BUILDING & EARTH

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September 23, 2010

Mr. Carl Hebert
James R. Childers Architect, Inc.
314/316 Lexington Avenue
Fort Smith, Arkansas 72901

Subject: Report of Subsurface Exploration
and Geotechnical Evaluation
Vinita Health Center
Vinita, Oklahoma
Building & Earth Report No. OK10131

Dear Mr. Hebert:

Building & Earth Sciences, Inc. has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Vinita Health Center on Will Rogers Turnpike near South 4410 Road in Vinita, Oklahoma. Our services were performed in general accordance with our proposal numbered OK12141, dated August 30, 2010.

The purpose of this exploration and evaluation was to assess the general subsurface conditions at the site and to provide recommendations for site grading, foundation design for the proposed health center building, and pavement considerations for parking lots, entrance and access roadways. The recommendations in this report are based on a geotechnical reconnaissance of the site and observation and classification of samples obtained from eighteen (18) borings drilled at the site. Confirmation of the anticipated subsurface conditions during construction is an essential part of geotechnical services.

We appreciate the opportunity to provide consultation services for the subject project. If you have any questions regarding the information in this report or need any additional information, please contact the undersigned.

Respectfully Submitted,
BUILDING & EARTH SCIENCES, INC.
Certificate of Authorization #3975, Expires 6/30/2012

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REPORT OF SUBSURFACE EXPLORATION AND GEOTECHNICAL EVALUATION

VINITA HEALTH CENTER

VINITA, OKLAHOMA

BUILDING & EARTH PROJECT NUMBER: OK10131

PREPARED FOR:

James R. Childers Architect, Inc.

PREPARED BY:

BUILDING & EARTH

Geotechnical, Environmental, and Materials Engineers

DATE:

SEPTEMBER 23, 2010

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1.0 SITE DESCRIPTON

The site for the proposed Vinita Health Center is located within the southwest quadrant of the intersection of Will Rogers Turnpike and South 4410 Road in Vinita, Oklahoma. South Boon Road intersects South 4410 Road just east of the site. East 0272 Road runs in a diagonal southwest-northeast direction, across the center of the site. The site is mostly open and grass covered with woods in the central portion. There is an existing pond with a berm surrounding the pond in the central portion of the site. Topographic site plan provided to our office indicate that the site generally slope up from about elevation 700 feet at the north and west ends to about elevation 715 at the south and east ends.

2.0 PROPOSED CONSTRUCTION

We understand that the project will include construction of a one to two-story building, associated parking lots, entrance and access roadways for the proposed Vinita Health Center. The proposed building will have a pharmacy delivery dock, storage access and drive through connected to the south end of the building footprint. A drop off area will be connected to the west end of the proposed building footprint. Two entrance roadways will be built off of South 4410 Road and one entrance roadway off of Will Rogers Turnpike. Trail and patient parking lots will be built north and east of the proposed building. EMT and staff parking will be built southwest and south of the proposed building. A detention pond is proposed north of the planned entrances into the site, from Will Rogers Parkway.

Based on information furnished to our office, finished floor elevation for the proposed building is planned at elevation 709.0 feet. Existing grades within the footprint of the proposed building vary from about elevation 705 feet at the west end, to about elevation 710 at the east end of the building footprint. Based on the existing grades and the planned finished floor elevation, up to about 4 feet of fill and less than about 1 foot of cut will be required to grade the proposed building pad. Structural loading information provided to our office indicate that maximum column loads for the two-story and one-story portions of the proposed building will not exceed 250 kips and 75 kips, respectively.

3.0 SCOPE OF SERVICES

The recommendations and considerations presented in this report are based on the limited site development information provided to us and information obtained from the subsurface exploration and laboratory analysis. The scope of services included a geotechnical site reconnaissance and subsurface exploration that included eighteen (18) soil test borings for the proposed building, pavements and detention pond.

In the laboratory, the soil samples were visually-manually classified. Representative soil samples were selected and tested for the natural moisture content, Atterberg Limits testing and No. 200 sieve wash analysis. The results of the work are presented within this report that addresses:

- Site geology and potential impact on the site development.
- Summary of existing surface conditions.
- A description of the subsurface conditions encountered at the soil test boring locations including a description of the groundwater conditions observed in the boreholes during drilling.
- Presentation of laboratory test results.
- Site preparation considerations including material types to be expected at the site and treatment of unsuitable soils.
- Recommendations to be used for foundation design, including appropriate foundation types, bearing pressures, foundation depths and estimated settlements.
- Recommendations for design of loading dock and site retaining walls.
- Seismic site classification, according to 2006 International Building Code.
- Recommendations to be used for design of slab-on-grade, including modulus of subgrade reaction.
- Compaction requirements and recommended criteria to establish suitable material for structural backfill.
- Recommended typical minimum asphaltic concrete and Portland cement concrete pavement sections for light-duty and heavy-duty traffic.

4.0 SITE GEOLOGY

According to the Reconnaissance of the Water Resources of the Forth smith Quadrangle, East-Central Oklahoma, second printing 1988, the general geology at the site is described as Pennsylvanian age, McAlester and Hartshorne Formations. These formations are undifferentiated and include shale, sandstone and coal. The formations yield limited amounts of poor quality water.

5.0 FIELD EXPLORATION

The authorized subsurface exploration was completed on September 3, 2010. Building & Earth Sciences, Inc. provided the scope of services for this project in our proposal OK12141, dated August 30, 2010. The subsurface exploration presented in this report consisted of eighteen (18) soil test borings drilled within the footprint of the proposed building and in areas for proposed parking lots, entrance and access roadways, and detention pond.

The following table summarizes the boring locations and approximate termination depths of borings drilled for this project.

Summary of Boring Locations and Depths		
Boring Nos.	Areas Explored/Boring Description	Approximate Termination Depth (ft)
B-1, B-2, B-2A, B-2B, B-4, B-5	Within or in the vicinity of the proposed building footprint.	4.5 to 24.1
B-6, B-7, B-8, B-9, B-10	MEP Borings	5 to 10
B-11 and B-12	Proposed Detention Basin north of site	8.5 and 10
B-13, B-14, B-15, B-16, B-17	Proposed parking lots, entrance and access roadways	4.3 to 5

The soil boring locations were determined in the field by a representative of our staff by estimating right angles and measuring distances from adjacent roadways and existing site features. The approximate boring locations are indicated on the Boring Location Plan included in the Appendix of this report. Elevations shown on the boring logs were estimated from contour lines shown on site survey plan dated August 11, 2010 and provided by James R. Childers Architect, Inc. The locations and elevations should be considered accurate only to the degree implied by the methods used to establish them.

Jet Drilling, Inc. drilled the borings using 2¼-inch inside diameter hollow stem auger drilling procedures. At each boring location, soil samples were retrieved at standard sampling intervals by driving a split-tube sampler. The borehole was first advanced to the sample depth by augering, and the sampling tools were placed in the open hole. The sampler was then driven into the ground 18 inches by blows from a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler each 6-inch increment was recorded. The initial increment is considered the “seating” blows, where the sampler penetrates any loose or disturbed soil in the bottom of the borehole. The blows required to penetrate the final two increments are added together, and referred to as the Standard Penetration Test (SPT) N-Value. The N-Value, when properly evaluated, gives an indication of the soil's strength and ability to support structural loads. Many factors can affect the SPT N-Value, so this result should not be used exclusively to evaluate soil conditions.

Samples retrieved from the boring locations were labeled and stored in plastic bags and buckets at the jobsite before being transported to our laboratory for analysis and testing. The project engineer prepared Boring Logs summarizing the subsurface conditions at the boring locations. The boring logs are included in the Appendix of this report.

6.0 LABORATORY ANALYSIS

After the soil samples were visually classified, the project engineer selected representative samples for laboratory analysis. The laboratory analysis included Atterberg Limits tests, No. 200 sieve washes and natural moisture content determinations. The results of the laboratory analysis are presented on the appropriate boring logs in the Appendix of this report. A brief description of each laboratory test performed is provided in the following sections.

6.1 DESCRIPTION OF SOILS (VISUAL-MANUAL PROCEDURE) (ASTM D 2488)

The soil samples were visually examined by the project geotechnical engineer who provided soil descriptions. Representative samples were then selected and tested in accordance with the aforementioned laboratory-testing program to determine soil classifications and engineering properties. This data was used to correlate the visual descriptions with the Unified Soil Classification System (USCS).

6.2 NATURAL MOISTURE CONTENT (ASTM D 2216)

Natural moisture contents were determined on selected samples. The natural moisture content is the ratio, expressed as a percentage, of the weight of water in a given amount of soil to the weight of solid particles.

6.3 ATTERBERG LIMITS (ASTM D 4318)

Atterberg Limits tests were performed to evaluate the soils' plasticity characteristics. The Plasticity Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid. The PL is the moisture content at which the soil is between "plastic" and the semi-solid stage. The Plasticity Index (PI = LL - PL) is a frequently used indicator for a soil's potential for volume change. Typically, a soil's potential for volume change increases with higher plasticity indices.

6.4 WASH #200 TEST (ASTM D 422)

Grain-size tests were performed to determine the partial soil particle size distribution. The amount of material finer than the openings on the No. 200 sieve (0.074 mm) was determined by washing soil over the No. 200 sieve. The results of the No. 200 sieve washes are presented on the appropriate boring logs in the Appendix of this report.

7.0 GEOTECHNICAL SITE CHARACTERIZATION

The subsurface conditions at the site were evaluated by observation and classification of soil samples obtained from eighteen (18) soil test borings drilled at locations for the proposed building, parking lots, entrance and access roadways and detention pond.

The conditions between the boreholes are assumed to be similar to the conditions encountered at the boring locations. The following conditions and subsequent recommendations presented in this report are based on the presumption that no significant changes in subsurface conditions occur between boreholes. However, anomalous conditions can occur due to the geologic conditions at the site, and it will be necessary to verify the assumed conditions during site grading and foundation installation.

7.1 SURFACE CONDITIONS

About 4 to 8 inches of topsoil and grass were encountered at the existing ground surface of the borings drilled for this project. Trees were present around the central portion of the site. A pond is also present around the central portion of the site.

7.2 RESIDUAL SOILS

Residual soils are formed by the in-place weathering of the parent rock formation. Residual soils were encountered below topsoil and continued to depths of about 2 to 8 feet below the existing ground surface grades. Borings B-15 and B-16 drilled at proposed pavement locations north and south of the proposed building respectively, were terminated within the residual soils at a depth of about 5 feet. Boring B-2B encountered refusal on limestone at the bottom of a residual lean clay soil stratum at about 4.5 feet. The residual soils consisted of lean clay (CL), silty clay (CL-ML), lean to fat clay (CL-CH) and fat clay (CH), with various amounts of sand. Trace amounts of roots and varying amounts of sandstone fragments and seams were noted in portions of the residual soils. The residual soils varied in color from brown, gray, dark gray, red brown, orange brown, yellow brown, dark brown, tan and black.

Residual Lean Clays (CL) and Silty Clays (CL-ML):

The residual lean clay (CL) and silty clay (CL-ML) soils were encountered below topsoil and below residual fat clay soils to depths of about 2 to 8 feet in seventeen of the eighteen borings drilled, with the exception of Boring B-17. The residual lean clay and silty clay soils were of very soft to hard consistency with Standard Penetration Test (SPT) N-values of 2 to 38 blows.

Very soft consistency residual lean clay soils with Standard Penetration Test (SPT) N-values of 2 blows were encountered from below topsoil to the termination depth of Boring B-15, about 5 feet. Boring B-15 was drilled at the location of an access roadway, north of the proposed building footprint.

The natural moisture content of the residual lean clays and silty clays ranged from about 8 to 23 percent. Atterberg limits tests performed on six samples representing the residual silty clays (CL-ML) and lean clays (CL) indicated liquid limit (LL) values from 32 to 45, plastic limit (PL) values from 17 to 22, and plasticity index (PI) values from 13 to 27. Sieve wash analysis performed on five lean clay samples indicated about 62 to 72 percent of the soil particles passed the No. 200 sieve.

Residual Lean to Fat Clays (CL-CH) and Fat Clays (CH):

The residual lean to fat clay (CL-CH) and fat clay (CH) soils were encountered below topsoil and below residual silty clays and lean clays, to depths of about 3 to 5 feet in Borings B-1, B-5, B-10, B-12 and B-16. The residual lean to fat clays and fat clays were of stiff to hard consistency, with Standard Penetration Test (SPT) N-values of 8 to 41 blows.

The natural moisture content of the residual lean to fat clays and fat clays ranged from about 14 to 19 percent. Atterberg limits tests performed on four samples representing the residual lean to fat clays and fat clays indicated liquid limit (LL) values from 48 to 59, plastic limit (PL) values from 19 to 25, and plasticity index (PI) values from 30 to 39. Sieve wash analysis performed on the lean to fat clay and fat clay samples indicated about 56 to 90 percent of the soil particles passed the No. 200 sieve.

7.3 WEATHERED SANDSTONE AND SANDSTONE

Strata of weathered sandstone and sandstone were encountered below topsoil and below the residual clays to depths of about 4 to 12 feet in twelve of the eighteen borings drilled. Various amounts of clay seams were present in the sandstone units. Borings B-2A, B-4, B-9, B-11 and B-13 were terminated within the weathered sandstone and sandstone units at depths of about 4 to 8.5 feet. Auger refusal on sandstone was encountered at a depth of about 6.5 feet in Boring B-4. SPT N-values within the weathered sandstone ranged from 17 blows to 50 blows per 5.5 inches of penetration. SPT N-Values within the sandstone unit ranged from 55 blows to 50 blows per 0 inch of penetration.

The weathered sandstone and sandstone units were red brown, brown, gray, light gray, yellow brown, dark gray orange brown, and dark brown in color. The moisture content of weathered sandstone and sandstone units tested ranged from about 6 to 22 percent.

7.4 HIGHLY WEATHERED SHALE AND WEATHERED SHALE

Highly weathered shale and weathered shale were encountered below the residual clays, weathered sandstone and sandstone units to the termination depths of eight borings, at depths of about 5 to 24.1 feet. Various amounts of clay seams, sandstone fragments and seams were encountered within the weathered shale and shale units. The highly weathered shale and shale units were generally soft rock with SPT N-values ranging from 20 blows to 78 blows per 7 inches of penetration.

The highly weathered and weathered shale units were gray, dark gray, yellow brown, brown, red brown and black in color. The moisture content of highly weathered shale and shale units tested ranged from about 8 to 18 percent.

7.5 LIMESTONE UNIT

Limestone was encountered below the residual clays and weathered sandstone at depths ranging from about 4.5 to 7.0 feet in Borings B-2, B-2A and B-2B. Boring B-2 extended into the limestone unit from a depth of about 5 feet to shallow refusal depth of the boring, about 7 feet. Borings B-2A and B-2B which were offsets of Boring B-2 also encountered shallow refusal at a depth of 4.5 feet. The limestone appeared moderately hard to hard with SPT N-values of 65 blows per 11 inches, to 50 blows per 0 inch of penetration.

The limestone unit sampled in Boring B-2 was brown, yellow brown and gray in color. The moisture content of limestone unit tested was about 11 percent.

7.6 AUGER AND SAMPLER REFUSAL

Auger and sampler refusal were encountered in the limestone and sandstone units at five boring locations (Borings B-1, B-2, B-4, B-10 and B-11). Auger refusal is said to occur when there is continuous grinding of the augers on the rock unit with no noticeable penetration into the rock stratum. Sampler (SPT) refusal is defined as 50 blows with 6 inches or less of penetration. The following table indicates the depths and elevations at which sampler and/or auger refusal were encountered in the borings.

Boring Number	Depth/Elevation to SPT Refusal (ft)	Depth/Elevation to Auger Refusal (ft)	Refusal Material
B-1	8.8/696.6	Not encountered	Sandstone
B-2	7.0/699.3	7.0/699.3	Limestone
B-2A	Not encountered	4.5/702.7	Limestone
B-2B	Not encountered	4.5/702.8	Limestone
B-4	5.4/703.5	6.5/702.4	Sandstone
B-10	5.5/702.5	Not encountered	Sandstone
B-11	5.3/692.7	Not encountered	Sandstone

7.7 GROUNDWATER IN THE BOREHOLES

Ground water seepage was not encountered at any of the soil boring locations during drilling. Water observation wells (piezometers) were installed in three of the proposed MEP borings (Borings B-6, B-7, B-8 and B-10). The piezometers extended to termination depth of the borings, about 10 feet. A piezometer was not installed in one of the MEP borings (Boring B-9) as originally planned. The boring refused at a shallow depth of about 4.0 feet.

Piezometer readings taken about fourteen days after completion of drilling indicated ground water levels at depths of about 2.1 feet to 6.2 feet below the existing ground surface grades. The following table summarizes water level readings taken in the piezometers.

Water Level Readings

Boring No./ Ground Surface Elevation (ft)	Date of Water Level Reading	Ground Water Depth/Elevation During Drilling (ft)
B-06 / 704.2	9/17/10	2.1/702.1
B-07 / 706.0	9/17/10	2.3/702.9
B-08 / 705.2	9/17/10	5.6/699.6
B-10 / 708.0	9/17/10	6.2/701.8

It is important to note that the piezometer readings were taken a few days after a period of persistent rainfall that lasted at least three days, within the proposed project site location. Fluctuations in the water level can occur due to seasonal rainfall, surface runoff, pumping, evaporation and similar factors.

8.0 SITE GRADING CONSIDERATIONS

Grading plans were not available at the time this report was prepared. Information provided to our office indicates that the finished floor elevation for the proposed building is currently planned at elevation 709.0 feet. Accordingly, up to about 4 feet of fill and less than about 1 foot of cut will be required to grade the proposed building pad. We anticipate that cut and fill required to achieve final grades for proposed pavements will be within about 3 to 5 feet or less. If final subgrade elevations differ significantly from those presented above then Building and Earth should be given the opportunity to re-evaluate the recommendations presented in this report.

The primary geotechnical considerations for development of the project site include:

- The moisture sensitivity of the near-surface silty clays encountered at several boring locations.
- The presence of soft, near-surface residual clays to the termination depth of Boring B-15, at 5 feet. It is likely that soft clays may be encountered at other locations of the site.
- The moderate to high shrink-swell potential of the lean to fat clay and fat clay soils encountered at near surface.
- The potential development of perched ground water conditions at the interface of the low plasticity silty and lean clays and the moderate to high plasticity lean to fat and fat clays, and between the residual clays and the weathered shale, sandstone and limestone units.
- The varying conditions and relatively shallow depths of weathered shale, sandstone and limestone units. Difficult excavation should be anticipated in these materials during construction of the proposed building foundations, excavation for the proposed detention basin or in deep utility excavations if any are planned.

8.1 INITIAL SITE PREPARATION

Grass and topsoil should be stripped. Where present, existing trees, stumps, and root systems should be removed from proposed construction areas. A geotechnical engineer should observe stripping and grubbing operations to evaluate that all unsuitable materials are removed from locations for proposed construction.

During initial site preparation activities, the contractor should identify materials that will be used as structural fill and provide samples to the testing laboratory to evaluate the suitability for use as structural fill and to determine moisture-density relationships.

8.2 BACKFILLING EXISTING POND

There is an existing pond around the central portion of the site. Based on its location, the pond will need to be drained and backfilled prior to subgrade preparation for the proposed building and pavements. We recommend that draining, dredging, and backfilling of the pond be completed in the presence of a geotechnical engineer. The engineer should evaluate the pond subgrade conditions following dredging to determine its suitability to support the weight of new fill required to reach the proposed design grades. All soft and wet materials encountered in the bottom of the pond must be removed prior to structural fill placement. Materials placed as pond backfill should be compacted as recommended herein Sections 8.7 and 8.8 of this report. Dredged materials from the pond should not be used as backfill or structural fill

8.3 MOISTURE SENSITIVE SURFICIAL SOILS

Surficial low plasticity lean clays and silty clays were encountered at near-surface in the borings drilled for this project. Some of the lean clays and silty clays had relatively low natural moisture contents. These types of soils are sensitive to increased moisture levels and can become unstable under building or traffic loads.

The contractor should anticipate some difficulty during the earthwork phase of this project if moisture levels are moderate to high during construction. Increased moisture levels will soften the subgrade and the soils may become unstable under the influence of construction traffic.

Accordingly, wet weather conditions prior to and during construction should be avoided, as this will result in soft and unstable soil conditions at near surface. Unstable surficial soils identified during construction should be undercut to stable materials prior to fill placement.

8.4 VERY SOFT RESIDUAL CLAYS

Very soft residual lean clays with SPT N-value of 2 blows were encountered from below topsoil to termination depth of Boring B-15, at about 5 feet. Although the very soft clays were not encountered in the remaining borings, it is possible that they may be exposed in other unexplored areas of the site. The soft clays are not considered suitable for support of proposed foundations, floor slabs and pavements. If encountered at design grades for building and pavements, the soft clays should be undercut to firm and stable subgrade materials prior to placement of structural fill and/or new construction. Undercut areas should extend at least 5 feet beyond building perimeter limits and at least 2 feet beyond pavement edges.

8.5 POTENTIAL VERTICAL RISE (PVR) OF ON-SITE CLAYS

Laboratory test results indicate that the clay soils encountered within the project site have moderate to high plasticity characteristics, with liquid limits and plasticity indices of 32 to 59 percent and 13 to 39 percent, respectively.

The potential vertical rise (PVR) of the clay soils encountered at near surface in the proposed building borings was evaluated using the Texas Department of Transportation's test method TEX-124-E, Potential Vertical Rise (PVR). This empirical method estimates the potential vertical rise (PVR) of the clay soils based on the plasticity characteristics, soil moisture levels at the time of the subsurface exploration, thickness of the clay soils, and surcharge loads. For this project site, an active zone of 8 feet was used in the calculations. A surcharge load of 0.5 psi was considered for the proposed slab on grade. Based on the subsurface conditions encountered in the borings, the TexDOT method estimates a PVR on the order of about 1¼ to 2 inches.

We recommend that at least 30 inches of low plasticity compacted structural fill be placed underneath the proposed building floor slab in order to limit the PVR to 1 inch or less. Moderate to high plasticity clay soils that do not meet the criteria for use as compacted structural fill should be removed within 30 inches below the bottom of a recommended capillary moisture break layer to be placed below grade supported slabs. Undercutting should extend at least 5 feet beyond the proposed building perimeter lines.

In addition to reducing the PVR to 1 inch or less, the recommended amount of undercut and replacement will also provide for uniform subgrade conditions for grade supported slabs.

8.6 DIFFICULT EXCAVATION

Our subsurface exploration encountered weathered sandstone, sandstone, and limestone at depths ranging from about 2 to 8 feet below the existing ground surface grades, in most of the borings drilled at the project site. Auger and/or sampler (SPT) refusal occurred within the sandstone and limestone units at depths of about 4.5 to 8.8 feet below the existing ground surface grades.

It is likely that these materials will be encountered during site grading, during construction of the proposed building foundations and during excavation for the proposed detention pond or for deep underground utilities. We anticipate that a trackhoe equipped with rock teeth in good working order will be able to excavate the weathered sandstone, sandstone and limestone units, at last to the termination depths of the borings. However, effort will be required and the contractor should be prepared to provide appropriate equipment if any difficult excavation is encountered in harder sandstone and limestone below the depths explored. When excavations encounter the harder sandstone, a large trackhoe with pneumatic hammer attachment may be required to rip the sandstone.

Auger refusal is generally a good indication of the transition between material that can be excavated with a track-hoe and material that will require rock removal techniques (blasting, pneumatic hammer, etc.). The depth to which weathered rock can be ripped will depend on the equipment used and the effort applied. We recommend performing a test pit exploration at the time of site clearing to evaluate the ripability of the weathered shale, weathered sandstone, sandstone and limestone at the site.

8.7 SUBGRADE PREPARATION

Upon completion of initial site preparation and undercutting of any loose materials encountered, the moisture content of the exposed subgrade soils should be evaluated. Depending on the moisture content of the exposed materials, moisture conditioning may be required prior to proofrolling or fill placement. The exposed subgrade should be scarified to a depth of at least 8 inches, moisture conditioned to within a range of 2% below to 2% above the optimum moisture content and recompacted to at least 95% of the material's maximum dry density (standard Proctor ASTM D 698).

All areas that will require fill or that will support structures or pavements should then be carefully proofrolled with a fully loaded, tandem-axle dump truck prior to fill placement or construction. The proofrolling will help identify unstable and/or soft subgrade materials. Soft and/or unstable materials identified during the proofrolling or subgrade evaluation process should be moisture conditioned, undercut to suitable material, or stabilized in place prior to fill placement or new construction. Information regarding suitable stabilization methods can be provided during construction, based on actual conditions encountered.

8.8 STRUCTURAL FILL

Structural fill placed under floor slabs and pavements should be composed of material with a maximum dry density in excess of 100 pounds per cubic foot (pcf), Plasticity Index (PI) less than 20, and a Liquid Limit (LL) less than 40.

Based on the laboratory test results performed on representative samples, most of the residual clay soils encountered on the project site do not meet the criteria for use as low plasticity structural fill within the proposed building and pavement areas. On-site materials used as low plasticity structural fill should be free of any organics, should be tested and approved by the geotechnical engineer, should be free of any organics and, should not contain rock fragments greater than 3 inches in any dimension, and should be properly moisture conditioned prior to use as structural fill.

The structural fill should be compacted to a minimum of 98% and 95% of the standard Proctor maximum dry density within proposed building and pavement areas, respectively. All fill should be moisture conditioned within ±2% of the optimum moisture content as determined by ASTM D 698. The specifications should state that both density and moisture requirements should be met.

The structural fill should be spread in horizontal lifts starting at the lowest elevation to receive fill. The lifts should not exceed eight (8) to twelve (12) inches loose lift thickness, depending on the compaction equipment used. Density and moisture tests should be performed on each lift prior to placement of subsequent lifts. A commonly used testing criterion is one test per 2,500 square feet per lift in building areas, and one test per 5,000 square feet in parking or drive areas, with a minimum of three (3) tests performed per lift.

8.9 DEWATERING CONSIDERATIONS

Piezometer readings taken about fourteen days after completion of drilling indicated relatively shallow ground water levels at depths between 2.1 to 6. 2 feet below the existing ground surface grades. The piezometer readings were taken a few days after persistent rainfall that lasted at least three days, within the proposed project site location.

Accordingly ground water should be anticipated in excavations during periods of wet weather conditions. The depth of water seepage in excavations will depend on the amount of rainfall prior to and during construction. Typical temporary dewatering techniques such as pumping from sumps or well points are anticipated to be sufficient to remove any water seepage that may be encountered in foundation excavations. Dewatering should be the responsibility of the Contractor.

8.10 UTILITY TRENCH BACKFILL

All utility trenches must be backfilled and compacted in the manner specified for structural fill above. The lift thickness may have to be reduced to four to six inches to achieve compaction when using hand-operated equipment. Density tests should be performed at least every 200 feet along the trenches.

8.11 WET WEATHER CONDITIONS

The contractor should be aware of the importance of proper maintenance of surficial drains. Surface water should be positively drained and not allowed to stand or pond for long periods. Repetitive traffic will tear up completed work on the subgrade and will require repairs to achieve a smooth, stable surface prior to construction proceeding. Building and Earth suggests that completed work be protected from traffic and ponding water, and be evaluated again after long periods of rain.

During rainy periods, additional effort will be required to properly prepare the site and establish/maintain an acceptable subgrade. The difficulty will increase in areas where lower plasticity clay soils overly highly plastic clays, weathered shale and shale units, creating perched water conditions and causing the surface soils to become saturated. Grading contractors typically postpone grading operations during wet weather to wait for conditions that are favorable. Contractors can typically disk or aerate the upper soils to promote drying during intermittent periods of favorable weather. When deadlines restrict postponement of grading operations, additional measures such as undercutting and replacing saturated soils or chemical stabilization of saturated soils can be considered to prepare a subgrade suitable for fill placement.

8.12 LANDSCAPING AND DRAINAGE CONSIDERATIONS

The potential for soil moisture fluctuations within building areas and pavement subgrades should be minimized in order to reduce the potential of subgrade movement. Site grading should include positive drainage away from building and pavements. Ponding of water adjacent to building and pavements could result in soil moisture increases and subsequent heave of the soils. Landscaping and irrigation immediately adjacent to building and pavements should be limited. Trees can develop large root systems which can draw water from subgrade soils, resulting in subsequent shrinkage of the soils. Periodic irrigation of landscaping poses a risk of saturating and softening soils below shallow footings and pavements, which could result in settlement of footings and premature failure of pavements.

9.0 FOUNDATION RECOMMENDATIONS

The borings drilled for the proposed project encountered residual soils consisting of generally firm to very stiff consistency clays extending to depths of about 2 to 8 feet below the existing ground surface. Highly weathered shale, weathered sandstone, sandstone and limestone units were encountered below the residual soils to refusal and termination depths of the borings.

Structural loading information provided to our office indicate that maximum column loads for the two-story and one-story portions of the proposed building will not exceed 250 kips and 75 kips, respectively. Based on the existing grades and the proposed finished floor elevation, up to about 4 feet of fill and less than about 1 foot of cut will be required to grade the proposed building pad.

Based on the information obtained from the field exploration and our site preparation recommendations, it is our opinion that shallow spread footings are suitable for support of the proposed building. The building footings should be excavated to bear at least 24 inches below the finished exterior subgrade elevation. Based on data from our subsurface exploration and the proposed building finished floor elevation, footing design subgrades will likely consist of new compacted structural fill, undisturbed firm to stiff residual clays, weathered sandstone, sandstone, weathered shale and limestone.

Footing subgrades consisting of soft consistency clays as encountered in Boring B-15 should be undercut and backfilled to design subgrade elevation with compacted structural fill. Footings founded on the recommended materials and to the required bearing depth can be dimensioned for a maximum allowable bearing capacity of 2,500 pounds per square foot (psf).

Total long-term settlement of footings designed and constructed as recommended above could be on the order of 1 inch or less. Differential settlements are not expected to exceed about half of this value.

Based on the proposed finished floor elevation and the stratigraphy of the site, it is likely that a combination of residual soils and sandstone, weathered shale or limestone may be exposed at design bearing level of the proposed building footings. We recommend that all footings bear on uniform materials in order to reduce the risk of differential settlement. If a combination of residual soils and sandstone, shale or limestone is exposed at bearing level in footing excavations, the sandstone should be undercut at least 12 inches below bearing level and brought back up to design bearing elevation using compacted structural fill or low-strength flowable fill.

The following items should be considered during the preparation of construction documents and foundation installation:

- Even though computed footing dimensions may be less, column footings should be at least 24 inches wide and strip footings should be at least 16 inches wide. These dimensions facilitate hand cleaning of footing subgrades disturbed by the excavation process and the placement of reinforcing steel. They also reduce the potential for localized punching shear failure. All exterior footing bottoms should be at least 24 inches below the adjacent exterior grade. Interior footings may be founded at least 12 inches below finished subgrade.

- The geotechnical engineer of record should observe the exposed foundation bearing surfaces prior to concrete placement to verify that the conditions anticipated during the subsurface exploration are encountered. Bearing elevations may have to be adjusted based on actual conditions encountered.

- Wherever possible, the foundation concrete should be placed "neat", using the sides of the excavations as forms. Where this is not possible, the excavations created by forming the foundations must be backfilled with suitable structural fill and properly compacted.

- All bearing surfaces must be free of soft or loose soil prior to placing concrete.

- Concrete should be placed the same day the excavations are completed and bearing materials verified by the engineer. If the excavations are left open for an extended period or if the bearing surfaces are disturbed after the initial observation, then the bearing surfaces should be re-evaluated prior to concrete placement.

- Water should not be allowed to pond in foundation excavations prior to concrete placement or above the concrete after the foundation is completed.

- Building pads should be sloped to drain away from the building foundations. Roof drains should be routed away from the foundation soils.

10.0 FLOOR SLABS

Based on the need for undercutting moderate to highly plastic clay soils where encountered, the proposed building floor slabs are anticipated to bear on low plasticity compacted structural fill with thickness of at least 30 inches.

At a minimum, the building floor slabs should be supported on a four-inch thick compacted layer of free-draining, granular material, such as No. 57 stone. The purpose of this layer is to help distribute concentrated loads and act as a capillary break for moisture migration through the subgrade soil. Depending on the proposed floor covering, consideration should be given to the use of a polyethylene vapor barrier.

An effective modulus of subgrade reaction of 150 pci can be used in the design of grade supported building floor slabs.

The floor slabs should be designed as "floating" slabs, that is, fully ground supported and structurally independent of the building walls. Adequate expansion joints should be incorporated into the floor slab near the foundations so that the floor slabs do not impose any loads on the foundations. The expansion joints would also allow the foundations and floor slabs to move independently of each other. This provision will reduce the possibility of floor slab cracking because of differential movements between the slab and the foundation elements. The slabs should be appropriately reinforced to support the proposed loads.

11.0 LOADING DOCK AND SITE RETAINING WALLS

Loading docks are planned for this project. Also, site retaining walls may be constructed as part of this project. Loading dock and site retaining walls can be supported on shallow footings based on recommendations provided in Section 9 of this report. All soft soils encountered at footing design grades for proposed loading dock and site retaining walls should be undercut to stiff materials. Undercutting should extend laterally a distance of at least 2 feet beyond the edges of the footings. The undercut areas should be brought back up to bearing level using suitable structural fill.

11.1 LATERAL EARTH PRESSURES

Loading dock and retaining walls should be backfilled with free-draining granular fill such as No. 57 stone. The stone fill should be placed in the zone defined by projecting a 1(H):1(V) line from the base of the wall to the finished subgrade elevation or ground surface. A layer of suitable filtration fabric should be placed between the soil and stone backfill to reduce migration of soil fines into the drainage zone behind the wall.

In areas where the aggregate fill behind the walls will support pavements, sidewalks, or other structural elements, the backfill must be placed and compacted in a systematic manner. The aggregate fill should be placed in lifts not exceeding 6 inches, and compacted using a vibratory plate compactor.

The following soil parameters and earth pressures should be considered for the design of retaining walls. At rest parameters should be used to design walls that are not allowed to rotate or translate.

Soils Parameters and Earth Pressure Values

Backfill Material	Soils Parameters		Equivalent Fluid Unit Weights for Active & At-Rest Earth Pressures (pcf)	
	Wet Unit Weight (pcf)	Effective Angle of Internal Friction	At-Rest Condition	Active Condition
ASTM No. 57 Stone	110	36°	45	30
Structural Fill/ Site Soils	120	28°	65	45

Lateral earth pressures may be greater for walls with free-draining material placed in a zone steeper than the 1(H):1(V) projection recommended above. In that case, we recommend that walls are designed using the soil parameter values for structural fill and site soils as shown in the table above.

The recommended lateral earth pressure values are based on a fully-drained condition. If hydrostatic pressure is allowed to build up behind walls, additional pressures will develop. The No. 57 aggregate backfill will function as a drainage blanket. The drainage blanket should have a minimum width of 2 feet and should be wrapped in filter fabric to minimize intrusion of fines. A perforated drain line should be installed at the base of the wall footing and should extend to a sump where water can be collected and removed or drains should discharge by gravity flow to a suitable outfall.

Lateral pressures arising from surcharge loading, earthquake loading, and groundwater, should be added to the above earth pressures to determine the total lateral pressures. In addition, transient loads imposed on the loading dock and retaining walls by construction equipment during backfilling should be taken into consideration. Excessively heavy grading equipment (that could impose temporary excessive lateral pressures) should not be allowed within 5 feet (horizontally) of the walls.

Passive earth pressures of materials adjacent to the loading dock and retaining wall footings as well as bearing material friction at the footing bases may be used to resist shear. The following table presents allowable friction coefficient values and passive earth pressure values for various anticipated materials.

Soil Parameter Values Resisting Shear

Material Description	Friction Coefficient	Passive Earth Pressure, Equivalent Fluid Unit Weight, pcf
Compacted Structural Fill, Undisturbed Stiff Residual Soils	0.30	250
Weathered Shale, Weathered Sandstone, Sandstone	0.35	350

The use of passive resistance requires that the material adjacent to the footing base not be removed (for utility installation, excavation, etc.). The passive resistance values given in the table above are unfactored.

12.0 SEISMIC SITE CLASSIFICATION

Based on the 2006 Edition of the International Building Code, the subsurface conditions encountered in the borings, and our knowledge of the geologic conditions of the site, we recommend that the site be classified as Site Class C (Table 1613.5.2). Our subsurface exploration extended to a maximum depth of about 24 feet; hence the seismic site classification should be re-evaluated in the event subsurface information is made available to a depth of 100 feet.

13.0 PAVEMENT CONSIDERATIONS

Paved entrance roadways driveways and parking areas associated with the new building will be constructed as part of this project. Based on the proposed construction and project information, we anticipate the majority of the traffic will consist of light passenger vehicles and occasional light delivery trucks for light duty pavement, delivery trucks and trash trucks utilizing heavy duty pavement.

Grading plans were not available at the time of writing this report. We anticipate that cut and fill required to achieve final pavement subgrade elevations will be within about 3 to 5 feet or less.

Pavement subgrade materials should be evaluated and prepared as recommended in Section 8 of this report. Based on the grading plans and subsurface conditions encountered in the pavement borings, pavement subgrade materials are anticipated to consist of residual clays, weathered shale, weathered sandstone and sandstone and structural fill. Soft clays encountered at proposed pavement design subgrade elevations should be undercut to firm/dense, stable subgrades and backfilled with compacted structural fill.

Based on the materials encountered at the boring locations, pavements at the subject site may be designed based on a California Bearing Ratio (CBR) value of 3. Note that no CBR or plate load testing was completed to develop these recommendations. Rigid pavements may be designed using modulus of subgrade reaction, k, of 125 pounds per cubic inch. We have assumed concrete elastic modulus (E_c) of 3.1 X 10^6 psi, and a concrete modulus of rupture (S'_c) of 600 psi.

We have used the following design equivalents for the recommended pavement sections:

Summary of Pavement Design Criteria		
Design Criteria	Standard Duty	Heavy Duty
Assumed Minimum ESAL	40,000	150,000
Traffic Type	Passenger cars and occasional light delivery truck	Passenger cars, heavy delivery trucks and trash trucks
Design life (Years)	20	
Terminal Serviceability	2.0	
Reliability	90%	
Initial Serviceability	4.2 (Flexible) 4.5 (Rigid)	
Standard Deviation	0.45(Flexible) 0.35(Rigid)	

All subgrade, base and pavement construction operations should meet minimum requirements of the Oklahoma Department of Transportation (ODOT), *Standard Specifications for Highway Construction,* dated 1999. The applicable sections of the specifications are identified in the following table.

ODOT Specification Sections	
Title	ODOT Specification Section
Aggregate for Aggregate Base	303 & 703.01
Plant Mix Asphalt Concrete Pavement	411 & 708
Portland Cement Concrete Pavement	414 & 701

The recommended pavement sections are based on assumed traffic conditions. If the minimum ESAL capacities presented above are not suitable for the subject site, then upon notification we will evaluate the recommendation as additional information is made available to us.

The asphalt pavement sections described herein were designed using the "AASHTO Guide for Design of Pavement Structures, 1993". Alternative pavement sections were designed by establishing the structural numbers used for the AASHTO design system and substituting materials based upon structural equivalency as follows:

Estimated Structural Equivalency Coefficients	
Material Description	Structural Equivalency Coefficient
Asphalt Concrete Surface Course	0.42
Asphalt Concrete Base Course	0.39
Crushed Stone Base	0.14

The following flexible and rigid pavement sections are based on the design parameters presented above.

Pavement Type	Flexible Pavement Section (Hot Mix Asphaltic Concrete, HMAC), inches
Light Duty Parking Areas (passenger cars and occasional light delivery truck)	2.0 HMAC Surface Course (1) 2.0 HMAC Base Course (2) 6.0 Limestone Aggregate Base (3) 8.0 Properly Compacted Subgrade
Trail Parking Heavy Duty Drives (delivery trucks and trash trucks)	2.0 HMAC Surface Course (1) 4.0 HMAC Base Course (2) 6.0 Limestone Aggregate Base (3) 8.0 Properly Compacted Subgrade

(1) ODOT Type "C" HMAC, Sections 411 & 708
(2) ODOT Type "A" HMAC, Sections 411 & 708
(3) ODOT Type "A" Crushed Limestone, Sections 303 & 703.01

Pavement Type	Rigid Pavement Section (Portland cement concrete), inches
Light Duty Parking Areas (passenger cars and occasional light delivery truck)	5.0 Portland Cement Concrete (1) 4.0 Limestone Aggregate Base (2) 8.0 Properly Compacted Subgrade
Trail Parking Heavy Duty Drives (delivery trucks and trash trucks)	6.0 Portland Cement Concrete (1) 4.0 Limestone Aggregate Base (2) 8.0 Properly Compacted Subgrade

(1) ODOT Portland Cement Concrete, Sections 414 & 701
(2) ODOT Type "A" Crushed Limestone, Sections 303 & 703.01

For access drive approaches, trash compactor pads, loading docks, and other pavement areas that are frequently subjected to high traffic loads with frequent braking and turning of wheels, consideration should be given to using a rigid pavement section comprised of 7 inches Portland cement concrete over 4 inches limestone aggregate base.

A separator fabric should be considered between recompacted subgrade soils and limestone aggregate base course to prevent migration of fines into the coarse aggregate.

All pavement components must be placed and compacted in accordance with the applicable section of the Oklahoma Department of Transportation. All subgrade, base, and pavement construction operations should meet minimum requirements of the state of Oklahoma Standard Specifications for Highway Construction, 1999 edition.

14.0 CONSTRUCTION MONITORING

The recommendations presented in this report are based on information obtained from eighteen (18) boring locations. Field verification of site conditions is an essential part of the services provided by the geotechnical consultant. In order to confirm our recommendations, it will be necessary for Building & Earth personnel to make periodic visits to the site during site grading. We can prepare a proposal for construction monitoring services based on the construction schedule and your risk management preferences.

Typical construction monitoring services are listed below.

- Periodic observations and consultations by a member of our engineering staff during site grading.
- Field density tests during structural fill placement.
- Observation and verification of the bearing surfaces exposed after foundation excavation.
- Reinforcing steel for structural concrete and masonry
- Molding and testing of concrete cylinders, mortar and grout.
- Sampling of asphalt for mix verification and coring for determination of in-place thickness and density.

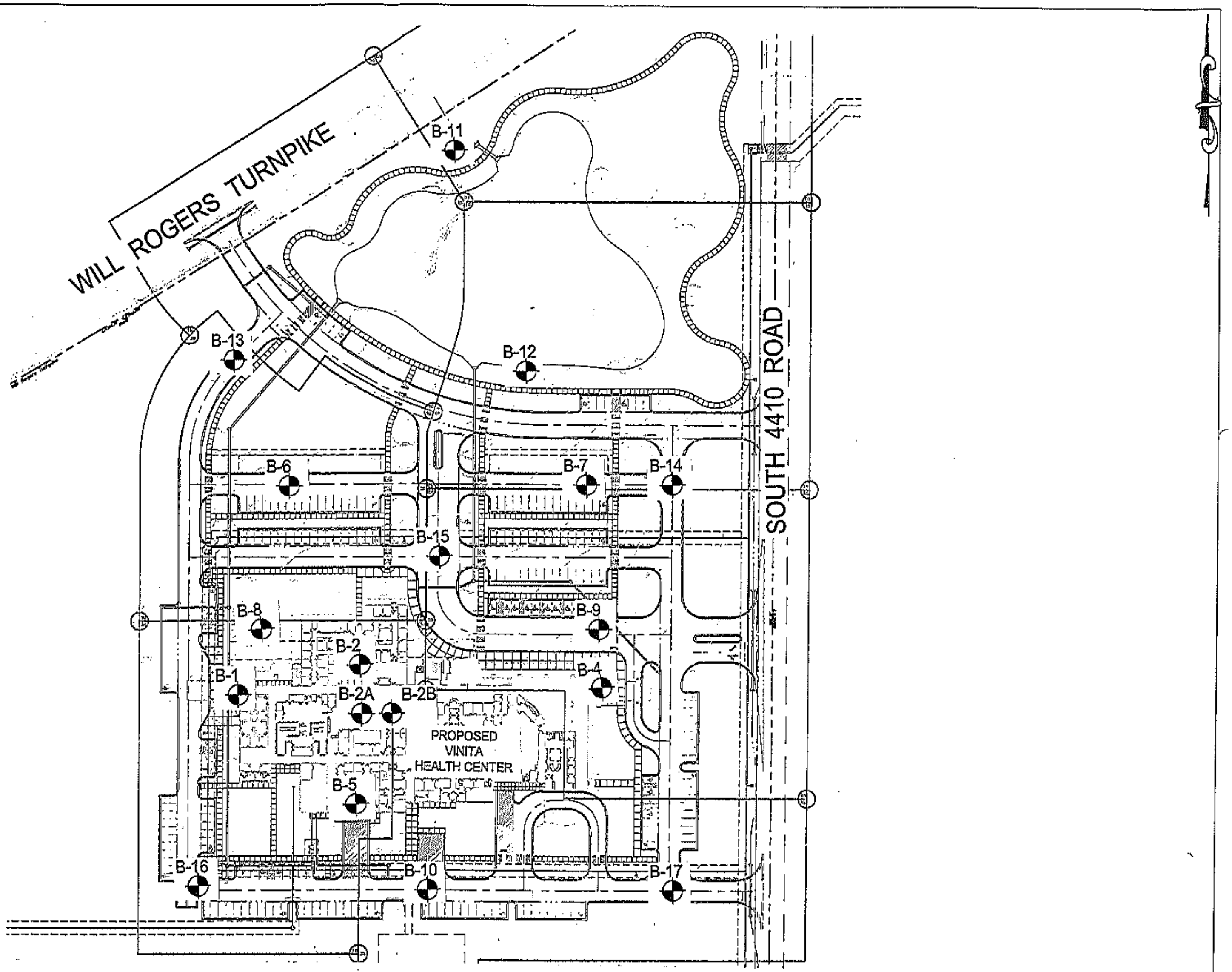
15.0 CLOSING

This report was prepared for the exclusive use of James R. Childers Architect, Inc. for specific application to the subject project. The information in this report is not transferable. This report should not be used for a different development on the same property without first being evaluated by the engineer. The recommendations in this report were based on the information obtained during the field exploration, laboratory analysis and engineering judgment regarding conditions between borings. The anticipated subsurface conditions should be confirmed during site grading and foundation installation.

This report is intended for use during design and preparation of specifications and may not address all conditions at the site at the time of construction. Contractors reviewing this information should acknowledge that this document is for design information only.

An article published by the Association of Engineering Firms Practicing in the Geosciences (ASFE), titled *Important Information About Your Geotechnical Report,* has been included in the Appendix. We encourage all individuals to become familiar with the article to help managing risk.

APPENDIX



LEGEND

⊕ APPROXIMATE TEST BORING LOCATION

BUILDING & EARTH

VINITA HEALTH CENTER
WILL ROGERS TURNPIKE
VINITA, OKLAHOMA

TEST BORING
LOCATION PLAN
PROJECT No. OK10131
FIGURE 1

Done:
J. KAMANDA
Reviewed:
M. SILVESTRE

Approximate Scale:
1" = 120'
Date:
SEPTEMBER 2010

BORING LOG DESCRIPTION

Building & Earth Sciences, Inc. (Building & Earth) used the gINT software program to prepare the attached boring logs. The gINT program provides the flexibility to custom design the boring logs to include the pertinent information from the subsurface exploration and results of our laboratory analysis. The soil and laboratory information included on our logs is summarized below:

Depth
The depth below the ground surface is shown.

Sample Type
The method used to collect the sample is shown. The typical sampling methods include Split Spoon Sampling, Shelby Tube Sampling, Grab Samples, and Rock Core. A key is provided at the bottom of the log showing the graphic symbol for each sample type.

Sample Number
Each sample collected is numbered sequentially

Blows per 6", REC%, RQD%
When Standard Split Spoon sampling is used, the blows required to drive the sampler each 6-inch increment are recorded and shown in column 4. When rock core is obtained the recovery ration (REC%) and Rock Quality Designation (RQD%) is recorded.

Soil Data
Column 5 is a graphic representation of 4 different soil parameters. Each of the parameters use the same graph, however, the values of the graph subdivisions vary with each parameter. Each parameter presented on column 5 is summarized below:

- **N-Value**- The Standard Penetration Test N-Value, obtained by adding number of blows required to drive the sampler the final 12 inches, is recorded. The graph labels range from 0 to 50.
- **Qu** – Unconfined Compressive Strength estimate from the Pocket Penetrometer test in tons per square foot (tsf). The graph labels range from 0 to 5 tsf.
- **Atterberg Limits** – The Atterberg Limits are plotted with the plastic limit to the left, and liquid limit to the right, connected by a horizontal line. The difference in the plastic and liquid limits is referred to as the Plasticity Index. The Atterberg Limits test results are also included in the Notes column on the far right column of the boring log. The Atterberg Limits graph labels range from 0 to 100.
- **% Moisture** – The Natural Moisture Content of the soil sample as determined in our laboratory.

Soil Description
The soil description prepared in accordance with ASTM D 2488, Visual Description of Soil Samples. The Munsel Color chart is used to determine the soil color. Strata changes are indicated by a solid line, with the depth of the change indicated on the left side of the line. If subtle changes within a soil type occur, a broken line is used. The Boring Termination or Auger Refusal depth is shown as a solid line at the bottom of the boring.

Graphic
The graphic representation of the soil type is shown. The graphic used for each soil type is related to the Unified Soil Classification chart. A chart showing the graphic associated with each soil classification is included.

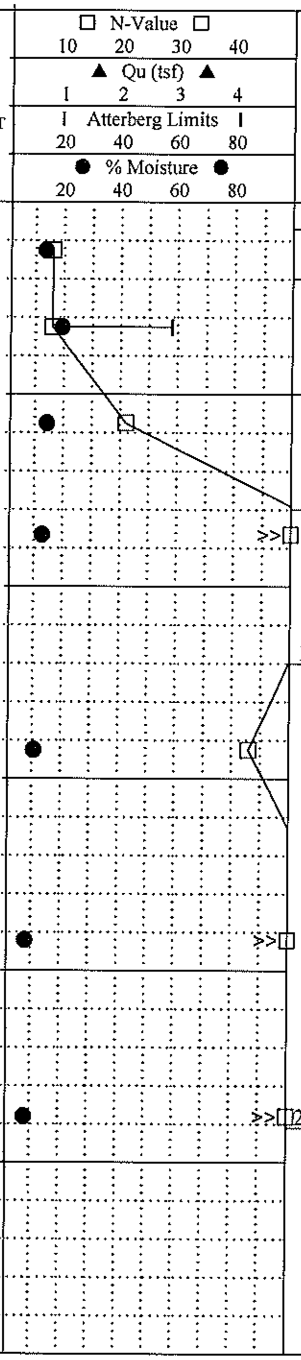
Remarks
Remarks regarding borehole observations, and additional information regarding the laboratory results and groundwater observations.

LOG OF BORING: B-01

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: West end of proposed building footprint

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 705.4



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION		REMARKS
0.7				8 inches topsoil	704.7	
	☒	1	3-4-4	SANDY LEAN CLAY (CL): stiff, trace roots, moist-brown		
2.0					703.4	
	☒	2	1-4-4	SANDY FAT CLAY (CH): contains sandstone fragment, very stiff, moist-dark gray, dark brown and brown		Sample No. 1: LL=58, PL=19, PI=39 Passing No. 200 = 56% RESIDUAL
5.0					700.4	
	☒	3	3-7-14	SANDY LEAN CLAY (CL): very stiff, contains sandstone fragments, moist-dark gray, dark brown and brown		
8.0					697.4	
	☒	4	50/3"	SANDSTONE: highly cemented		
12.0					693.4	
	☒	5	8-20-23	WEATHERED SHALE: soft, moist-gray and dark gray		McALESTER & HARTSHORNE FORMATIONS
	☒	6	4-30-50/5"	same: yellow brown, gray and dark gray		
	☒	7	28-50/1"	same: contains sandstone fragments		
24.1				-Boring terminated at a depth of 24.1 ft. -Boring backfilled on 9/2/10	681.3	No ground water encountered during drilling

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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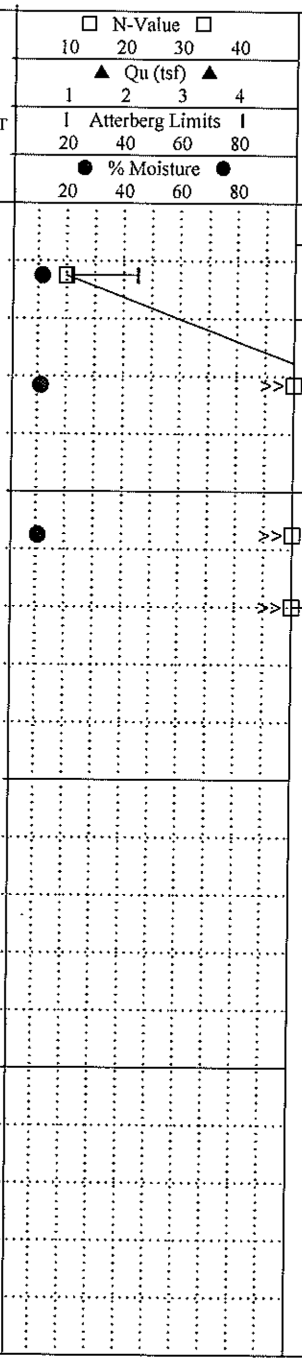
LOG OF BORING: B-02

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: North end of proposed building footprint

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 706.3

DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	Elevation	GRAPHIC	REMARKS
0.7				8 Inches topsoil	705.6		
2.0	☒	1	3-4-6	SANDY LEAN CLAY (CL): stiff, trace roots, red brown and brown	704.3	▨	RESIDUAL Sample No. 1: LL=45, PL=22, PI=23 Passing No. 200 =66%
5.0	☒	2	4-24-50/4"	WEATHERED SANDSTONE: poorly cemented, contains clay pockets, moist-orange brown, red brown and brown	701.3		
7.0	☒	3	15-50/5"	LIMESTONE with clay seams: moderately hard, moist-yellow brown, brown and gray	699.3		McALESTER & HARTSHORNE FORMATIONS
		4	50/0"	-Auger refusal on limestone at 7.0 ft -Boring terminated at a depth of 7.0 ft. -Boring backfilled on 9/2/10			No ground water encountered during drilling



DEPTH (ft): 5, 10, 15

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

LOG OF BORING 2 OK10131 BORING LOGS.GPJ BESI.GDT 9/20/10

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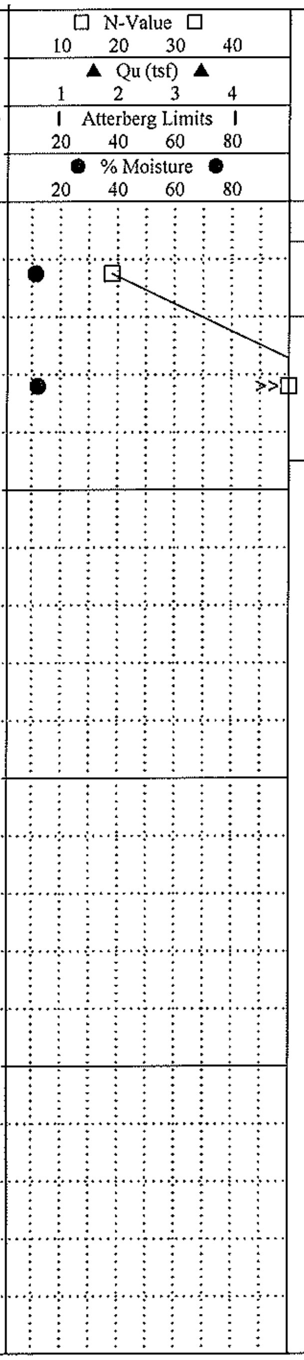
LOG OF BORING: B-02A

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Center of proposed building footprint (Offset 50 ft south of Boring B-2)

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 707.2



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION			GRAPHIC	REMARKS
					8 inches topsoil		⁘	
	☒	1	4-8-11	0.7	SANDY LEAN CLAY (CL): very stiff, trace roots and sandstone fragments, dry-yellow brown, orange brown, gray and dark gray	706.5	▨	RESIDUAL
	☒	2	6-14-50/5"	2.0	WEATHERED SANDSTONE with clay: poorly cemented, moist-yellow brown, light gray, gray and brown	705.2	░	McALESTER & HARTSHORNE FORMATIONS
5				4.5	-Auger refusal on limestone at 4.5 ft -Boring terminated at a depth of 4.5 ft. -Boring backfilled on 9/310	702.7		No ground water encountered during drilling
10								
15								

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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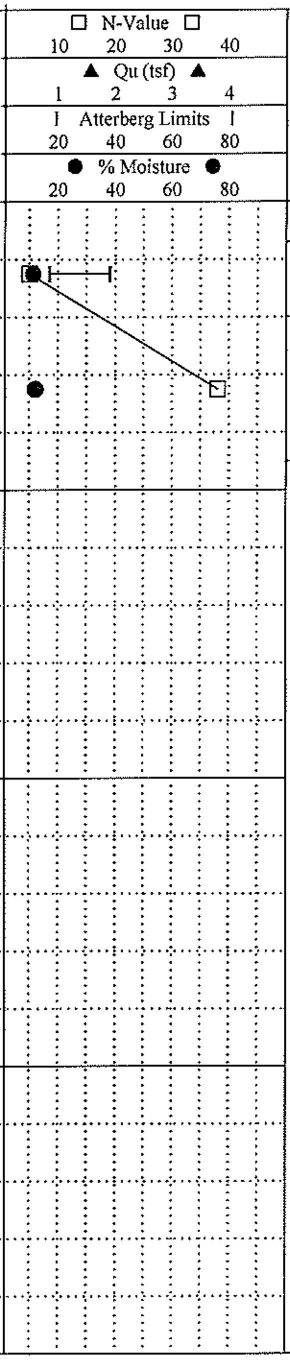
LOG OF BORING: B-02B

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Center of proposed building footprint (Offset 18 ft east of Boring B-2)

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 707.3



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT		SOIL DESCRIPTION		GRAPHIC	REMARKS
				0.7	8 inches topsoil	706.6		
	☒	1	1-2-3	2.0	LEAN CLAY WITH SAND (CL): firm, trace roots, dry-brown	705.3	▨	RESIDUAL
	☒	2	5-15-23	4.5	SANDY LEAN CLAY (CL): hard, contains sandstone fragments, dry-red brown, yellow brown, brown and dark gray	702.8	▨	Sample No. 2: LL=38, PL=17, PI=21 Passing No. 200 = 63%
5					-Auger refusal on limestone at 4.5 ft -Boring terminated at a depth of 4.5 ft. -Boring backfilled on 9/310			No ground water encountered during drilling
10								
15								

SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (ASTM D-1586)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
∇ GROUNDWATER LEVEL IN THE BOREHOLE
Qu UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST
REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED

BUILDING & EARTH SCIENCES, INC.

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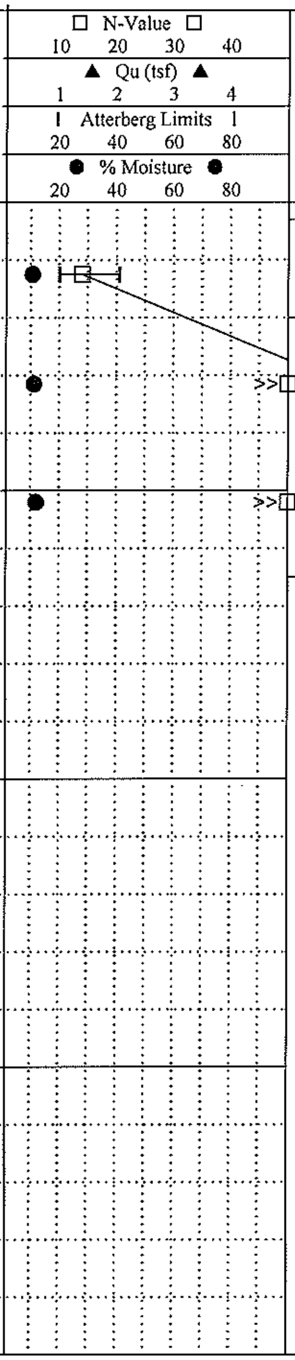
LOG OF BORING: B-04

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Northeast of proposed building footprint

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 708.9



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	REMARKS
				0.3 4 inches topsoil 708.6	
	☒	1	7-7-7	LEAN CLAY WITH SAND (CL): stiff, trace roots, dry-red brown and brown 2.0 706.9	Sample No. 1: LL=41, PL=20, PI=21 Passing No. 200 = 71% RESIDUAL
	☒	2	7-28-50/4"	WEATHERED SANDSTONE with clay: poorly cemented, moist-yellow brown and gray	
5	☒	3	50/5"	SANDSTONE: poorly cemented, dry-brown and gray 6.5 702.4	McALESTER & HARTSHORNE FORMATIONS
				-Auger refusal on sandstone at 6.5 ft -Boring terminated at a depth of 6.5 ft. -Boring backfilled on 9/3/10	No ground water encountered during drilling
10					
15					

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

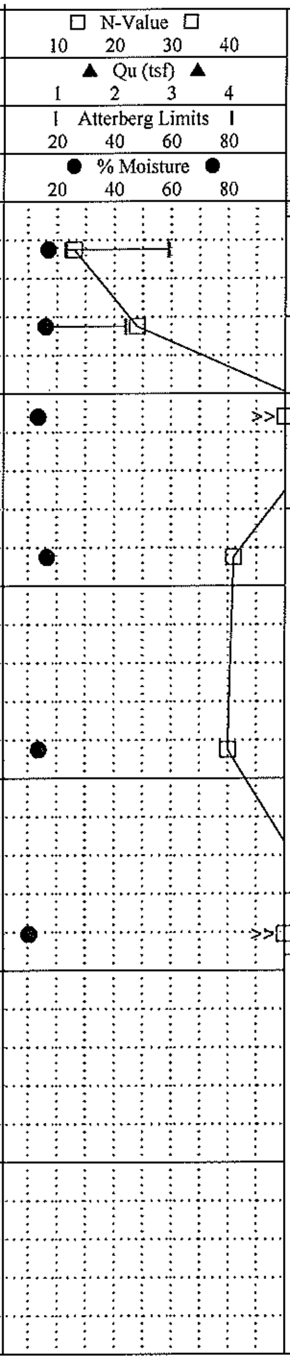
LOG OF BORING 2 OK10131 BORING LOGS.GPJ BESI.GDT 9/20/10

LOG OF BORING: B-05

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: South end of proposed building footprint

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 707.2



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	GRAPHIC	REMARKS
				0.4 5 inches topsoil 706.8		
	☒	1	3-5-8	FAT CLAY (CH): stiff, trace sand and roots, moist-yellow brown, gray and dark gray		Sample No. 1: LL=59, PL=23, PI=36 Passing No. 200 = 85% RESIDUAL
	☒	2	3-11-13	3.0 704.2 SANDY LEAN CLAY (CL): very stiff, moist-brown and gray		Sample No. 2: LL=44, PL=17, PI=27 Passing No. 200 = 62%
5	☒	3	5-38-50/2"	5.0 702.2 WEATHERED SANDSTONE with clay: poorly cemented, moist-yellow brown, gray and brown		
	☒	4	5-16-25	8.0 699.2 HIGHLY WEATHERED SHALE: soft, moist-yellow brown, gray and brown		
10						
	☒	5	3-15-25	same: dark gray, brown and black		McALESTER & HARTSHORNE FORMATIONS
15						
	☒	6	6-20-50/1"	18.0 689.2 WEATHERED SHALE: soft, moist-dark gray, gray and black		
20				19.6 687.6 -Boring terminated at a depth of 19.6 ft. -Boring backfilled on 9/2/10		No ground water encountered during drilling
25						

SAMPLE TYPE ☒ Split Spoon

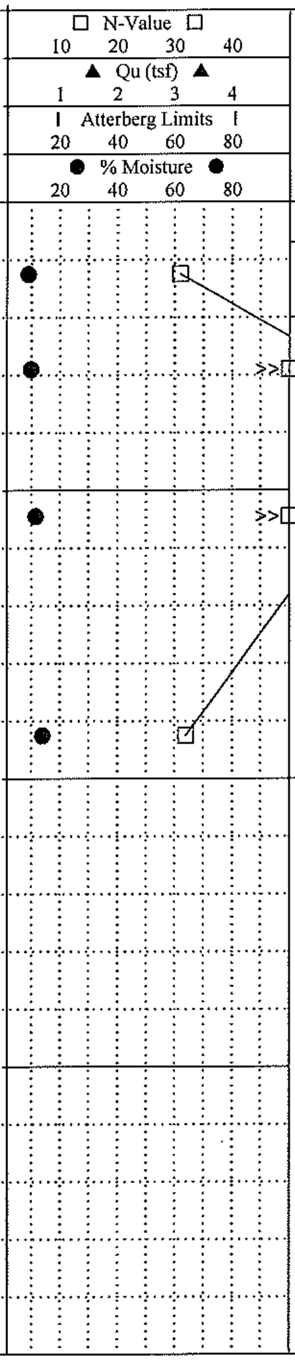
N-VALUE STANDARD PENETRATION RESISTANCE (ASTM D-1586)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
∇ GROUNDWATER LEVEL IN THE BOREHOLE
Qu UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST
REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED

LOG OF BORING: B-06

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: MEP - Proposed Northwest Parking Lot

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 704.2



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT		SOIL DESCRIPTION		REMARKS
				0.7	8 inches topsoil	703.5	
	☒	1	8-12-19	2.0	SANDY LEAN CLAY (CL): hard, trace roots and sandstone fragments, dry-brown	702.2	RESIDUAL
	☒	2	10-50/3"		WEATHERED SHALE: soft, contains clay seams and sandstone fragments, moist-yellow brown, brown and gray		
5	☒	3	12-50/5"				McALESTER & HARTSHORNE FORMATIONS
	☒	4	8-14-18	10.0	same: dark gray, gray and brown	694.2	
10					-Boring terminated at a depth of 10.0 ft. -Water observation well installed upon completion.		No ground water encountered during drilling
15							

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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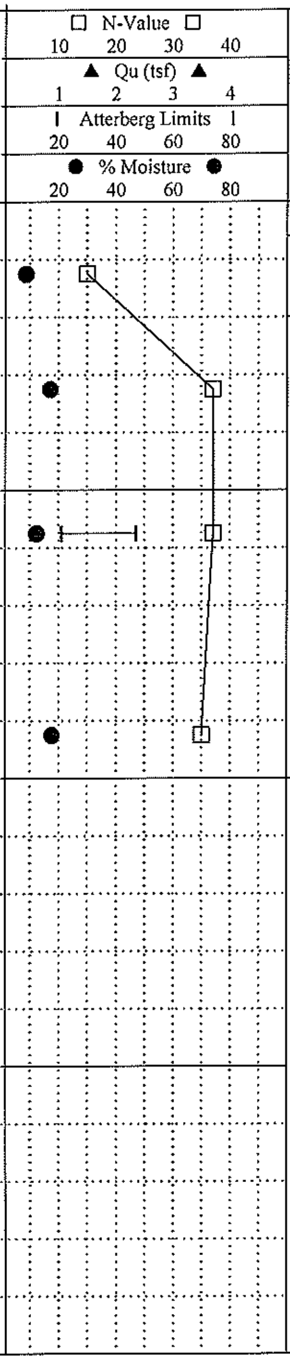
LOG OF BORING: B-07

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: MEP - Proposed Northeast Parking

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 706.0



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION		GRAPHIC	REMARKS
0.6				7 inches topsoil	705.4		
	☒	1	3-4-11	SANDY, SILTY CLAY (CL-ML): stiff, trace roots, moist-brown			RESIDUAL
2.0					704.0		
	☒	2	3-10-27	HIGHLY WEATHERED SHALE with clay: soft, contains sandstone fragments and seams, moist-yellow brown, brown and gray			
5	☒	3	4-24-13	same: gray, brown and dark brown			McALESTER & HARTSHORNE FORMATIONS Sample No. 3: LL=47, PL=21, PI=26
	☒	4	7-14-21				
10.0					696.0		
10				-Boring terminated at a depth of 10.0 ft. -Water observation well installed upon completion.			No ground water encountered during drilling
15							

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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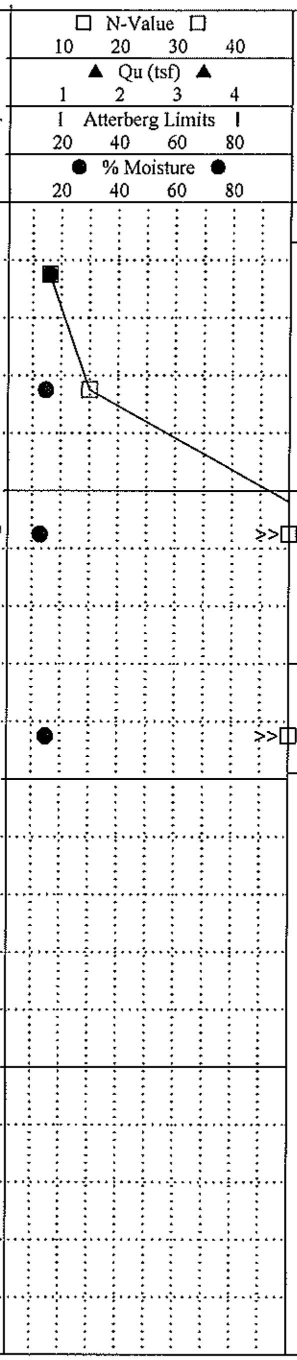
LOG OF BORING: B-08

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: MEP - Northwest of proposed building

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 705.2



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT		SOIL DESCRIPTION		GRAPHIC	REMARKS
				0.7	8 inches topsoil	704.5		
	☒	1	3-4-4		SANDY LEAN CLAY (CL): stiff, moist-red brown, orange brown, yellow brown and gray			
	☒	2	4-6-9		same: very stiff, trace sandstone fragments			RESIDUAL
5				5.0		700.2		
	☒	3	4-14-50/5.5"		WEATHERED SANDSTONE with clay: moist-gray, dark gray, yellow brown and dark brown			
				8.0		697.2		McALESTER & HARTSHORNE FORMATIONS
	☒	4	6-23-50/5"		WEATHERED SHALE: soft, moist-olive gray, yellow brown, brown and red brown			
10				9.9	-Boring terminated at a depth of 9.9 ft. -Water observation well installed upon completion.	695.3		No ground water encountered during drilling
15								

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
$\underline{\nabla}$	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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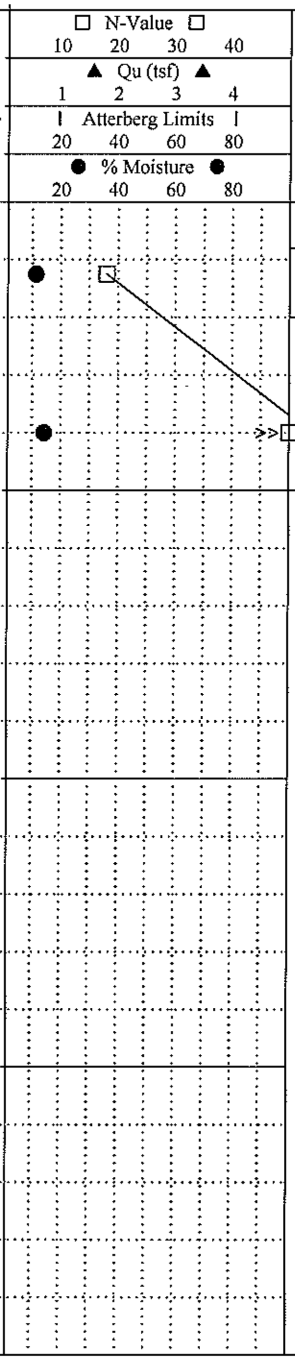
LOG OF BORING: B-09

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: MEP - Northeast of proposed building

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 708.5



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	GRAPHIC	REMARKS
				9 inches topsoil		
0.8				707.7		
	☒	1	2-6-12	SANDY, SILTY CLAY (CL-ML): trace roots, moist-red brown, brown, gray and dark gray		RESIDUAL
2.0				706.5		
				WEATHERED SANDSTONE with clay: poorly cemented, moist-yellow brown and dark gray		
	☒	2	4-50			McALESTER & HARTSHORNE FORMATIONS
5.0				703.5		
				-Boring terminated at a depth of 5.0 ft. -Boring backfilled on 9/3/10		No ground water encountered during drilling

Depth scale: 5, 10, 15

SAMPLE TYPE ☒ Split Spoon

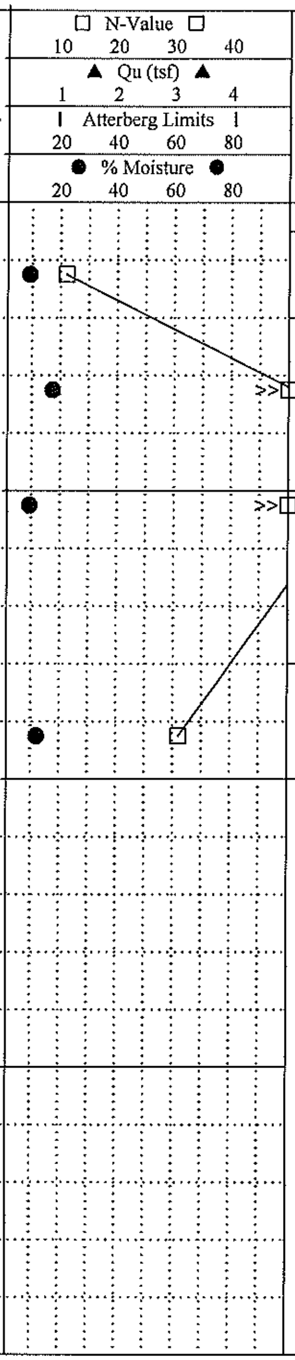
N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

LOG OF BORING: B-10

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: MEP - South of proposed building

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 708.0



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT		SOIL DESCRIPTION		GRAPHIC	REMARKS
				0.5	6 inches topsoil and grass	707.5		
	☒	1	2-4-7	2.0	SANDY, SILTY CLAY (CL-ML): stiff, trace roots, dry-red brown, yellow brown and gray	706.0	▨	
	☒	2	5-15-36	5.0	LEAN TO FAT CLAY (CL-CH): hard, contains sandstone fragments, moist-orange brown, red brown, brown and gray	703.0	▨	RESIDUAL
5	☒	3	50/5.5"	8.0	WEATHERED SANDSTONE: poorly cemented, contains clay seams, moist-dark brown and gray	700.0	▨	McALESTER & HARTSHORNE FORMATIONS
	☒	5	5-13-18	10.0	HIGHLY WEATHERED SHALE: soft, moist-gray, dark gray and brown	698.0	☰	
10					-Boring terminated at a depth of 10 ft. -Water observation well installed upon completion.			No ground water encountered during drilling
15								

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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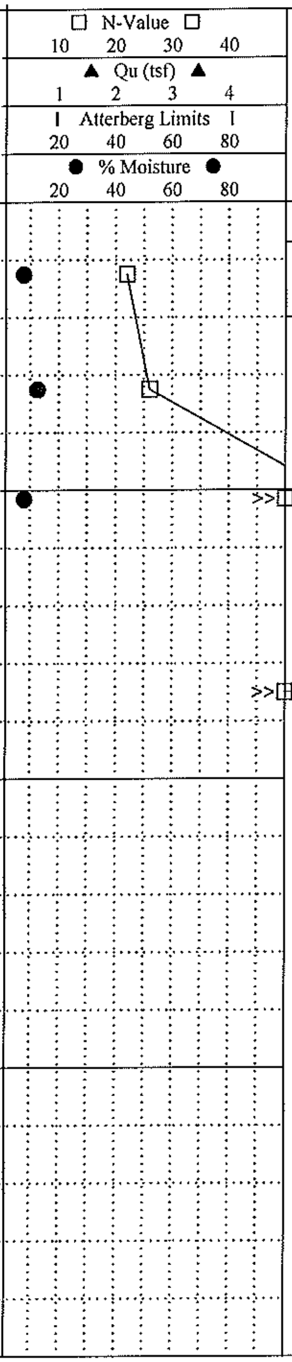
LOG OF BORING: B-11

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Proposed SWM Pond - North end

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 698.0

DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	REMARKS
				8 inches topsoil and grass	
				0.7 — 697.3	
	☒	1	6-9-13	SANDY, SILTY CLAY (CL-ML): very stiff, trace roots, dry-gray and brown	
				2.0 — 696.0	
	☒	2	5-12-14	SANDY LEAN CLAY (CL): very stiff, contains sandstone fragments, moist-dark gray, red brown, yellow brown and black	RESIDUAL
5				5.0 — 693.0	
	☒	3	50/4"	SANDSTONE: highly cemented, contains clay seams, moist-gray and dark gray	McALESTER & HARTSHORNE FORMATIONS
		5	50/0"	8.5 — 689.5	
				-Boring terminated at a depth of 8.5 ft. -Boring backfilled on 9/3/10	No ground water encountered during drilling
10					
15					



SAMPLE TYPE ☒ Split Spoon

N-VALUE STANDARD PENETRATION RESISTANCE (ASTM D-1586)
% MOISTURE PERCENT NATURAL MOISTURE CONTENT
∇ GROUNDWATER LEVEL IN THE BOREHOLE
Qu UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST
REC RECOVERY
RQD ROCK QUALITY DESIGNATION
UD UNDISTURBED

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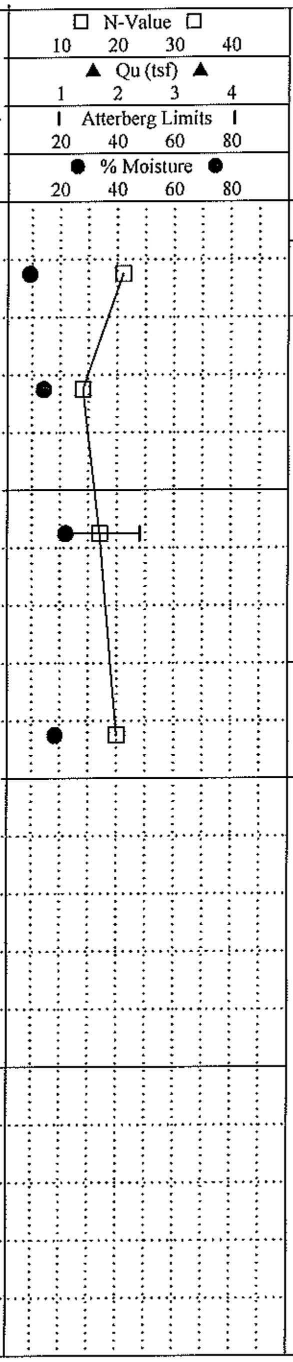
LOG OF BORING: B-12

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Proposed SWM Pond - South end

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 702.0



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	GRAPHIC	REMARKS
				8 inches topsoil and grass		
0.7				701.3		
	☒	1	5-8-13	SANDY, SILTY CLAY (CL-ML): stiff, trace roots, dry-red brown, yellow brown and gray		
2.0				700.0		
	☒	2	5-6-8	LEAN TO FAT CLAY (CL-CH): contains sandstone fragments, moist-orange brown, red brown, brown and gray		RESIDUAL
5	☒	3	8-9-8	same: dark brown and gray		Sample No.3: LL=48, PL=21, PI=27 Passing No. 200 = 90%
8.0				694.0		
	☒	5	5-8-12	HIGHLY WEATHERED SHALE: soft, moist-gray, dark gray and brown		McALESTER & HARTSHORNE FORMATIONS
10.0				692.0		
10				-Boring terminated at a depth of 10 ft. -Boring backfilled on 9/2/10		No ground water encountered during drilling
15						

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
▽	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

LOG OF BORING 2 OK10131 BORING LOGS.GPJ BESI.GDT 9/20/10

BUILDING & EARTH SCIENCES, INC.

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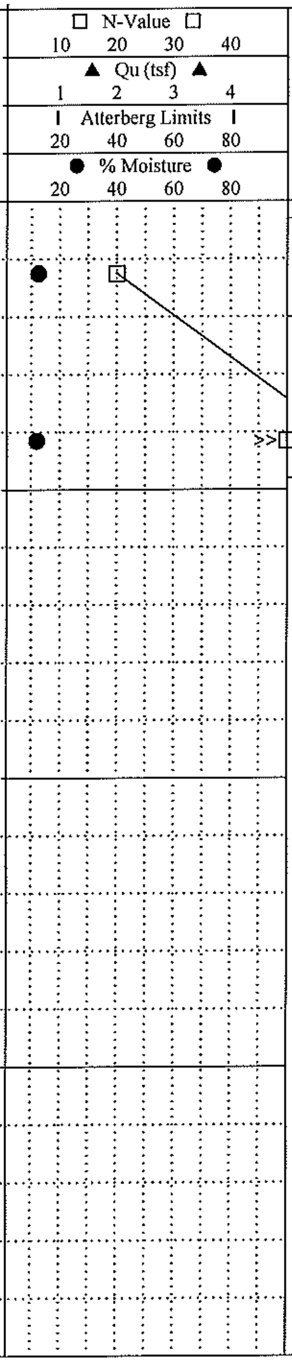
LOG OF BORING: B-13

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Pavement - Driveway northwest of site

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 702.8



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION			REMARKS
0.3				4 inches topsoil		702.5	
2.0	☒	1	11-11-9	SANDY LEAN CLAY (CL): very stiff, trace sandstone fragments, moist-orange brown, red brown, yellow brown and gray		700.8	RESIDUAL
4.8	☒	2	4-31-50/4"	WEATHERED SANDSTONE: contains clay seams, moist-yellow brown, orange brown and gray		698.0	McALESTER & HARTSHORNE FORMATIONS
5				-Boring terminated at a depth of 4.8 ft. -Boring backfilled on 9/3/10			No ground water encountered during drilling
10							
15							

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
$\underline{\nabla}$	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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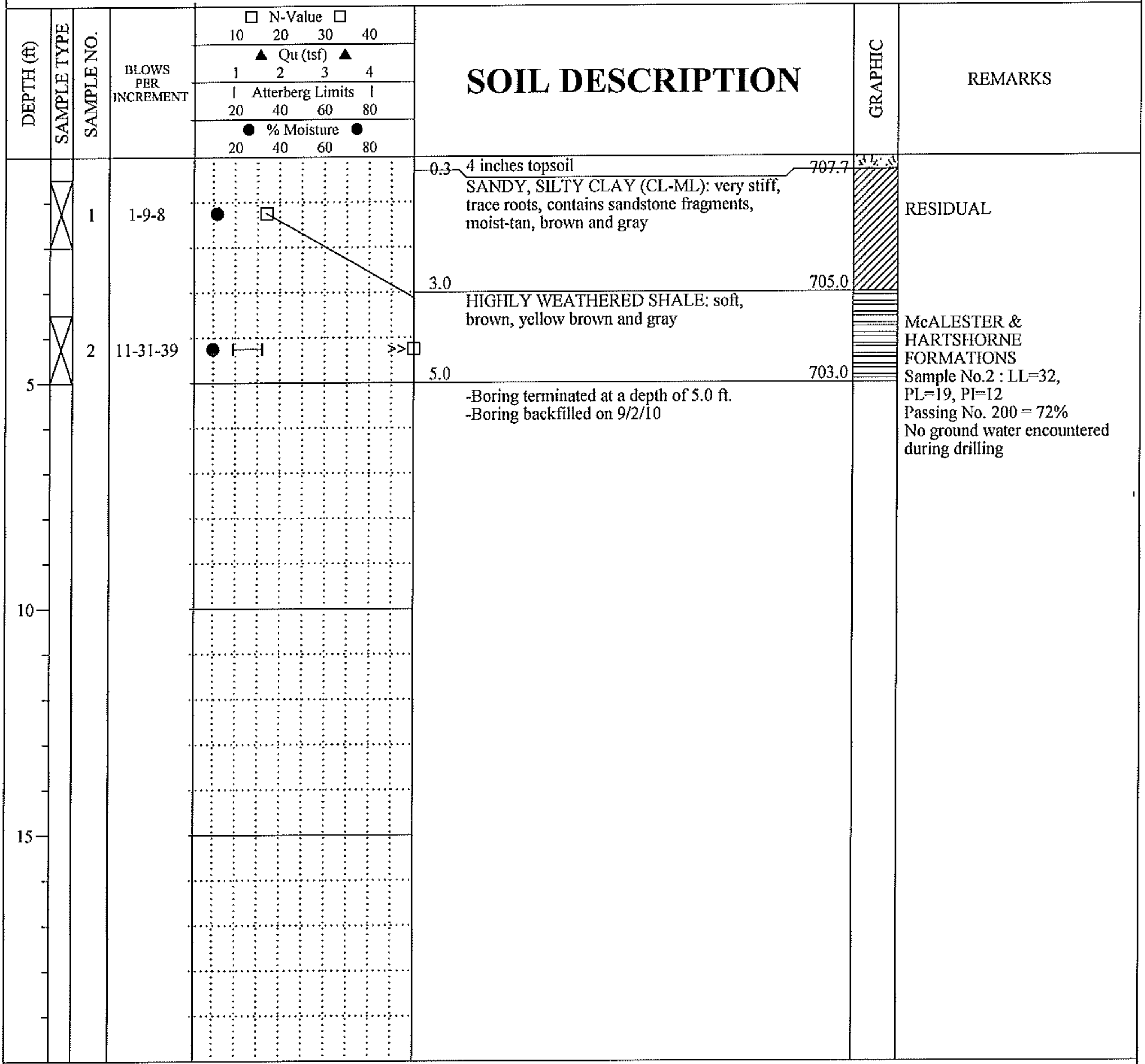
LOG OF BORING: B-14

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Pavement - Driveway northeast of site

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 708.0



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	Elevation	REMARKS
0.3				4 inches topsoil	707.7	
	☒	1	1-9-8	SANDY, SILTY CLAY (CL-ML): very stiff, trace roots, contains sandstone fragments, moist-tan, brown and gray		RESIDUAL
3.0					705.0	
	☒	2	11-31-39	HIGHLY WEATHERED SHALE: soft, brown, yellow brown and gray		McALESTER & HARTSHORNE FORMATIONS
5.0					703.0	Sample No.2 : LL=32, PL=19, PI=12 Passing No. 200 = 72% No ground water encountered during drilling
				-Boring terminated at a depth of 5.0 ft. -Boring backfilled on 9/2/10		

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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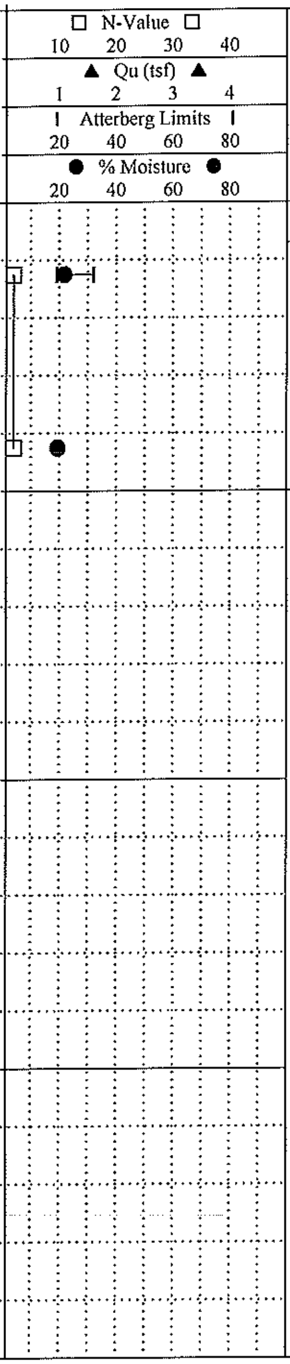
LOG OF BORING: B-15

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Pavement - Driveway north-central portion of site

Project Location: Vinita, Oklahoma
Date Drilled: 9/3/10
Surface Elevation: 705.8



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	Elev.	GRAPHIC	REMARKS
0.7				8 inches topsoil	705.1		
	☒	1	1-1-1	LEAN CLAY WITH SAND (CL): very soft, moist-red brown, orange brown, brown, gray and dark gray		▨	Sample No. 1: LL=32, PL=19, PI=13 Passing No. 200 = 72% RESIDUAL
5.0	☒	2	1-1-1		700.8	▨	
				-Boring terminated at a depth of 5.0 ft. -Boring backfilled on 9/3/10			No ground water encountered during drilling

Depth scale: 5, 10, 15

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
$\underline{\nabla}$	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

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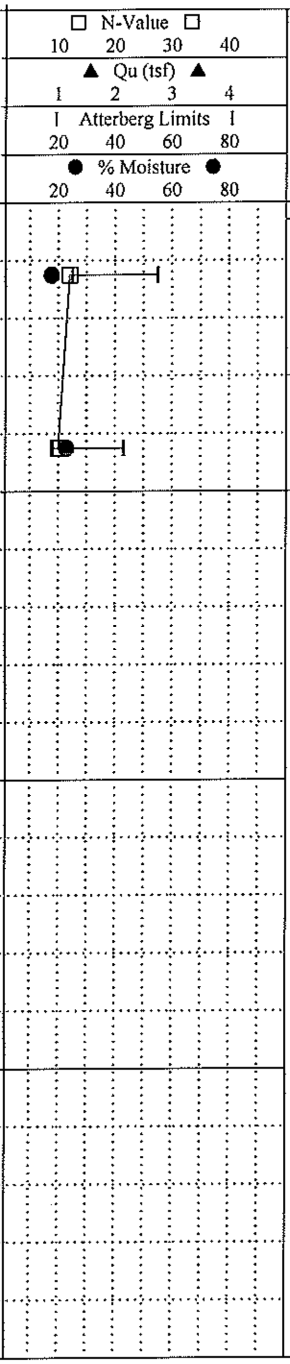
LOG OF BORING: B-16

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Pavement - Driveway southwest corner of site

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 706.2



DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	SOIL DESCRIPTION	GRAPHIC	REMARKS
0.3				4 inches topsoil (705.9)		
				FAT CLAY (CH): stiff, trace roots, moist-red brown and gray		
	☒	1	2-6-6			Sample No.1: LL=55, PL=25, PI=30 Passing No. 200 = 90%
3.0				(703.2)		RESIDUAL
				LEAN CLAY (CL): stiff, moist-brown and gray		
	☒	2	3-4-6			Sample No. 2: LL=43, PL=18, PI=25
5.0				(701.2)		
				-Boring terminated at a depth of 5.0 ft. -Boring backfilled on 9/2/10		No ground water encountered during drilling
10						
15						

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

LOG OF BORING 2 OK10131 BORING LOGS.GPJ BESI.GDT 9/20/10

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LOG OF BORING: B-17

Sheet 1 of 1

Project Name: Vinita Health Center
Project Number: OK10131
Drilling Method: Hollow Stem Auger and SPT
Boring Location: Pavement - Driveway southeast of site

Project Location: Vinita, Oklahoma
Date Drilled: 9/2/10
Surface Elevation: 711.2

DEPTH (ft)	SAMPLE TYPE	SAMPLE NO.	BLOWS PER INCREMENT	☐ N-Value ☐ 10 20 30 40 ▲ Qu (tsf) ▲ 1 2 3 4 Ⅰ Atterberg Limits Ⅰ 20 40 60 80 ● % Moisture ● 20 40 60 80	SOIL DESCRIPTION	GRAPHIC	REMARKS
0.4					5 inches topsoil — 710.8		
	☒	1	5-25-30	● >>☐	SANDSTONE: poorly cemented, contains clay seams, moist-dark gray and brown	▨	RESIDUAL
4.3	☒	2	35-50/3"	● >>☐	same: dry — 706.9	▨	
5					-Boring terminated at a depth of 4.3 ft. -Boring backfilled on 9/2/10		No ground water encountered during drilling
10							
15							

SAMPLE TYPE ☒ Split Spoon

N-VALUE	STANDARD PENETRATION RESISTANCE (ASTM D-1586)	**REC**	RECOVERY
% MOISTURE	PERCENT NATURAL MOISTURE CONTENT	**RQD**	ROCK QUALITY DESIGNATION
∇	GROUNDWATER LEVEL IN THE BOREHOLE	**UD**	UNDISTURBED
Qu	UNCONFINED COMPRESSIVE STRENGTH ESTIMATE FROM POCKET PENETROMETER TEST		

LOG OF BORING 2 OK10131 BORING LOGS.GPJ BESI.GDT 9/20/10

Important Information about Your

Geotechnical Engineering Report

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

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

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

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

Read the Full Report

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

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

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

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

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

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

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