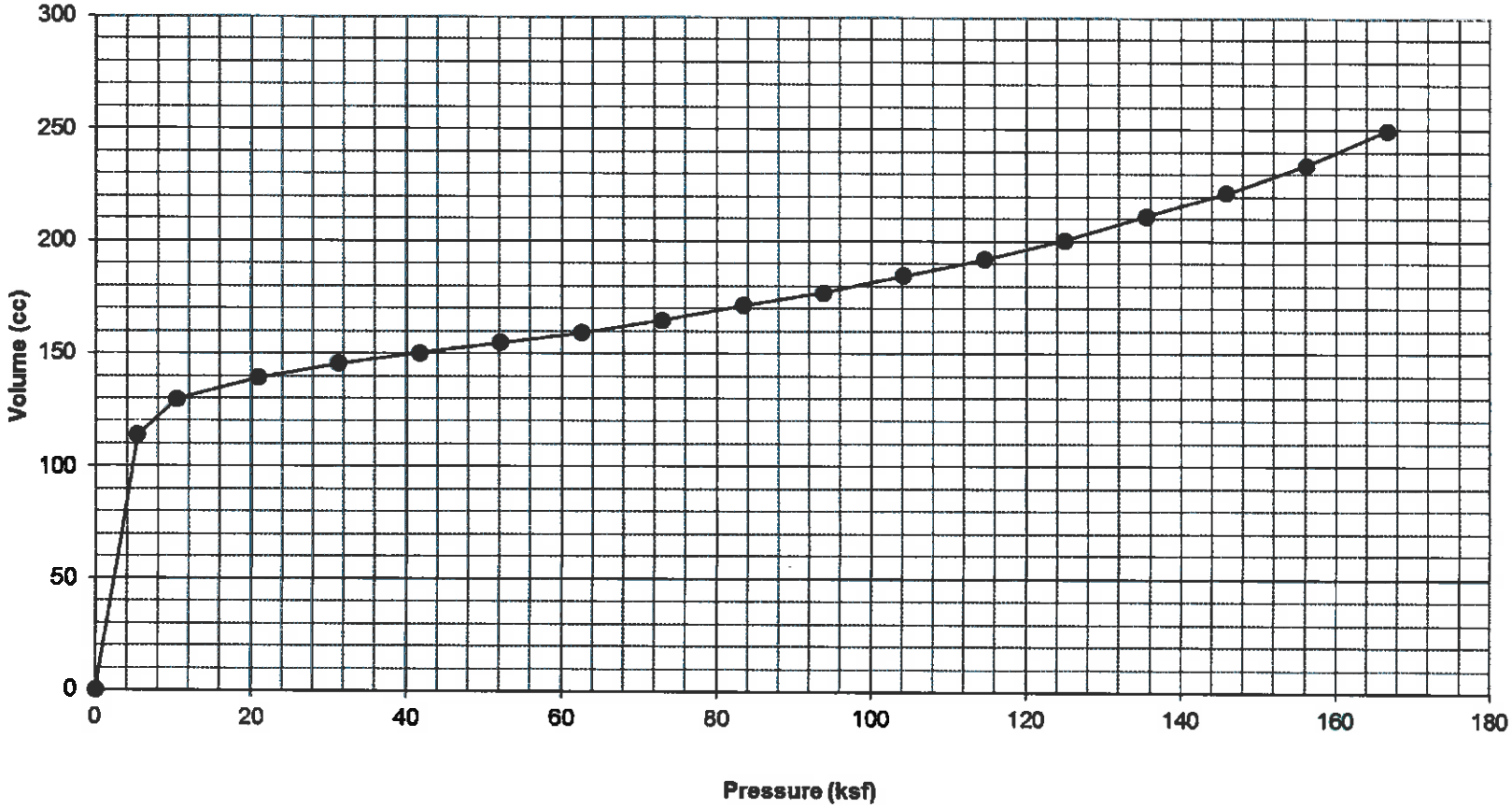


Terracon

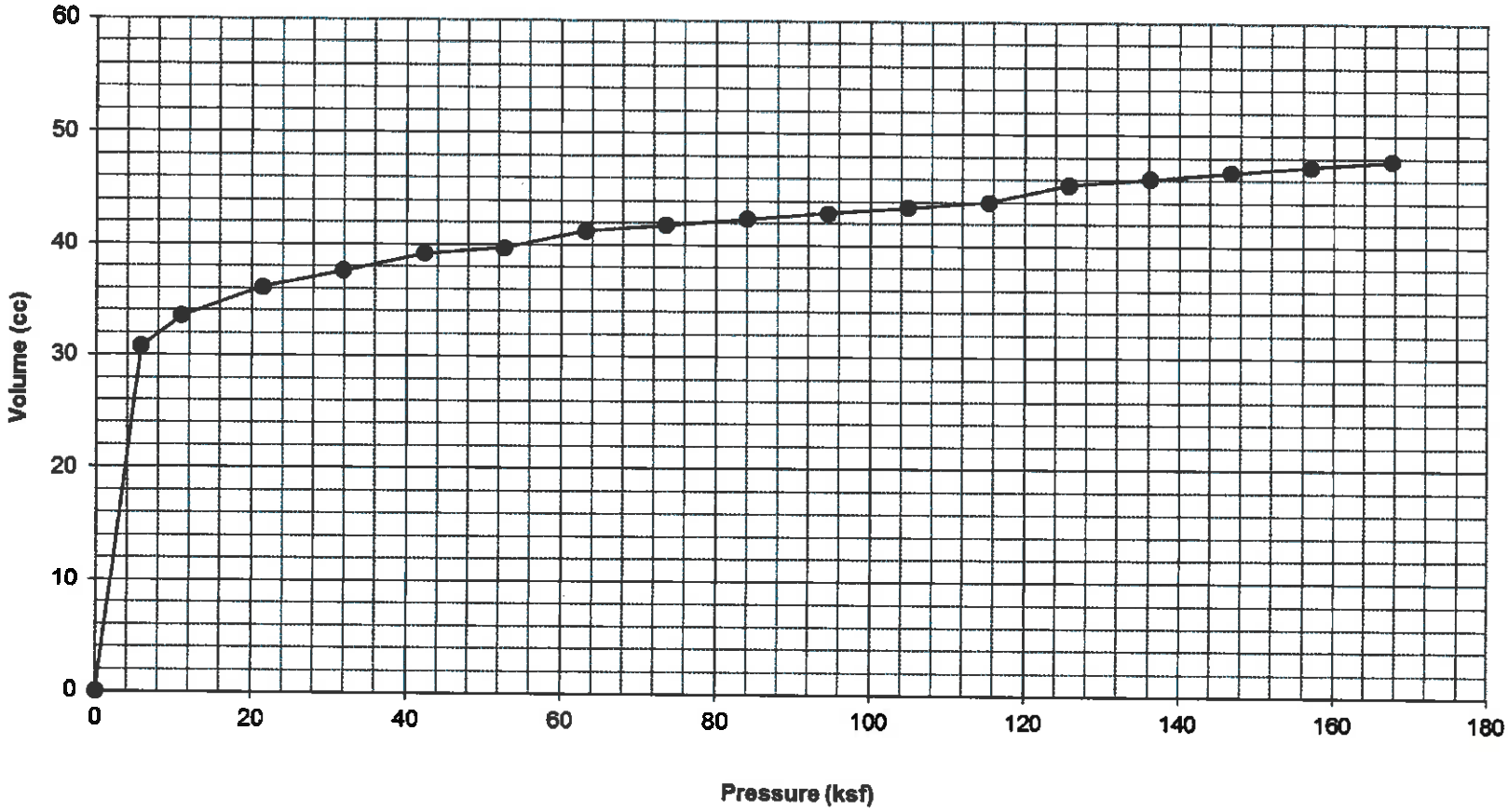
New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-8: 19'-21'
Terracon Project No. 03125095



New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-8: 24'-26'
Terracon Project No. 03125095



New Parking Garage
V.A. Medical Center
921 N.E. 13th Street
Oklahoma City, Oklahoma
Boring B-8: 29'-31'
Terracon Project No. 03125095



APPENDIX B

LABORATORY TESTING

Laboratory Testing

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. Samples of bedrock were classified in accordance with the general notes for Sedimentary Rock Classification. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil and bedrock samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil and bedrock samples obtained from the site were tested for the following engineering properties:

- In-situ Water Content
- Atterberg Limits
- -#200 Sieve

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon – 1-3/8" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube - 2" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling	N/E:	Not Encountered
WCI:	Wet Cave in	WD:	While Drilling		
DCI:	Dry Cave in	BCR:	Before Casing Removal		
AB:	After Boring	ACR:	After Casing Removal		

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	<2	Very Soft
500 – 1,000	2-3	Soft
1,001 – 2,000	4-6	Medium Stiff
2,001 – 4,000	7-12	Stiff
4,001 – 8,000	13-26	Very Stiff
8,000+	26+	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Ring Sampler (RS) Blows/Ft.	Relative Density
0 – 3	0-6	Very Loose
4 – 9	7-18	Loose
10 – 29	19-58	Medium Dense
30 – 49	59-98	Dense
50+	99+	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F, G, H]
			Fines classify as CL or CH		GC	Clayey gravel[F, G, H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[E]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well-graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G, H, I]
			Fines classify as CL or CH		SC	Clayey sand[G, H, I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K, L, M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K, L, M]
		organic	Liquid limit — oven dried / Liquid limit — not dried	< 0.75	OL	Organic clay[K, L, M, N] / Organic silt[K, L, M, O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line		CH	Fat clay[K, L, M]
			PI plots below "A" line		MH	Elastic silt[K, L, M]
		organic	Liquid limit — oven dried / Liquid limit — not dried	< 0.75	OH	Organic clay[K, L, M, P] / Organic silt[K, L, M, Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel", whichever is predominant.

[L] If soil contains ≥ 30% plus. No. 200 predominantly sand, add "sandy" to group name.

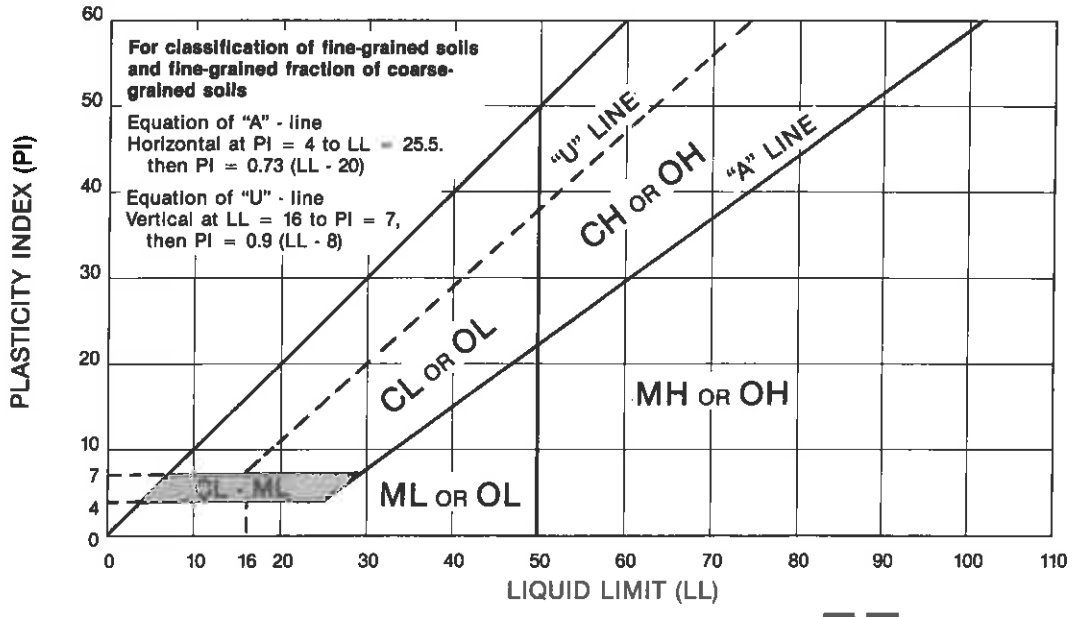
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



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Form 111—6-85

GENERAL NOTES

Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of $CaCo_3$, reacts readily with HCl.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO_3)_2$, harder than limestone, reacts with HCl when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz ($Si0_2$), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (½ inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

PHYSICAL PROPERTIES:

DEGREE OF WEATHERING

Slight	Slight decomposition of parent material on joints. May be color change.
Moderate	Some decomposition and color change throughout.
High	Rock highly decomposed, may be extremely broken.

HARDNESS AND DEGREE OF CEMENTATION

Limestone and Dolomite:

Hard	Difficult to scratch with knife.
Moderately Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Soft	Can be scratched with fingernail.

Shale, Siltstone and Claystone

Hard	Can be scratched easily with knife, cannot be scratched with fingernail.
Moderately Hard	Can be scratched with fingernail.
Soft	Can be easily dented but not molded with fingers.

Sandstone and Conglomerate

Well Cemented	Capable of scratching a knife blade.
Cemented	Can be scratched with knife.
Poorly Cemented	Can be broken apart easily with fingers.

BEDDING AND JOINT CHARACTERISTICS

Bed Thickness	Joint Spacing	Dimensions
Very Thick	Very Wide	> 10′
Thick	Wide	3′ - 10′
Medium	Moderately Close	1′ - 3′
Thin	Close	2″ - 1′
Very Thin	Very Close	.4″ - 2″
Laminated	—	.1″ - .4″

Bedding Plane	A plane dividing sedimentary rocks of the same or different lithology.
Joint	Fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.
Seam	Generally applies to bedding plane with an unspecified degree of weathering.

SOLUTION AND VOID CONDITIONS

Solid	Contains no voids.
Vuggy (Pitted)	Rock having small solution pits or cavities up to ½ inch diameter, frequently with a mineral lining.
Porous	Containing numerous voids, pores, or other openings, which may or may not interconnect.
Cavernous	Containing cavities or caverns, sometimes quite large.

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