State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Request for Quotation

RFQ NUMBER	PAGE
PTR09024	1

ADDRESS CORRESPONDENCE TO ATTENTION OF:
FRANK WHITTAKER
304-558-2316

VENDOR
RFQ COPY
TYPE NAME/ADDRESS HERE

SHIP TO
DIVISION OF PUBLIC TRANSIT
BLUEFIELD TRANSIT SYSTEM

1642 BLUEFIELD AVENUE
BLUEFIELD, WV
24701 304-327-8418

DATE PRINTED	TERMS OF SALE	SHIP VIA	F.O.B.	FREIGHT TERMS
04/09/2009				

BID OPENING DATE: 04/23/2009 BID OPENING TIME 01:30PM

LINE	QUANTITY	UOP	CAT NO	ITEM NUMBER	UNIT PRICE	AMOUNT
	********** ADDENDUM NO. 1 **********					
	THIS ADDENDUM IS ISSUED TO PROVIDE THE ATTACHED BID CLARIFICATIONS, GEOTECHNICAL REPORT AND TO CHANGE THE BID OPENING DATE AND TIME.					
	THE BID OPENING DATE AND TIME IS CHANGED TO: 04/23/09 AT 1:30 PM					
0001	1	EA		968-20		
	PRE-ENGINEERED METAL AND BRICK CONSTRUCTION ADM.OFFI					
	****** THIS IS THE END OF RFQ PTR09024 ****** TOTAL:					

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

SIGNATURE	TELEPHONE	DATE

TITLE	FEIN	ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO RFQ, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

GENERAL TERMS & CONDITIONS
REQUEST FOR QUOTATION (RFQ) AND REQUEST FOR PROPOSAL (RFP)

1. Awards will be made in the best interest of the State of West Virginia.

2. The State may accept or reject in part, or in whole, any bid.

3. All quotations are governed by the ***West Virginia Code*** and the ***Legislative Rules*** of the Purchasing Division.

4. Prior to any award, the apparent successful vendor must be properly registered with the Purchasing Division and have paid the required $125 fee.

5. All services performed or goods delivered under State Purchase Order/Contracts are to be continued for the term of the Purchase Order/Contracts, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise available for these services or goods, this Purchase Order/Contract becomes void and of no effect after June 30.

6. Payment may only be made after the delivery and acceptance of goods or services.

7. Interest may be paid for late payment in accordance with the ***West Virginia Code.***

8. Vendor preference will be granted upon written request in accordance with the ***West Virginia Code.***

9. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

10. The Director of Purchasing may cancel any Purchase Order/Contract upon 30 days written notice to the seller.

11. The laws of the State of West Virginia and the ***Legislative Rules*** of the Purchasing Division shall govern all rights and duties under the Contract, including without limitation the validity of this Purchase Order/Contract.

12. Any reference to automatic renewal is hereby deleted. The Contract may be renewed only upon mutual written agreement of the parties.

13. BANKRUPTCY: In the event the vendor/contractor files for bankruptcy protection, this Contract may be deemed null and void, and terminated without further order.

14. HIPAA BUSINESS ASSOCIATE ADDENDUM: The West Virginia State Government HIPAA Business Associate Addendum (BAA), approved by the Attorney General, and available online at the Purchasing Division's web site (**http://www.state.wv.us/admin/purchase/vrc/hipaa.htm**) is hereby made part of the agreement. Provided that, the Agency meets the definition of a Cover Entity (45 CFR §160.103) and will be disclosing Protected Health Information (45 CFR §160.103) to the vendor.

15. WEST VIRGINIA ALCOHOL & DRUG-FREE WORKPLACE ACT: If this Contract constitutes a public improvement construction contract as set forth in Article 1D, Chapter 21 of the West Virginia Code ("The West Virginia Alcohol and Drug-Free Workplace Act"), then the following language shall hereby become part of this Contract: "The contractor and its subcontractors shall implement and maintain a written drug-free workplace policy in compliance with the West Virginia Alcohol and Drug-Free Workplace Act, as set forth in Article 1D, Chapter 21 of the West Virginia Code. The contractor and its subcontractors shall provide a sworn statement in writing, under the penalties of perjury, that they maintain a valid drug-free work place policy in compliance with the West Virginia and Drug-Free Workplace Act. It is understood and agreed that this Contract shall be cancelled by the awarding authority if the Contractor: 1) Fails to implement its drug-free workplace policy; 2) Fails to provide information regarding implementation of the contractor's drug-free workplace policy at the request of the public authority; or 3) Provides to the public authority false information regarding the contractor's drug-free workplace policy."

INSTRUCTIONS TO BIDDERS

1. Use the quotation forms provided by the Purchasing Division.

2. SPECIFICATIONS: Items offered must be in compliance with the specifications. Any deviation from the specifications must be clearly indicated by the bidder. Alternates offered by the bidder as **EQUAL** to the specifications must be clearly defined. A bidder offering an alternate should attach complete specifications and literature to the bid. The Purchasing Division may waive minor deviations to specifications.

3. Complete all sections of the quotation form.

4. Unit prices shall prevail in case of discrepancy.

5. All quotations are considered F.O.B. destination unless alternate shipping terms are clearly identified in the quotation.

6. BID SUBMISSION: All quotations must be delivered by the bidder to the office listed below prior to the date and time of the bid opening. Failure of the bidder to deliver the quotations on time will result in bid disqualifications: Department of Administration, Purchasing Division, 2019 Washington Street East, P.O. Box 50130, Charleston, WV 25305-0130

Addendum #1
PTR09024
Bluefield Area Transit Project

1. Page 3 of RFQ, WAGE RATES: The Mercer County wage rates are in effect for this project. The higher of the Federal or State must be paid at time of the bid opening for this project. Harrison County as noted on page 3 of RFQ is a misprint.

2. The Bid remains in effect for 90 days from bid opening.

3. The deadline for questions to be answered is April 7, 2009 at 4:00pm. Please forward all questions to Buyer Frank Whittaker at the West Virginia Purchasing Division. His information is on page 1 of the RFQ.

4. Change the bid opening from April 15, 2009 to April 23, 2009. Time is 1:30pm.

5. Geotechnical report is attached for your review.

GEOTECHNICAL ENGINEERING REPORT

BLUEFIELD AREA TRANSIT AUTHORITY BUILDING
BLUEFIELD, MERCER COUNTY, WEST VIRGINIA

Terracon Project No. N2085128
January 7, 2009

Prepared for:

CHAPMAN TECHNICAL GROUP
ST. ALBANS, WEST VIRGINIA

Prepared by:

H.C. NUTTING – A Terracon COMPANY
Charleston, West Virginia

TABLE OF CONTENTS

APPENDIX

H. C. NUTTING
A Terracon COMPANY

912 Morris Street
Charleston, West Virginia 25301
304-344-0821 Fax:304-342-4711

January 7, 2009

Chapman Technical Group
200 Sixth Avenue
St. Albans, West Virginia 25177

Attention: Mr. Dale Withrow
Manager, Architecture Group
Tel: 304.727.5501
Fax: 304.727.5580

Re: Geotechnical Engineering Report
Proposed Bluefield Area Transit Authority Building
Bluefield, Mercer County, West Virginia
Terracon Project No. N2085128

Dear Mr. Withrow:

H.C. Nutting – A Terracon Company (Terracon) has completed the geotechnical engineering exploration for the proposed Bluefield Area Transit Authority Building to be located on US Route 52 in Bluefield, Mercer County, West Virginia. These services were performed in general accordance with our proposal number 08256 dated July 11, 2008. The results of our engineering services, including the site plan, boring location plan, laboratory test results, logs of borings, and the geotechnical recommendations needed to aid in the design and construction of foundations and other earth connected phases of this project are attached.

In summary, it is our opinion the proposed building could be supported on a combination of shallow and deep foundations/soil improvement or modification system due to the variable depth to bedrock and the high variability of the soil conditions across the site. Further details are provided in this report.

We appreciate the opportunity to be of service to you during the design phase of your project, and look forward in assisting you during the construction phase. If you have any questions concerning this report, or if we may be of further service to you, please contact us.

Sincerely,
H.C. Nutting
A Terracon Company

Todd A. Griffith, E.I.
Staff Geotechnical Engineer

Yogesh S. Rege, P.E.
Senior Geotechnical Engineer

YOGESH S. REGE
REGISTERED
16606
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

Enclosures
Copies to: Addressee (3)

GEOTECHNICAL ENGINEERING REPORT

PROPOSED BLUEFIELD AREA TRANSIT AUTHORITY BUILDING
BLUEFIELD, MERCER COUNTY, WEST VIRGINIA

Terracon Project No. N2085128
January 7, 2009

INTRODUCTION

Terracon has completed the subsurface exploration for the planned Bluefield Area Transit Authority Building along US Route 52 in Bluefield, West Virginia. A total of eleven (11) borings were drilled on the project site. The individual boring logs and a Boring Location Plan are attached to this report. The purposes of this report are to describe the subsurface conditions encountered in the borings, present the laboratory test data, and provide geotechnical recommendations regarding foundations, floor slabs, pavement subgrade and typical pavement thickness, as well as general site preparation and earthwork recommendations for the proposed project.

PROJECT INFORMATION

We understand that the project will consist of construction of an approximate 14,000 square foot L-shaped building along with ancillary parking and drive areas. We understand the structure will be a single-storied load bearing masonry structure with an attached tall bay metal building. Based on the information provided, we have considered that the structure would be supported by a combination of load-bearing walls and individual columns with respective structural loads on the order of 2 to 8 kips per linear foot and 50 to 100 kips.

We understand that at the time of our initial field investigation, Borings B-1 through B-7 were within the proposed footprint of the building. Since the initial subsurface investigation, the proposed building location has been moved approximately 80 feet south and three additional borings were performed to explore the southern portion of the site. No finished floor elevation or grading plan was available at the time of this report. According to a site survey, the elevation relief from the northwest corner to the southeast corner of the proposed building footprint is approximately 6 feet across a horizontal distance of approximately 190 feet. Therefore, we have assumed that minimal cut / fill operations (less than 3 feet) would be required to reach design elevation.

We understand that parking and drive areas are planned at the north, east, and west sides of the proposed building. Information regarding the type and volume of traffic anticipated for the project pavements is unavailable at this time. If specific traffic data becomes available, Terracon should be contacted to review the typical pavement sections that are provided in this report.

SITE EXPLORATION PROCEDURES

Field Exploration

Our field exploration consisted of performing at total of eleven (11) borings. The borings were extended to depths ranging from about 3.5 feet to 26 feet below the existing grades. The locations for borings were selected by and were staked in the field by Chapman Technical Group personnel. The approximate boring locations are indicated on the attached Boring Location Map. Ground surface elevations at the individual boring locations were also provided by Chapman Technical Group personnel; however, the elevations indicated on the attached boring logs have been rounded to the nearest 0.1 foot.

The borings were drilled with ATV-mounted, rotary drill rigs using hollow-stemmed augers to advance the boreholes. Representative samples were obtained using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch O.D. split-barrel sampling spoon is driven into the ground with a 140-pound hammer falling a distance of 30 inches. A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on the site. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the standard penetration resistance value. These values are indicated on the boring logs at the depths of occurrence. The samples were sealed and returned to the laboratory for testing and classification.

Field logs of each boring were prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Once the exploration procedures were complete, the soil samples were delivered to our Charleston soil laboratory where the driller's field logs and each soil sample were reviewed by a geotechnical engineer or geologist. The boring logs included with this report represent the review of the field logs and include modifications based on laboratory observation and tests of the samples.

Laboratory Testing

During the field investigation, a representative portion of each recovered sample was sealed in containers and transported to our laboratory for further visual and laboratory examination. Selected samples retrieved from the borings were tested for moisture content, Atterberg Limits, and organic content by loss-on-ignition, to aid in soil classification and provide input for our analysis. A hand penetrometer was used to measure the approximate unconfined compressive strength of some samples. The hand penetrometer test provides a better

estimate of a cohesive soil's consistency and strength than visual examination alone. The results of the laboratory tests are shown on the boring logs, adjacent to the soil profiles, at their corresponding sample depths.

As a part of the laboratory testing program, the soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described above. Additional testing could be performed to more accurately classify the samples. Portions of the recovered samples were placed in jars, and the samples will be retained for at least 1 month if additional testing is requested. The soil descriptions presented on the boring logs for native soils are in accordance with our enclosed General Notes and Unified Soil Classification System (USCS). The estimated group symbol for the USCS is also shown on the boring logs, and a brief description of the Unified System is included in this report.

SITE CONDITIONS

The proposed site is currently undeveloped agricultural land. Most of site has been used for row crops, but there are some large trees located on the northern edge of the property. The site slopes downward from west to east with about 15 feet of elevation relief. A drainage way with running water is located along the west side of the property.

SUBSURFACE CONDITIONS

Geology

A review of the Mercer County, West Virginia Soil Survey published by the United States Department of Agriculture / Soil Conservation Service indicates Cateache-Berks channery silt loam and Urban Land-Lilly Complex soils are present at or near the present grades in undisturbed areas of the project site. The Urban Land-Lilly Complex soils cover approximately 75 % of the site and are not rated for suitability. The proposed building footprint is found within this type of soil. The classifications and suitability provided are for the USDA textural soil classification system for approximately the upper 60 inches of the soil profile. According to the soil survey, the Cateache-Berks channery silt loam soils are reported to be very limited for shallow excavations due to their slopes, cutbanks cave characteristics, and depth to hard and soft bedrock. These soils are also reported to be very limited for small commercial buildings due to their slope, depth to hard bedrock and potential for shrink/swell characteristics.

Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect building site development. "Not limited" indicates that the soil has features that

are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

According to the USGS Geologic Map of West Virginia, the project site is located within the Appalachian Plateau Physiographic Provinces of West Virginia. The Appalachian Plateau Province is comprised of relatively flat lying, sedimentary rock formations in the western part of the state and moderately folded, sedimentary rock formations on the eastern side of the Province within West Virginia. Generally, bedrock in the area is comprised of sandstone, siltstone, shale, coal and thin limestone beds.

The bedrock at the project site consists of sedimentary rocks from the Bluestone and Princeton Formations of the Mississippian Geologic Period. The Bluestone Formation consists of shale and siltstone with lesser sandstone and limestone. The formation includes the Pride shale and Glady Fork sandstone. The maximum thickness is 650 feet. The Princeton Formation is a distinctive 60-foot thick coarse conglomerate that grades into a sandstone.

Soil Conditions

Subsurface conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate depths of changes in soil/bedrock types. In-situ, the transition between materials may be gradual. Please review the attached boring logs for a detailed description of the conditions encountered at the individual boring locations. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows. All depths discussed in the following paragraph are referenced below existing grade.

Borings B-1, B-7, B-8, and B-9 (the westernmost borings drilled at the project site) encountered a relatively deep bedrock profile. In these borings, bedrock was encountered between 17 feet and 25 feet below the existing ground surface. Existing fill material was encountered at the ground surface in each of these borings extending to depths ranging from 10 feet to 15 feet below the existing ground surface. This existing fill material varied from sandy lean clay with gravel to clayey gravel with sand having an average SPT N-value of 7

bpf (blows per foot) and a range from 0 to 15 bpf. This existing fill material had in-situ moisture contents ranging from 13 to 20 percent. A loss on ignition test performed at 2.5 feet depth in Boring B-1 indicated an organic content of 4.4%

Underlying this existing fill material was a layer of natural lean clay with varying amounts of sand that extended to the top of bedrock. This layer of soil had an average SPT N-value of 14 bpf and was considered to be stiff to very stiff. Two in-situ moisture content tests within this clay layer showed that the natural moisture content was 30%. Bedrock underlying this lean clay layer was comprised of gray, highly weathered, very soft to soft shale.

Borings B-2 through B-6, B-10 and B-11 encountered a relatively shallow bedrock profile. Bedrock in these borings was encountered at depths ranging from 2.5 feet to 10 feet below the existing ground surface. Existing fill material was again encountered at the ground surface of each of these borings. This existing fill material consisted of sandy lean clay with gravel to clayey gravel with sand. SPT N-values in this existing fill ranged from 5 to 31 bpf with an average of 10 bpf. In-situ moisture contents within this layer ranged from 12% to 21%. Loss on ignition tests taken at 5 feet in Borings B-2 and B-3 yielded results of 3.1% and 9.0% respectively. In borings B-2 through B-5 and B-11, the existing fill material extended to the top of bedrock.

In Borings B-6 and B-10, a 2.5 feet thick layer of natural soil was encountered above the bedrock. This layer was encountered at 5 feet and 2.5 feet below the existing ground surface, respectively. This layer was residual in nature and ranged from sandy lean clay to clayey gravel with sand. Bedrock encountered within these borings also consisted of highly weathered, very soft to soft gray shale.

Groundwater Conditions

The borings were monitored while drilling for the presence and level of groundwater. Groundwater levels observed are noted on the individual boring logs. At that time, groundwater was encountered only in Boring B-5 at a depth of 1.0 feet. Bedrock was encountered within this boring at a depth of 2.5 feet. Following the completion of drilling, the boreholes were backfilled with on-site soils. Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

It should be recognized that fluctuations of the groundwater table will occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. In addition, perched water can develop within sand seams or

higher permeability soils overlying less permeable soils following periods of heavy or prolonged precipitation. Therefore, groundwater levels during construction or at other times in the future will be higher or lower than the levels indicated on the boring logs. Groundwater level fluctuations should be considered when developing the design and construction plans for the project.

ENGINEERING RECOMMENDATIONS

Geotechnical Considerations

Based on the results of our subsurface exploration, the western half of the proposed structure's footprint is located in an area with a relatively deep bedrock profile and very soft to soft existing clayey fill soils; while the eastern half of the proposed structure's footprint has a shallow bedrock profile with stiff to medium dense overburden soils. In addition, the eastern portion of the site is higher in elevation and therefore may be excavated to reach design elevation. It is our opinion that marginal site soils are not suitable for supporting the proposed structure using spread footings. Based on the results of our subsurface exploration and our analyses, we recommend two options for your consideration. The first option (not necessarily in the order of preference) consists of supporting the proposed structure on spread footings following a soil improvement / modification system, such as Geopiers™ or similar system in areas where bedrock is deeper than 5 feet or so below the proposed finished grade elevation. The other option would consist of using drilled caissons for supporting the portions of the building where bedrock is deeper. In areas where the bedrock elevation is within 5 feet or so below the proposed finished grade elevation, shallow foundations bearing on bedrock can be used.

Based on the existing grades across the structure's proposed footprint, we anticipate up to 3 feet of new fill will be placed on the western portion of the building. It should be noted that settlements under the weight of the new fill will vary across the area due to variations in thickness of new fill to be placed and compressible layers. The foundation construction should be delayed until most of the settlement is completed.

Support of footings, floor slabs, and pavements on or above existing fill soils is discussed in this report. However, even with the recommended construction testing services, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill will not be discovered. This risk of unforeseen conditions cannot be eliminated without completely removing the existing fill, but can be reduced by performing additional testing and evaluation.

Please refer to the following sections for further details and recommendations.

Earthwork

In preparing the site for construction, all topsoil and root zone, and any loose, soft, frozen or otherwise unsuitable materials should be removed from below the proposed building and pavement areas. The actual depth of removal of unsuitable materials will be dependent upon the materials encountered at the time of actual construction. The extent of removal should be evaluated by Terracon personnel during construction. Excavated materials not suitable for use as engineered fill should be disposed of off-site or stockpiled for future use in landscaped areas.

At the time of this report, no grading plan was available to review the quantities and locations of structural fill placement. Therefore, general recommendations for fill placement are provided

Prior to placement of any new fill, the exposed subgrade should be scarified to a depth of about 9 inches, moisture conditioned, and recompacted. The surficial compaction will aid in providing a firm base for compaction of new fill and delineating soft or disturbed areas that may exist at or near the exposed subgrade level. Unsuitable areas observed at this time should be improved by scarification and recompaction or by undercutting and replacement with suitable compacted fill. Where granular soils are encountered, they should be surficially compacted with a heavy-duty, steel-drum vibratory roller. Subgrade stability should be observed by a geotechnical engineer during construction. Terracon personnel should also observe and test fill placement and compaction.

The soils observed in our borings are subject to disturbance by construction activity. Lower strength, existing fill soils and potentially unstable subgrades will likely be encountered on portions of site, especially on the western portion of the site. Lightweight construction equipment could possibly be used over soft subgrades, but repetitive construction traffic on the subgrade soils should be minimized to help reduce subgrade disturbances. Performing earthwork during drier periods may reduce the risk of corrective work needed to help develop and maintain stable subgrades at the site. Weather conditions such as freezing, thawing, rainy or excessively dry weather can also contribute to subgrade disturbance. If time elapses between subgrade preparation and further construction, subgrades may need to be reworked and retested.

Corrective measures may be required to increase subgrade stability during subgrade preparation. The owner should budget for additional costs to provide the required corrective

measures. Based on our experience in soils of these types, crushed stone thicknesses on the order of 1 to 2 feet could be required to stabilize subgrade soils. A geotextile stabilization material could also be placed below the crushed stone to help stabilize the subgrade soils. As an alternative, the unstable subgrade soils could be undercut, scarified on-site, and compacted with moisture and density control in maximum 9-inch loose lifts up to final subgrade elevation to provide a uniform thickness of well-compacted material, as discussed above. The anticipated depth of removal and soil replacement could be about 3 feet or more. The method of undercutting, drying, and replacing subgrade soils to provide stability should be reviewed by Terracon and performed during the summer when prolonged periods of dry weather and warm temperatures are anticipated. However, this method of stabilization is usually not as practical in areas where more than 1 foot (in thickness) of unstable soil is present or if construction is performed during a period of wet or cold weather when drying is difficult.

Structural fill should consist of approved materials that are free of organic matter, debris and frozen materials. We recommend structural fill consist of a low-plasticity cohesive soil with a liquid limit less than 45 and a plasticity index less than 25, or an approved granular soil. Appropriate testing of fill materials should be performed prior to their usage at this site as structural fill.

The soil's water content at the time of compaction should be in the range specified in the following table. All fill materials should be placed and compacted in horizontal lifts. The fill lifts should not exceed 9 inches in loose thickness for heavy compaction equipment, and 4 to 6 inches for smaller equipment such as vibratory plates and jumping jacks used in foundation and utility excavations. All fill material should be compacted as specified in the table below.

Fill Material Type	Relative Density (ASTM D4253 and D4254)	Laboratory Compaction Characteristics of Soil using Standard Effort (ASTM D-698)	
		Minimum Percent Compaction	Moisture content range, from optimum
Granular*	70%	98%	Generally -3% to +3%, specific evaluation for each material**
Low Plasticity Cohesive (e.g., lean clay or sandy lean clay)	N/A	98%	-2% to +3%

* If granular material is a coarse sand or gravel, is of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate.
** The gradation of a granular material may affect its stability and the moisture content required for proper compaction. Samples of all proposed fill materials should be submitted to Terracon for testing and approval prior to use.

Upon completion of earthwork operations, care should be taken to minimize the subgrade disturbance and maintain the subgrade moisture content prior to construction of the foundations, floor slabs, and pavements. Weather conditions such as freezing, thawing, rain, or dry weather can also contribute to subgrade disturbance. If the subgrade should become saturated, desiccated, or disturbed, the affected material should be removed or replaced, or these materials should be scarified, moisture conditioned as necessary, and recompacted prior to construction of the foundations, floor slabs, and pavements. If time elapses between subgrade preparation and further construction, subgrades should be reworked and retested prior to placement of the structure.

Adequate surface drainage should be provided at the site in order to reduce wetting of the foundation and subgrade soils. Excessive moisture can significantly reduce the soils bearing capacity and contribute to foundation and floor slab settlement. For protection of the bearing soils, we recommend that the surrounding grades be sloped away from the structure on all sides. In addition, roof drainage should be collected by a system of gutters and downspouts and transmitted by pipe to a stormwater drainage system or discharged at least 5 feet away from the structures. As an alternative, splash blocks may be used as long as the ground surface is paved and slopes away from the structure. Trees or vegetation that have a high demand for water should not be planted near the building, to minimize fluctuations in the moisture content of the lean to fat clay and fat clay soils on this site.

Excavations should be performed in accordance with governing safety regulations. All vehicles and soil piles should be kept back from the crest of excavation slopes. The stability of excavation slopes should be reviewed continuously by qualified personnel. The responsibility for excavation safety and temporary construction slopes lies solely with the contractor.

Terracon should be retained during construction to observe site preparation activities and to perform necessary tests and observations during site preparation, removal of unsuitable soils, placement and compaction of structural fills and backfilling of excavations.

Foundation Systems

Based on the information obtained from the subsurface exploration, we provide the following options for your consideration.

Geopiers™ or Similar System

Use of Geopiers™ elements or similar system can be considered for support of the portion of proposed building where bedrock is deeper. Such a soil improvement / modification system is generally designed and constructed by a specialty contractor, and therefore in this section we have only provided general information related to the use of such foundation system. It should be noted that a portion of the building will be supported on shallow foundations bearing on bedrock. Therefore, larger than normal differential settlement should be anticipated between areas supported on improved / modified soils which are likely to settle much more than those supported on bedrock where minimal amount of settlement is anticipated. The designer should make sure that this differential settlement is tolerable.

Rammed aggregate piers (Geopiers™) or similar systems are constructed by first removing a volume of compressible material, either by drilling a hole or excavating a trench. A thin lift of open graded stone is then placed at the bottom of the cavity. The soil at the bottom of the cavity is prestressed and prestrained by ramming the stone with a specially designed tamper. A very stiff element is then constructed within the cavity using well-graded aggregate placed in thin lifts and highly densified by ramming with the same tamper used for bottom prestressing. The adjacent soils are improved, not primarily by densification but rather by lateral prestressing. The energy source applies impact ramming action, rather than vibratory energy to a 45-degree beveled tamping apparatus that maximizes lateral prestressing of the matrix soil. The buildup of lateral stress in the surrounding soils develops an over-consolidated soil surrounding each rammed aggregate pier, resulting in a stiffened aggregate pier/matrix soil mass. In addition, the prestressing and prestraning of soils adjacent to the

sides of the aggregate pier results in an undulated aggregate pier/matrix soil interphase that provides excellent engagement of the aggregate pier with the surrounding soil. The lateral stress buildup approaches the passive limit of the soil, thereby providing maximum shear strength along the aggregate pier shaft.

The resulting improved ground can be used for construction of conventional shallow foundations.

The slab-on-grade floor slab can also be supported on Geopiers™ elements or similar system.

Drilled Caisson Foundations

It is recommended that the drilled caisson excavations completely penetrate the existing fill material and the underlying natural soils and bear at least 3 feet below the top of bedrock elevation within shale bedrock. The drilled caissons should be proportioned using an allowable bearing capacity of 20 ksf. A minimum caisson diameter of 2 feet and a minimum length of 10 feet are recommended.

Close inspection by geotechnical personnel will be required during caisson installation to confirm that the bedrock embedment requirements are being met.

The spacing between the caissons should be no less than at 3D, where D is the pile diameter, to prevent reduction in capacity due to group efficiency loss. The compression capacity should be limited to 25 percent of the 28-day specified concrete compressive strength.

We recommend that the following criteria be used in the design and construction of the drilled caisson foundation system.

1. The minimum caisson diameter should be at least 24 inches.

2. A temporary steel casing should be available at the site if conditions require its use during construction.

3. Drilled caissons should be constructed by a "Specialty Contractor". Consideration should be given to contractor's pervious experience in such type of construction during the bid approval process.

4. The actual bearing elevation at each caisson location should be determined by inspection of each drilled caisson hole in the field by a representative of the geotechnical engineer.

5. The specifications should require that no concrete be placed until the dimensions, bottom elevation, and excavation for each drilled caisson has been approved by a representative of the geotechnical engineer. It is recommended that the specifications state that the depth of water or loose material at the bottom of the drilled caisson hole, just prior to concreting, shall not be greater than ½ inch.

6. It is preferable to place concrete in dry conditions, but if dewatering is not practical, concrete should be placed by tremie methods. During concrete placement the temporary steel casing should be withdrawn at such a rate as to maintain concrete in the drilled caisson above the bottom of the casing to avoid caving, necking, or other compromise to the integrity of the drilled caisson cross-section.

7. It is recommended that no completed drilled caisson holes be left open overnight without being filled with concrete.

8. It is recommended that prospective contractors be allowed the opportunity to perform test borings so that they can make their own evaluation concerning the excavation of the materials and casing requirements.

Shallow Foundation on Bedrock

In areas where the bedrock elevation is within 5 feet or so below the proposed finished grade elevation, shallow foundations bearing on bedrock can be used.

The shallow foundations bearing on competent shale bedrock can be designed for an allowable bearing capacity up to 4 ksf for square and continuous footings. The footings can be constructed to directly bear on the bedrock or the overexcavation can be backfilled with flowable fill or lean concrete to establish the design bottom of footing elevation. The existing overburden soils should be completely excavated in the foundation areas and all footing excavations extended no less than 12-inches into undisturbed bedrock. Even if loading would allow for smaller sizes, it is recommended that square and continuous footing widths be no less than 24" and 18", respectively. Exterior footings should be at least 36 inches deep for frost protection. Interior footings can bear at nominal depths below the floor. However, the requirements of reaching suitable bedrock conditions must be satisfied.

Floor Slab Design and Construction

The floor slab area will expose variable subgrade material including existing fill soils and overburden underlain by shallow bedrock. Also, the consistency of the existing fill is not satisfactory, combined with the fact that bedrock depth is shallow elsewhere, therefore we have following options for your consideration:

- Perform a partial undercut of the fill (2 feet below design subgrade) and then surcharge the area of the floor slab where this existing fill is present to bring about its consolidation. The weight of the surcharge should be atleast twice the anticipated floor slab loads. The surcharge will have to remain upon the area being surcharged until the settlement is completed.
- Support floor slab on Geopiers™ elements or similar system.
- Use a structural floor slab in the existing fill areas, transitioning into a slab-on-grade floor slab as the depth to bedrock gets shallower.

It is essential that the final subgrade for the areas to receive floor slab be free of water or any wet or water-softened soils. If the subgrade becomes wet due to rain or any other causes, all water should be removed and any wet or water-softened soils be stripped to expose drier soils. Qualified geotechnical personnel should confirm the fulfillment of this requirement.

A minimum 4-inch-thick, relatively free draining granular base is recommended beneath all slabs. This granular blanket will allow for uniform slab thickness, more uniform load transfer and aid in curing of the concrete at both the top and bottom of the floor slab. We recommend that the placement of granular material and construction of the slab-on-grade be performed immediately after final subgrade preparation. For point loading conditions, a modulus of subgrade reaction of 100 pci can be used for design. Note that a reduced value applies to "area loading" condition.

The need for a vapor retarder, and where to place it, should be determined by the architect based on the proposed floor treatment, building function, concrete properties, placement techniques, and the construction schedule. When moisture retarders are used, precautions should be taken during the initial floor slab concrete curing period to reduce differential curing and possible curling of the slabs. The recommendations provided in ACI 302 should be followed.

Pavement Subgrade

The thickness of flexible and rigid pavement can be established assuming a subgrade as represented by the existing fill materials. Based on cohesive soil subgrade conditions, considering on-site near surface soils, flexible pavement design consisting of asphaltic concrete paving can be based on a CBR value of 3 and a resilient modulus of 3,600 psi. For rigid concrete pavement, a modulus of subgrade reaction of 100 pci can be used for design.

Within paved areas, including parking lots, drives, and roadways it is recommended that the amount of undercut be 2 ft. in the area which expose existing fill. Areas which expose natural soils should be thoroughly proof rolled, inspected and stabilized if needed. After surface stripping and 2 ft. undercut below pavement subgrade, it is recommended that we inspect the area to determine if any additional undercut is required. The area should be proof rolled and densified under several passes of a fully loaded tandem axle dump truck. Areas which deflect or yield should be undercut and replaced with structural fill or stabilized using geogrid and stone.

Climatic conditions are considered in the design subgrade support value listed above and in the paving material characteristics.

It is our opinion that in areas where trucks unload and semi tractor-trailers are parked for a few days (loading dock areas), that concrete strips or pads be considered instead of asphaltic concrete, where wheels and dollies will be supported. An 8" thick pad is recommended which should be thickened at the edges by approximately 2". Concrete having a 28-day minimum compressive strength of 4,000 psi is recommended. It has been our experience that during unloading, the truck support dollies or jacks and wheels make depressions in the flexible asphaltic pavement surface, particularly during hot summer months of July and August.

Asphaltic concrete aggregates and base course materials should conform to the West Virginia Department of Transportation (WVDOT) "Standard Specifications for Construction Materials". Concrete pavement should be air-entrained and have a minimum compressive strength of 4,000 psi after 28 days of laboratory curing per ASTM C-31.

It is further recommended that the apron where the trash dumpster is located, be constructed on a 6" thick, non-reinforced concrete pad, bearing on compacted subgrade soil. This apron should be of dimensions to accommodate the heavy garbage truck, both in lifting the dumpster and in turn movements. A concrete pad is recommended because of the heavy loads transmitted to the pavement from a typical garbage truck during the lifting of the dumpster and in turn from a typical garbage truck during the lifting of the dumpster and in turn movements. During turns, the

wheels cause abrasive action and transmit horizontal thrusts to a flexible asphaltic concrete pavement. It has been our experience that flexible asphaltic concrete pavements tend to fail, crack, or rut at the location of the trash dumpsters. Our pavement thickness estimate is based on concrete having a 28-day compressive strength of 4,000 psi.

Openings in pavements, such as decorative landscaped areas, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are edge drains connected to the storm water collection system or other suitable outlet and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Long term pavement performance will be dependent upon several factors, including maintaining subgrade moisture levels and providing for preventive maintenance. The following recommendations should be considered the minimum:

- Site grading at a minimum 2% grade away from the pavements;
- The subgrade and the pavement surface have a minimum ¼ inch per foot slope to promote proper surface drainage.
- Consider appropriate edge drainage and pavement under drain systems,
- Install joint sealant and seal cracks immediately,
- Seal all landscaped areas in, or adjacent to pavements to minimize or prevent moisture migration to subgrade soils;
- Placing compacted, low permeability backfill against the exterior side of curb and gutter; and,
- Placing curb, gutter and/or sidewalk directly on subgrade soils without the use of base course materials.

Preventive maintenance should be planned and provided for through an on-going pavement management program. Preventive maintenance activities are intended to slow the rate of pavement deterioration, and to preserve the pavement investment. Preventive maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventive maintenance.

Seismic Site Classification

The International Building Code (IBC) requires structural design to be in accordance with the appropriate site class definition for soil profile type. Based upon the Site Class Definitions in Table 1615.1.1 of the 2003 International Building Code, subsurface conditions encountered on the project site, Terracon recommends a Class D seismic site classification for design.

GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

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 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

FIGURE 1: SITE LOCATION MAP

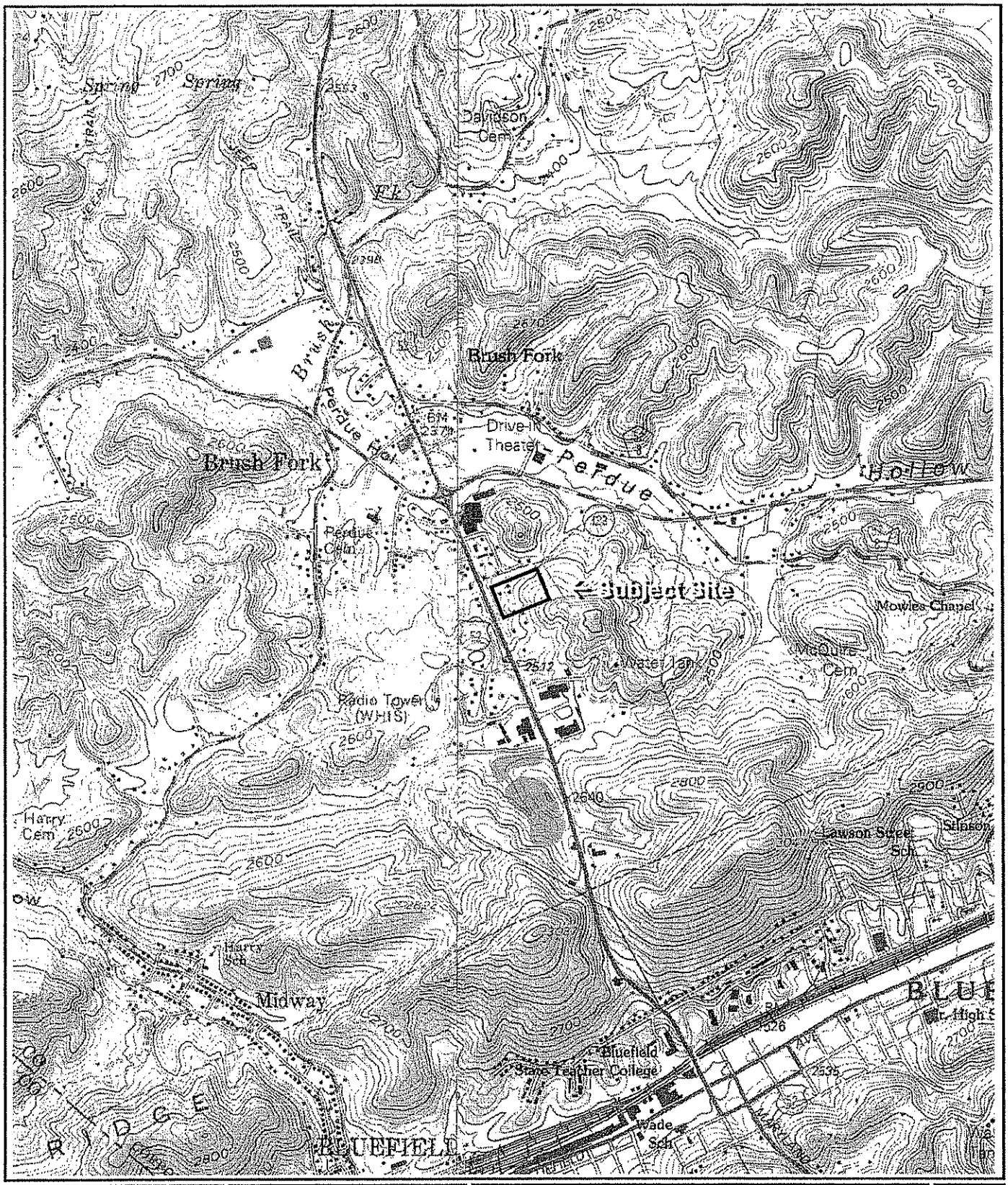
FIGURE 2: TEST BORING LOCATION PLAN

TEST BORING LOGS

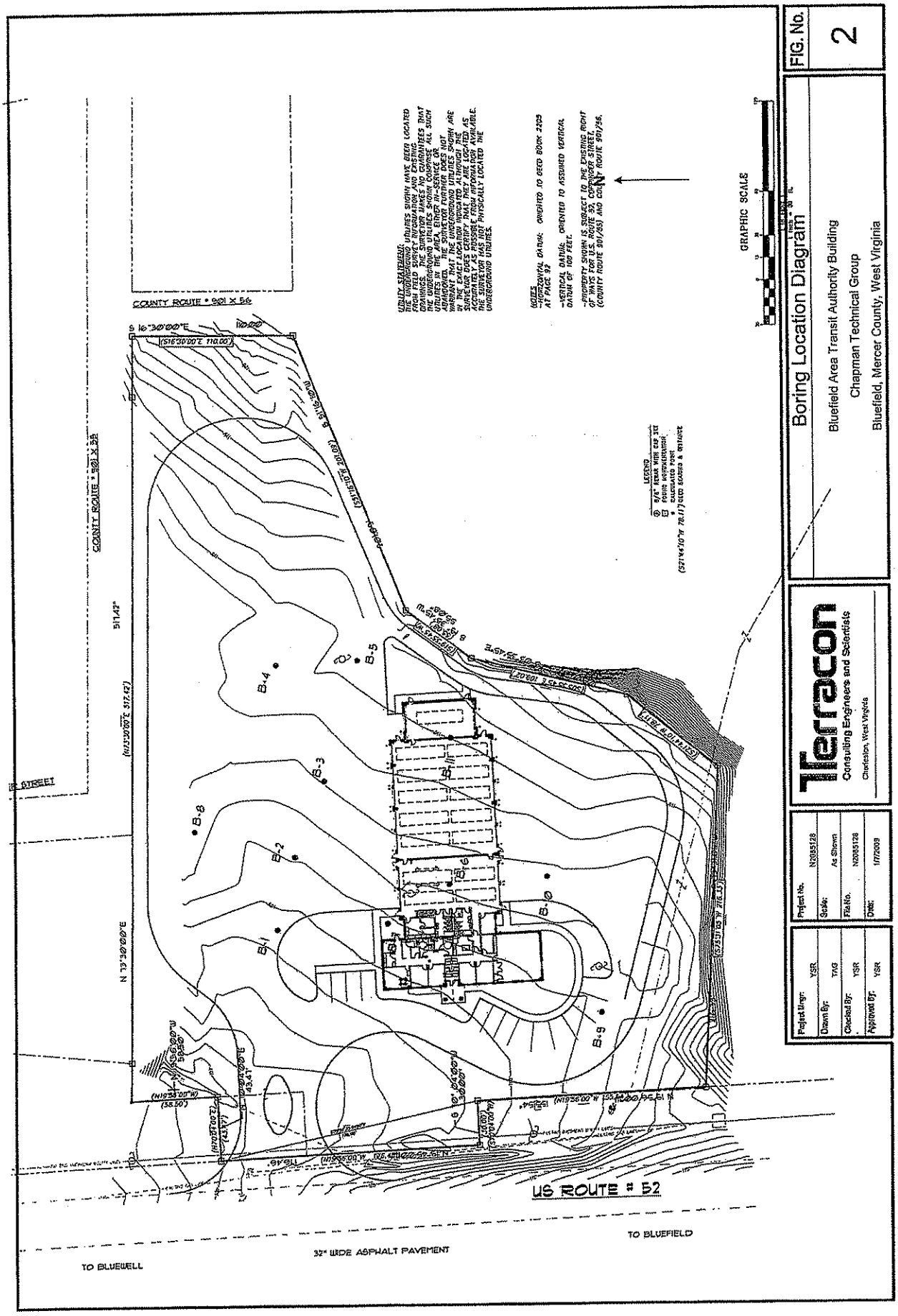
LABORATORY TEST RESULTS

GENERAL NOTES

UNIFIED SOIL CLASSIFICATION SYSTEM



Project Mngr: YSR Drawn By: TAG Checked By: YSR Approved By: YSR	Project No. N2085128 Scale: N/A File No. Figure1 Date: January 2009	Terracon Consulting Engineers and Scientists	Site Coordinates are 37.2800288 °, 81.248016° Site Location Map Bluefield Area Transit Authority Building Bluefield, West Virginia Chapman Technical Group.	FIG. No. 1


Boring Location Diagram
Bluefield Area Transit Authority Building
Chapman Technical Group
Bluefield, Mercer County, West Virginia
FIG. No. 2
Terracon
Consulting Engineers and Scientists
Charleston, West Virginia
Project No. N2085128
Scale: As Shown
File No. N2085128
Date: 1/7/2009
Project Mngr: YSR
Drawn By: TAG
Checked By: YSR
Approved By: YSR
GRAPHIC SCALE
LEGEND
NOTES
UTILITY STATEMENT
COUNTY ROUTE • 901 X 56
COUNTY ROUTE • 901 X 58
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
US ROUTE # 52
TO BLUEFIELD
TO BLUEWELL
32' WIDE ASPHALT PAVEMENT

LOG OF BORING NO. B-1

Page 1 of 1

CLIENT: Chapman Technical Group

SITE: Bluefield, WV

PROJECT: Bluefield Area Transit Authority Building

Approx. Surface Elev.: 104.4 ft

DEPTH, ft.	NUMBER	TYPE	DEPTH, ft.	RECOV, in./(RQD %)	BLOWS / 6in. (SPT - N)	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNCONFINED STRENGTH, tsf	POCKET PEN, tsf	DESCRIPTION
	1	SS	0 - 1.5	15	3-4-6 (10)					3.0	**sandy lean clay with gravel (FILL)**, brown, stiff to soft, moist to very moist, fine to coarse grained sand, shale fragments throughout
	2	SS	2.5 - 4	16	5-5-3 (8)	13					
5	3	SS	5 - 6.5	13	1-1-2 (3)					0.5	
	4	SS	7.5 - 9	10	2-2-1 (3)					0.5	
10	5	SS	10 - 11.5	12	1-1-1 (2)	20				0.5	
15											89.5
15	6	SS	15 - 16.5	15	1-4-5 (9)	30				1.75	**LEAN CLAY (CL)**, trace fine grained sand, brown and gray mottled, stiff to very stiff, moist Trace organics (roots) at 15.0 ft.
20	7	SS	20 - 21.5	15	3-6-11 (17)					2.5	
25											79.5
25	8	SS	25 - 25.4	3	50/5"						26 **SHALE**, very severely weathered, gray, very soft 78.5 AUGER REFUSAL AT 26 ft

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

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NE	WD	▽ NE DCI
WL	▽		▽
WL			

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-1-08		
BORING COMPLETED	12-1-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-2

CLIENT: **Chapman Technical Group**

SITE: **Bluefield, WV**

PROJECT: **Bluefield Area Transit Authority Building**

Approx. Surface Elev.: 105.9 ft

DEPTH, ft.	NUMBER	TYPE	DEPTH, ft.	RECOV, in./(RQD %)	BLOWS / 6in. (SPT - N)	WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNCONFINED STRENGTH, tsf	POCKET PEN, tsf	DESCRIPTION
	1	SS	0 - 1.5	12	2-5-8 (13)					3.5	**sandy lean clay with gravel (FILL)**, trace organics (roots) upper 2.5 ft, brown and dark gray, medium dense to loose, moist to dryt, fine to coarse grained sand, shale fragments throughout
	2	SS	2.5 - 4	11	8-5-4 (9)	16	43	20		4.0	
5	3	SS	5 - 6.5	13	15-5-7 (12)	15				1.5	
7.5 / 98.5											
	4	SS	7.5 - 8.9	16	19-32-50/5"						**SHALE**, completely to severely weathered, brown to gray, very soft to soft
10	5	SS	10 - 10.4	5	50/5"						
15	6	SS	15 - 15.9	10	40-50/5"						
20.2 / 85.5											
20	7	SS	20 - 20.2	2	50/2"						BORING TERMINATED AT 20.2 ft

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-2-08		
BORING COMPLETED	12-2-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-3

CLIENT
Chapman Technical Group

SITE
Bluefield, WV

PROJECT
Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 107.9 ft											
	sandy lean clay with gravel (FILL), trace organics (roots) upper 1.5 ft, brown and dark gray, stiff to medium stiff, moist, fine to coarse grained sand, shale fragments throughout		1	SS	0 - 1.5	12	5-6-8 (14)					
			2	SS	2.5 - 4	9	7-4-4 (8)	12				
		5	3	SS	5 - 6.5	8	4-4-4 (8)	16				
	7.5 100.5											
	SHALE, severely weathered, gray, soft		4	SS	7.5 - 7.7	2	50/2"					
		10	5	SS	10 - 10.3	3	50/3"					
	14 94											
	AUGER REFUSAL AT 14 ft											

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-2-08		
BORING COMPLETED	12-2-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-4

CLIENT
Chapman Technical Group

SITE
Bluefield, WV

PROJECT
Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 109.2 ft											
	sandy lean clay with gravel (FILL), trace organics (roots) upper 1.5 ft, brown and dark gray, medium stiff to striff, moist to very moist, fine to coarse grained sand, shale fragments throughout		1	SS	0 - 1.5	13	2-3-4 (7)					
			2	SS	2.5 - 4	16	9-5-5 (10)					
		5	3	SS	5 - 6.5	16	2-2-3 (5)	21				
			4	SS	7.5 - 9	18	3-3-10 (13)					
	10 99	10	5	SS	10 - 10.6	7	32-50/1"					
	SHALE, severely weathered, dark gray, soft											
	12.5 96.5											
	AUGER REFUSAL AT 12.5 ft											

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-2-08		
BORING COMPLETED	12-2-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-5

CLIENT: Chapman Technical Group

SITE: Bluefield, WV

PROJECT: Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 110.4 ft											
	clayey gravel with sand (FILL), gray, medium dense, moist, fine to coarse grained sand, predominantly limestone fragments with some shale fragments ▽		1	SS	0 - 1.5	14	7-13-11 (24)					
	2.5 108											
	SHALE, severely weathered, gray, soft 3.5 107		2	SS	2.5 - 2.8	1	50/3"					
	AUGER REFUSAL AT 3.5 ft											

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

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 1.0	WS ▽ NE	WCI
WL	▽	▽	
WL			

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-1-08		
BORING COMPLETED	12-1-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-6

CLIENT: **Chapman Technical Group**

SITE: **Bluefield, WV**

PROJECT: **Bluefield Area Transit Authority Building**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 107.2 ft											
	sandy lean clay with gravel (FILL), brown and dark gray, hard to stiff, dry to moist, fine to coarse grained sand, shale fragments throughout		1	SS	0 - 1.5	13	5-6-25 (31)					
			2	SS	2.5 - 4	15	5-7-4 (11)	15	38	17		1.75
	5 102	5										
	SANDY LEAN CLAY (CL), brown and gray, hard, moist, fine to medium grained sand		3	SS	5 - 6.5	16	5-15-16 (31)					
	7.5 99.5											
	SHALE, severely weathered, gray, soft		4	SS	7.5 - 9	15	32-41-50/5"					
		10	5	SS	10 - 11.3	16	45-32-50/3"					
	13.5 93.5											
	AUGER REFUSAL AT 13.5 ft											

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

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NE	WD	▽ NE DCI
WL	▽		▽
WL			

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-1-08		
BORING COMPLETED	12-1-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-7

Page 1 of 1

CLIENT: Chapman Technical Group

SITE: Bluefield, WV

PROJECT: Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 105.9 ft											
	clayey gravel with sand (FILL), gray, medium dense, moist, fine to coarse grained sand, predominantly limestone fragments with some shale fragments		1	SS	0 - 1.5	7	6-8-7 (15)					
	2.5 / 103.5											
	clayey gravel with sand (FILL), dark gray, medium dense to loose, moist to very moist, fine to coarse grained sand, predominantly shale fragments		2	SS	2.5 - 4	12	3-5-9 (14)					
		5	3	SS	5 - 6.5	14	14-6-3 (9)	5				
			4	SS	7.5 - 9	12	4-2-2 (4)	13				
	10 / 96											
	LEAN CLAY with SAND (CL), , trace organics (roots), grayish brown, medium stiff, moist, fine to medium grained sand	10	5	SS	10 - 11.5	18	1-3-3 (6)	30				1.75
	15 / 91											
	LEAN CLAY (CL), , gray to brown, hard, moist	15	6	SS	15 - 16.5	18	8-21-27 (48)					
	20 / 86											
	20.3 **SHALE**, severely weathered, gray, soft / 85.5	20	7	SS	20 - 20.3	3	50/3"					
	BORING TERMINATED AT 20.3 ft											

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-1-08		
BORING COMPLETED	12-1-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-8

Page 1 of 1

CLIENT: **Chapman Technical Group**

SITE: **Bluefield, WV**

PROJECT: **Bluefield Area Transit Authority Building**

Approx. Surface Elev.: 107 ft

DESCRIPTION		
sandy lean clay with gravel (FILL), trace organics (roots) upper 1.5 ft, brown, soft to medium stiff, moist, fine to coarse grained sand, shale fragments throughout	5	102
silty gravel with sand (FILL), gray, dense, dry, fine to coarse grained sand, predominantly sandstone fragments	7.5	99.5
sandy lean clay with gravel (FILL), dark gray, stiff, moist, fine to coarse grained sand, shale fragments throughout	15	92
SANDY LEAN CLAY (CL), brown, very stiff, moist, fine grained sand	20	87
SHALE, completely to severely weathered, brown to gray, very soft to soft	29	78
AUGER REFUSAL AT 29 ft		

DEPTH, ft.	NUMBER	TYPE	SAMPLES DEPTH, ft.	RECOV, in./(RQD %)	BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	LIQUID LIMIT, %	PLASTICITY INDEX, %	UNCONFINED STRENGTH, tsf	POCKET PEN, tsf
	1	SS	0 - 1.5	12	2-2-2 (4)	20				3.0
	2	SS	2.5 - 4	15	2-3-3 (6)	13				3.0
5	3	SS	5 - 6.5	15	30-20-16 (36)					
	4	SS	7.5 - 9	10	7-4-5 (9)					
10	5	SS	10 - 11.5	13	7-4-10 (14)					
15	6	SS	15 - 16.5	15	6-10-15 (25)					4.5+
20	7	SS	20 - 20.9	10	30-50/5"					
25	8	SS	25 - 25.3	3	50/3"					

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

WATER LEVEL OBSERVATIONS, ft

WL	▽ NE	WD ▽ NE	DCI
WL	▽	▽	
WL			

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-2-08		
BORING COMPLETED	12-2-08		
RIG	Track	FOREMAN	C.S.
APPROVED	CJF	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-9

CLIENT
Chapman Technical Group

SITE
Bluefield, WV

PROJECT
Bluefield Area Transit Authority Building

Approx. Surface Elev.: 106.1 ft

GRAPHIC LOG	DESCRIPTION		DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	lean clay with sand (FILL), trace gravel, brown with gray, soft, moist, shale and siltstone gravel			1	SS	0 - 1.5	18	1-1-1 (2)					
				2	SS	2.5 - 4	18	4-5-8 (13)					
		5 101	5										
	sandy lean clay with sand (FILL), brown with gray, medium stiff to soft, wet to moist, shale and siltstone gravel			3	SS	5 - 6.5	18	1-2-3 (5)					
				4	SS	7.5 - 9	11	0-1-1 (2)					
			10	5	SS	10 - 11.5	13	0-1-3 (4)					
		15 91	15										
	LEAN CLAY, trace organics (roots and wood fragments), blue-gray with brown, very soft, very moist			6	SS	15 - 16.5	18	0-0-0 (0)					0.5
		17 89											
	17.3 **SHALE**, probable, moderately severe weathering, soft	89		7	SS	17 - 17.3	0	50/4					
	BORING TERMINATED AT 17 ft												

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-29-08		
BORING COMPLETED	12-29-08		
RIG	Track	FOREMAN	E.P.
APPROVED	JRB	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-10

Page 1 of 1

CLIENT: Chapman Technical Group

SITE: Bluefield, WV

PROJECT: Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 107.4 ft											
	clayey gravel with sand (FILL), gray, loose, moist		1	SS	0 - 1.5	5	4-5-5 (10)					
	2.5 105											
	CLAYEY GRAVEL with SAND (GC), brown and gray, medium dense, moist, silty shale and siltstone gravel		2	SS	2.5 - 4	18	10-23-35 (58)					
	5 102.5											
	SILTY SHALE, moderately severe weathering, gray, soft, fossiliferous	5	3	SS	5 - 5.5	5	50/6					
			4	SS	7.5 - 8.1	5	39-50/1					
		10	5	SS	10 - 10.3	2	50/4					
	12 95.5											
	BORING TERMINATED AT 12 ft											

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

H. C. NUTTING
A Terracon COMPANY

BORING STARTED	12-29-08		
BORING COMPLETED	12-29-08		
RIG	Track	FOREMAN	E.P.
APPROVED	JRB	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

LOG OF BORING NO. B-11

CLIENT
Chapman Technical Group

SITE
Bluefield, WV

PROJECT
Bluefield Area Transit Authority Building

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES DEPTH, ft.	SAMPLES RECOV, in./(RQD %)	SAMPLES BLOWS / 6in. (SPT - N)	TESTS WATER CONTENT, %	TESTS LIQUID LIMIT, %	TESTS PLASTICITY INDEX, %	TESTS UNCONFINED STRENGTH, tsf	TESTS POCKET PEN, tsf
	Approx. Surface Elev.: 109.9 ft											
	gravelly lean clay with sand (FILL), brown with gray, loose, moist, shale and siltstone gravel		1	SS	0 - 1.5	13	2-3-3 (6)					
	3.5 106.5		2	SS	2.5 - 4	12	7-7-50/6					
	SILTY SHALE, severe to moderately severe weathering, soft, laminated, fossiliferous	5										
	6 104		3	SS	5 - 5.6	6	47-50/1					
	BORING TERMINATED AT 6 ft											

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

WATER LEVEL OBSERVATIONS, ft				
WL	▽ NE	WD	▽ NE	DCI
WL	▽		▽	
WL				

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BORING STARTED	12-29-08		
BORING COMPLETED	12-29-08		
RIG	Track	FOREMAN	E.P.
APPROVED	JRB	JOB #	N2085128

BOREHOLE 99 N2085128.GPJ TERRACON 20080217.GDT 1/7/09

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Determination of Moisture Content of Soil and Rock by Mass
ASTM D 2166, Method A

Client: Chapman Technical Group
Project: Bluefield Area Transit Authority Building
Project No. N2085128
Date: 12/10/2008

Boring No.	Sample No.	Depth Range	Moisture Content, %	Mass of Water, g	Mass of Solids, g
B-1	S-2	2.5'-4.0'	13	20.0	154.4
B-1	S-5	10.0'-11.5'	20	16.1	80.7
B-1	S-6	15.0'-16.5'	30	24.4	82.5
B-2	S-2	2.5'-4.0'	16	25.3	162.5
B-2	S-3	5.0'-6.5'	15	18.6	123.2
B-3	S-2	2.5'-4.0'	12	12.3	98.9
B-3	S-3	5.0'-6.5'	16	15.9	97.6
B-4	S-3	5.0'-6.5'	21	19.7	95.9
B-6	S-2	2.5'-4.0'	15	28.1	188.4
B-7	S-3	5.0'-6.5'	5	5.8	115.9
B-7	S-4	7.5'-9.0'	13	15.1	112.6
B-7	S-5	10.0'-11.5'	30	24.1	79.2
B-8	S-1	0.0'-1.5'	20	18.0	88.4
B-8	S-2	2.5'-4.0'	13	12.0	94.6

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Analysis for Moisture, Ash & Organic Content
ASTM D 2974

Client: Chapman Technical Group
Project: Bluefield Area Transit Authority Building
Project No.: N2085128 Date: 12/16/2008

Boring No. B-1 Sample No. S-2
Depth Range: 2.5'-4.0'
Description:

Moisture Content *(% of O.D. Mass) Test Method A*			
Wet Weight - Sample + Tare (g.)	273.40	Weight of Water (g.)	20.00
Dry Weight - Sample + Tare (g.)	253.40	Weight of Solids (g.)	154.40
Tare Weight (g.)	99.00	Moisture Content (%)	**12.95**
Ash & Organics Content *Test Method C*			
Beginning Weight (g.)	136.79	Tare Weight (g.)	73.80
Ending Weight (g.)	133.99	Muffle Furnace Temperature (°C)	440
Ash Content (%)	95.55	Organic Content (%)	**4.4**

Boring No. B-2 Sample No. S-3
Depth Range: 5.0'-6.5'
Description:

Moisture Content *(% of O.D. Mass) Test Method A*			
Wet Weight - Sample + Tare (g.)	242.60	Weight of Water (g.)	18.60
Dry Weight - Sample + Tare (g.)	224.00	Weight of Solids (g.)	123.20
Tare Weight (g.)	100.80	Moisture Content (%)	**15.10**
Ash & Organics Content *Test Method C*			
Beginning Weight (g.)	137.71	Tare Weight (g.)	74.00
Ending Weight (g.)	135.76	Muffle Furnace Temperature (°C)	440
Ash Content (%)	96.94	Organic Content (%)	**3.1**

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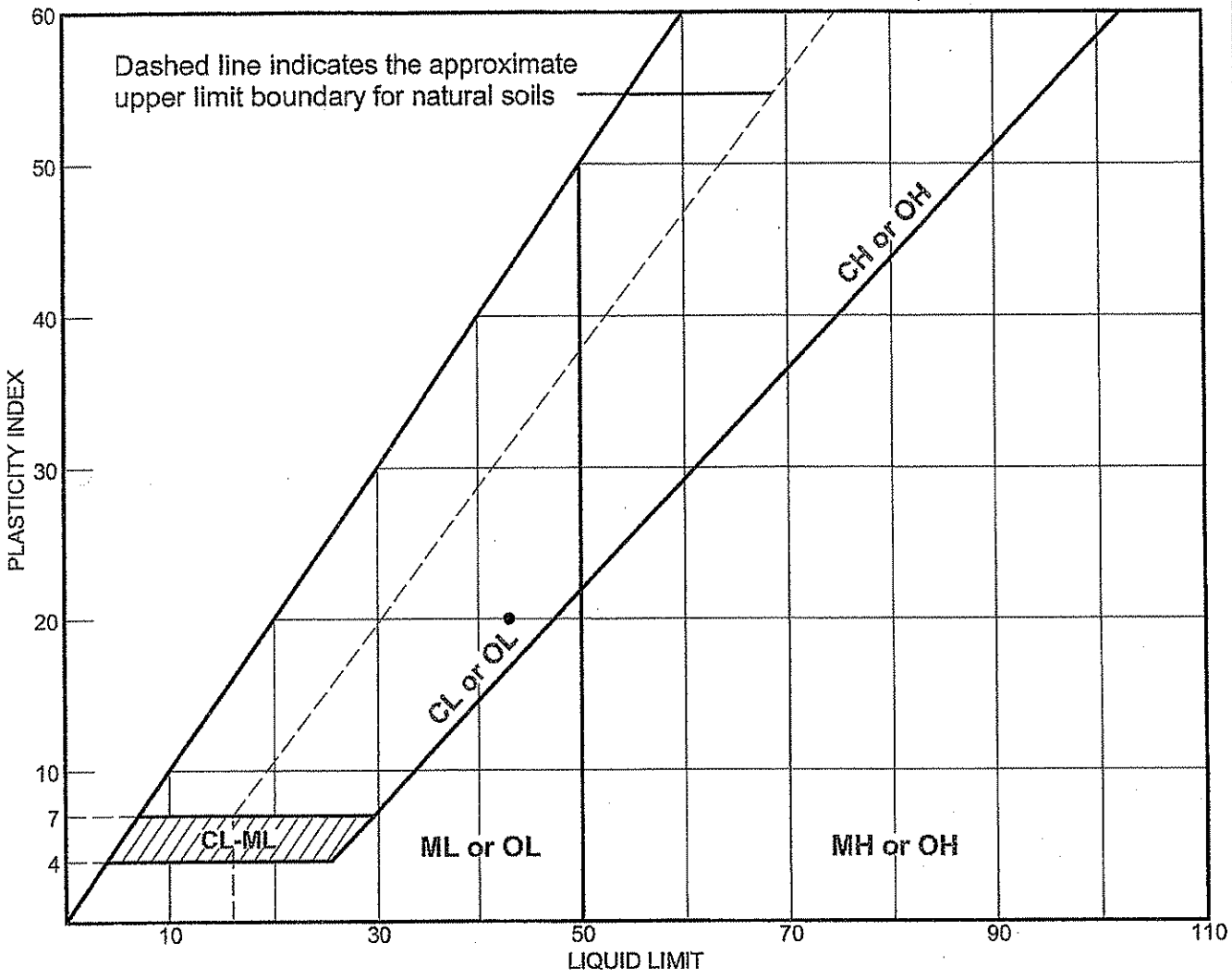
Analysis for Moisture, Ash & Organic Content
ASTM D 2974

Client: Chapman Technical Group
Project: Bluefield Area Transit Authority Building
Project No.: N2085128 Date: 12/16/2008

Boring No. B-3 Sample No. S-3
Depth Range: 5.0'-6.5'
Description:

Moisture Content *(% of O.D. Mass) Test Method A*			
Wet Weight - Sample + Tare (g.)	203.50	Weight of Water (g.)	15.90
Dry Weight - Sample + Tare (g.)	187.60	Weight of Solids (g.)	97.60
Tare Weight (g.)	90.00	Moisture Content (%)	**16.29**
Ash & Organics Content *Test Method C*			
Beginning Weight (g.)	135.84	Tare Weight (g.)	73.80
Ending Weight (g.)	130.23	Muffle Furnace Temperature (°C)	440
Ash Content (%)	90.96	Organic Content (%)	**9.0**

LIQUID AND PLASTIC LIMITS TEST REPORT

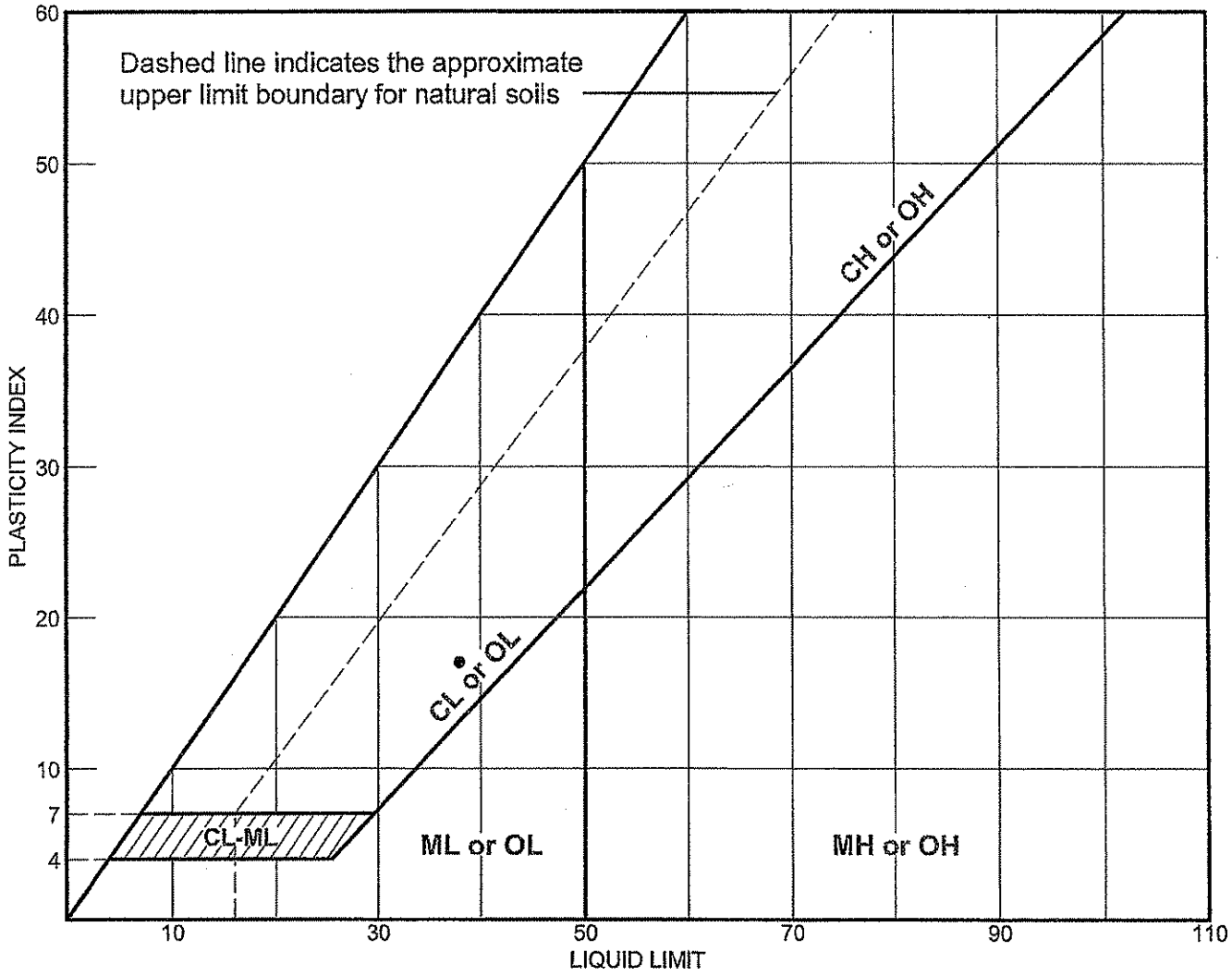


SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-2	S-2	2.5'-4.0'		23	43	20	

H. C. NUTTING COMPANY
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS
SINCE 1921

Client: Chapman Technical Group
Project: Bluefield Area Transit Authority Building
Project No.: N2085128

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●	B-6	S-2	2.5'-4.0'		21	38	17	

H. C. NUTTING COMPANY
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GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS
SINCE 1921

Client: Chapman Technical Group
Project: Bluefield Area Transit Authority Building
Project No.: N2085128

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	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
> 50	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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GENERAL NOTES

Description of Rock Properties

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer if crystalline.
Very slight	Rock generally fresh, joints stained, some joints may show thin clay coatings, crystals in broken face show bright. Rock rings under hammer if crystalline.
Slight	Rock generally fresh, joints stained, and discoloration extends into rock up to 1 in. Joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored. Crystalline rocks ring under hammer.
Moderate	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored; some show clayey. Rock has dull sound under hammer and shows significant loss of strength as compared with fresh rock.
Moderately severe	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and majority show kaolinization. Rock shows severe loss of strength and can be excavated with geologist's pick.
Severe	All rock except quartz discolored or stained. Rock "fabric" clear and evident, but reduced in strength to strong soil. In granitoid rocks, all feldspars kaolinized to some extent. Some fragments of strong rock usually left.
Very severe	All rock except quartz discolored or stained. Rock "fabric" discernible, but mass effectively reduced to "soil" with only fragments of strong rock remaining.
Complete	Rock reduced to "soil". Rock "fabric" not discernible or discernible only in small, scattered locations. Quartz may be present as dikes or stringers.

HARDNESS (for engineering description of rock – not to be confused with Moh's scale for minerals)

Very hard	Cannot be scratched with knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
Hard	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
Moderately hard	Can be scratched with knife or pick. Gouges or grooves to ¼ in. deep can be excavated by hard blow of point of a geologist's pick. Hand specimens can be detached by moderate blow.
Medium	Can be grooved or gouged 1/16 in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about 1-in. maximum size by hard blows of the point of a geologist's pick.
Soft	Can be gouged or grooved readily with knife or pick point. Can be excavated in chips to pieces several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure.
Very soft	Can be carved with knife. Can be excavated readily with point of pick. Pieces 1-in. or more in thickness can be broken with finger pressure. Can be scratched readily by fingernail.

Joint, Bedding and Foliation Spacing in Rock[a]

Spacing	Joints	Bedding/Foliation
Less than 2 in.	Very close	Very thin
2 in. – 1 ft.	Close	Thin
1 ft. – 3 ft.	Moderately close	Medium
3 ft. – 10 ft.	Wide	Thick
More than 10 ft.	Very wide	Very thick

Rock Quality Designator (RQD)[b]		Joint Openness Descriptors	
RQD, as a percentage	Diagnostic description	Openness	Descriptor
Exceeding 90	Excellent	No Visible Separation	Tight
90 – 75	Good	Less than 1/32 in.	Slightly Open
75 – 50	Fair	1/32 to 1/8 in.	Moderately Open
50 – 25	Poor	1/8 to 3/8 in.	Open
Less than 25	Very poor	3/8 in. to 0.1 ft.	Moderately Wide
		Greater than 0.1 ft.	Wide

a. Spacing refers to the distance normal to the planes, of the described feature, which are parallel to each other or nearly so.
b. RQD (given as a percentage) = length of core in pieces 4 in. and longer/length of run.

References: American Society of Civil Engineers. Manuals and Reports on Engineering Practice - No. 56. Subsurface Investigation for Design and Construction of Foundations of Buildings. New York: American Society of Civil Engineers, 1976.
U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual.

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[D]	$Cu \geq 6$ 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	< 0.75	OL	Organic clay[K,L,M,N]
			Liquid limit - not dried			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	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			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.

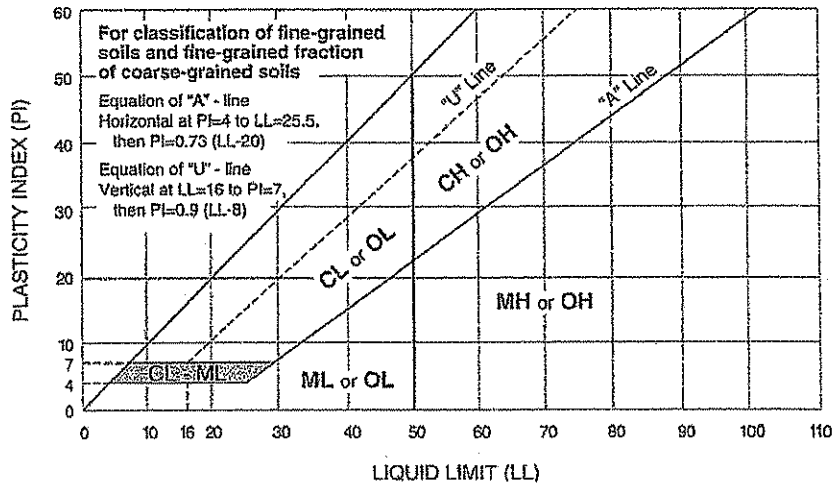
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[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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