Geotechnical Report

Proposed Boone County 911/Joint Communications Facility

Roger B. Wilson Memorial Drive,

Boone County, Missouri

May 30, 2014

Project No. 14015.02

For

PW Architects, Inc.

Prepared By:

Allstate Consultants, LLC
Columbia, Missouri

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ENGINEERING • PLANNING • SURVEYING • GEOTECHNICAL • INVESTIGATIVE

May 30, 2014

PW Architects, Inc.
15 South Tenth Street
Columbia, Missouri 65201

ATTN: Mr. Erik Miller, AIA, CDT
Principal

RE: Geotechnical Report
Proposed Boone County 911/Joint Communications Facility
Roger B. Wilson Memorial Drive, Boone County, Missouri
Allstate Project No. 14015.02

Dear Mr. Miller;

We have completed the subsurface exploration, laboratory testing and geotechnical engineering report for the Proposed Boone County 911/Joint Communications Facility to be constructed west of the Boone County Jail and Sheriff's Annex in Boone County, Missouri. The accompanying geotechnical report presents the findings of the subsurface exploration, the results of the laboratory tests and our engineering recommendations regarding design and construction of the earthwork, foundations, and floor slabs for the proposed facility.

It has been a pleasure to be of service to you during the initial phase of this project. If you have any questions regarding this geotechnical report, or if we may be of further service during the design or construction phases, please feel free to contact our office.

Sincerely,

Allstate Consultants, LLC

William A. Barrow

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Proposed Boone County 911/Joint Communications Facility
Roger B. Wilson Memorial Drive - Boone County, Missouri
Allstate Consultants Project No. 14015.02

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GEOTECHNICAL REPORT

PROPOSED BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
ROGER B. WILSON MEMORIAL DRIVE
BOONE COUNTY, MISSOURI

ALLSTATE PROJECT NO. 14015.02
MAY 30, 2014

INTRODUCTION

Allstate Consultants, LLC has completed the subsurface exploration for the Proposed Boone County 911/Joint Communications Facility to be constructed west of the Boone County Jail and Sheriff's Annex on the west side of Roger B. Wilson Memorial Drive in Boone County, Missouri.

Six (6) test borings, designated TB-1 through TB-6, were performed to depths of approximately 15 to 20 feet below the existing ground surface in the building and generator/chiller enclosure areas. Laboratory water content, density, unconfined compression, Atterberg limit and swell tests were performed on samples recovered from the borings and the soil and rock samples were visually classified. The Test Boring Location Plan and Test Boring Logs are included in the Appendix to this report.

The purpose of this geotechnical engineering report is to describe the subsurface conditions encountered in the borings, evaluate the field and laboratory test data and provide recommendations regarding the design and construction of earthwork, foundations and floor slabs for the proposed facility.

PROJECT DESCRIPTION

The proposed facility will be located on a relatively undeveloped, grass covered site lying northwest of the existing Boone County Jail and southwest of the existing Sheriff's Annex on the west side of Roger B. Wilson Memorial Drive. The locations and footprints of the proposed building and generator/chiller enclosure area are shown on the Test Boring Location Plan in the Appendix.

The proposed building will be generally rectangular in shape and will have a footprint of approximately 25,000 square feet. The single story, slab on grade structure will be designed to be tornado resistant and will likely be constructed of reinforced concrete. Current plans indicate the floor slab will have a finished elevation of 788 feet. A partial basement will be located in the west corner of the building and the basement floor elevation in this area will be established at approximate elevation 776 feet.

The proposed building site lies on an upland valley slope that drains down to the west toward a tributary to Cow Branch. Available topographic surveys indicate a minimum of about 1 foot of fill will be required to establish the finished floor elevation in the east corner of the proposed building. To the west, as the topography declines toward the tributary, as much as 10 to 11 feet of fill will be required to establish the finished floor elevation of 788 feet and to backfill the proposed basement walls. Additional fill may be needed if unsuitable bearing soils are encountered requiring removal and replacement before the planned fill is placed.

Structural information is not yet available, however, for the purposes of our geotechnical analyses we have estimated that maximum building column and bearing wall loads will be less than 100 kips and 4 kips/lineal foot, respectively. We should be notified when actual structural loads become available.

FIELD EXPLORATION AND LABORATORY TESTING PROCEDURES

Borings were located and ground surface elevations at these locations were determined by an Allstate Consultants survey crew using traditional surveying methods. Boring locations are shown on the Test Boring Location Plan in the Appendix.

Test borings were performed using a truck-mounted, Mobile B47 rotary drilling rig. Hollow stem augers with a center plug were used to advance the borings. At relatively close vertical intervals, the center plug was removed from the hollow stem augers and samples of the subsurface materials were obtained using thin-walled tube and split barrel sampling methods.

As the borings were advanced, an Allstate Consultant's geotechnical engineer recorded the results of the subsurface exploration on field boring logs. Information reported on the field boring logs included, the number, type, depth, recovery, Standard Penetration Test blow counts, and/or calibrated hand penetrometer reading for each soil or rock sample. The field logs also included visual descriptions of the recovered samples; the driller and field representative's interpretation of subsurface conditions between samples based on drilling observations and the field representative's groundwater observations. Recovered soil samples were sealed to reduce moisture loss and transported to the laboratory for further testing and classification. On completion of borings and after final groundwater observations were made the following day, the boreholes were backfilled with auger cuttings.

Thin-walled tube samples obtained from the borings were tested in the laboratory to determine the field water content, dry unit weight and unconfined compressive strength. The unconfined compressive strength of some of the samples was estimated using a calibrated hand penetrometer. The strength estimated using this device is approximate and was considered accordingly. Split-barrel samples were tested in the laboratory to determine the field water content and approximate unconfined compressive strength by use of a calibrated hand penetrometer.

On completion of laboratory testing, the soil samples were described and classified in general accordance with the Unified Soil Classification System (USCS) using visual-manual procedures. USCS Group Letter Symbols and Group Names were also assigned based on visual-manual estimates. Atterberg limit tests were performed on selected samples to assist in soil classification and in evaluating the engineering characteristics of the site soils. The results of these tests are shown on the Test Boring Logs.

Swell tests were also conducted on thin-walled tube samples of the site soils to assist in evaluating the potential for soil expansion and future heave. These tests were conducted by placing soil samples in a fixed ring consolidometer; applying surcharge pressures approximately equal to the effective stresses anticipated after construction is complete and measuring the amount of vertical swell resulting from inundating the samples with water. The results of these tests are presented in the Appendix.

The final Test Boring Logs included in this report present the results of the field exploration and the laboratory testing program. The final logs delineate the soil and rock strata encountered in the borings and represent the geotechnical engineer's interpretation of subsurface conditions at the boring locations. These interpretations were developed from a review of the field boring logs with modifications based on the laboratory test results and on visual observations of the recovered samples. Graphical symbols depicting the soil and rock strata are shown on the boring logs for illustrative purposes only. It should be recognized that differing soil and rock types could be present between samples and between borings.

The Test Boring Log Notes included in the Appendix describe the symbols used on the Test Boring Logs and provide additional information regarding sampling procedures; soil and rock descriptions and classification; Standard Penetration Tests; laboratory test results; the consistency of fine grained soils; the relative density of coarse grained soils; bedrock quality and borehole water level observations.

The Unified Soil Classification System is also described in the Appendix and a legend is included relating graphical symbols used on the boring logs to the USCS Group Letter Symbols and Names and to the principal rock types encountered in the project area.

SITE DESCRIPTION

The grass covered site slopes down from the uplands on the east toward a tributary to Cow Branch on the west. Topographic relief in the building area is approximately 12 feet from the higher upland terrain near the east building corner and test boring TB-2 at approximate elevation 787 feet to the lower terrain near the west building corner and TB-5 at elevation 775 feet. Within the northern portion of the proposed building footprint, a substantial stockpile of fill material was observed at the time of exploration. This loose fill material is believed to have been placed during construction of the existing structures to the east.

West of the loose fill stockpile, a gentle west draining swale was observed between TB-1 and TB-5 and in the area of TB-6 near the proposed generator/chiller enclosure. Ground conditions in the swale were soft and our driller's truck mounted drilling rig made deep ruts and got stuck driving across the slight swale between TB-5 and TB-1.

SUBSURFACE CONDITIONS

Subsurface conditions encountered at the individual boring locations are indicated on the Test Boring Logs. Stratification lines shown on these logs represent approximate boundaries between soil and rock types. In-situ, the change between material types may be more gradual. Based on a review of the Test Boring Logs, subsurface conditions at the project site can be generally characterized as follows:

Soil and Rock Conditions

Test borings encountered approximately 12 inches of topsoil over loessial, post-glacial and glacial soil deposits composed primarily of fat clays, lean to fat clays and lean clays. Upland boring TB-2, on the higher terrain to the east, penetrated approximately 5 feet of weathered loess and some 7 feet of post-glacial "Ferrelview" soil and was terminated in glacial drift at a depth of about 20 feet beneath the surface. At the other boring locations, on the lower sloping terrain, the post-glacial and/or glacial soils extended to depths of about 8 to 12 feet and were underlain by Pennsylvanian aged deposits of highly weathered claystone. In TB-1 and TB-4, the claystone was underlain by weathered shale.

The loessial soils, encountered in the upper 3 to 5 feet of the soil profile in most of the borings, consisted of weathered fat clays and lean clays on the higher terrain and reworked fat clays and lean clays on the lower terrain. The weathered fat clay and lean clay loess encountered in the upper 3 feet of TB-1, TB-2, TB-3 and TB-4 was typically medium to stiff in consistency. On the lower terrain, the reworked loess encountered in the upper 3 feet of the soil profile in TB-5 and TB-6 was soft to medium in consistency. Soft surficial soils were also observed in the swale extending between TB-5 and TB-1 where the drilling rig was stuck during exploration.

Beneath the topsoil in TB-4; the weathered loessial soils in TB-2 and TB-3; and the reworked loessial soils in TB-5 and TB-6, sampling encountered post-glacial Ferrelview soils composed of fat clays. The fat clays were typically stiff and occasionally very stiff in consistency and extended to depths of 3 to 8 feet in borings on the lower terrain and to a depth of 12 feet in TB-2 on the higher terrain to the east.

Glacial drift was encountered below the post-glacial soils in most of the borings. The glacial soils were composed of a variety of lean clays, lean clays with silt and sand lenses, lean to fat clays and fat clays. These preconsolidated soils were typically very stiff but were also occasionally stiff or hard in consistency.

In TB-1, TB-3, TB-4, TB-5 and TB-6 on the lower terrain, the post-glacial and/or glacial soils were underlain highly weathered claystone. The upper several feet of the claystone was jointed and had the consistency of a medium to very stiff, clay soil. Some of the upper claystone was also high in plasticity.

Beneath the highly weathered claystone in TB-1 and TB-4, weathered shale was encountered. The shale had the consistency of a hard clay soil. TB-1, TB-3, TB-4, TB-5 and TB-6 on the lower terrain were terminated in the highly weathered claystone or the underlying weathered shale.

Groundwater Conditions

Field observations were periodically made during drilling and sampling and immediately after boring completion to measure borehole water levels. Groundwater was first observed at a depth of approximately 18 feet during drilling in boring TB-2, but was not observed at this time in the other borings.

Immediately after the borings were performed, groundwater was observed at a depth of approximately 17 feet in TB-2, but was not observed in the other borings at this time. Some 16 to 23 hours after boring completion, ground water was observed at depths of 11 feet, 13 feet and 3 feet in TB-2, TB-3 and TB-6, respectively, but was not observed in the other borings.

It should be recognized that short term water level observations in open boreholes, drilled into low permeability soil and rock, may not represent actual groundwater conditions in these materials. In fact, a considerable length of time may be required for a groundwater level to be detected and to stabilize in open boreholes extending into materials similar to those encountered in the test borings at this site.

Installation and long term observation of piezometers or groundwater observation wells, screened in the hydrologic units of interest and sealed to prevent the entrance of surface water, would be required to more accurately characterize and evaluate groundwater levels and fluctuations in these levels in this geologic setting. While these services can be provided if requested, they are beyond the scope of this investigation.

Groundwater levels often vary across a project site and typically fluctuate at individual locations with variations in seasonal and climatological conditions. Perched water tables can develop and groundwater levels can be influenced by alterations in site grades, other construction activities, modifications to adjacent sites, leaking utility piping, water following utility trench backfill, and other factors not readily evident at the time the borings are performed.

During construction and at other times during the life of the proposed development, groundwater levels may be higher or lower than the levels reported on the boring logs. The likelihood of fluctuating groundwater levels and the potential occurrence of seasonally perched groundwater in the near surface soils should be appropriately considered during development of design and construction plans for this project.

GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

Geotechnical Evaluation

Borings typically encountered topsoil over weathered and/or reworked loessial, post-glacial and glacial soil deposits composed of lean clays, lean to fat clays and fat clays. In most of the borings, the soil cover was underlain by highly weathered Pennsylvanian aged claystone and some underlying weathered shale.

The site soils were often high in moisture content and low in strength in the upper 2 to 3 feet of the soil profile. Below these depths the lean clays, lean to fat clays and fat clays were typically moist and stiff to very stiff in consistency. Underlying highly weathered claystones were typically jointed and medium to very stiff in consistency in the upper few feet and very stiff to hard at depth.

In our opinion, the upper 2 feet of the soil profile in TB-1, TB-2 and TB-4 and the upper 3 feet in TB-3, TB-5 and TB-6 was low in strength at the time of exploration and should be removed and replaced with controlled compacted fill before proposed site fills are placed. Additionally, the existing stockpile of loose fill that is believed to be unsuitable material from previous construction should be removed from the site prior to building area earthwork.

The proposed building site lies on an upland valley slope that drains down to the west toward a tributary to Cow Branch. Topographic relief across the sloping site is approximately 12 feet from the higher upland terrain near the proposed east building corner and TB-2 to the lower terrain near the west building corner and TB-5. Removal and replacement of the upper 2 to 3 feet of the low strength site soil and development of the proposed finished floor slab at elevation 788 feet will require substantial earth fill that will vary from about 2 to 3 feet in thickness on the east near TB-2 to approximately 14 feet in thickness near the inside basement walls on the west and near TB-4 on the south.

Clay soils are commonly used for site fill due to their economy. However, even closely controlled compacted clay fills with a thickness of more than 6 to 8 feet often experience settlements on the order of about 1 percent of their thickness. Our experience indicates a 14 foot thick controlled compacted clay fill would experience a surface settlement of approximately 1½ to 2 inches over time due to long term consolidation of the clay fill under its own weight. Additional settlements of up to 1 inch could occur beneath compacted fill supported foundations. The anticipated differential settlement of the fill supported floor slab and foundations, across the variable fill thickness of 2 to 3 feet on the east and 14 feet on the west and south, would be on the order of 1½ to 2 inches.

The anticipated differential settlement of the 2 to 14 feet thick clay fill could be accommodated by constructing the fill then delaying construction of the building for a period of about 6 months while most of the fill settlement takes place. Another approach that has been successful in the past involves construction of the fill and placement of a temporary surcharge of loose fill to preload the compacted fill and accelerate the fill settlement prior to removal of the temporary surcharge followed by building construction. For a 14 foot thick fill, we would recommend a temporary surcharge of 6 feet of loose fill and a monitored surcharge period of about 30 to 45 days. Monitoring would need to be performed by placing settlement gauges on the surface of the completed permanent fill. We can provide additional recommendations if this approach is considered.

Another approach, that has also been used in the past to reduce post-construction settlement of compacted fills when there is not the time for delaying construction or surcharging, involves use of a zoned controlled compacted fill that utilizes compacted granular fill in the lower portion and compacted clay fill in the upper portion. The compacted granular fill typically experiences most of its settlement rather rapidly during fill construction thus reducing the overall post-construction settlement. For this project, we would recommend use of MODOT Type 1 base course, limestone screenings or suitable wastelime for all controlled compacted granular fill placed below elevation 780 feet in the building area. Controlled compacted clay fill and an overlying low volume change zone constructed as described in this report is recommended for fill placed above elevation 780 feet in the building area. An exception would occur at the basement walls and any exposed foundation walls where controlled compacted granular fill is recommended for the entire wall backfill to control settlements of supported floor slabs and to limit earth pressures in these areas.

Because expansive soils are commonly encountered in the project area, Atterberg limit and swell tests were performed on the native site soils that will provide immediate support of the main floor slab near TB-2 and the basement floor in the vicinity of TB-5.

Atterberg limit tests indicated the lean clays, encountered in the upper 5 feet of the soil profile in TB-2 on the higher terrain to the east, were moderately plastic having liquid limits of 43 to 46 and plasticity indices (PI's) of 27 to 31. The moisture content of these soils was typically a few percent above the plastic limit indicating these materials could have a low to moderate swell potential. Additional Atterberg limit testing on the fat clay soils encountered between depths of 5 to 10 feet in TB-2 and the fat clays and highly weathered claystone encountered between depths of 1 to 10 feet in TB-5, indicated these materials were highly plastic having liquid limits of 50 to 71 and PI's of 32 to 47. The moisture content of these materials was typically just above to well above the plastic limit indicating some of these materials could have a moderate swell potential.

Laboratory swell tests performed on native soil and highly weathered claystone samples obtained from depths of 1 to 10 feet in TB-2 and TB-5 indicated these relatively moist materials had swell potentials in the range of approximately 0.2 to 1.9 percent under surcharge pressures of 250 to 1125 psf. Most of the swell potentials were less than 1.0 percent. Swell potentials of this magnitude are considered to be relatively low and analysis indicates that full saturation of these materials could lead to up to 1 inch of floor slab heave. Heave of this magnitude is typically tolerable if flexible design measures are utilized which allow for some floor movement and if occasional cosmetic cracks can be tolerated. We have found that placement of steel reinforcement in floor slabs often helps to hold minor cracks together and to even out floor movements. It should be recognized that the site soils could develop higher swell potentials if subgrade moisture contents are allowed to become lower at the time of construction due to prolonged exposure and/or seasonal drying.

Based on the generally low swell potential of the site soils and upper highly weathered claystones, at the time of exploration, the type of facility planned and our experience with expansive materials in the project area, we recommend the owner consider establishing a low volume change zone with a nominal minimum thickness of 24 inches beneath the proposed building floor slabs to separate the floor slabs from the site soils and to reduce the potential for future floor slab heave. While a less substantial low volume change zone could be used, there is a potential that building floor movements would be more significant and more noticeable with a thinner low volume change zone.

In our opinion, the proposed building can be supported on shallow foundations and a floor slab on grade can be utilized in the building area, if the upper 2 to 3 feet of low strength site soil is removed and replaced; controlled compacted granular fill is used below elevation 780 feet and for basement wall backfill; moisture conditioned, controlled compacted clay fill is used above elevation 780 feet but not for basement wall backfill; subgrades are kept moist during construction; and low volume change zones are established beneath the building floor slabs as recommended in this report. Detailed earthwork, foundation, and floor slab recommendations are as follows:

Earthwork

Prior to controlled compacted fill placement, the topsoil and upper low strength site soils should be stripped from all proposed fill areas including the building area; the generator/chiller enclosure area; the surrounding fill areas and slopes and the adjacent pavement areas. Borings indicate the upper 2 feet of the soil profile in TB-1, TB-2 and TB-4 and the upper 3 feet in TB-3, TB-5 and TB-6 was low in strength and should be removed. Similar removal depths will likely be required beneath surrounding fill areas and slopes and beneath unexplored pavement areas. Additionally, the existing stockpile of loose fill that is believed to be unsuitable material from previous construction should be removed from the site prior to building area earthwork.

Topsoil should be stockpiled for later use on the upper 12 inches of completed slopes and the upper 12 inches of lawn areas. Wet low strength material underlying the topsoil can be considered for use in pavement area fills and earth slopes at least 10 feet outside of building and generator/chiller enclosure areas provided these materials are free of organic matter and debris and are adequately aerated, dried back to a suitable moisture content and placed and compacted as recommended in this report.

After stripping of topsoil and the upper low strength site soils, the exposed subgrades should be observed by the geotechnical engineer or his on-site representative. In proposed fill areas, the exposed native soils should be carefully probed and thoroughly proof-rolled with a loaded tandem axle dump truck, scraper, or other suitable rubber tired construction equipment in the presence of the geotechnical engineer or his on-site representative. If additional low strength or otherwise unsuitable materials are identified in the bottom of the proposed fill areas, these unsuitable materials should also be removed to stiff native clay or be aerated, reworked and recompacted to meet the requirements of moisture conditioned, controlled compacted fill and proof-rolling. Moisture deficient soils should be scarified to a minimum depth of at least 6 inches, moisture conditioned to the optimum moisture content or above and recompacted and the entire fill area should be backfilled with moisture conditioned, controlled, compacted fill constructed as recommended below.

To reduce the post-construction settlement potential of the thicker portions of the proposed zoned fill in the building area, we recommend the lower zone of closely controlled compacted granular fill consist of MODOT Type 1 crushed limestone base course material, limestone screenings or suitable wastelime containing at least 15 percent low plasticity fines passing the No. 200 sieve. The zoned granular fill should extend beneath the entire portion of the building footprint lying below elevation 780 feet after stripping and low strength soil removal and should extend out beyond the building footprint for a horizontal distance of at least 10 feet in each direction.

The granular fill material should be placed in approximate horizontal lifts having a maximum loose thickness of 8 inches and should be compacted to at least 98 % of the standard Proctor maximum dry density (ASTM D 698) at moisture contents in the range of 2 percent below to no more than 1 percent above the optimum moisture content. Neither very low nor high moisture contents should be used as this will increase the potential for post-construction settlement. A steel-wheeled vibratory roller weighing at least 8 tons is recommended for compaction of the lower zone of controlled, compacted granular fill below elevation 780 feet. In confined areas such as for compacted granular wall backfill, above and below elevation 780 feet, hand operated compactors and 4 inch thick lifts may need to be used.

The upper zone of controlled, compacted fill to be placed above the compacted granular fill and elevation 780 feet in the thicker building area fills and the remaining controlled, compacted fill to be placed above the prepared native subgrades in the building, fill slope and pavement area fills should consist of moisture conditioned, controlled compacted clay fill from suitable borrow sources.

After topsoil is stripped, the wet and low strength soils to be removed from the building area can be considered for use in pavement area fills and earth slopes at least 10 feet outside of building and generator/chiller enclosure areas provided these materials are free of organic matter and debris and are adequately aerated, dried back to a suitable moisture content and placed and compacted as recommended in this report.

Borrow sources providing lean clay fill materials with a liquid limit of 50 or less and a plasticity index (PI) of 30 or less are preferred sources for moisture conditioned, controlled compacted clay fill that will be placed in building and generator/chiller enclosure areas or in the upper two feet of pavement subgrades. We understand borrow sources with sufficient quantities of these materials are not always readily available in the project area. Commonly, the available borrow sources contain lean clays, lean to fat clays and some fat clays that are not always easily or cost effectively separated. As a result, lean clays, lean to fat clays and fat clays are all often used as borrow sources for building area fills below low volume change zones. Since these clay materials can have a significant swell potential if compacted at low moisture contents, these soils are often moisture conditioned to reduce the swell potential and are often capped with a low volume change zone of select material before floor slabs are placed. While modification of the lean clays and fat clays with an admix of hydrated lime or Class C fly ash is a feasible means of reducing the volume change potential of these soils and is frequently recommended this procedure is not often used in the project area due to a lack of local stabilization contractors with the necessary specialized mixing and blending equipment.

We prefer and recommend that off-site borrow soils consist of lean clays that are free of organic matter and debris and have a liquid limit of 50 or less and a plasticity index (PI) of 30 or less. If a borrow source meeting these recommendations is not available and fat clays, free of organic matter and debris, are considered for use the liquid limit of the fat clays should not exceed 55 and the fat clays should be placed, carefully moisture conditioned and compacted as recommended in this report for moisture conditioned, controlled, compacted clay fill.

The upper zone of moisture conditioned, controlled compacted clay fill above elevation 780 in the building area and throughout the surrounding fill slopes, generator/chiller enclosure pad and pavement areas should be placed in lifts having a maximum loose thickness of 8 inches and should be compacted to at least 95 % of the standard Proctor maximum dry density (ASTM D 698) at a moisture content in the range of 1 percent above the optimum moisture content to 4 percent above the optimum moisture content for suitable, moderately plastic lean clays having a liquid limit of 50 or less and in the range of at least 2 percent above the optimum moisture content to 5 percent above the optimum moisture content for suitable, fat clays having a liquid limit of 55 or less. Low plasticity lean clays, silty clays and clayey silts used in fill slopes and only at depths of at least 2 feet beneath the top of pavement subgrades should be compacted within a range of 2 percent below to 2 percent above the optimum moisture content.

Moisture conditioning is important and adequate incorporation of moisture into the potentially expansive clay soils encountered in the project area typically involves spreading the lifts of clay fill to a reasonably uniform thickness, breaking up the soil clods with a disk or other approved equipment, watering the soils as necessary and mixing and blending the soil and water together with the disk to a relatively uniform moisture content within the moisture ranges described above. Where borrow soils are dry, several cycles of disking, watering, mixing and blending are sometimes necessary to achieve the desired results. Sheepsfoot and padfoot rollers are recommended for compaction of moisture conditioned clay soils. In confined areas, hand operated pneumatic compactors and 4 inch thick lifts are recommended.

If in the judgment of the geotechnical engineer of record, the moisture range for the above soils needs to be adjusted based on field observations during compaction, such adjustments may need to be made as the work progresses. For silty borrow soils or granular fills that become spongy or rubbery under construction traffic, the geotechnical engineer may need to adjust the upper range of acceptable moisture content to achieve the desired results.

We recommend that significant zones of fat clay soil encountered in on-site excavations or off-site borrow areas be separated from the lean clay soils as nearly as is practical during excavation and be utilized outside the building area.

To reduce the potential for post-construction floor slab settlement, we recommend the earthwork contractor be required to overbuild compacted fills into the basement area so that the excess controlled compacted fill can be excavated to sound compacted fill prior to basement wall construction and backfilling with controlled compacted granular backfill. This will significantly reduce the potential that a sloping zone of loosely placed fill is buried beneath the wall backfill as it is later placed.

To provide more uniform floor slab support and to reduce the magnitude of future floor slab movements due to moisture induced subgrade volume change, we recommend that any compacted fill placed within 24 inches of the bottom of the floor slab inside and to a horizontal distance of 5 feet outside the building perimeter consist of low volume change, controlled compacted granular fill constructed as described below. Low volume change fill used in the building area, should consist of approved granular materials containing at least 15 percent low plasticity fines passing the No. 200 sieve such as MODOT Type 1 crushed limestone, limestone screenings or suitable wastelime. Approved granular materials should be compacted at workable moisture contents to at least 95 percent of the standard Proctor maximum dry density (ASTM D698) in the low volume change zone. Heavy vibratory rollers are recommended for compaction of granular soils. In confined areas, vibrating plate compactors and 4 inch thick lifts are recommended.

Utility trench backfill located within 5 feet of the outside of the building should consist of on-site clay soils placed and compacted at the optimum moisture content or above and to the compaction requirements described in this report for controlled, compacted clay fill.

We recommend permanent slopes in cut areas and in moisture conditioned, controlled, compacted fill areas be no steeper than 3 horizontal to 1 vertical. Each lift of compacted fill placed on or against an existing slope having an inclination greater than 6 horizontal to 1 vertical should be placed in horizontal lifts and should be benched into the stripped and properly prepared slope to bond the fill to the existing soil and prevent development of a plane of weakness between the fill and the existing material.

Samples of granular materials and clay borrow soils proposed for use in lower granular fill zones, granular low volume change zones below floor slabs, and moisture conditioned, compacted clay fills should be evaluated by the geotechnical engineer of record prior to being used at the site. Off-site borrow areas should be explored with test pits by the geotechnical engineer of record and representative soil samples should be tested and deemed suitable for use prior to borrow soils being hauled to the project site.

Each lift of controlled compacted fill should be observed during placement and compaction and should be subjected to in-place field density testing by the geotechnical engineer of record's on-site representative. Should the field density test results indicate the recommended moisture and compaction levels have not been achieved, the area(s) represented by the test(s) should be reworked and/or re-compacted and retested until the moisture and compaction requirements are met.

We recommend the geotechnical engineer of record's firm be retained on a full time basis during earthwork construction to perform necessary tests and observations during removal of unsuitable materials; preparation of subgrades; placement and compaction of controlled compacted clay fills, granular fills, and low volume change zones; backfilling of utility trench, foundation and other excavations and final subgrade preparation just prior to foundation, floor slab and pavement construction.

Foundations

In our opinion, the proposed building and generator/chillers can be satisfactorily supported on shallow foundations, if earthwork is constructed as recommended in the ***Earthwork*** section of this report.

Shallow foundations supported on native clay soils similar to those encountered in the borings or moisture conditioned, controlled compacted fill prepared as recommended in this report should be proportioned using a net allowable total load design bearing pressure of 2000 psf. The net allowable bearing pressure refers to the pressure at the footing bearing level in excess of the minimum surrounding overburden pressure.

Footings beneath unheated areas and footings around the perimeter of the buildings should extend a minimum depth of 36 inches below the lowest adjacent finished grade for frost protection and to reduce the effects of seasonal, moisture-related, volume change in the supporting soils. We recommend isolated footings have a minimum width of at least 30 inches and continuous formed footings a minimum width of at least 16 inches or such additional widths as necessary to support structural loads.

Foundations may be subjected to lateral loads. For lateral loads of short duration, we recommend sliding be resisted by an allowable base adhesion of 400 psf acting on the bottom contact area of the foundation that is in compression or by an allowable passive resistance of 800 psf acting on the vertical face of the foundation element in the direction perpendicular to the lateral load. Passive resistance should not be relied upon within 3 feet of finished grade. For any sustained lateral loads of long duration, we recommend an ultimate coefficient of friction of 0.3 be used on the bearing area of the foundation that is in compression. An appropriate factor of safety should be applied to the ultimate base resistance calculated using this ultimate value.

Surface water and/or perched groundwater may enter foundation excavations during construction. In our opinion, water entering foundation excavations from these sources should be promptly removed using sump pumps or gravity drainage ditches.

The bearing surface of all foundation excavations should be free of water and loose or unsuitable soil prior to placing concrete. Reinforcement and concrete should be placed soon after excavation to minimize disturbance of the bearing surface and supporting soils. Should the bearing soils become dry, disturbed, frozen or saturated, the impacted soil should be removed to suitable material prior to placing concrete. The geotechnical engineer should be retained to observe and test the foundation bearing materials during construction.

Use of the site preparation procedures recommended in this report will greatly reduce the potential that unsuitable soils will be encountered in foundation excavations. However, if unsuitable bearing materials are identified by the geotechnical engineer or his on-site representative, the foundation excavations should be extended deeper to suitable soils. Foundations could bear directly on these deeper suitable materials or on lean concrete backfill placed in the excavations. Foundations could also bear on controlled compacted fill extending down to the suitable materials and placed and compacted as recommended in this report. Over-excavations for placement of compacted backfill below foundations should extend at least 1 foot horizontally beyond all footing edges for each foot of over-excavation depth below the footing bearing elevation. Where controlled compacted backfill is placed in confined spaces and compacted with hand operated equipment, the lift thickness may need to be reduced to 4 inches to achieve the recommended compaction levels.

Foundations designed and constructed on subgrades prepared as recommended in this report are expected to experience total settlements on the order of 1 inch or less and differential settlements between adjacent foundation elements of approximately 3/4 of an inch or less.

Seismicity

Building foundations should be capable of supporting earthquake loads as stipulated in the International Building Code (IBC) or other such applicable code as determined by the structural engineer of record. Based on the results of the subsurface exploration and our experience with geologic conditions in the project area, we recommend the proposed site be classified as Site Class C as defined in Table 20.3-1 and Section 20.3 of the ASCE *Minimum Design Loads for Buildings and Other Structures* if IBC, 2012 governs the design.

Lateral Earth Pressures and Drains for Basement and Above Grade Walls

We understand the basement walls in the west portion of the building will retain significant earth backfill. Depending on the site grading design, some exposed foundation walls retaining earth fill may also be used in the west and south portions of the structure. Walls retaining earth backfill on one side will be subjected to lateral earth pressures. Reinforced concrete walls that are provided with appropriate lateral support at the top and bottom are commonly designed for the "at rest" lateral earth pressure. This earth pressure is the minimum lateral earth pressure that should be used to design appropriately restrained walls that will experience essentially no wall rotation.

Cantilever retaining walls founded on soil typically experience a small amount of rotation and are typically designed for the "active" lateral earth pressure. Additional lateral earth pressures can develop that exceed the "at rest" and "active" earth pressures. The actual earth pressures developed will depend on the structural design, wall bracing and restraint during and after construction, construction sequence and methods, backfill compaction procedures, any floor or footing surcharge loads and the type and shear strength of the wall backfill.

Basement walls and any exposed foundation walls retaining earth fill should be adequately braced before backfilling. Braced walls should be designed for the "at rest" condition. If walls are not going to be braced during backfilling, the walls and foundations could be designed as cantilever retaining walls. Under these conditions the walls should be designed for the "active" condition.

Compacted granular backfill is recommended for settlement control and to reduce earth pressures on interior basement walls and/or exposed foundation walls with backfill that will support floor slabs. Lean clay backfill may be used to backfill exterior basement walls that do not support floor slabs.

For the "at rest" condition and granular backfill constructed as recommended in this report, we recommend that restrained interior basement walls and any restrained and exposed foundation walls be designed for an earth pressure equivalent to that of a fluid exerting a lateral pressure of at least 60 pounds per cubic foot (pcf) per foot of wall height. Where suitable, lean clay soil is used for general wall backfill not supporting floor slabs on the outside of the structure, we recommend a design equivalent fluid pressure of at least 70 pcf per foot of wall height be used for the "at rest" condition. Walls retaining earth fills will need to be adequately braced during construction and prior to the time that backfill supported floor slabs are tied to the tops of the walls.

For any cantilever retaining walls with the "active" condition and granular backfill, we recommend that the interior basement walls and any exposed foundation walls be designed for an earth pressure equivalent to that of a fluid exerting a lateral pressure of at least 40 pounds per cubic foot (pcf) per foot of wall height. Where suitable, lean clay soil is used for general cantilever retaining wall backfill not supporting floor slabs on the outside of the structure, we recommend a design equivalent fluid pressure of at least 50 pcf per foot of wall height be used for the "active" condition.

The above minimum design earth pressures do not include a factor of safety and assume that the wall backfill will consist of controlled, compacted fill placed in horizontal lifts as recommended in this report. The recommended minimum design earth pressures do not include the additional lateral stresses that can develop during compaction of the wall backfill or due to heavy equipment that may be operated too close to walls or other surcharge loads that may be present above or below finish grade. The minimum design earth pressures also do not account for possible hydrostatic forces that may develop on the walls due to the presence of groundwater.

In our opinion, the backfill placed behind these type walls should consist of the recommended granular fill for interior basement walls and any exposed foundation walls with backfill that will support floor slabs or suitable lean clay soil for exterior basement walls not supporting floor slabs. Suitable lean clay soil should be free of organic matter and debris and should have a liquid limit less than 50 and a plasticity index (PI) less than 30. The lower design earth pressures recommended for granular backfill are only valid if the granular backfill extends out from the heel of the wall footing at an angle of 45 degrees or less from the horizontal.

We recommend the basement walls be provided with wall drains to reduce the potential that hydrostatic loads will be applied to these walls. Slotted or perforated rigid plastic drain piping should be installed on top of the footing beneath the back side of these walls.

Drainage piping should provide positive gravity drainage and should be surrounded by clean, freely draining granular material graded to prevent clogging due to the intrusion of fines. If graded filter materials are not preferred, clean, open graded, free draining gravel may be used if the gravel is surrounded with a suitable nonwoven geotextile designed to prevent the migration of fines into the drainage material.

We recommend the backfilled side of the basement walls or any exposed foundation walls be provided with compacted wall drains installed above the drainage piping and surrounding drainage material. The compacted wall drains should consist of clean, open graded, free draining material protected from clogging due to the intrusion of fines. Compacted wall drains should be at least 2 feet thick and should extend to finished subgrade level when located inside the building. Outside the building, wall drains should be capped with nonwoven geotextile and 2 feet of compacted lean clay.

The wall drainage systems should discharge into non-perforated or non-slotted discharge piping sloped to drain away from the building by gravity.

Floor Slab Subgrades

After floor slab subgrade construction is complete, care should be taken to maintain the recommended subgrade moisture and density prior to placement of the building floor slabs. Completed subgrades that become dry, saturated, frozen, disturbed or altered by weather, plumbing installations or other construction activity should be reconditioned to meet the recommendations of this report prior to floor slab placement.

We recommend a clean, open graded and free draining, compacted, gravel leveling course be placed below the main floor slab to provide a capillary break and uniform floor slab support. The thickness of this layer should be at least 4 to 6 inches and the layer can be considered a part of the 24 inch thick low volume change zone. For floor slab subgrades prepared as recommended in this report, the concrete slab can be designed using a modulus of subgrade reaction, k, of 150 pounds per square inch per inch (psi/in).

We also recommend consideration be given to installation of an under-drainage system beneath the basement floor slab. The under-drainage system should consist of an 8 inch thick layer of clean, open graded, free draining, compacted, gravel with a system of perforated piping leading to gravity drainage through a non perforated discharge pipe extending outside the building area.

Consideration should also be given to use of an independent floor slab in the basement area to accommodate volume change related movements. The basement floor slab should be independent of foundations and any interior columns and should be allowed to move freely with respect to these structural elements.

Pavement Subgrades

Pavement subgrades and adjacent fill areas should be developed and prepared as recommended in the ***Earthwork*** section of this report. In cut areas and in shallow fill areas where less than 12 inches of fill will be placed, we recommend that at least the upper 12 inches of the soil subgrade in truck drive areas and the upper 6 inches of the soil subgrade in car parking areas consist of moisture conditioned, controlled, compacted fill constructed as recommended in this report. This may require some undercutting in cut and shallow fill areas and placement, moisture conditioning and compaction of the subgrade soils in controlled lifts.

Pavement subgrades prepared properly during the early stages of construction may be altered by the passage of time, weather and ongoing construction activities. These subgrades should be carefully evaluated by the geotechnical engineer or his on-site representative and should be properly reconditioned prior to base course placement and paving. Close attention should be paid to restoration of heavily traveled areas that were rutted and disturbed during construction and to areas where utility trenches have been backfilled. We recommend these areas and all other pavement subgrades be moisture conditioned and recompacted to meet the requirements of controlled, compacted fill and be proof-rolled with a loaded tandem axle dump truck just prior to finish grading, base course placement and paving. Unsuitable subgrades identified in this process should be reworked and recompacted or removed and replaced with materials meeting the requirements of controlled, compacted fill.

Borings were not performed in proposed pavement areas. However, based on the results of the building area test borings and our previous experience with the types of soils anticipated at the project site and proposed in this report for use in the moisture conditioned, controlled, compacted subgrades, we recommend a soaked CBR value of about 2 to 3 or a resilient modulus, $M_{r,}$ of about 3500 to 4000 psi be used to develop any flexible asphalt pavement sections. A modulus of subgrade reaction, k, of about 75 to 100 psi/in can be used to develop rigid pavement designs.

In the unexplored areas where gravel surfaced pavement sections will be subjected to exposure to weather and repeated loading from truck traffic, a long term soaked CBR value on the order of 1 to 1.5 should be used since the supporting subgrade soils will likely lose strength due to repeated freeze thaw cycles and exposure to extreme variations in moisture.

Geotextiles and geogrids such as Tensar TX 140 and TX 160 used in conjunction with crushed stone base material are recommended to enhance pavement performance and to reduce the overall thickness of the pavement sections. If pavement subgrade preparation does not follow the recommendations of this report, much lower CBR values and subgrade reaction modulii may be encountered and unsatisfactory pavement performance may develop.

Concrete pavements should be properly jointed and although joint details are a design consideration, we recommend that joints be sawed promptly and be closely spaced to control shrinkage cracking and to provide adequate load transfer through aggregate interlock.

While pavement sections designed based on the subgrade recommendations of this report should be adequate from a structural perspective, some movement and occasional cracking or rutting may still occur due to moisture related volume and strength changes in the supporting subgrade.

Pavements and adjacent shoulders should be well drained and constructed joints and cracks in concrete or asphalt pavements as well as ruts that may develop in the stone pavements should be periodically maintained. Even with proper drainage and periodic maintenance, some subgrade movement and subsequent pavement degradation may still occur and may require occasional repair. Pavement performance can be enhanced additionally by installation of edge drains and other subsurface drainage systems.

Although not frequently undertaken in the project area, modification of the subgrade soils with an admixture of hydrated lime or Class C flyash can enhance pavement performance and/or reduce the thickness of pavement sections. We can provide additional recommendations for soil modification if desired.

Surface Drainage and Plantings

We recommend final grading plans rapidly direct surface run-off away from building, generator/chiller enclosure and pavement areas. Roof gutter and downspout discharge should be channeled well away from building and pavement areas to reduce the potential that water will accumulate adjacent to these facilities. Future foundation and/or utility trench backfill settlement around the perimeter of the building should be corrected to prevent ponding of water in these areas. We recommend that plants and trees with significant moisture requirements not be located adjacent to buildings.

Additional Considerations

The clay soils in the project area are prone to shrinkage and swelling with variations in moisture content. High plasticity soils such as fat clay generally have a greater potential for moisture induced volume change than less plastic materials such as lean clay. However, even lean clay can shrink and swell significantly with variations in moisture levels. We recommend subgrades be constructed as recommended in this report and that close attention be paid to maintaining moisture levels in subgrades prior to installation of foundations, floor slabs and pavements; providing adequate surface drainage and keeping plants and trees well outside the area where they can adversely influence building performance.

The procedures recommended in this report may not eliminate all future settlement, subgrade volume change and resultant foundation and floor slab movements. However, the recommendations described in this report should reduce the potential for consolidation settlement, subgrade volume change and future building movements to reasonably uniform and tolerable levels. If minor movements and occasional cosmetic cracks are not tolerable, then other more expensive procedures would need to be implemented. This could include support of the building on drilled pier foundations extending into the underlying claystone and use of structural floors supported on a system of grade beams and the drilled piers. While this type support can limit movements to very small levels, these measures would be very expensive.

Slope Stability

The proposed building site lies on an upland valley slope underlain by lean clays, fat clays, highly weathered claystone and weathered shale. Existing topographic relief in the building area is approximately 12 feet from the east down to the west. The building area fill required to develop the main floor slab will result in a side hill fill placed over the underlying highly weathered claystones that were jointed and medium to very stiff in consistency in the upper few feet. These conditions could give rise to slope stability issues which are beyond the scope of this study and report. If the client or Owner would like Allstate Consultants to further evaluate this condition we can do so under a separate scope of work.

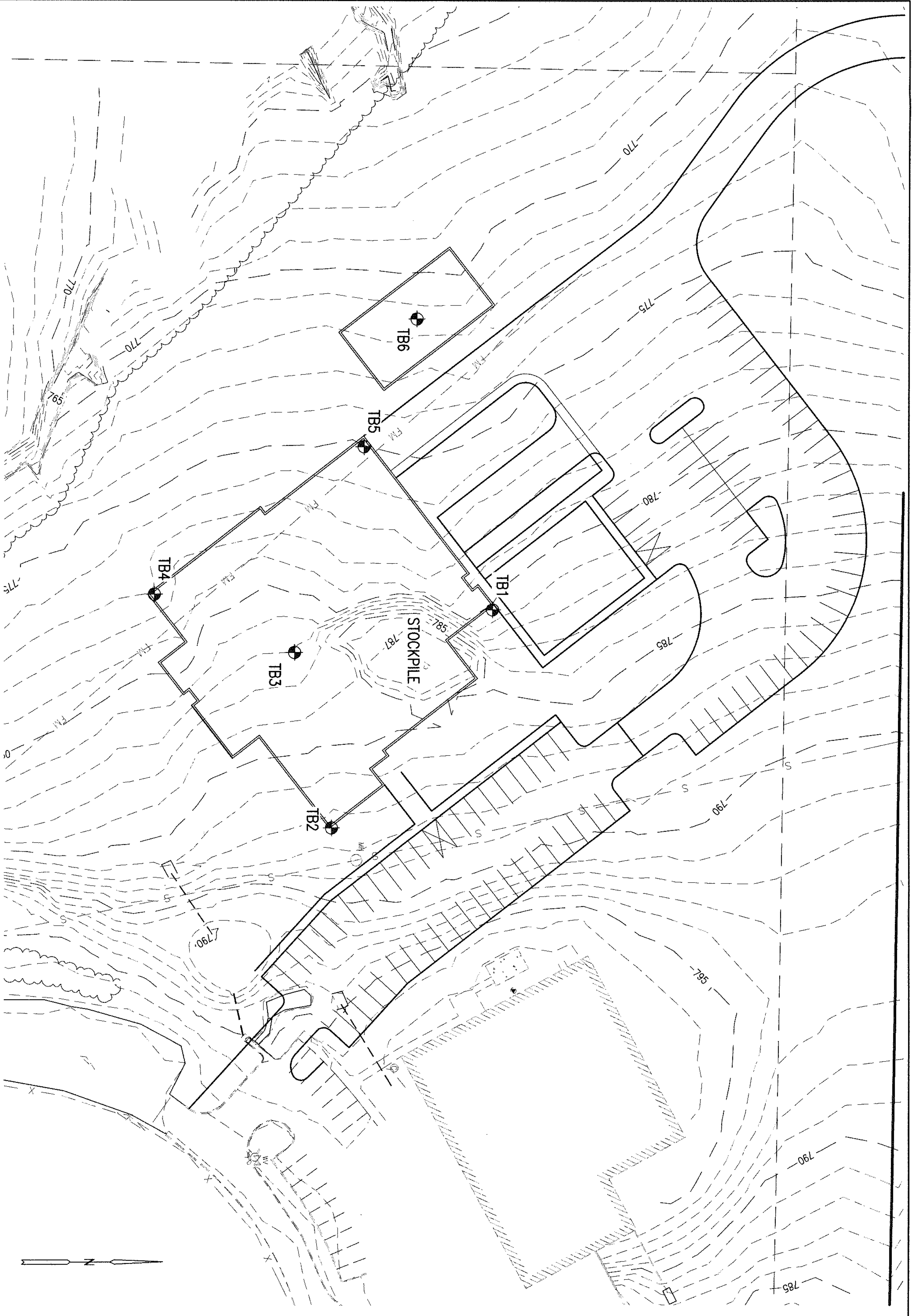
CONCLUSION AND LIMITATIONS

The authorized geotechnical engineering services have been completed. The resulting geotechnical recommendations included in this report provide a basis for development of earthwork, foundation, and floor slab and pavement subgrade designs for the proposed facility. We recommend that Allstate Consultants be retained to review the final project plans and specifications so that we can comment on and assist in the interpretation and implementation of our geotechnical recommendations. Allstate Consultants should be retained during construction to provide geotechnical observation and testing services for earthwork, foundations, floor slabs and pavements.

The evaluations, analyses and recommendations provided in this report are based on the subsurface conditions encountered in the test borings performed at the locations indicated on the Test Boring Location Plan and from other information discussed in this report. Our geotechnical report does not consider variations that could occur between boring locations or changes that may occur due to the passage of time, the modifying effects of weather or adjacent construction activities. The character and extent of such variations may not become evident until during or after construction. Should variations be identified, we should be notified immediately so that further evaluations and additional recommendations can be developed.

The scope of our geotechnical engineering services does not include either specifically or by implication any environmental evaluation of this site nor identification of contaminated or hazardous materials or conditions. Further, we have performed no assessment of the possible presence of bacteria or fungi nor the potential for development of problems associated with mold. If the Owner or client is concerned about the potential for such issues, other environmental studies should be performed.

This geotechnical report has been prepared for the exclusive use of our client for specific application to this project only and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended to be made. During construction, site safety, excavation support, and dewatering will be the responsibility of others. Should changes occur in the nature, design or location of the proposed building and pavements, as described in this report, the evaluations, recommendations and conclusions contained herein shall not be considered valid unless Allstate Consultants reviews the changes and provides written verification or modification of the conclusions of this report.



TEST BORING LOCATION PLAN
BOONE COUNTY 911/EOC FACILITY

COLUMBIA, MO

DATE	5-29-2014
JOB NUMBER	14015.02
SCALE	1" = 50'

ALLSTATE CONSULTANTS
3312 LEMONE INDUSTRIAL BLVD.
COLUMBIA, MO. 65201
(573) 875-8799
ENGINEERING • PLANNING • SURVEYING • GEOTECHNICAL • INVESTIGATIVE

TEST BORING LOG

TEST BORING NO. 1

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY

CLIENT: PW ARCHITECTS, INC.

SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.

PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	TYPE	RECOVERY (inches)	USCS SYMBOL	MATERIAL DESCRIPTION Approx. Surface Elevation: 780.0	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL / FIELD WATER CONTENT / LIQUID LIMIT LL (10 20 30 40 50 60)	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
					12" TOPSOIL				
	1	3ST	8	CH	**FAT CLAY,** Brown Mottled Red, Stiff, CH 3 — 777.0		24.4	97	2240
5	2	3ST	24	CL CH	**LEAN TO FAT CLAY,** With Sand, Trace Gravel, Gray Mottled Yellow Brown, Very Stiff, CL/CH to CH (Glacial Drift) 8 — 772.0		20.7	109	4310
	3	3ST	24	CH			21.9	106	5130
10	4	3ST	18	CH	**HIGHLY WEATHERED CLAYSTONE,** Olive Gray Mottled Brown, Jointed, Medium to Very Stiff, CH		26.5	98	1490 *5500
15	5	SS	12	CL	Grading Hard, CL 16 — 764.0	9/15/16	15.8		*9000+
					WEATHERED SHALE, Tan, Fissle, Hard, CL				
20	6	SS	14	CL	19.5 — 760.5	22/50-6"	14.0		*9000+
					BOTTOM OF BORING AT 19.5 FT.				
25									
30									
35									

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: NONE ∇
DEPTH TO WATER AFTER BORING COMPLETION (AB): NONE ▼
DEPTH TO WATER 23 HOURS AFTER BORING COMPLETION: NONE ▼

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

TEST BORING NO. 1
PAGE 1 OF 1

TEST BORING LOG

TEST BORING NO. 2

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.
CLIENT: PW ARCHITECTS, INC.
PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	TYPE	RECOVERY (inches)	USCS SYMBOL	GRAPHICAL SYMBOL	MATERIAL DESCRIPTION Approx. Surface Elevation: 787.3	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL — FIELD WATER CONTENT — LIQUID LIMIT LL 10 20 30 40 50 60	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
						12" TOPSOIL				
	1	3ST	15	CL		LEAN CLAY, Brown Mottled Red, Stiff, CL		31.0 PL 16.7 LL 15 46	90 114	2480 *3500
5	2	3ST	24	CL		Grading Gray, Jointed, Very Stiff, CL 5 782.3		PL 18.1 LL 16 43	101	6570
	3	3ST	24	CH		FAT CLAY, Gray Mottled Red Brown, Jointed, Stiff to Very Stiff, CH		PL 21.5 LL 16 53	103	2990 *5500
10	4	3ST	24	CL CH		Grading Olive Gray, CL/CH		PL 20.7 LL 18 50	107	3200 *6500
						12 775.3	▼			
15	5	SS	18	CL		LEAN CLAY, With Silt and Sand Lenses, Yellow Brown Mottled Gray, Very Stiff to Hard, CL	11/19/20	19.3		*8500
						(Glacial Drift)	▽ ▽			
20	6	SS	13	CL		20 767.3	23/15/18	22.0		*6000
						BOTTOM OF BORING AT 20 FT.				
25										
30										
35										

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: 18 FT. ▽
DEPTH TO WATER AFTER BORING COMPLETION (AB): WCI - 17 FT. ▽
DEPTH TO WATER 22 HOURS AFTER BORING COMPLETION: 11 FT. ▼

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

TEST BORING NO. 2
PAGE 1 OF 1

TEST BORING LOG
TEST BORING NO. 3

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.

CLIENT: PW ARCHITECTS, INC.
PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (inches)	USCS SYMBOL	GRAPHICAL SYMBOL	MATERIAL DESCRIPTION	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL / FIELD WATER CONTENT / LIQUID LIMIT LL (10 20 30 40 50 60)	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
						Approx. Surface Elevation: 781.9				
						12" TOPSOIL				
	1	3ST	10	CH		**FAT CLAY,** Gray Mottled Brown, Medium, CH		● 31.9	83	1470
3						778.9				
5	2	3ST	18	CH		**FAT CLAY,** Light Gray Mottled Brown, Jointed, Very Stiff, CH		● 23.3	103	5500
5						776.9				
	3	3ST	16	CL CH		**LEAN TO FAT CLAY,** With Sand, Trace Gravel, Gray Mottled Brown, Very Stiff to Stiff, CL/CH to CH		● 20.3	109	4330
10	4	3ST	19	CH				● 24.0	103	3900
						(Glacial Drift)				
12						769.9				
						HIGHLY WEATHERED CLAYSTONE, Olive Gray,	▼			
15	5	SS	18	CL		Jointed, Hard, CL	5/14/19	● 21.5		*9000+
20	6	SS	18	CH		Grading Olive Gray Mottled Brown, Hard, CH	6/9/12	● 25.6		*8000
20						761.9				
						BOTTOM OF BORING AT 20 FT.				
25										
30										
35										

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: NONE ▽
DEPTH TO WATER AFTER BORING COMPLETION (AB): NONE ▼
DEPTH TO WATER 21 HOURS AFTER BORING COMPLETION: 13 FT. ▼

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

TEST BORING NO. 3
PAGE 1 OF 1

TEST BORING LOG
TEST BORING NO. 4

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.
CLIENT: PW ARCHITECTS, INC.
PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (inches)	USCS SYMBOL	GRAPHICAL SYMBOL	MATERIAL DESCRIPTION Approx. Surface Elevation: 777.0	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL / FIELD WATER CONTENT / LIQUID LIMIT LL 10 20 30 40 50 60	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
						12" TOPSOIL				
	1	3ST	18	CH		FAT CLAY, Gray Mottled Brown, Stiff, CH 3 — 774.0		23.1	104	2750
5	2	3ST	20	CL		LEAN CLAY, With Sand, Trace Gravel,		19.6	110	6450
	3	3ST	24	CL		Brown Mottled Gray, Very Stiff, CL		15.3	119	5770
10	4	3ST	6	CL		Grading Stiff, CL		18.7		*3500
						(Glacial Drift) 12 — 765.0				
						HIGHLY WEATHERED CLAYSTONE,				
15	5	SS	12	CH		Gray, Stiff to Very Stiff, CH	4/6/8	24.6		*4000
						17 — 760.0				
						WEATHERED SHALE, Olive Gray to Tan, Hard, CL				
20	6	SS	18	CL		20 — 757.0	11/21/29	16.3		*9000+
						BOTTOM OF BORING AT 20 FT.				
25										
30										
35										

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: NONE ▽
DEPTH TO WATER AFTER BORING COMPLETION (AB): NONE ▽
DEPTH TO WATER 19 HOURS AFTER BORING COMPLETION: NONE ▼

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

TEST BORING NO. 4
PAGE 1 OF 1

TEST BORING LOG

TEST BORING NO. 5

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
CLIENT: PW ARCHITECTS, INC.
SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.
PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (inches)	USCS SYMBOL	GRAPHICAL SYMBOL	MATERIAL DESCRIPTION Approx. Surface Elevation: 774.9	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL	FIELD WATER CONTENT	LIQUID LIMIT LL	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
						12" TOPSOIL						
	1	3ST	16	CH		FAT CLAY, Brown, Soft to Medium, CH			25.8		97	680
								PL 24	29.3	LL 71	90	*2000
3						771.9						
5	2	3ST	18	CH		FAT CLAY, Light Gray Mottled Brown,		PL 16	22.6	LL 53	105	3190
	3	3ST	23	CH		Stiff to Very Stiff, CH With Sand, Trace Gravel		PL 19	19.9	LL 56	107	4160
8						766.9						
10	4	3ST	24	CH		HIGHLY WEATHERED CLAYSTONE, Light Gray Mottled Brown, Jointed, Medium to Very Stiff, CH		PL 22	29.6	LL 60	94	1470 *6000
						Grading Olive Gray, Hard, CL						
14.5	5	SS	14	CL		760.4	20/50-6"		14.1			*9000+
15						BOTTOM OF BORING AT 14.5 FT.						
20												
25												
30												
35												

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: NONE ▽
DEPTH TO WATER AFTER BORING COMPLETION (AB): NONE ▽
DEPTH TO WATER 18 HOURS AFTER BORING COMPLETION: NONE ▼

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

TEST BORING NO. 5
PAGE 1 OF 1

TEST BORING LOG
TEST BORING NO. 6

PROJECT: BOONE COUNTY 911/JOINT COMMUNICATIONS FACILITY
SITE LOCATION: ROGER B. WILSON MEM. DRIVE, BOONE COUNTY, MO.

CLIENT: PW ARCHITECTS, INC.
PROJECT NO.: 14015.02

DEPTH (feet)	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY (inches)	USCS SYMBOL	GRAPHICAL SYMBOL	MATERIAL DESCRIPTION	SPT BLOW COUNTS (Blows/6")	PLASTIC LIMIT PL — FIELD WATER CONTENT ● — LIQUID LIMIT LL (10 20 30 40 50 60)	DRY UNIT WEIGHT pcf	UNCONFINED COMPRESSIVE STRENGTH psf
						Approx. Surface Elevation: 771.5				
						12" TOPSOIL				
	1	3ST	22	CL		LEAN CLAY, Dark Brown, Soft, CL 3 768.5	▼	● 27.3	94	690
5	2	3ST	21	CH		FAT CLAY, Brown Mottled Red, Stiff, CH		● 25.4	99	3360
	3	3ST	18	CH		Grading Gray Mottled Brown 8 763.5		● 25.1	100	2850 *5000
10	4	3ST	24	CL		HIGHLY WEATERED CLAYSTONE, Olive Gray, Jointed, Stiff to Hard, CL		● 17.5	115	2590 *8500
15	5	SS	8	CL		14.3 757.2	33/50-3"	● 12.0		*8000
						BOTTOM OF BORING AT 14.3 FT.				
20										
25										
30										
35										

Note: Stratification lines represent approximate boundaries between soil and rock types. In-situ, the transition between strata may be gradual.
* Based on Calibrated Hand Penetrometer.

DRILLING CONTRACTOR: BOWERS & ASSOCIATES, INC.
DRILLING METHOD: MOBILE B47 WITH 7" HOLLOW STEM AUGERS
DEPTH WATER FIRST ENCOUNTERED: NONE ▽
DEPTH TO WATER AFTER BORING COMPLETION (AB): NONE ▼
DEPTH TO WATER 16 HOURS AFTER BORING COMPLETION: 3 FT. ▼

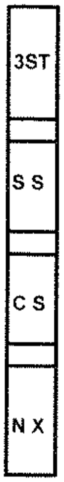
ALLSTATE CONSULTANTS, LLC
COLUMBIA, MISSOURI

BORING
STARTED: 4/9/2014
COMPLETED: 4/9/2014
LOG APPROVED BY: WAB

TEST BORING NO. 6
PAGE 1 OF 1

TEST BORING LOG NOTES

SAMPLE TYPE



SHELBY TUBE SAMPLE – Obtained by pushing a standard 3 inch OD thin-walled tube sampler using the hydraulic stroke of the drilling rig.

SPLIT-SPOON SAMPLE – Obtained by driving a standard 2 inch OD by 1 3/8 inch ID split-barrel sampler during performance of a Standard Penetration Test (SPT).

CONTINUOUS SAMPLE - Obtained by inserting a 3 inch OD by 2 ¼ ID continuous split-barrel sampler into the lead section of a hollow stem auger string and advancing the sampler with the hollow stem auger as the auger penetrates into the underlying soil.

ROCK CORE SAMPLE - Obtained by coring the rock with an NX size core barrel and diamond bit. The NX size core is approximately 2 1/8 inches in diameter. An NQ size core is approximately 2 inches in diameter.

SOIL AND ROCK DESCRIPTIONS AND CLASSIFICATION

Soil samples are described and classified in general accordance with the Unified Soil Classification System (USCS) using visual-manual procedures. All USCS Group Letter Symbols and Group Names are based on visual-manual estimates except where accompanied by results of Atterberg limits tests and grain size analyses. A brief description of the USCS is attached.

Fine-grained soils are also described in terms of their consistency and coarse-grained soils in terms of their in-place relative density. For fine-grained soils, the consistency is based on the unconfined compressive strength (Table 1). For coarse-grained soils the relative density is related to the N value determined from the Standard Penetration Test (Table 2).

Rock strata penetrated by flight augers or rock bits and intermittently sampled with a split-barrel sampler are described and classified based on drilling performance and visual observation of disturbed samples. Rock cores may reveal other rock types.

Rock core samples, obtained with a core barrel and diamond bit, are visually described and classified based on lithology, bedding, structure, degree of weathering, and hardness. All rock descriptions and classifications are based on visual observations. Petrographic analyses may indicate other rock types. Rock core recovery is expressed as the ratio of the length of core recovered to the length of the core run. Rock Quality Designation (RQD) is the ratio of the total length of the pieces of core that are hard, sound and 4 inches or longer to the length of the core run. Both core recovery and RQD are expressed as a percentage.

Soil and rock strata, delineated on the boring log, represent the geotechnical engineer's interpretation of subsurface conditions at the boring location. The interpretation is developed from the field boring log with modifications based on the laboratory test results and visual observations of the soil and rock samples. Graphical symbols depicting the soil and rock strata are shown on the boring logs for illustrative purposes. Different soil or rock types could be present between samples. A legend relating the graphical symbols to the USCS Group Letter Symbols and Group Names and the principal rock types encountered in the project area is attached. Stratification lines shown on the boring logs represent approximate boundaries between the various soil and rock types. In-situ, the transition between the soil and rock strata may be gradual.

STANDARD PENETRATION TEST

A standard split-barrel sampler (2 inch OD by 1 3/8 inch ID) is driven 18 inches into the soil by a 140 pound hammer repeatedly dropped from a height of 30 inches. The hammer blows are recorded for each 6 inches of penetration and the penetration resistance or N Value is considered the number of blows required for the final 12 inches of sampler penetration. Blows per 6 inch interval are recorded as 8/18/23 etc. under the Test Boring Log heading *SPT Blow Counts*. Where the sampler penetrated less than 6 inches under 50 hammer blows for one of the intervals, the results are recorded as 8/18/50-3".

LABORATORY TEST RESULTS AND SYMBOLS

PLASTIC LIMIT (PL) - Water content at which a soil will just begin to crumble when rolled into a thread approximately 1/8 inch in diameter. Generally represents the water content below which the soil develops cracks upon significant deformation.

LIQUID LIMIT (LL) - Water content at which a pat of soil, cut by a groove of standard dimensions, will flow together for a distance of ½ inch under the impact of 25 blows in a standard liquid limit apparatus. Generally represents the water content above which the soil is in suspension and has minimal shear strength.

FIELD WATER CONTENT - Water content of the soil or rock at depth indicated at time of exploration. The water content may fluctuate with seasonal and climatological conditions and may be altered by excavation, exposure and other construction activities or by conditions not apparent during exploration.

- Relationship between plastic limit (PL), field water content, and liquid limit (LL). The plasticity index, (PI), is the difference between the liquid and plastic limits. In general, the higher the liquid limit and PI, the more a soil is inherently prone to volume change. However, soils with lower liquid limits and PI's can also experience volume change.

Soils having field water contents approaching the liquid limit typically have low shear strength and high compressibility. Soils having water contents near the plastic limit typically have higher shear strength and lower compressibility.

UNCONFINED COMPRESSIVE STRENGTH _ The load per unit area at which an unconfined cylindrical specimen of soil will fail in a simple, quick compression test without lateral support. Expressed in pounds per square foot on the boring log.

* Indicates unconfined compressive strength estimated using a calibrated hand penetrometer.

TABLE 1

CONSISTENCY OF FINE-GRAINED SOILS

UNCONFINED COMPRESSIVE STRENGTH, Qu, psf	CONSISTENCY
Less than 500 psf	Very Soft
500 - 1,000	Soft
1,000 - 2,000	Medium
2,000 - 4,000	Stiff
4,000 - 8,000	Very Stiff
Above - 8,000	Hard

TABLE 2

RELATIVE DENSITY OF COARSE-GRAINED SOILS

SPT N VALUE Blows/ft.	RELATIVE DENSITY
0 - 4	Very Loose
4 - 10	Loose
10 - 30	Medium Dense
30 - 50	Dense
Above 50	Very Dense

TABLE 3

ROCK QUALITY DESIGNATION RQD

RQD (%)	ROCK QUALITY
0 - 25	Very Poor
25 - 50	Poor
50 - 75	Fair
75 - 90	Good
90 – 100	Excellent

WATER LEVEL SYMBOLS AND OBSERVATIONS:

WS or WD - Borehole water level observation *While Sampling* or *While Drilling* - ▽

AB - Borehole water level observation *After Boring* completion - ▼

24 Hrs AB – Water level observation *24 Hrs After Boring* completion - ▼
or other such time as recorded on the boring log.

WCI - *Wet Cave In*

DCI - *Dry Cave In*

Borehole water level measurements were made at the times and under the conditions indicated on the boring logs. Groundwater levels may vary across the site and will fluctuate with seasonal and climatological conditions. Groundwater levels may also be altered by site grading and/or other construction activities. Borehole water level measurements in highly pervious soils may represent groundwater conditions in these units at the time of the observations. In semi-pervious and fine-grained soils, short term water level measurements in borings may not represent actual groundwater conditions. Long term observations of piezometers, screened in the hydrologic units of interest, and sealed from the influence of surface water are typically required to evaluate groundwater conditions and fluctuations in groundwater levels in low permeability soils.

SOIL AND ROCK SYMBOLS FOR BORING LOGS

SOIL SYMBOLS

GRAPHICAL SYMBOL	USCS Group Symbol	USCS Group Name
⁘	GW	Well-graded gravel
⁘	GP	Poorly graded gravel
▥	GM	Silty gravel
▨	GC	Clayey gravel
░	SW	Well-graded sand
░	SP	Poorly graded sand
▥	SM	Silty sand
▨	SC	Clayey sand
▨	CL	Lean clay
▥	ML	Silt
▨	CL-ML	Silty Clay
▨	OL	Organic clay
▥		Organic silt
▨	CH	Fat clay
▥	MH	Elastic silt
▨	OH	Organic clay
▥		Organic silt
≈	PT	Peat

ROCK SYMBOLS

GRAPHICAL SYMBOL	MAJOR ROCK TYPE
▥	SILTSTONE
▤	SHALE
░	SANDSTONE
▦	LIMESTONE
▨	DOLOMITE
■	COAL
▥	UNDERCLAY
✚	CLAYSTONE

OTHER SYMBOLS

▨	CL	Lean Clay, with Sand and Gravel (Glacial Drift)
▨	CH	Fat Clay, with Sand and Gravel (Glacial Drift)

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UNIFIED SOIL CLASSIFICATION SYSTEM

Soil Classification Chart

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

Footnotes

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

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

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

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

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

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

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

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

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

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

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

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

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

[N] $PI \geq 4$ and plots on or above "A" line.

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

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

[Q] PI plots below "A" line.

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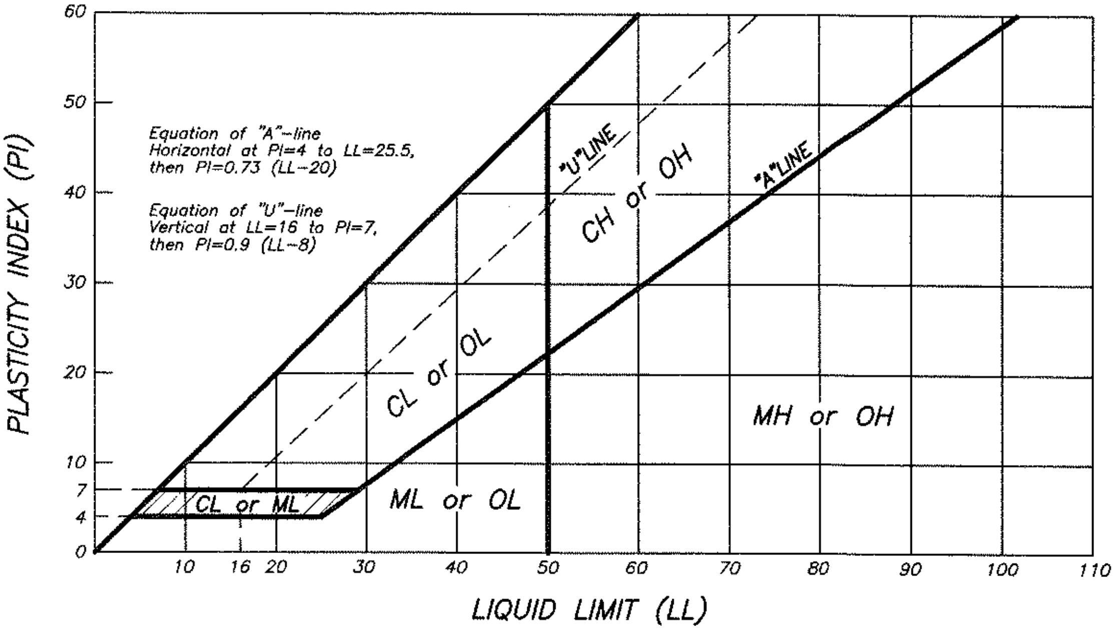
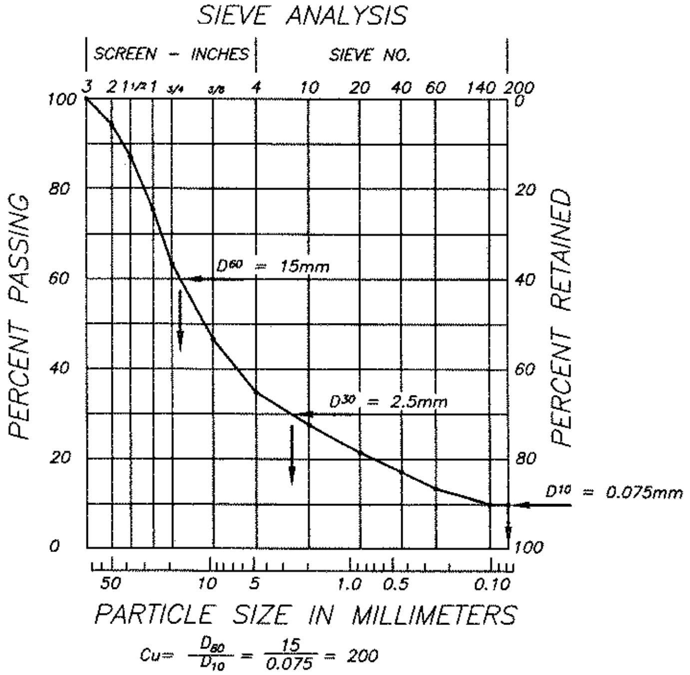
UNIFIED SOIL CLASSIFICATION SYSTEM



Equation of "A"-line
Horizontal at PI=4 to LL=25.5,
then PI=0.73 (LL-20)

Equation of "U"-line
Vertical at LL=16 to PI=7,
then PI=0.9 (LL-8)

PLASTICITY CHART FOR CLASSIFICATION OF FINE-GRAINED SOILS AND FINE-GRAINED FRACTION OF COARSE-GRAINED SOILS.



$$Cu = \frac{D_{80}}{D_{10}} = \frac{15}{0.075} = 200$$

$$Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$$

Cumulative Particle-Size Plot

FOR CLASSIFICATION OF COARSE-GRAINED SOILS
WITH 12% OR LESS FINES.

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LABORATORY SWELL TEST REPORT

Allstate Consultants, LLC
3312 LeMone Industrial Blvd.
Columbia, Missouri 65201
(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 1, 2014
Project No.: 14015.02

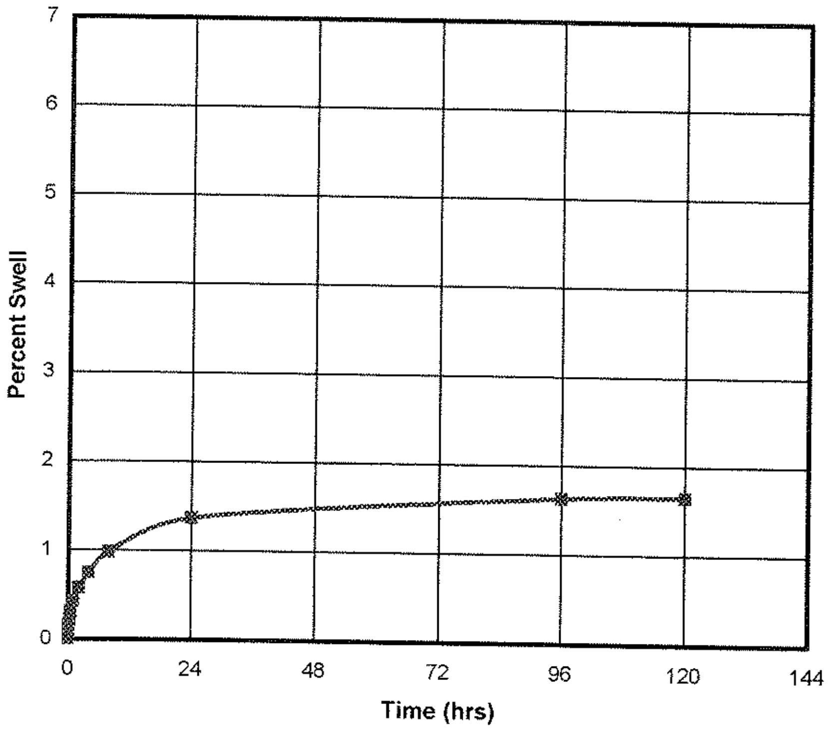
MATERIAL INFORMATION

Boring No.: TB-2
Sample No.: ST-1
Depth: 1'-3'
Date: April 24, 2014
Description: Lean Clay, With Sand, Trace Gravel, Gray Mottled Tan, Stiff, CL

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
1.7 %
SURCHARGE PRESSURE
250 PSF

Sample Diameter (in):	2.50
Sample Height (in):	0.98
Initial Moisture Content (%):	16.7
Initial Dry Density (pcf):	113.8
Final Moisture Content (%):	18.7
Final Dry Density (pcf);	112.6

Atterberg Limits

Liquid limit:	(LL)	46
Plastic limit:	(PL)	15
Plasticity Index:	(PI)	31

USCS Classification
Group Symbol: CL

Comments:

Reviewed by:

William A. Barrow
William A. Barrow, P.E., R.G.
Geotechnical Manager

LABORATORY SWELL TEST REPORT

Allstate Consultants, LLC
3312 LeMone Industrial Blvd.
Columbia, Missouri 65201
(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 1, 2014
Project No.: 14015.02

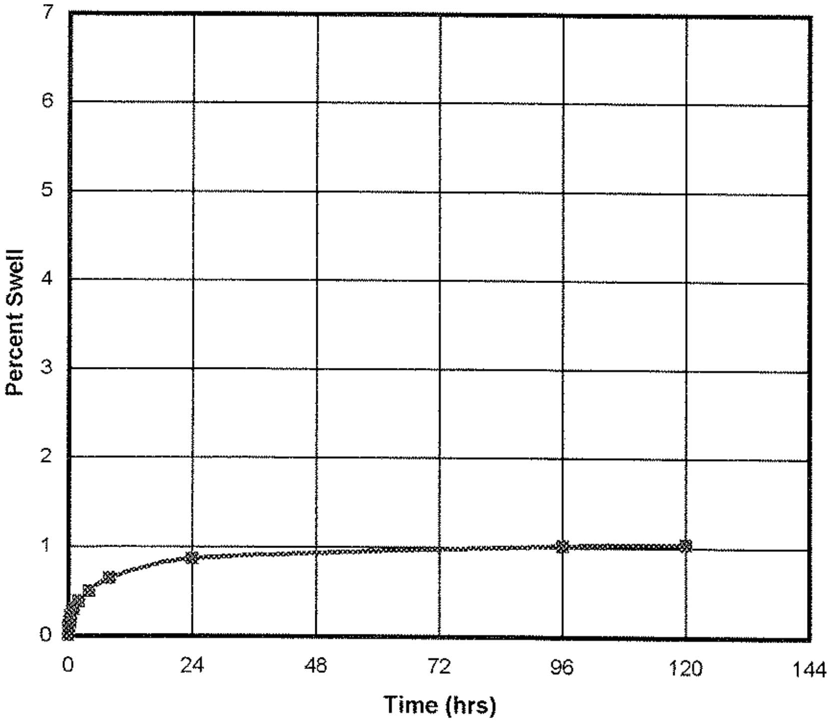
MATERIAL INFORMATION

Boring No.: TB-2
Date: April 24, 2014
Sample No.: ST-2
Depth: 3'-5'
Description: Lean Clay, Gray Mottled Tan, Hard, CL

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
1.0 %
SURCHARGE PRESSURE
500 PSF

Sample Diameter (in): 2.50
Sample Height (in): 0.98
Initial Moisture Content (%): 14.6
Initial Dry Density (pcf): 100.8

Final Moisture Content (%): 23.0
Final Dry Density (pcf); 100.3

Atterberg Limits

Liquid limit:	(LL)	43
Plastic limit:	(PL)	16
Plasticity Index:	(PI)	27

USCS Classification
Group Symbol: CL

Comments:

Reviewed by:

William A. Barrow

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Geotechnical Manager

LABORATORY SWELL TEST REPORT

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(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 1, 2014
Project No.: 14015.02

MATERIAL INFORMATION

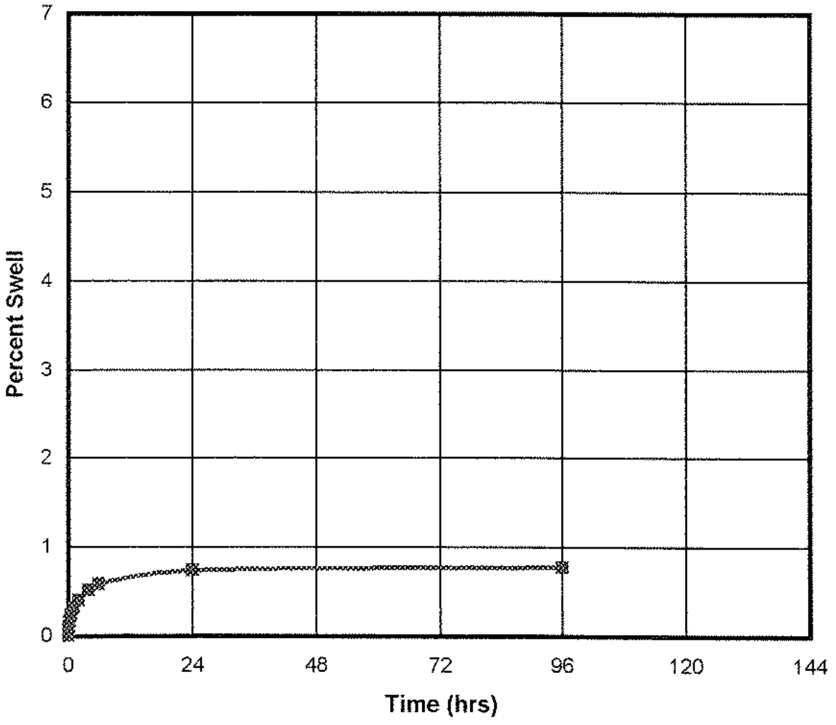
Boring No.: TB-2
Sample No.: ST-3
Depth: 5'-7'
Description: Fat Clay, With Sand, Trace Gravel, Gray Mottled Tan, Very Stiff, CH

Date: April 24, 2014

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
0.8 %
SURCHARGE PRESSURE
750 PSF

Sample Diameter (in):	2.50
Sample Height (in):	0.99
Initial Moisture Content (%):	19.8
Initial Dry Density (pcf):	107.4
Final Moisture Content (%):	21.2
Final Dry Density (pcf);	107.8

Atterberg Limits

Liquid limit:	(LL)	53
Plastic limit:	(PL)	16
Plasticity Index:	(PI)	37

USCS Classification
Group Symbol: CH

Comments:

Reviewed by:

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LABORATORY SWELL TEST REPORT

Allstate Consultants, LLC
3312 LeMone Industrial Blvd.
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(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 1, 2014
Project No.: 14015.02

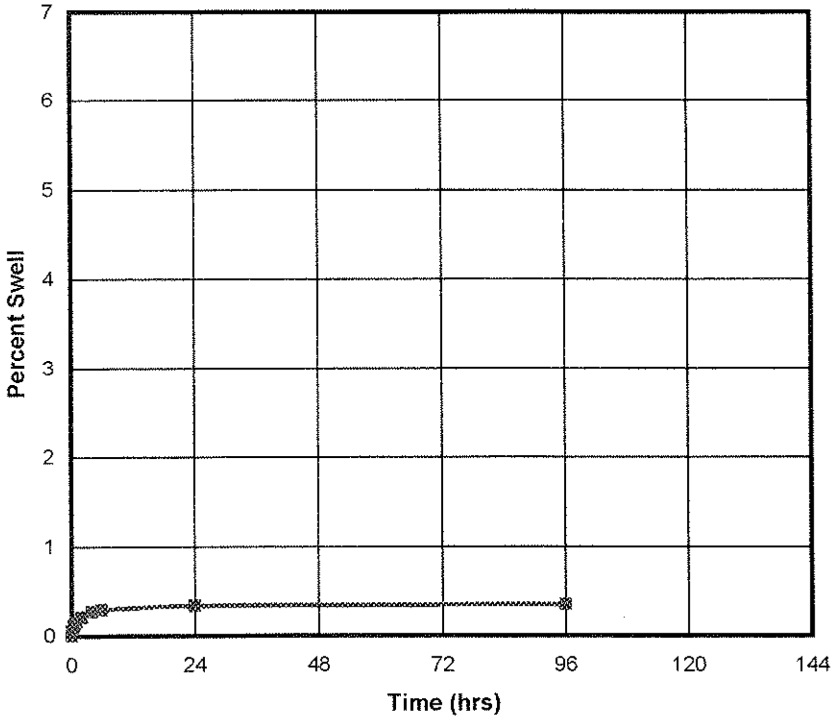
MATERIAL INFORMATION

Boring No.: TB-2
Sample No.: ST-4
Depth: 8'-10'
Date: April 24, 2014
Description: Lean to Fat Clay, Trace Gravel, Gray Mottled Tan, Very Stiff, CL/CH

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
0.4 %
SURCHARGE PRESSURE
1125 PSF

Sample Diameter (in): 2.50
Sample Height (in): 1.00
Initial Moisture Content (%): 19.3
Initial Dry Density (pcf): 108.9

Final Moisture Content (%): 20.1
Final Dry Density (pcf): 109.8

Atterberg Limits

Liquid limit:	(LL)	50
Plastic limit:	(PL)	18
Plasticity Index:	(PI)	32

USCS Classification
Group Symbol: CL/CH

Comments:

Reviewed by:

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Geotechnical Manager

LABORATORY SWELL TEST REPORT

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Columbia, Missouri 65201
(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 2, 2014
Project No.: 14015.02

MATERIAL INFORMATION

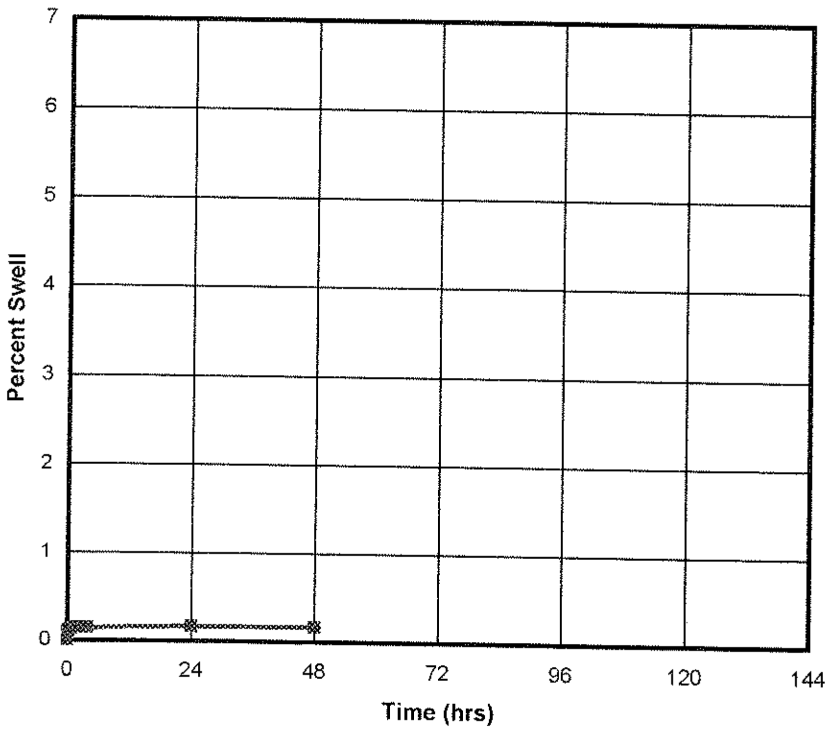
Boring No.: TB-5
Sample No.: ST-1
Depth: 1'-3'
Description: Fat Clay, Gray Mottled Reddish Tan, Stiff, CH

Date: April 29, 2014

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
0.2 %
SURCHARGE PRESSURE
250 PSF

Sample Diameter (in):	2.50
Sample Height (in):	0.99
Initial Moisture Content (%):	29.3
Initial Dry Density (pcf):	90.1
Final Moisture Content (%):	30.4
Final Dry Density (pcf);	90.4

Atterberg Limits

Liquid limit:	(LL)	71
Plastic limit:	(PL)	24
Plasticity Index:	(PI)	47

USCS Classification
Group Symbol: CH

Comments:

Reviewed by:

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Geotechnical Manager

LABORATORY SWELL TEST REPORT

Allstate Consultants, LLC
3312 LeMone Industrial Blvd.
Columbia, Missouri 65201
(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 2, 2014
Project No.: 14015.02

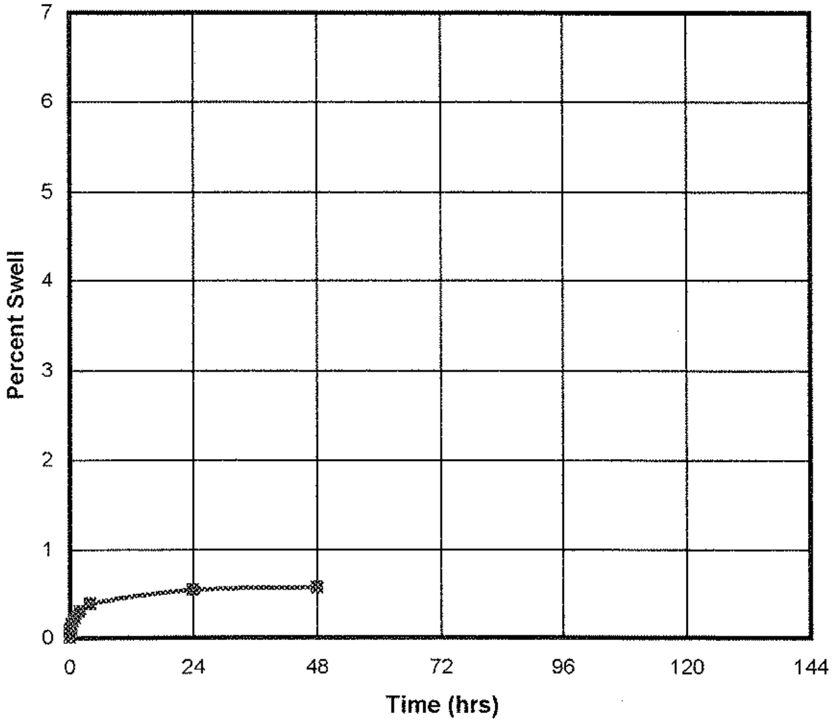
MATERIAL INFORMATION

Boring No.: TB-5
Date: April 29, 2014
Sample No.: ST-2
Depth: 3'-5'
Description: Fat Clay, Trace Gravel, Gray Mottled Brown & Tan, Very Stiff, CH

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
0.6 %
SURCHARGE PRESSURE
500 PSF

Sample Diameter (in):	2.50
Sample Height (in):	1.00
Initial Moisture Content (%):	19.0
Initial Dry Density (pcf):	107.1
Final Moisture Content (%):	20.6
Final Dry Density (pcf);	107.0

Atterberg Limits

Liquid limit:	(LL)	53
Plastic limit:	(PL)	16
Plasticity Index:	(PI)	37

USCS Classification
Group Symbol: CH

Comments:

Reviewed by:

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LABORATORY SWELL TEST REPORT

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Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 8, 2014
Project No.: 14015.02

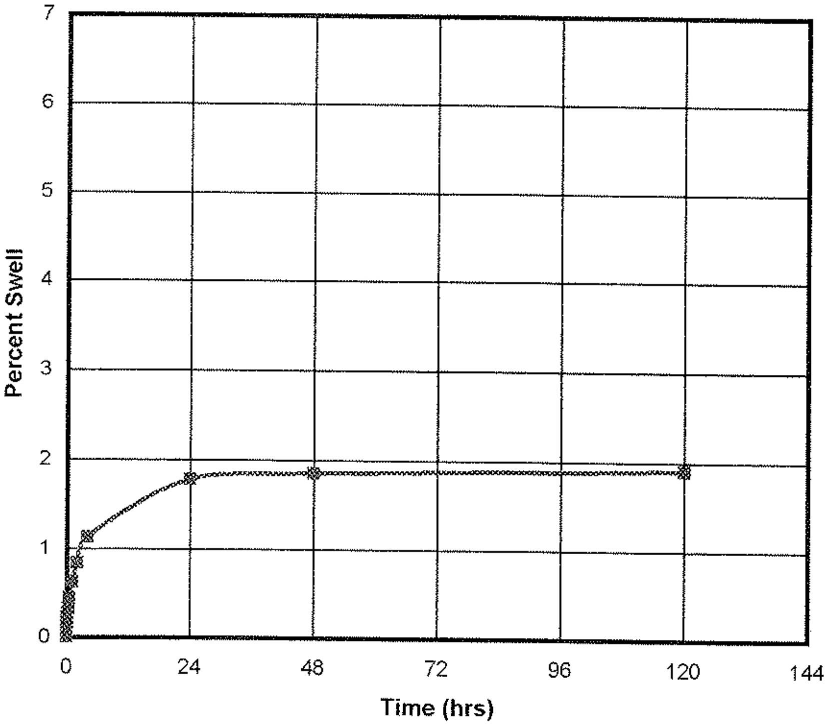
MATERIAL INFORMATION

Boring No.: TB-5
Date: April 30, 2014
Sample No.: ST-3
Depth: 5'-7'
Description: Fat Clay, Trace Gravel, Tan Mottled Gray, Very Stiff, CH

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
1.9 %
SURCHARGE PRESSURE
750 PSF

Sample Diameter (in): 2.50
Sample Height (in): 0.98
Initial Moisture Content (%): 20.7
Initial Dry Density (pcf): 107.1

Final Moisture Content (%): 22.8
Final Dry Density (pcf); 105.9

Atterberg Limits
Liquid limit: (LL) 56
Plastic limit: (PL) 19
Plasticity Index: (PI) 37

USCS Classification
Group Symbol: CH

Comments:

Reviewed by:

William A. Barrow
William A. Barrow, P.E., R.G.
Geotechnical Manager

LABORATORY SWELL TEST REPORT

Allstate Consultants, LLC
3312 LeMone Industrial Blvd.
Columbia, Missouri 65201
(573) 875-8799

Client: PW Architects, Inc.
Project: Boone County 911/Joint Communications Facility
Location: Roger B. Wilson Memorial Drive, Boone County, Missouri

Report Date: May 5, 2014
Project No.: 14015.02

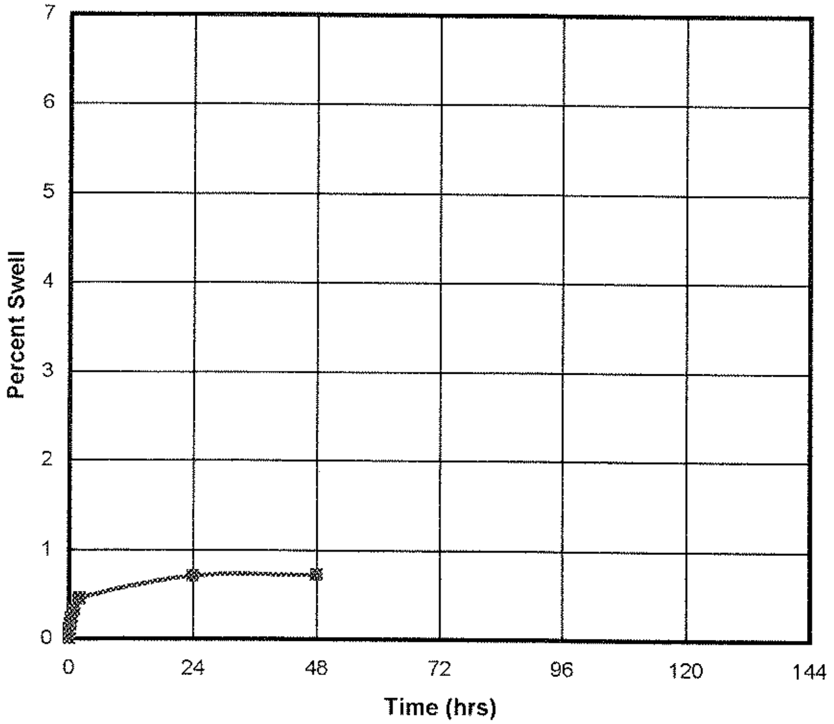
MATERIAL INFORMATION

Boring No.: TB-5
Sample No.: ST-4
Depth: 8'-10'
Date: April 30, 2014
Description: Fat Clay, Trace Gravel, Tan Mottled Gray, Very Stiff, CH (Highly Weathered Claystone)

TEST INFORMATION

Test Method: ASTM D 4546
Test Procedure: Method B (Modified)
Sample Preparation: Undisturbed

LABORATORY TEST RESULTS



SWELL
0.7 %
SURCHARGE PRESSURE
1125 PSF

Sample Diameter (in): 2.50
Sample Height (in): 0.98
Initial Moisture Content (%): 24.9
Initial Dry Density (pcf): 102.8

Final Moisture Content (%): 25.9
Final Dry Density (pcf): 103.1

Atterberg Limits
- Liquid limit: (LL) 60
- Plastic limit: (PL) 22
- Plasticity Index: (PI) 38

USCS Classification
- Group Symbol: CH

Comments:

Reviewed by:

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