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January 15, 2015

AKEA, Inc.
3603 NW 98th Street, Suite B
Gainesville, Florida 32606

Report No. 140852

Attention: Tom Gyllstrom AIA LEED AP

Geotechnical Investigation
Proposed Outpatient Services Center
VA Medical Center
Jackson, Mississippi

Gentlemen:

Submitted here is the report of our geotechnical investigation for the above-captioned project. This investigation was authorized by Mr. Anthony Kwan's execution of our contract agreement on December 4, 2014 and was generally performed in accordance with our Proposal No. 14001P-176 dated November 20, 2014.

We appreciate the opportunity to be of service. If you should have any questions concerning this report, please do not hesitate to call us.

Very truly yours,

BURNS COOLEY DENNIS, INC.

W. David Dennis, Jr., P.E.

W. DAVID DENNIS, JR. REGISTERED PROFESSIONAL ENGINEER 7022 STATE OF MISSISSIPPI

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Copies Submitted: (2)

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1.0 INTRODUCTION

1.1 Project Description

Plans are being made for the construction of an addition to the VA Medical Center in Jackson, Mississippi. The addition will consist of a new Outpatient Services Center building that will be constructed along the south side of the medical center near the east end. The new building will have plan dimensions of approximately 110 ft by 125 ft. The building addition will be a two-story structure that could potentially become five-story in the future. The building will include a basement. Concentrated loads for the building will range from approximately 100 to 400 kips. We understand the existing VA Medical Center buildings are supported above-grade on a deep foundation system.

The ground surface within the planned construction area for the new Outpatient Services Center building generally slopes down toward the east and northeast. Based on 25-percent design submittal drawings, ground surface elevations within the construction area for the building range from about 345 ft to 356 ft. The finished floor elevation of the basement will be 346 ft, and the floor elevation of the first level will be 360 ft. There will be a crawl space beneath the basement floor. Therefore, the crawl space grade could be on the order of 5 ft to 15 ft below existing ground surface elevations within the construction area.

1.2 Purposes

The specific purposes of this investigation were:

1) to make exploratory soil borings within the area planned for construction of the new Outpatient Services Center building;

2) to verify field classifications and to evaluate pertinent physical properties of the soils encountered in the borings by means of visual examination of the soil samples in the laboratory and tests performed on the samples; and

3) after analysis of the soil boring and laboratory test data, to provide recommendations for site preparation, earthwork construction, and design and construction of the building foundation.

2.0 FIELD EXPLORATION

2.1 General

Subsurface soil conditions within the area planned for construction of the new Outpatient Services Center building were explored by means of five borings. The approximate locations of the borings are shown on Figure 1 of this report. The borings were located in the field by means of visual sighting and taped measurements from existing site features using distances scaled from the 25-percent design submittal site plan we were furnished.

A synopsis of the Unified Soil Classification System is presented on Figure 2 along with symbols and terminology typically utilized on graphical soil boring logs. Graphical logs of the borings are presented on Figures 3 through 7. The graphical logs illustrate the types of soil encountered with depth below the surface at the individual boring locations. Surface elevations included at the top of the graphical boring logs were estimated from elevation contours shown on the 25-percent design submittal Drawing No. C301. Therefore, the estimated surface elevations shown on the graphical logs should be considered as approximate. GPS coordinates for the boring locations as determined in the field by our drill crew using a hand-held device are shown at the bottom of the graphical logs within the "Comments" section.

2.2 Drilling Methods and Groundwater Observations

The borings were made using truck and buggy-mounted rotary drill rigs. Borings 1, 3, 4 and 5 were made to an exploration depth of 40 ft, and Boring 2 was made to a depth of 80 ft. The borings were initially advanced by dry augering to depths of either 7 ft or 15 ft and then were extended to completion using rotary wash drilling procedures. Observations were made continuously during auger drilling to detect free water entering the open boreholes. Notes pertaining to groundwater observations are included at the bottom right corner of the graphic boring logs.

2.3 Sampling Methods

Relatively undisturbed samples of the soils encountered in the borings were obtained at approximate 3-ft to 5-ft intervals of depth by pushing a 3-in. OD Shelby tube sampler approximately 0.5 ft to 2 ft into the soil. The Shelby tube samples were obtained within the depth intervals illustrated as shaded portions of the "Samples" column of the graphic boring logs. Disturbed auger cutting samples were also obtained during auger drilling at selected depths between the Shelby tube samples. The depths at which the auger cutting samples were taken are illustrated as small I-shaped symbols under the “Samples” column of the graphic logs.

2.4 Field Classification, Sample Preservation and Borehole Abandonment

All soils encountered during drilling were examined and classified in the field by a geotechnical engineering technician. Each undisturbed Shelby tube sample was extruded from the sampling tube in the field. An approximate 6-in. long portion of each Shelby tube sample was sealed with melted paraffin in a cylindrical cardboard container to prevent moisture loss and structural disturbance. An additional portion of each Shelby tube sample and the auger cutting samples were sealed in jars to provide material for visual examination and testing in the laboratory. In compliance with Mississippi Department of Environmental Quality (MDEQ) regulations, the boreholes were filled with cement-bentonite grout after completion of drilling and sampling.

3.0 LABORATORY TESTING

3.1 General

All of the soil samples were examined in the laboratory and tests were performed on the samples to assist in evaluating the strengths, classifications and volume change properties of the soils encountered. The types of laboratory tests performed are described in the following paragraphs.

3.2 Strength and Moisture/Density Tests

The undrained shear strengths of the fine-grained soils encountered in the borings were investigated by means of 25 unconfined compression tests and three unconsolidated undrained (UU) triaxial compression tests performed on selected undisturbed Shelby tube samples. The results of the unconfined compression tests in terms of cohesion are plotted as small open circles in the data section of the graphic boring logs. The cohesions resulting from the UU triaxial compression tests are plotted as small open triangles in the data section of the graphic logs. The water content and dry density were also determined for each unconfined and UU triaxial compression test specimen. The water contents are plotted as small shaded circles in the data section of the graphic logs. The dry densities are tabulated to the nearest lb per cu ft under the "Dry Density" column of the logs.

Moisture/density tests were performed on two undisturbed Shelby tube samples from Borings 1 and 2. The resulting water contents and dry densities are plotted and tabulated on the graphic logs for Borings 1 and 2 in the manner described in the preceding paragraph.

3.3 Classification Tests

The classifications and volume change properties of the fine-grained soils encountered in the borings were investigated by means of 14 sets of Atterberg liquid and plastic limit tests performed on selected samples. The results of the liquid and plastic limit tests are plotted as small crosses interconnected by dashed lines in the data section of the graphic boring logs. In accordance with the Unified Soil Classification System, fine-grained soils are classified as either clays or silts of low or high plasticity based on the results of Atterberg limit tests. The numerical difference between the liquid limit and plastic limit is defined as the plasticity index (PI). The magnitudes of the liquid limit and plasticity index and the proximity of the natural water content to the plastic limit are indicators of the potential for a fine-grained soil to shrink or swell upon changes in moisture content or to consolidate under loading. The proximity of the natural water content to the plastic limit is also an indicator of soil strength.

The classification of a fine-grained soil containing sand encountered in Boring 2 was investigated by means of a minus No. 200 sieve test. The percentage of fines resulting from the minus No. 200 sieve test is tabulated under the far right column of the graphic log for Boring 2.

3.4 Water Content Tests

Water content tests were performed on 46 samples to assist in corroborating field and laboratory visual classifications and to extend the usefulness of the strength and plasticity data. The results of the water content tests are plotted as small shaded circles in the data section of the graphic boring logs. The water content data have been interconnected on the logs to illustrate a continuous profile with depth.

4.0 GENERAL SUBSURFACE CONDITIONS

4.1 General

Subsurface soils encountered within the 80-ft maximum exploration depth of the borings made for this investigation generally include fill materials and natural silty clays (CL), sandy clays (CL) and clays (CH) that are underlain in turn by weathered Yazoo clays (CH), unweathered Yazoo clays (CH) and Moodys Branch formation soils. A general description of the subsurface soils is provided in the following paragraphs. The graphical logs shown on Figures 3 through 7 should be referred to for specific soil conditions encountered at each boring location. A stick log profile of the borings is shown on Figure 8 to aid in visualizing the subsurface soil stratification. Tabulated adjacent to the stick logs are liquid and plastic limits, water contents, dry densities, cohesions, and the percentage of fines from the single minus No. 200 sieve test.

4.2 Soil Stratification

4.2.1 Fill Materials. The ground surface at all five boring locations was found to be underlain by apparent fill materials. The fill soils were encountered to variable depths ranging from about 7 ft at Boring 4 to approximately 11 ft at the location of Boring 5. The fill materials vary from boring to boring and for the most part include silty clays (CL), sandy clays (CL) and clays (CH). Clayey sand (SC) and/or silty sand (SM) fill materials were encountered within the approximate depth intervals of 1.5 ft to 3 ft and 4 ft to 7.5 ft at Boring 1, and between depths of about 6 ft and 7 ft at Boring 4. The fill materials were found to include gravel within some depth intervals. For the most part, the silty clay (CL), sandy clay (CL) and clay (CH) fill materials encountered at the locations of Borings 1 through 4 are classified as stiff, very stiff and hard with respect to consistency and are considered to have moderate to high strength and moderate to low compressibility. The sandy clay (CL) and clay (CH) fill materials encountered to a depth of about 11 ft below the surface at Boring 5 and the clay (CH) fill materials within the approximate depth interval of 7 ft to 9.5 ft at Boring 2 are for the most part classified as medium stiff with respect to consistency, and therefore, are considered to have low to moderate strength and moderate to high compressibility. The clayey sand (SC) and silty sand (SM) fill materials encountered at Borings 1 and 4 are characterized as medium dense and are considered to have moderate strength and low compressibility. The silty clay (CL) and sandy clay (CL) fill materials are considered to have low shrink/swell potential. The clayey sand (SC) and silty sand (SM) fill materials are considered to be nonexpansive. The clay (CH) fill materials are considered to be expansive with moderate to high shrink/swell potential. Highly expansive Yazoo clay (CH) fill materials were encountered within the approximate depth intervals of 7 ft to 9.5 ft at Boring 2 and 3.5 ft to 6 ft at Boring 3.

4.2.2 Natural CL and CH Soils. The fill materials at the locations of Borings 1 and 3 were found to be underlain by apparent natural soils including silty clays (CL), sandy clays (CL) and clays (CH). The natural CL and CH soils were encountered within the approximate depth intervals of 7.5 ft to 16.5 ft at Boring 1 and 8 ft to 12.5 ft at Boring 3. The natural silty clays (CL), sandy clays (CL) and clays (CH) are classified as stiff and very stiff with respect to consistency and are considered to have moderate to high strength and moderate to low compressibility. The natural silty clays (CL) and sandy clays (CL), which were encountered at the location of Boring 1, are considered to have low shrink/swell potential. The natural clays (CH), which were encountered at Boring 3, are considered to be expansive with high shrink/swell potential.

4.2.3 Weathered Yazoo Clays (CH). Weathered Yazoo clays (CH) were encountered in the borings below either the fill materials or natural CL and CH soils at depths ranging from approximately 7 ft below the surface at Boring 4 to about 16.5 ft at Boring 1. For the most part, the weathered Yazoo clays (CH) are classified as stiff and very stiff with respect to consistency and are considered to have moderate to high strength and moderate to low compressibility. In general, the weathered Yazoo clays (CH) were found to be slickensided to approximate depths of 17 ft to 22 ft below the surface. Slickensides are randomly oriented micro-failure planes within the weathered Yazoo clays (CH) caused by differential shrink/swell movements. The weathered Yazoo clays (CH) are expansive with high shrink/swell potential.

4.2.4 Unweathered Yazoo Clays (CH). Unweathered blue Yazoo clays (CH) were encountered in the borings at depths ranging from approximately 28.5 ft at Boring 4 to about 37.5 ft at Boring 5. The unweathered Yazoo clays (CH) were encountered at elevations ranging from about 308 ft at Boring 5 to approximately 324.5 ft at Boring 4. The unweathered Yazoo clays (CH) are classified as hard with respect to consistency. Unconfined compression tests performed on undisturbed Shelby tube samples of the unweathered Yazoo clays (CH) yielded cohesions ranging from 4.86 to 7.87 kips per sq ft. The unweathered Yazoo clays (CH) are considered to have high strength and low compressibility. The unweathered Yazoo clays (CH) are highly expansive. The unweathered Yazoo clays (CH) were encountered to the 40-ft termination depth of Borings 1, 3, 4 and 5.

4.2.5 Moodys Branch Soils. Soils of the Moodys Branch formation were encountered at the location of Boring 2 at a depth of approximately 69 ft below the surface. The Moodys Branch formation soils were encountered at an elevation of approximately 280 ft at the location of Boring 2. The Moodys Branch formation soils generally include abundant shell fragments and glauconite. The Moodys Branch soils were found to include clays (CH) and sandy clays (CL). The clays (CH) were encountered within about the top 3 ft of the formation immediately below the unweathered blue Yazoo clays (CH). The Moodys Branch sandy clays (CL) were encountered below the clays (CH) to the 80-ft termination depth of Boring 2. The Moodys Branch clays (CH) and sandy clays (CL) are classified as very stiff and hard with respect to consistency. The Moodys Branch soils are considered to have high strength and low compressibility. The Moodys Branch clays (CH) are considered to be highly expansive. The Moodys Branch sandy clays (CL) are considered to have low shrink/swell potential.

4.3 Groundwater

As indicated previously in the report, the borings were initially advanced by dry augering to depths of either 7 ft or 15 ft. Free water was not encountered during auger drilling to a depth of 15 ft for Borings 1 through 4. As noted at the bottom right corner of the graphical log shown on Figure 7, Boring 5 was made at a location where water was standing above the ground surface at the time of our field exploration. It was necessary to dam off the standing water in order to complete Boring 5. The fill materials at Boring 5 were found to have relatively high water contents, and they are classified as soft and medium stiff. Thus, it is likely that water is perched within the fill soils above the underlying weathered Yazoo clays (CH) at Boring 5. It should be noted that groundwater conditions at the site will be influenced by rainfall, surface drainage, and by the rise and fall of water levels in any nearby ditches, creeks, ponds or other bodies of water. Groundwater conditions at the site can also be influenced by man-made changes. Surficial soils can become saturated and weak during periods of prolonged and heavy rainfall.

5.0 DISCUSSION

5.1 Subsurface Conditions

Subsurface soils encountered within the 80-ft maximum exploration depth of the borings made for this investigation generally include fill materials and natural silty clays (CL), sandy clays (CL) and clays (CH) that are underlain in turn by weathered Yazoo clays (CH), unweathered Yazoo clays (CH) and Moodys Branch formation soils. For the most part, the subsurface soils encountered in the borings are relatively strong with moderate to high strength and moderate to low compressibility. However, relatively weak fill materials including medium stiff sandy clays (CL) and clays (CH) were encountered at the locations of Borings 2 and 5. The fill materials were found to include moderately to highly expansive clays (CH), and highly expansive Yazoo clays (CH) were encountered within the fill at the locations of Borings 2 and 3. The natural soils directly underlying the fill at Boring 3 consist of highly expansive clays (CH). The highly expansive weathered Yazoo clays (CH) were encountered at the boring locations at depths ranging from about 7 ft to 16.5 ft below the surface. Hard unweathered blue Yazoo clays (CH) were encountered in the borings at depths ranging from about 28.5 ft to 37.5 ft and at approximate elevations varying between 308 ft and 324.5 ft. Moodys Branch formation soils were encountered in Boring 2 at a depth of about 69 ft and at an approximate elevation of 280 ft. Groundwater is likely perched within the fill materials above the weathered Yazoo clays (CH) at the location of Boring 5.

5.2 Expansive Clay Considerations

The moderately to highly expansive clay (CH) fill and natural soils, and the highly expansive weathered Yazoo clays (CH) can experience significant shrink/swell movements associated with seasonal moisture content fluctuations. Cover materials overlying expansive clay (CH) soils act as a buffer against seasonal moisture content changes caused by rainy weather, droughts and evapotranspiration. Thus, the potential magnitude of moisture content changes and associated shrink/swell movements within expansive clay (CH) soils is proportionate to the thickness of overlying cover materials. Seasonal moisture content changes and shrink/swell movements within expansive clay (CH) soils decrease as the thickness of cover materials increases. There is a general trend for expansive clay (CH) soils under structures to swell due to an increase in water content caused by capillary and vapor phase movement of moisture within the clays (CH). Expansive clay (CH) soils will also experience considerable swelling if directly supplied with water from rainfall, sprinkler systems, broken underground water and sewer pipes, or any other source. Trees growing adjacent to a structure can extract a considerable amount of moisture from the ground resulting in localized shrinkage of expansive clay (CH) soils accompanied by vertical and lateral movements. Overburden removal associated with the establishment of finished grades lower than existing ground elevations will cause stress relief in expansive clay (CH) soils resulting in long-term rebound. Expansive clay (CH) soils will also experience long-term downhill creep movements, depending on slope steepness.

5.3 Geotechnical-Related Design Considerations

The various aspects of expansive clay (CH) soils described in the preceding subsection must be considered in the design and construction of the foundation for the proposed new Outpatient Services Center building. Also, the weak and moderately to highly compressible fill materials encountered at the locations of Borings 2 and 5 must be taken into consideration. A foundation should be utilized which will accommodate the anticipated structural loads and also minimize future differential vertical movements resulting from settlement due to soil consolidation, and shrinking/swelling and rebound within the expansive clay (CH) soils. The new building will be a two-story structure that could potentially become five-story in the future. The building will include a basement with a crawl space below the basement floor slab. Concentrated loads for the building will range from about 100 to 400 kips. The new Outpatient Services Center building will connect to the existing VA Medical Center buildings that we understand are supported above-grade on a deep foundation system. Surface elevations within the area where the new building is to be constructed range from about 356 ft along the west side to approximately 345 ft near the northeast corner. The basement floor elevation will be 346 ft, which is near the existing ground surface elevation within the northeast corner of the site. The crawl space level at the western higher elevation end of the construction site could be as much as about 15 ft below existing grades.

Considering that concentrated loads for the new building will be as great as 400 kips, a relatively great thickness of weak soils was encountered at the location of Boring 5, expansive clay (CH) soils lie at fairly shallow depths at the building site, and the existing VA Medical Center buildings are supported on a deep foundation, we recommend that the structural frame and basement floor slab of the new Outpatient Services Center building be supported above grade by a deep foundation system consisting of either bell-bottom piers bearing in the hard unweathered blue Yazoo clays (CH) or straight-sided shafts that could penetrate through the unweathered Yazoo clays (CH) into the underlying Moodys Branch formation soils.

For the basement and crawl space excavation with variable depths ranging up to about 15 ft and permanent overburden removal, various geotechnical-related issues are relevant for the building foundation and perimeter basement walls. Heaving will occur over time within the crawl space area as a result of rebound within the Yazoo clays (CH) due to stress relief caused by the permanent overburden removal. The Yazoo clays (CH) will also creep laterally toward the center of the excavation imposing horizontal forces on the foundation system. The basement walls of the building will be subjected to lateral earth and water pressures. Earth pressures against the walls could exceed at-rest pressures due to lateral swelling of the Yazoo clays (CH). Sufficient space may not be available at some locations around the building area to permit inclined construction excavation slopes, and therefore, some type of temporary shoring wall might need to be considered. Bell-bottom piers utilized to support the building must penetrate a sufficient depth below the crawl space excavation level so that the net vertical movement of the piers due to rebound and settlement under loading is minimal. The Yazoo clays (CH) within the Outpatient Services Center building site are underlain by Moodys Branch formation soils. The Moodys Branch soils include sandy clays (CL). Underreaming for bell-bottom piers would not be possible within the sandy soils of the Moodys Branch formation; therefore, piers must be terminated within the unweathered Yazoo clays (CH) above the Moodys Branch formation.

Details of our recommendations for design and construction of the bell-bottom pier and straight-sided shaft foundations to support the building are included in the following subsections of this report. Recommendations for site preparation and earthwork construction for sidewalks and other appurtenances associated with the building are provided in a following subsection.

6.0 RECOMMENDATIONS

6.1 Bell-Bottom Pier Foundation

The Outpatient Services Center building could be supported entirely above grade by a deep foundation consisting of auger-drilled and cast-in-place, reinforced concrete, bell-bottom piers brought to bear in the hard unweathered blue Yazoo clays (CH). As indicated previously, unweathered blue Yazoo clays (CH) were encountered in the borings at depths ranging from approximately 28.5 ft to 37.5 ft below the surface. The unweathered Yazoo clays (CH) were encountered at elevations ranging from about 308 ft in the vicinity of Boring 5 to approximately 324.5 ft at the location of Boring 4. We recommend that the piers penetrate either not less than 35 ft below the crawl space excavation level or a minimum of 5 ft into the unweathered blue Yazoo clays (CH), whichever results in the lower elevation. We recommend that the piers not penetrate into Moodys Branch formation soils that were encountered in Boring 2 at an approximate depth of 69 ft below the surface. The Moodys Branch soils were encountered in Boring 2 at an elevation of about 280 ft. Since the Moodys Branch formation soils lie at a relatively great depth below the surface, penetration of the bell-bottom piers into those soils should not be a concern.

The bell-bottom piers should be designed for end bearing. We recommend that the bell-bottom portions of the piers be dimensioned for maximum combinations of dead, live and wind loads utilizing a net allowable soil bearing pressure of 12,000 lbs per sq ft. The recommended allowable bearing pressure refers to the imposed stress at the base of the piers in excess of the soil overburden pressure that will exist after finished grades have been established. The diameter of the bell-bottom portion of each pier should be at least 2.5 times the diameter of the pier shaft to provide resistance against uplift forces. The piers should be reinforced over their entire length with a net steel area equivalent to not less than 1.25 percent of the gross cross-sectional area of the shaft. If necessary, higher percentages of steel reinforcement within the piers should be based on either structural design for anticipated loading conditions or tensile forces resulting from skin friction between the soil and pier shaft caused by heaving Yazoo clays (CH) along the shaft. An adhesion of 1,500 lbs per sq ft should be utilized to estimate the uplift force caused by heaving soils. The pier shafts should be interconnected and braced at the crawl space excavation level by grade beams extending in at least two mutually perpendicular directions. The grade beams should be directly underlain by a void space with a minimum vertical thickness of 24 in. to allow for future unimpeded vertical movement of the underlying soils. The void spaces could be created utilizing wax-coated cardboard box forms that are commonly referred to as J-voids. Alternatively, GeoVoids produced by Plasti-Fab could be utilized. It should be noted that the grade beams must be designed for uplift pressure imposed upon the bottom of the beam considering the complete collapse of the GeoVoid. Estimated uplift pressures can be provided by Plasti-Fab. Vertical shields should be provided along the sides of the void spaces to prevent soil collapse into the voids. The side shields can consist of corrugated fiberglass panels.

Long-term vertical heave will occur beneath the Outpatient Services Center building as the Yazoo clays (CH) rebound in response to stress relief caused by the removal of up to about 15 ft of soil for the basement and crawl space. The belled piers supporting the building will be subjected to upward forces because of heaving of the surrounding Yazoo clays (CH). The amount of vertical rebound is primarily dependent upon the magnitude of stress relief and the thickness of Yazoo clays (CH) remaining beneath the crawl space grade. The clays (CH) and sandy clays (CL) of the Moodys Branch formation should not experience significant amounts of rebound. The thickness of unweathered Yazoo clays (CH) lying below the pier bearing levels at this site will yield less rebound than would occur at a site where the unweathered Yazoo clays (CH) are considerably thicker. The net movement of the piers is expected to be downward as a result of consolidation of the unweathered Yazoo clays (CH) below the pier bells. However, some rebound will occur around the pier shafts that will be reflected as heave in the bottom of the crawl space.

The maximum column load for the Outpatient Services Center building will be on the order of 400 kips. Considering a bell-bottom pier penetrating at least 5 ft into the unweathered blue Yazoo clays (CH) and proportioned for a 400-kip column load using the recommended allowable bearing pressure of 12,000 lbs per sq ft, the estimated settlement for the pier is on the order of 1 in. About one-half of the estimated settlement is expected to occur during and soon after construction, with the remainder of the settlement essentially completed within a few years. It is also roughly estimated that vertical rebound movements at the elevation of the crawl space level within the deepest portion of the excavation could be in the range of 5 in. to 8 in. Rebound is generally expected to develop progressively over a number of years.

The Yazoo clays (CH) underlying the Outpatient Services Center building site will also experience long-term lateral movement toward the center of the building as a result of stress relief caused by up to about 15 ft of overburden removal. The magnitude of the lateral movements is difficult to predict. In our opinion, the grade beams utilized to brace the pier shafts will minimize lateral movements and damage to the piers. Shear reinforcement should be provided within the pier shafts to accommodate horizontal loads caused by lateral movement of the Yazoo clays (CH).

Assuming existing surface elevations will be maintained around the outside of the Outpatient Services Center building, varying amounts of backfill will be placed against the perimeter basement walls of the building. The west end of the building will have as much as about 15 ft of backfill against it. So, effectively there will be a net horizontal force that must be resisted by either battered piers or the vertical pier shafts. If battered piers are not utilized to totally resist the net horizontal force, then the design of the vertical bell-bottom pier shafts should include a lateral load analysis. The pier shafts should be designed so that angular rotation and deflection at the tops of the shafts are maintained within structurally tolerable limits. We recommend that the response of the pier shafts to applied moment and lateral loading be analyzed utilizing the method developed by Dr. Lymon C. Reese of the University of Texas or a similar analysis procedure. Computer programs (e.g., LPILE) are available for this method of analysis. The analysis method utilizes finite difference approximations to solve for deflection, moment, soil modulus and soil reaction for a single pile. Soil response to the laterally loaded pile is represented in the analysis by a set of nonlinear "p-y" curves that are developed for various depths along the pile and for the different soil types. The "p-y" curves essentially indicate the soil reaction in lbs per linear in. of pile versus deflection for a given pile size. We are herein providing a tabulation of recommended soil parameters based on the soil boring and laboratory test data which can be utilized in the method of analysis briefly described in this paragraph.

Soil Type	Total Unit Weight (pcf)	Cohesion (psf)	ϵ_{50}	k (pci)	
				Static	Cyclic
Weathered Yazoo Clays (CH)	110	1,500	0.007	500	200
Unweathered Yazoo Clays (CH)	115	5,000	0.004	1,500	800

The analysis procedure described above will also yield internal stresses which can be utilized as an aid in reinforcement design for the pier shaft. The actual required percent steel reinforcement should be determined by the structural engineer to accommodate maximum anticipated internal stresses within the pier shaft.

The basement floor system of the building should be structurally supported above the crawl space by the bell-bottom pier foundation. The floor system should be designed to span between the piers and grade beams and support the anticipated loadings. All subfloor piping and conduits should be hung from the suspended floor system, and flexible couplings should be utilized at all points where the piping and conduits extend beyond the building and below ground. The crawl space beneath the building should be well ventilated and drained. A means for draining the void spaces beneath the grade beams should also be provided to prevent the accumulation of water.

Normal construction procedures should be employed for the auger-drilled and cast-in-place, reinforced concrete, bell-bottom piers. In the Jackson area, bell-bottom piers are usually constructed without the use of removable steel casing. However, casing will likely be required at some locations (e.g., near Borings 1 and 5) within the Outpatient Services Center building site to seal off perched water and/or to prevent sloughing of weak and/or sandy fill and natural soils and slickensided weathered Yazoo clays (CH) in individual pier holes during drilling and underreaming. Care should be taken to observe each pier excavation, and any loose materials that have sloughed into the drilled and underreamed pier holes should be removed prior to the placement of reinforcing steel and concrete. Concrete should be placed immediately after each pier excavation has been completed and observed. Pier excavations should not be allowed to remain open for more than one hour. All soils excavated during pier construction should be removed from the site and not used as fill material.

6.2 Straight-Sided Shaft Foundation

The Outpatient Services Center building could alternatively be supported by a deep foundation system consisting of relatively large diameter auger-drilled and cast-in-place, reinforced concrete, straight-sided shafts. In addition to column and wall loads, the basement floor slab should be supported by the shafts.

Compressive capacities for straight-sided shafts were estimated using design procedures established by the Federal Highway Administration (FHWA). The compressive capacity of an individual shaft consists of a combination of skin friction around the perimeter of the shaft and end bearing at the tip. Typically, a certain portion of the skin friction is neglected near the base of each shaft and also near the top. For the straight-sided shafts, skin friction was neglected within the depth interval of one shaft diameter above the tip and within the top 5 ft of the shaft. The shaft compressive capacity computations were performed using the ENSOFT computer program SHAFT 5.0 which was developed to model FHWA design criteria.

Allowable compressive capacity curves for various sizes of straight-sided shafts are presented on Figure 9. Ultimate compressive capacities were computed for the various shaft sizes for average subsurface soil conditions revealed by the borings and soil strength parameters based on laboratory test results and engineering judgment. Allowable compressive capacities were determined by applying a safety factor of 2.5 to the skin friction portion of the ultimate capacity and a safety factor of 3.0 to the end bearing portion. We recommend that the shafts minimally penetrate 45 ft below the crawl space excavation level. The allowable compressive capacities can be increased by 25 percent for short-term loadings such as wind loads. Reinforcing for the straight-sided shafts should be as necessary for the applicable compression, tension and lateral loadings. As for the bell-bottom pier shafts, structural design for straight-sided shafts should also consider tensile forces resulting from skin friction between the soil and shaft caused by heaving Yazoo clays (CH) along the shaft. An adhesion of 1,500 lbs per sq ft should be utilized to estimate the uplift force caused by heaving soils. Straight-sided shafts should be spaced a minimum of three diameters center-to-center. No reduction for group efficiency is needed for this spacing considering the site soil conditions. Straight-sided shafts designed and constructed according to recommendations included in this report should experience post-construction settlement of less than 1 in. for single shafts or groups of shafts.

As for the bell-bottom pier foundation, the straight-sided shafts should be interconnected and braced at the crawl space excavation level by grade beams extending in at least two mutually perpendicular directions. The grade beams and shaft caps should be directly underlain by a minimum 24-in. thick void space to allow for future unimpeded vertical movement of the underlying soils. As stated previously in the report, the void spaces could be created utilizing J-Voids or GeoVoids. Recommendations included previously in the report for bell-bottom piers regarding shear reinforcement within the pier shafts to accommodate horizontal loads caused by lateral movements of the Yazoo clays (CH) and lateral load analyses for the pier shafts are also applicable to the straight-sided shafts. Recommendations for the bell-bottom pier foundation pertaining to the support of the basement floor slab, subfloor piping and conduits, ventilation and draining of the crawl space, and draining void spaces beneath grade beams are also applicable to the straight-sided shaft foundation.

6.2.1 Straight-Sided Shaft Construction. The auger-drilled and cast-in-place, reinforced concrete, straight-sided shafts should be constructed in accordance with **Section 803-Deep Foundations** of the Mississippi Standard Specifications for Road and Bridge Construction (2004 Edition). The foundation contractor should demonstrate the minimum experience required by this document. Careful observations will be required during the production drilling and installation of shafts. The drilled shaft holes should be observed prior to reinforcing steel and concrete placement, and any sloughed materials should be removed. The observation procedures should also verify that any groundwater that might have seeped into the shaft holes is removed prior to reinforcing steel and concrete placement. Tremies should be used for placement of concrete to limit the free fall to 15 ft or less as required to prevent significant soil sloughing.

For the soil conditions at the site, it is likely that removable steel casing will be required at some locations to construct the shafts. Casing will likely be necessary at some locations (e.g., near Borings 1 and 5) to seal off perched water and/or to prevent sloughing of weak and/or sandy fill and natural soils and slickensided weathered Yazoo clays (CH) into the excavated shaft holes. It is probable that groundwater will be encountered within the sandy soils of the Moodys Branch formation that would necessitate the use of steel casing and possibly a mud slurry to maintain a stable shaft hole excavation. Care should be taken to observe each shaft excavation, and any loose materials that have sloughed into the drilled shaft holes should be removed prior to the placement of reinforcing steel and concrete. Concrete should be placed immediately after each shaft excavation has been completed and observed. Shaft excavations should not be allowed to remain open for more than one hour. All soils excavated during shaft construction should be removed from the site and not used as fill material.

Test shafts should be installed to define proper installation procedures for production shafts, including drilling, setting casing, tremieing concrete, etc. In addition to the evaluation of drilling, the open holes should be observed for a period of time after completion of drilling for sloughing and groundwater.

We would recommend shaft load testing; however, it is our understanding that the construction schedule may not permit the time for shaft load testing. Load testing could prove that higher unit skin friction and higher unit end bearing values are appropriate for shaft design, thus, resulting in smaller diameter shafts with less penetration to support the anticipated column loads. If performed, shaft load testing should be conducted utilizing an Osterberg load cell in accordance with **Section 803 - Deep Foundations** of the Mississippi Standard Specifications for Road and Bridge Construction (2004 Edition).

6.2.2 Other Shaft Foundation Construction Considerations. Shaft cap excavations should be protected during construction against the intrusion of storm water. Imported select backfill materials placed around and over the shaft caps meeting the classification requirements given in the "Site Preparation and Earthwork Construction" section of this report should be spread in maximum 5-in. thick loose lifts and compacted with hand-controlled mechanical tampers to not less than 95 percent of standard Proctor maximum dry density (ASTM D 698). The moisture content of the backfill materials should be within 3 percentage points of the optimum water content as determined by standard Proctor compaction tests.

6.3 Temporary Structure Excavation

A maximum depth of excavation of about 15 ft will be required for the Outpatient Services Center building to reach the level of the crawl space. Based on the borings, the excavation will extend primarily through silty clay (CL), sandy clay (CL) and clay (CH) fill materials, natural clays (CH), and natural weathered Yazoo clays (CH) that were found to be slickensided within some depth intervals. The excavation for construction of the building should be made in accordance with all OSHA regulations. It should be noted that weathered Yazoo clays (CH) exposed in excavation slopes will be susceptible to sloughing, particularly if rainwater enters cracks which form in the clays (CH) as a result of rebound and/or drying. It would be prudent to cover weathered Yazoo clays (CH) in the excavation slopes with visqueen or some other form of membrane to minimize drying of the clays (CH) and exposure to rainfall.

Temporary excavation support walls may be required at some locations around the building site where there is not sufficient space for an open excavation. We recommend that temporary excavation support walls be designed using the effective stress strength parameters shown in Table 1 below for the soil types revealed by the borings

Table 1
Recommended Soil Parameters
Design of Temporary Excavation Support Walls

Soil Strata	Φ' (degrees)	c' (psf)	γ_t (pcf)
Existing On-site Fill Materials	24	0	125
Weathered Yazoo Clays (CH)	20	0	120
Unweathered Yazoo Clays (CH)	25	0	122
Moodys Branch Soils	26	0	122

If temporary excavation support walls are located adjacent to existing structures that are sensitive to settlement, at-rest earth pressures should be used in the design of the temporary walls. Otherwise, active earth pressures can be used in the design of the temporary walls.

Geocomposite drainage board should be placed behind the temporary wall facing to prevent buildup of groundwater behind the wall.

6.4 Basement Walls

The basement walls of the Outpatient Services Center building will act as retaining walls and will be subjected to lateral earth pressures. The depth of backfill against the walls will be as great as about 15 ft. The basement walls will be supported by the building foundation system.

We recommend that backfill soils behind the walls consist of relatively free-draining granular materials. The granular backfill materials should consist of either sands (SP) with less than 5 percent fines or slightly silty sands (SP-SM) including 5 to 12 percent fines. The percentage of fines within the soil is defined as that portion which passes the No. 200 sieve size. The granular backfill soils should be covered with a minimum 18-in. thick layer of silty clay (CL) or sandy clay (CL) plating material. The silty clays (CL) and sandy clays (CL) should have a liquid limit less than 45 and a plasticity index (PI) in the range of 10 to 24. This plating material will serve to retard the intrusion of surface water into the backfill and reduce the potential for saturation of the backfill. We recommend that a perforated and filtered pipe drain be installed behind the walls.

We recommend that the wall backfill materials be compacted from 9-in. thick loose lifts to not less than 98 percent of standard Proctor maximum dry density (ASTM D 698) at moisture contents within 3 percentage points of the optimum water content. To avoid inducing excessive lateral pressures upon the walls, we recommend that motorized compaction equipment such as rollers or vibratory compactors be operated no closer than 3 ft from the walls. In this 3-ft wide zone immediately adjacent to the walls, we recommend compaction of the backfill in maximum 5-in. thick loose lifts utilizing hand-operated mechanical tampers. Stability must be evident during compaction of each lift before any subsequent lifts of fill material are added. Stability is defined as the absence of significant pumping or yielding of the soils during compaction.

Laboratory classification tests, including grain-size analyses and Atterberg limit determinations, should be performed on the backfill soils initially and routinely during earthwork operations to check for compliance with the recommendations provided herein. Field moisture/density tests should be performed frequently in each compacted lift to assist in evaluating whether the recommended dry density is being achieved.

Our recommendations for lateral earth pressures to be utilized in the design of the basement walls are presented on Figures 10 and 11. The recommended pressures are based on the assumption that at-rest earth pressure conditions are applicable because the walls are restrained and cannot experience any rotation.

Figure 10 presents the case where sufficient space exists beyond the basement wall alignment for excavation and placement of select fill with a minimum width at the base of the fill of at least one-half the wall height and a width at the top of the fill of one and one-half the wall height considering an excavation slope not steeper than 1H:1V. For this case, the design at-rest earth pressures are based on the properties of the select fill.

Figure 11 presents the case where limited space exists beyond the basement wall alignment for the temporary excavation and the widths of fill behind the wall as described in the preceding paragraph are not achievable. For this case, the design lateral earth pressures are based on the properties and swell potential of the weathered Yazoo clays (CH).

6.5 Site Preparation and Earthwork Construction

Since the new Outpatient Services Center building is to be supported entirely above grade by a deep foundation system, no special earthwork is needed for the building, except as required either to remove existing subsurface features that might interfere with construction or to grade to provide for drainage within the crawl and/or void spaces beneath the structure. Sidewalks and other appurtenances supported on grade that abut the building will move differentially with respect to the deep-foundation-supported structure. If the differential movement is considered detrimental or not acceptable, the appurtenances should also be supported on a deep foundation. Otherwise, the expected differential movements resulting from either settlement due to consolidation of weak soils as encountered at Borings 2 and 5 or shrinking and swelling of the expansive clay (CH) soils can be reduced by excavating and replacing the weak soils with compacted select fill and providing a separating buffer of low permeability and low shrink/swell potential soil between the sidewalks and other appurtenances and the underlying expansive clays (CH). The buffer should have a minimum thickness of 7 ft. Undercutting should be performed as required to provide for the placement of the recommended low shrink/swell potential soil buffer thickness.

As an initial step of site preparation, all existing pavement, foundations, utilities or pipes, and any other subsurface obstructions that might interfere with foundation construction for the building should be removed and/or relocated. Stripping should be performed to remove organic-laden surficial soils, vegetation, debris, brush and roots. Excavation should be performed as required to remove weak soils. Undercutting should be performed as required for sidewalks and other appurtenances that will abut the building to permit the construction of the low permeability and low shrink/swell potential soil buffer described above. The vertical and lateral extent of excavation required to remove weak soils and undercutting to remove expansive clays (CH) must be determined in the field during earthwork construction. Stripping, excavation and/or undercutting should extend laterally not less than 3 ft beyond the edges of sidewalks and not less than 5 ft beyond the limits of other appurtenances.

In areas to receive fill after stripping, excavation and/or undercutting, the exposed soils should be scarified to a minimum depth of 6 in. and compacted to not less than 95 percent of standard Proctor maximum dry density (ASTM D 698) with stability present. Alternatively, the exposed soils can be proofrolled to demonstrate stability. Stability is defined as the absence of significant pumping, yielding or rutting of soils during compaction or proofrolling. If stability is not evident in some areas, either additional excavation or treatment of the in situ soils with an admixture, or a combination of these approaches, might be required to achieve stable conditions.

It should be noted that fine-grained soils exposed after stripping, excavation and undercutting are susceptible to pumping under wet conditions. The construction techniques and types of equipment utilized and site drainage provided during construction will have a great effect on the performance of these soils throughout the project. The routing of heavy rubber-tired equipment should be controlled to minimize, as much as possible, traffic over the site. All traffic should be discouraged during periods of inclement weather. If pumping is initiated in fine-grained soils, as a construction expedient the pumping can be counteracted by treating these materials with hydrated lime. It is estimated that about 4 to 6 percent hydrated lime by dry weight of soil could be required for silty clays (CL) and sandy clays (CL).

After stripping, excavation, undercutting, and scarification/compaction or proofrolling have been performed as recommended in the preceding paragraphs, fill materials can be placed to achieve planned grades. Imported fill soils should consist of select, nonorganic and debris-free silty clays (CL) having a plasticity index (PI) within the range of 10 to 24 and a liquid limit less than 45. To be classified as silty clays (CL), the fill materials must have more than 70 percent fines passing the No. 200 sieve. Fill materials should be compacted from lifts not exceeding 9 in. in loose thickness to not less than 95 percent of standard Proctor maximum dry density (ASTM D 698) at moisture contents within 3 percentage points of the optimum water content. Where hand-controlled mechanical tampers are utilized for compaction of fill, the loose lift thickness should be limited to 5 in. Stability must be evident during compaction of each lift before any subsequent lifts of fill material are added. As a construction expedient, fill soils that are unstable and/or pumping due to excessive moisture can be treated with hydrated lime in accordance with recommendations given previously for pumping on-site soils. Finished site grades should be sloped to promote quick runoff of storm water away from the building.

Laboratory classification tests, including Atterberg limit determinations and grain-size analyses, should be performed on the fill soils initially and routinely during earthwork operations to check for compliance with the recommendations provided herein. Field moisture/density tests should be performed frequently in the scarified and compacted on-site soils and in each compacted lift of fill material to assist in evaluating whether the recommended moisture contents and dry densities are being achieved. As a guide for building and appurtenant features earthwork construction, we suggest a minimum of one test per lift for each 2,000 sq ft of surface area or portion thereof.

6.6 Other Design Considerations

The moderately to highly expansive clay (CH) fill and natural soils and the highly expansive weathered Yazoo clays (CH) which underlie the ground surface at the site will swell considerably if directly supplied with water. If flower and shrub beds including sprinkler systems are placed adjacent to the building, the beds should be prepared such that they do not trap water, and sprinklers should be operated only enough to satisfy the water demands of the plants and shrubs. Excessive watering and ponding adjacent to the building could result in downward percolation of water to the expansive clays (CH) causing them to swell. Rainwater falling directly on the building should be collected and prevented from reaching the ground beneath and immediately adjacent to the building. Downspouts transmitting water to the ground level should emit collected rainwater not less than 10 ft away from the building. The downspouts could be connected to solid discharge pipes buried beneath the ground. We caution that these pipes should be flexible enough to accommodate some differential movement and all pipe connections must be leak free. Trees remove water from the ground by transpiration causing vertical and horizontal shrinkage of clays (CH). To minimize these effects, any trees planted for landscaping purposes should be located at least one-half their anticipated mature height away from the building. If the risk of more movement is acceptable, a less strict building-to-tree spacing of about 25 ft for hardwoods and 15 ft for pines could be utilized.

The new Outpatient Services Center building will be supported completely above grade on a deep foundation and it will connect with existing VA Medical Center buildings that we understand are also supported above grade on a deep foundation system. Thus, differential movement between the new and existing buildings should be minimal. However, we recommend that an expansion joint be provided between the new and existing buildings at the connecting points to accommodate any differential movement that occurs.

The site for the Outpatient Services Center building at the VA Medical Center in Jackson, Mississippi lies within a relatively low seismic activity region according to the seismic zone mapping referenced in the 2003 International Building Code. Given the site soil profile as revealed by the borings and anticipated for the area based on our experience, a site class D could be used in a seismic load evaluation.

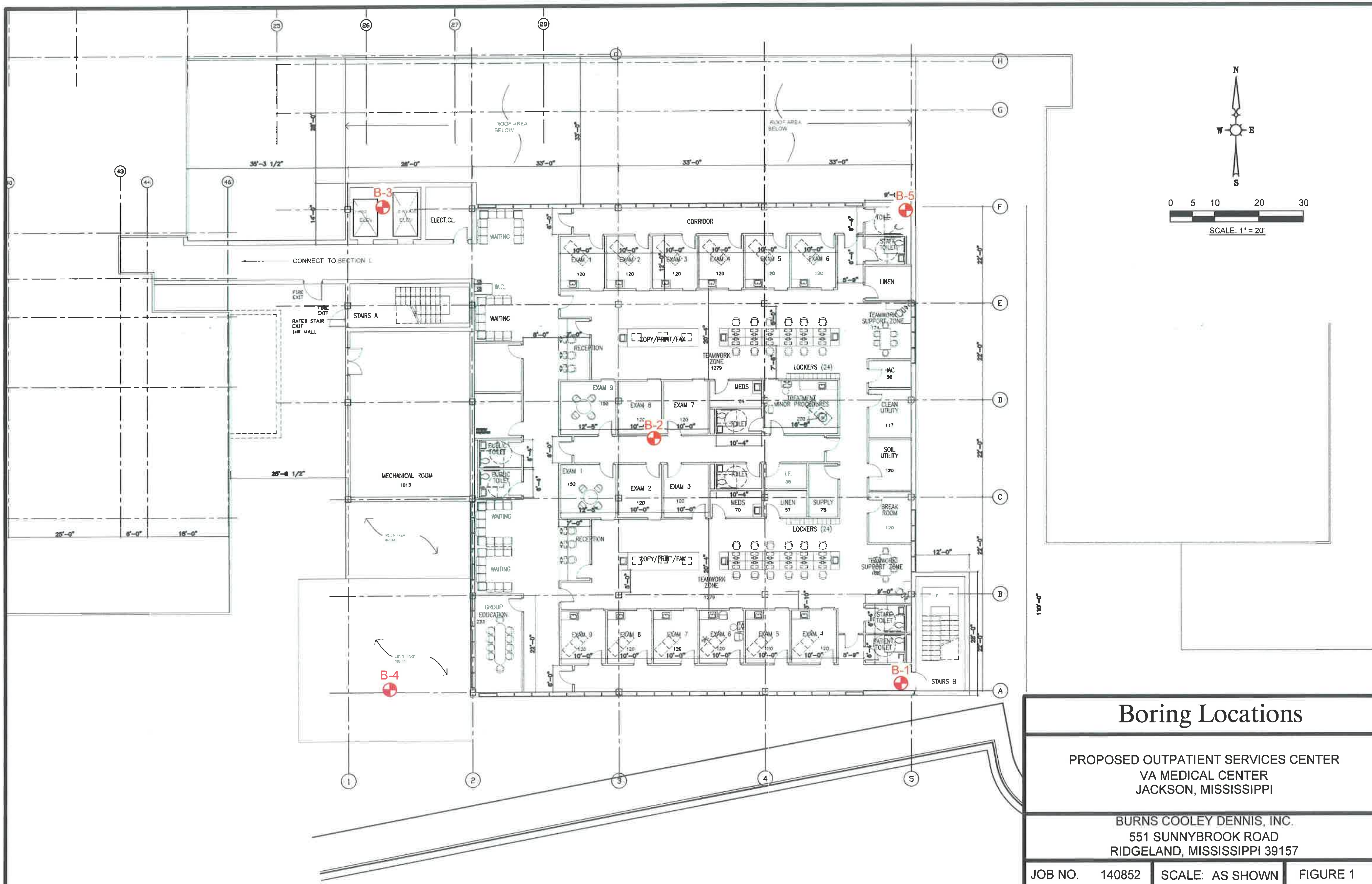
7.0 REPORT LIMITATIONS

The analyses, conclusions and recommendations discussed in this report are based on conditions as they existed at the time of our field investigation and further on the assumption that the exploratory borings are representative of subsurface conditions throughout the area investigated. It should be noted that actual subsurface conditions between and beyond the borings might differ from those encountered at the boring locations. If subsurface conditions are encountered during construction that vary from those discussed in this report, Burns Cooley Dennis, Inc. should be notified immediately in order that we may evaluate the effects, if any, on the recommendations provided.

Burns Cooley Dennis, Inc. should be retained for a general review of final design drawings and specifications. It is advised that we be retained to observe earthwork and foundation construction for the project in order to help confirm that our recommendations are valid or to modify them accordingly. Burns Cooley Dennis, Inc. cannot assume responsibility or liability for the adequacy of recommendations if we do not observe construction.

This report has been prepared for the exclusive use of AKEA, Inc. for specific application to the geotechnical aspects of design and construction for the proposed Outpatient Services Center building to be constructed at the VA Medical Center in Jackson, Mississippi. The only warranty made by us in connection with the services provided is we have used that degree of care and skill ordinarily exercised under similar conditions by reputable members of our profession practicing in the same or similar locality. No other warranty, express or implied, is made or intended.

FIGURES



Boring Locations

PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

BURNS COOLEY DENNIS, INC.
551 SUNNYBROOK ROAD
RIDGELAND, MISSISSIPPI 39157

JOB NO.	140852	SCALE: AS SHOWN	FIGURE 1

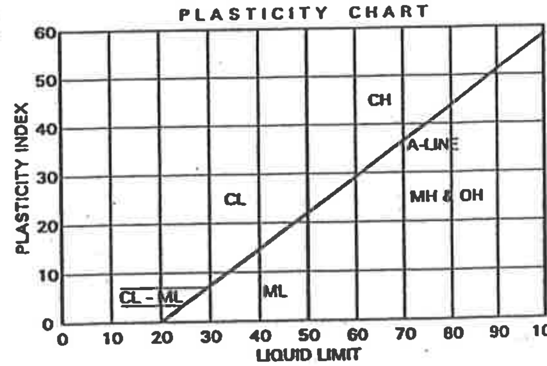
UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			SYMBOL & LETTER	DESCRIPTION
COARSE-GRAINED SOILS More than half of material larger than No. 200 sieve size	GRAVELS More than half of coarse fraction larger than No. 4 sieve size	Clean Gravels (Little or no fines)	GW	WELL GRADED GRAVEL, GRAVEL-SAND MIXTURE
			GP	POORLY GRADED GRAVEL, GRAVEL-SAND MIXTURE
		Gravels with fines (Appreciable amount of fines)	GM	SILTY GRAVEL, GRAVEL-SAND-SILT MIXTURE
			GC	CLAYEY GRAVEL, GRAVEL-SAND-CLAY MIXTURE
	SANDS More than half of coarse fraction smaller than No. 4 sieve size	Clean Sands (Little or no fines)	SW	WELL GRADED SAND, GRAVELLY SAND
			SP	POORLY GRADED SAND, GRAVELLY SAND
		Sands with fines (Appreciable amount of fines)	SM	SILTY SAND, SAND-SILT MIXTURE
			SC	CLAYEY SAND, SAND-CLAY MIXTURE
FINE-GRAINED SOILS More than half of material smaller than No. 200 sieve	SILTS AND CLAYS	Liquid limit less than 50	ML	SILT WITH LITTLE OR NO PLASTICITY
			ML	CLAYEY SILT, SILT WITH SLIGHT TO MEDIUM PLASTICITY
			CL	SILTY CLAY, LOW TO MEDIUM PLASTICITY
			CL	SANDY CLAY, LOW TO MEDIUM PLASTICITY (30% TO 50% SAND)
	SILTS AND CLAYS	Liquid limit greater than 50	MH	SILT, FINE SANDY OR SILTY SOIL WITH HIGH PLASTICITY
			CH	CLAY, HIGH PLASTICITY
			OH	ORGANIC CLAY OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOIL

TERMS CHARACTERIZING SOIL STRUCTURE

Slickensided	- Clays with polished and striated planes created as a result of volume changes related to shrinking, swelling and/or changes in overburden pressure.
Fissured	- Clays with a blocky or jointed structure generally created by seasonal shrinking and swelling.
Laminated	- Composed of thin alternating layers of varying color and texture.
Calcareous	- Containing appreciable quantities of calcium carbonate.
Parting	- Paper thin (less than 1/8 inch).
Seam	- 1/8 inch to 3 inch thickness.
Layer	- Greater than 3 inches in thickness.

PLASTICITY CHART



FOR CLASSIFICATION OF FINE GRAINED SOILS

DENSITY AND CONSISTENCY

COARSE-GRAINED SOILS

DENSITY	PENETRATION RESISTANCE, N Blows per Foot
Very loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	>50

FINE-GRAINED SOILS

CONSISTENCY	COHESION Kips/Sq.Ft	PENETRATION RESISTANCE, N Blows per Foot
Very Soft	<0.25	0 - 1
Soft	0.25 - 0.50	2 - 4
Medium Stiff	0.50 - 1.00	5 - 8
Stiff	1.00 - 2.00	9 - 15
Very Stiff	2.00 - 4.00	16 - 30
Hard	>4.00	>30

SAMPLE TYPES
(Shown in Sample Column)

Shelby Tube
Split Spoon
No Recovery
Auger
Dennison Barrell

PARTICLE SIZE IDENTIFICATION

Cobbles	- Greater than 3 inches
Gravel	- Coarse - 3/4 inch to 3 inches
	Fine - 4.76 mm to 3/4 inch
Sand	- Coarse - 2 mm to 4.76mm
	Medium - 0.42 mm to 2 mm
	Fine - 0.074 mm to 0.42 mm
Silt & Clay	- Less than 0.074 mm

RELATIVE COMPOSITION

Slightly	5 - 15%
With	16 - 29%
Sandy (or gravelly)	30 - 50%

CLASSIFICATION, SYMBOLS AND TERMS USED ON GRAPHICAL BORING LOGS

FIGURE 2

BURNS COOLEY DENNIS, INC.

LOG OF BORING NO. 1

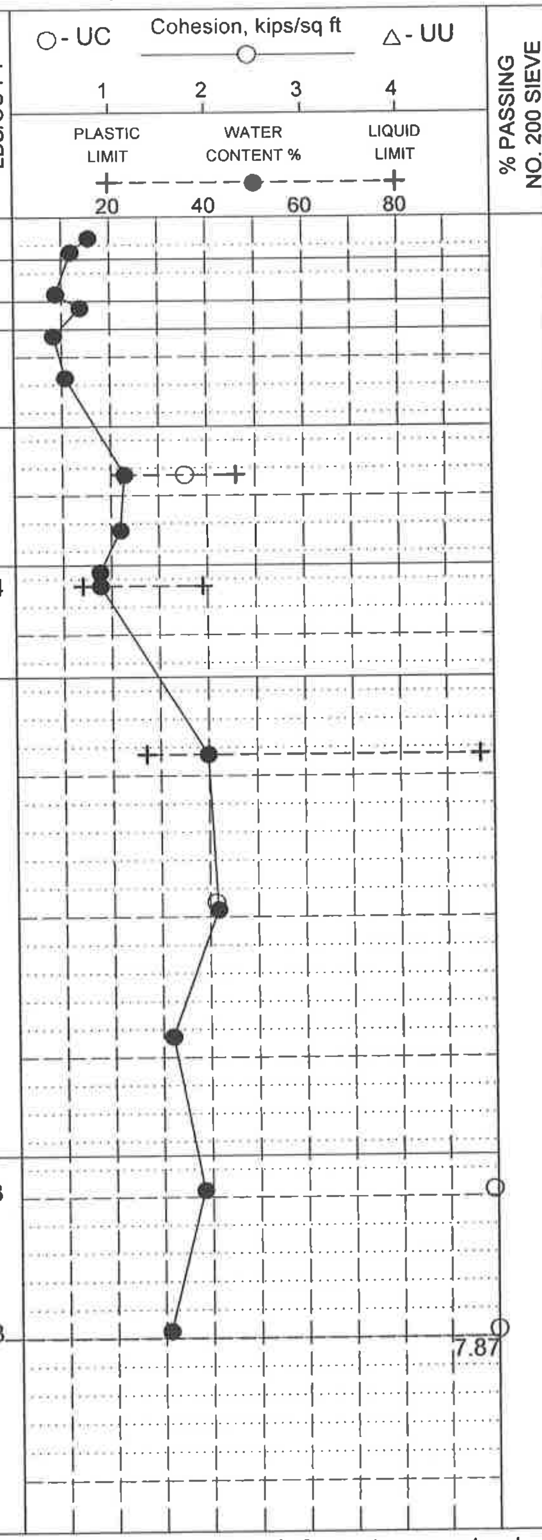
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

TYPE: 6" Short-flight auger to 15, then rotary wash to completion.

LOCATION: See Figure 1

SURFACE EL: 347.5 ±ft

DEPTH, ft	DESCRIPTION OF MATERIAL	BLOWS PER FT	DRY DENSITY LBS/CU FT
0	Very stiff red and tan sandy clay (CL) with clay pockets and gravel (FILL)		
	Medium dense tan silty fine to coarse sand (SM) with gravel and concrete rubble (FILL)		
5	Stiff tan sandy clay (CL) with gravel (FILL)		
	Medium dense red and tan clayey fine sand (SC) with gravel (FILL) - with clay pockets to 5.5'		101
10	Stiff tan and light gray silty clay (CL)		
	Very stiff tan, light gray and red sandy clay (CL) - with trace of gravel below 13.5'		114
15	Very stiff tan and light gray clay (CH) (WEATHERED YAZOO) - slickensided to 22'		
25	- hard, with gypsum below 27'		
35	Hard blue clay (CH) with shell fragments (UNWEATHERED YAZOO)		83
40			93



BORING DEPTH: 40 ft

DATE: 12/22/14

COMMENTS: Borehole filled with cement-bentonite grout after completion of drilling and sampling.
<u>GPS Coordinates</u>
N 32° 19' 38.2"
W 90° 09' 58.7"

GROUNDWATER DATA: No free water encountered during auger drilling.

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BURNS COOLEY DENNIS, INC.
GEOTECHNICAL AND MATERIALS ENGINEERING CONSULTANTS

FIGURE 3

LOG OF BORING NO. 2

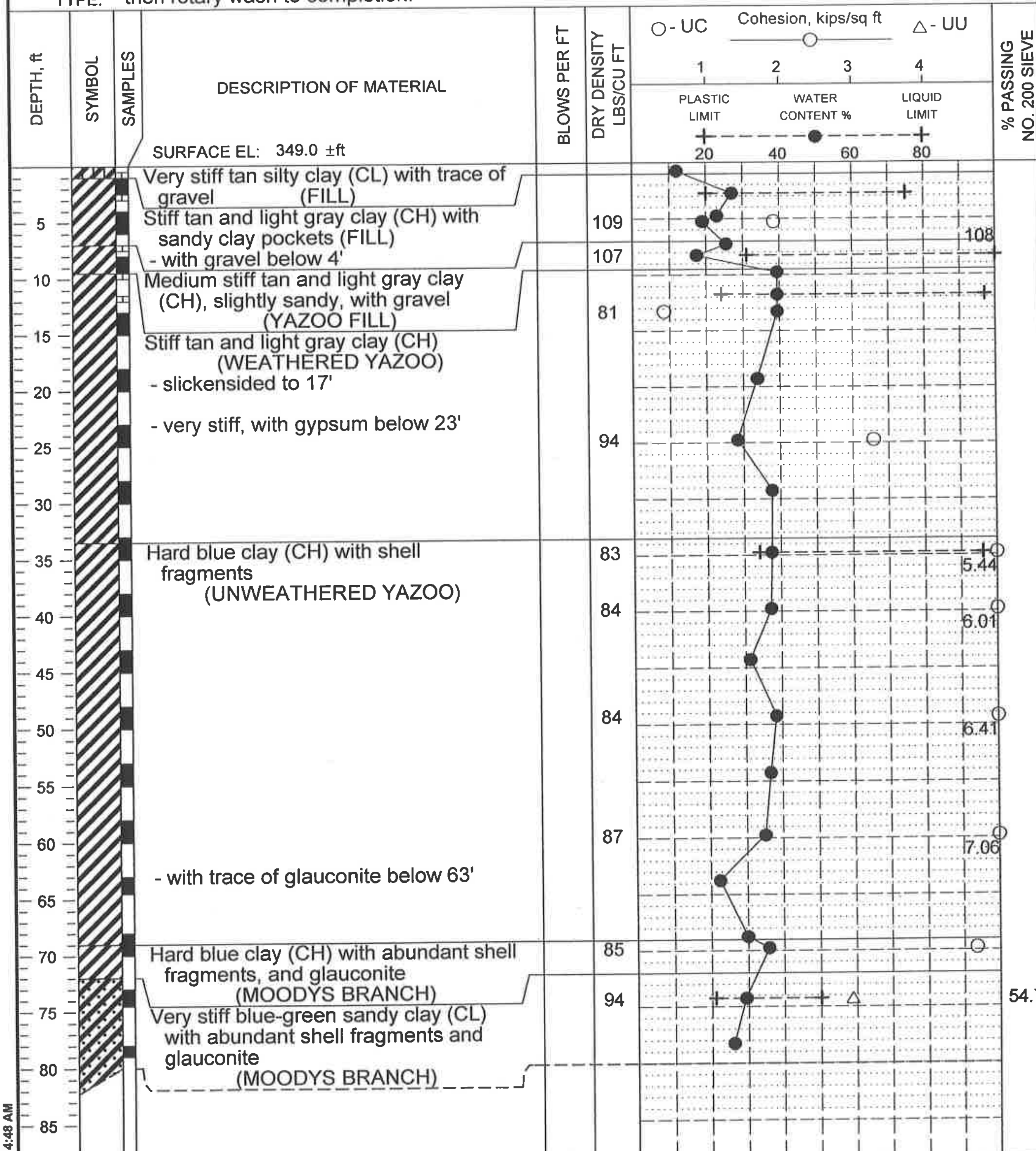
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

TYPE: 6" Short-flight auger to 15', then rotary wash to completion.

LOCATION: See Figure 1

SURFACE EL: 349.0 ±ft

DESCRIPTION OF MATERIAL	DRY DENSITY LBS/CU FT
Very stiff tan silty clay (CL) with trace of gravel (FILL)	
Stiff tan and light gray clay (CH) with sandy clay pockets (FILL)	109
- with gravel below 4'	107
Medium stiff tan and light gray clay (CH), slightly sandy, with gravel (YAZOO FILL)	81
Stiff tan and light gray clay (CH) (WEATHERED YAZOO)	
- slickensided to 17'	
- very stiff, with gypsum below 23'	94
Hard blue clay (CH) with shell fragments (UNWEATHERED YAZOO)	83
	84
	84
	87
- with trace of glauconite below 63'	
Hard blue clay (CH) with abundant shell fragments, and glauconite (MOODYS BRANCH)	85
Very stiff blue-green sandy clay (CL) with abundant shell fragments and glauconite (MOODYS BRANCH)	94



BORING DEPTH: 80 ft

DATE: 12/23/14 & 12/24/14

COMMENTS: Borehole filled with cement-bentonite grout after completion of drilling and sampling.
GPS Coordinates
N 32° 19' 38.7"
W 90° 09' 59.7"

GROUNDWATER DATA: No free water encountered during auger drilling.

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BURNS COOLEY DENNIS, INC.
GEOTECHNICAL AND MATERIALS ENGINEERING CONSULTANTS

FIGURE 4

LOG OF BORING NO. 3

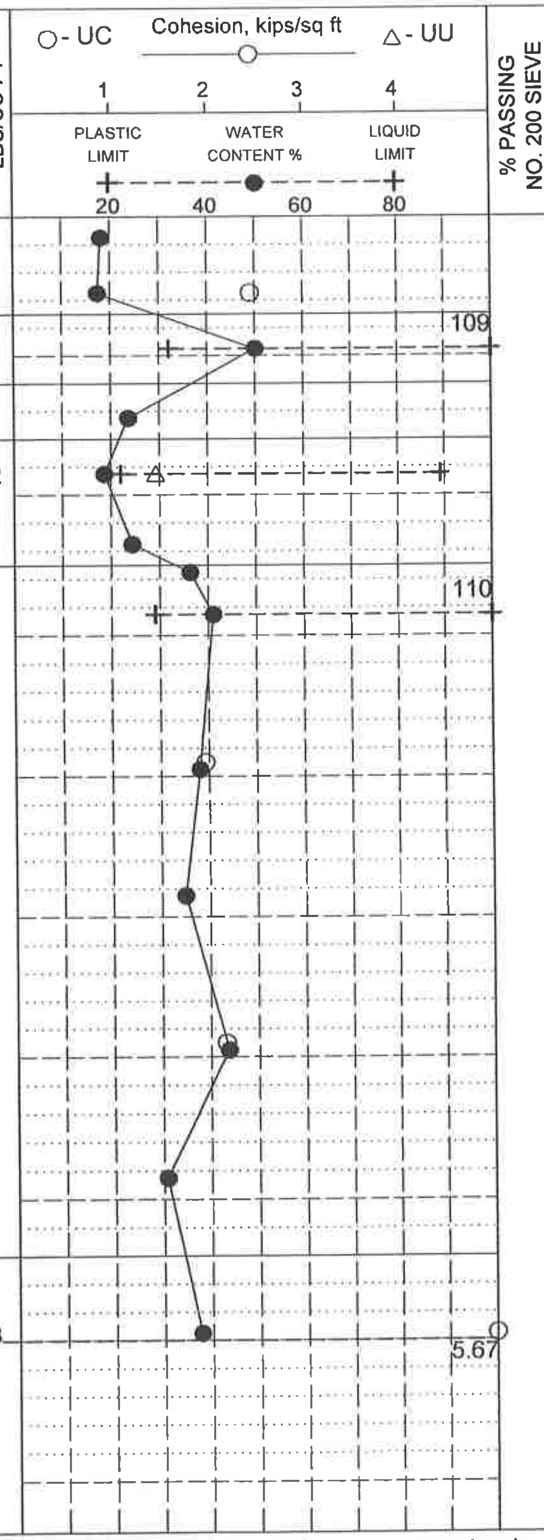
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

TYPE: 6" Short-flight auger to 15', then rotary wash to completion.

LOCATION: See Figure 1

SURFACE EL: 356.0 ±ft

DEPTH, ft	DESCRIPTION OF MATERIAL	BLOWS PER FT	DRY DENSITY LBS/CU FT
0 – 3.5	Very stiff tan and light gray silty clay (CL), slightly sandy, with gravel (FILL) - with clay pockets 1.5' - 2.5'		112
3.5 – 6	Stiff light gray and tan clay (CH) (YAZOO FILL)		
6 – 8	Stiff tan and light gray clay (CH) with silty clay pockets (FILL)		
8 – 12.5	Stiff gray and tan clay (CH) - slightly sandy to 11' - tan and light gray below 9'		112
12.5 – 37	Stiff tan and light gray clay (CH) (WEATHERED YAZOO) - slickensided to 17' - very stiff below 22' - with gypsum 27' - 32'		85, 77
37 – 40	Hard blue clay (CH) with shell fragments (UNWEATHERED YAZOO)		83



BORING DEPTH: 40 ft

DATE: 12/26/14

COMMENTS: Borehole filled with cement-bentonite grout after completion of drilling and sampling.
GPS Coordinates
N 32° 19' 38.7"
W 90° 09' 59.7"

GROUNDWATER DATA: No free water encountered during auger drilling.

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BURNS COOLEY DENNIS, INC.
GEOTECHNICAL AND MATERIALS ENGINEERING CONSULTANTS

LOG OF BORING NO. 4

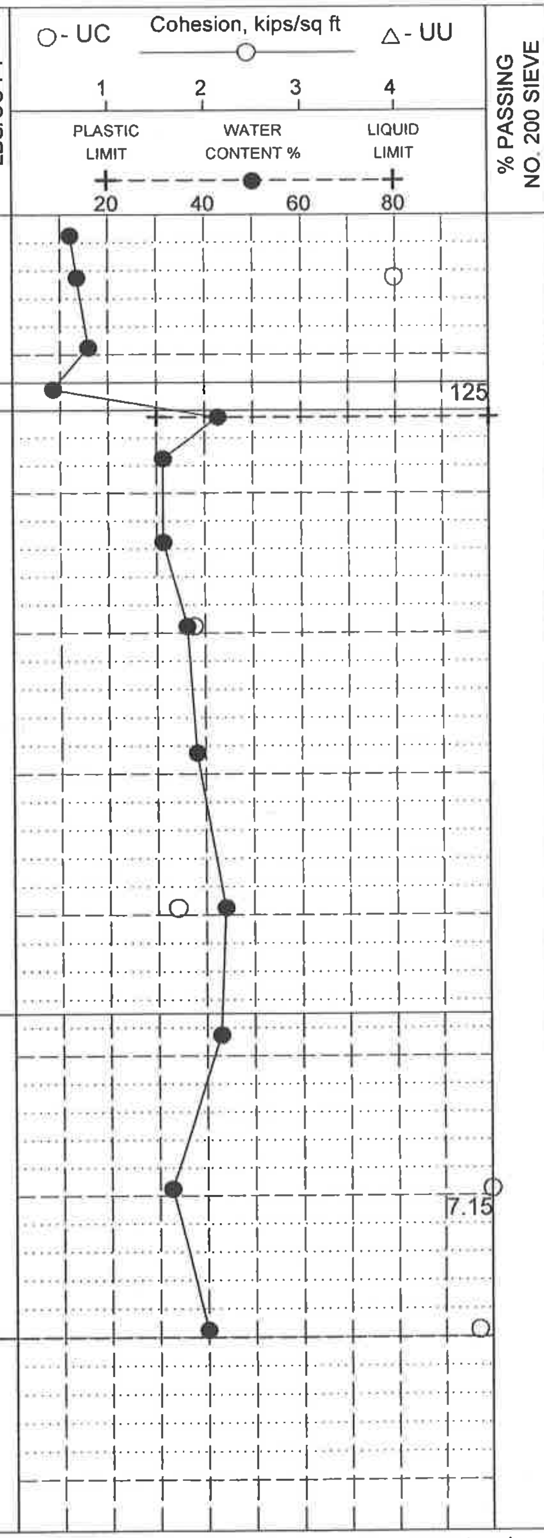
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

TYPE: 6" Short-flight auger to 15', then rotary wash to completion.

LOCATION: See Figure 1

SURFACE EL: 353.0 ±ft

DEPTH, ft	DESCRIPTION OF MATERIAL	BLOWS PER FT	DRY DENSITY LBS/CU FT
0 – 6	Hard tan and light gray silty clay (CL), slightly sandy (FILL) - with roots 1' - 2'		117
6 – 7	Medium dense red clayey fine sand (SC) with gravel (FILL)		
7 – 28.5	Stiff tan and light gray clay (CH) (WEATHERED YAZOO) - slickensided 11' - 17'		85, 77
28.5 – 40	Hard blue clay (CH) with shell fragments (UNWEATHERED YAZOO)		90, 83



BORING DEPTH: 40 ft

DATE: 12/26/14

COMMENTS: Borehole filled with cement-bentonite grout after completion of drilling and sampling.
GPS Coordinates
N 32° 19' 38.0"
W 90° 09' 59.8"

GROUNDWATER DATA: No free water encountered during auger drilling.

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FIGURE 6

LOG OF BORING NO. 5

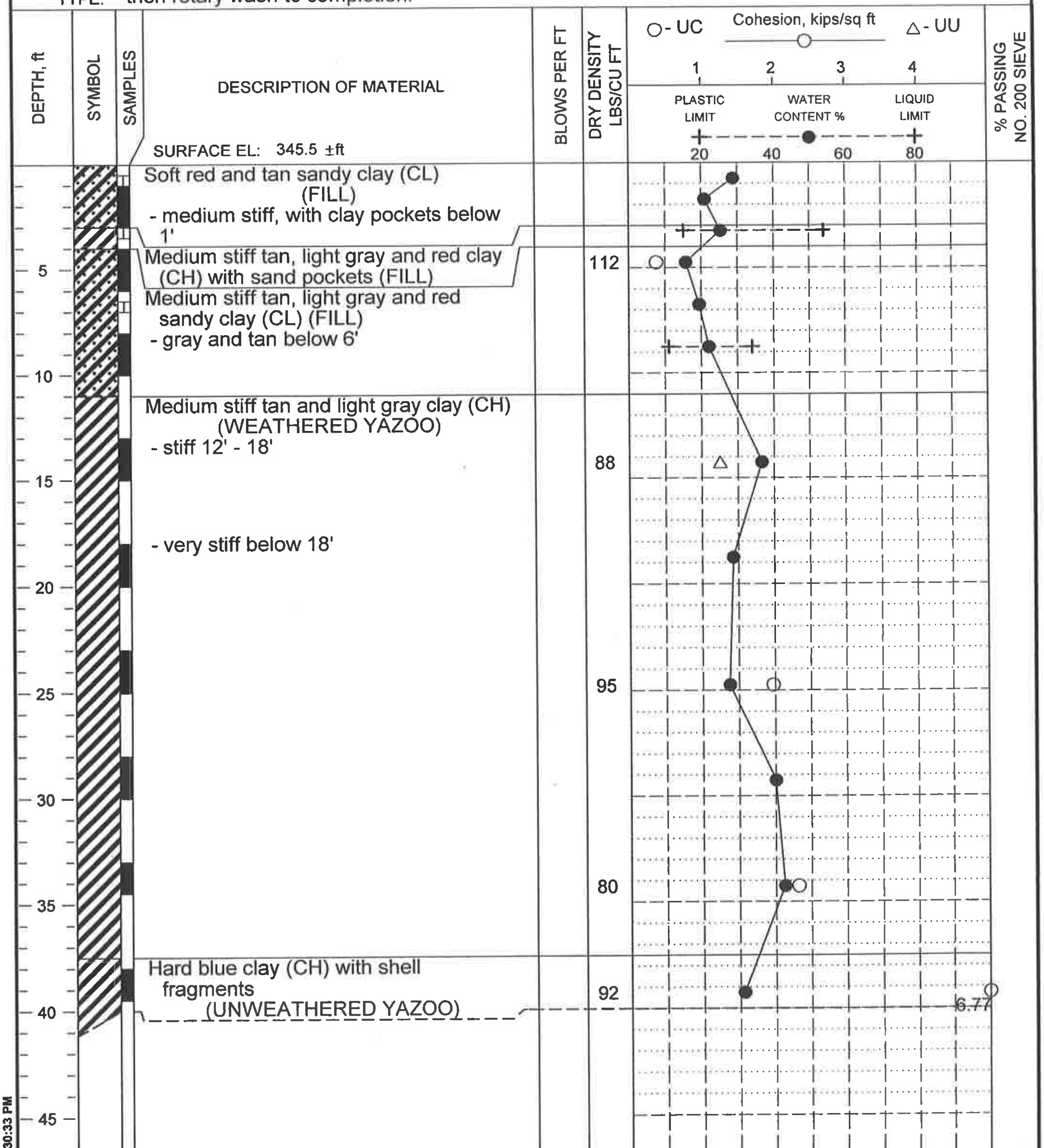
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI

TYPE: 6" Short-flight auger to 7', then rotary wash to completion.

LOCATION: See Figure 1

SURFACE EL: 345.5 ±ft

DEPTH, ft	DESCRIPTION OF MATERIAL	DRY DENSITY LBS/CU FT
0–3	Soft red and tan sandy clay (CL) (FILL) - medium stiff, with clay pockets below 1'	
3–4	Medium stiff tan, light gray and red clay (CH) with sand pockets (FILL)	112
4–11	Medium stiff tan, light gray and red sandy clay (CL) (FILL) - gray and tan below 6'	
11–37.5	Medium stiff tan and light gray clay (CH) (WEATHERED YAZOO) - stiff 12' - 18' - very stiff below 18'	88, 95, 80
37.5–40	Hard blue clay (CH) with shell fragments (UNWEATHERED YAZOO)	92



BORING DEPTH: 40 ft

DATE: 12/29/14

COMMENTS: Borehole filled with cement-bentonite grout after completion of drilling and sampling.
GPS Coordinates
N 32° 19' 39.1"
W 90° 09' 58.4"

GROUNDWATER DATA: About 6" to 8" of water standing above ground surface during drilling and sampling.

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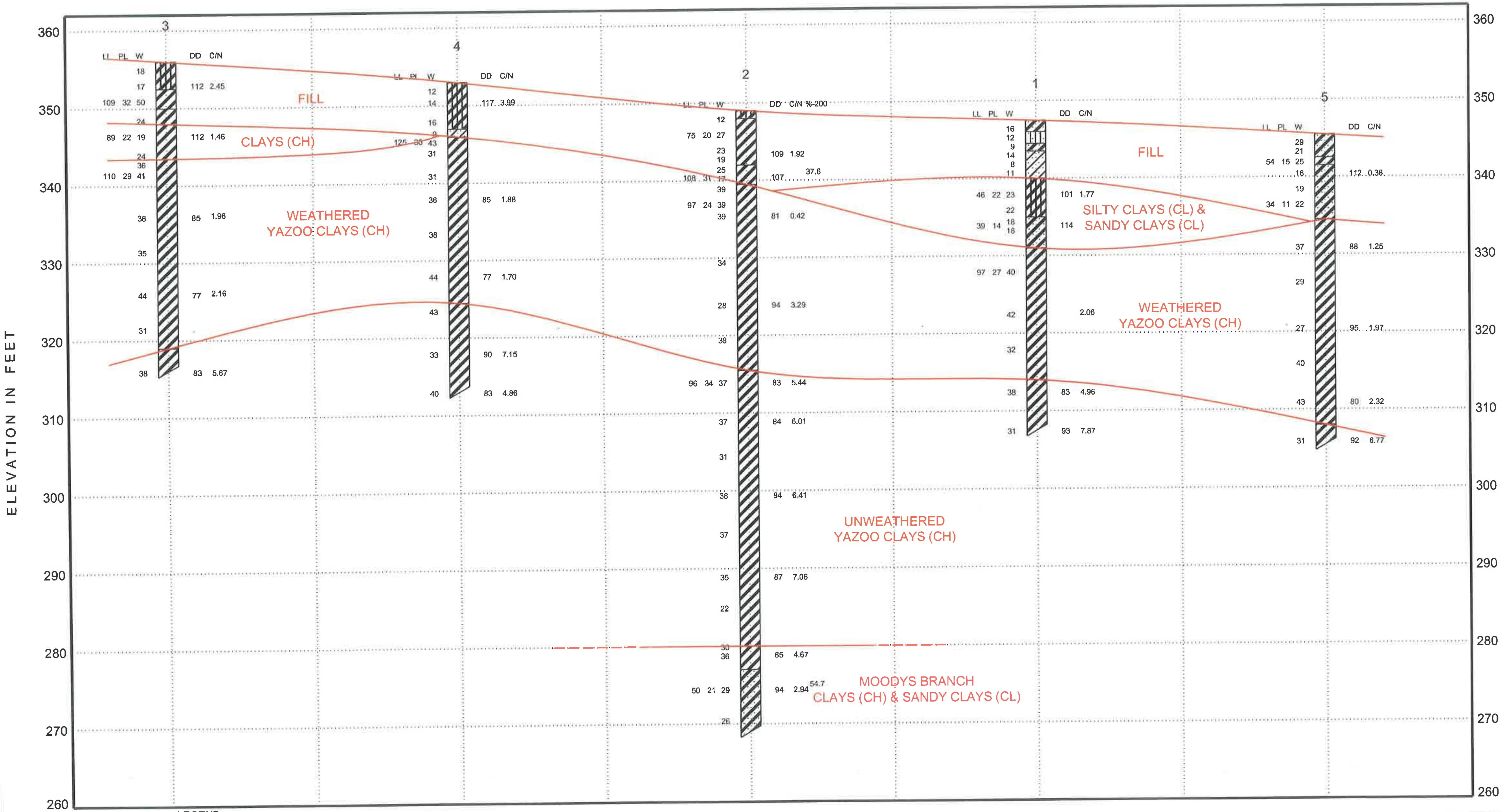
FIGURE 7

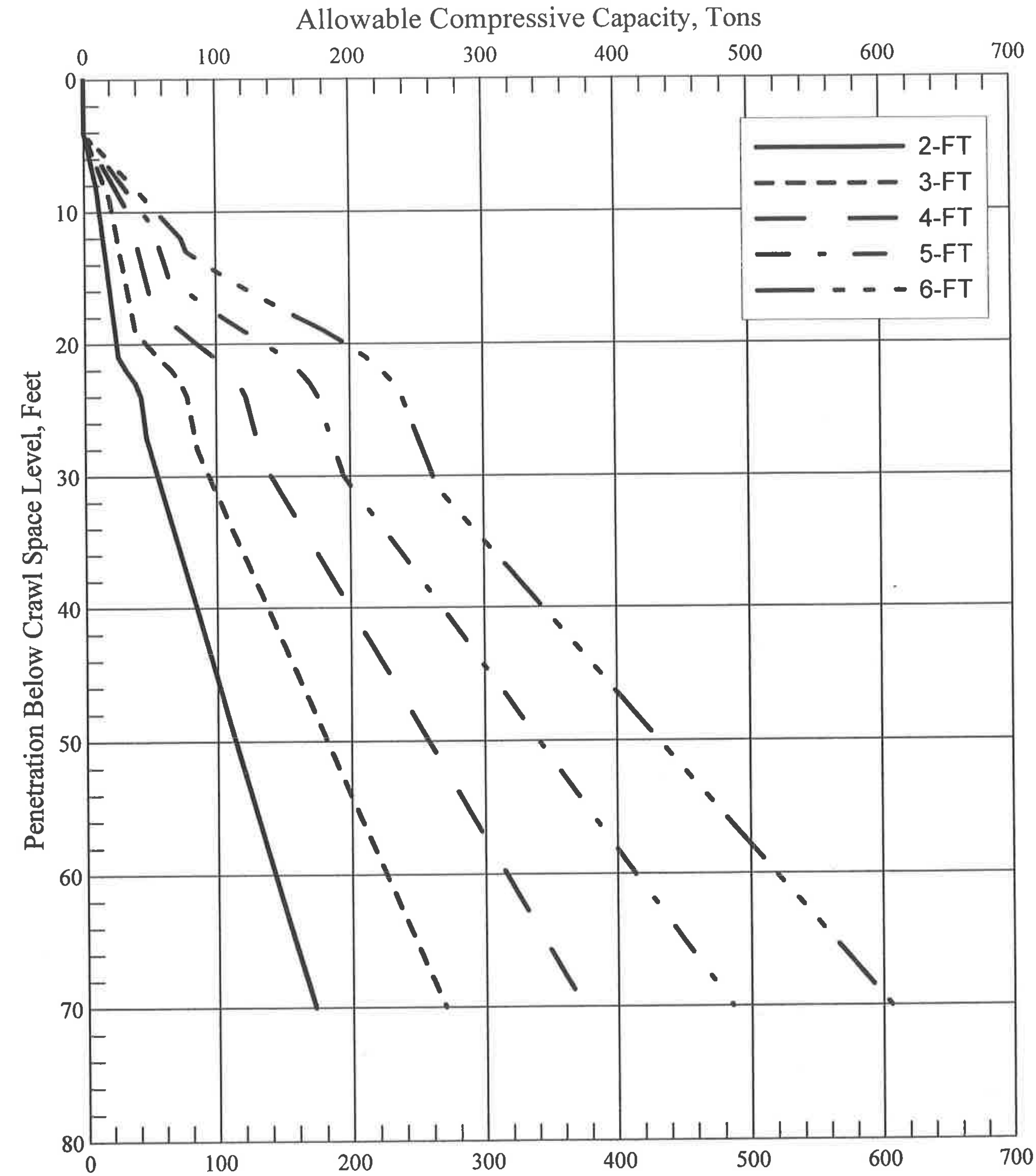


LEGEND:
LL = Liquid Limit
PL = Plastic Limit
W = Water Content
DD = Dry Density (pcf)
C/N = Cohesion (ksf)/Penetration Resistance, N (blows per ft) in the same column
% -200 = % Passing No. 200 Sieve

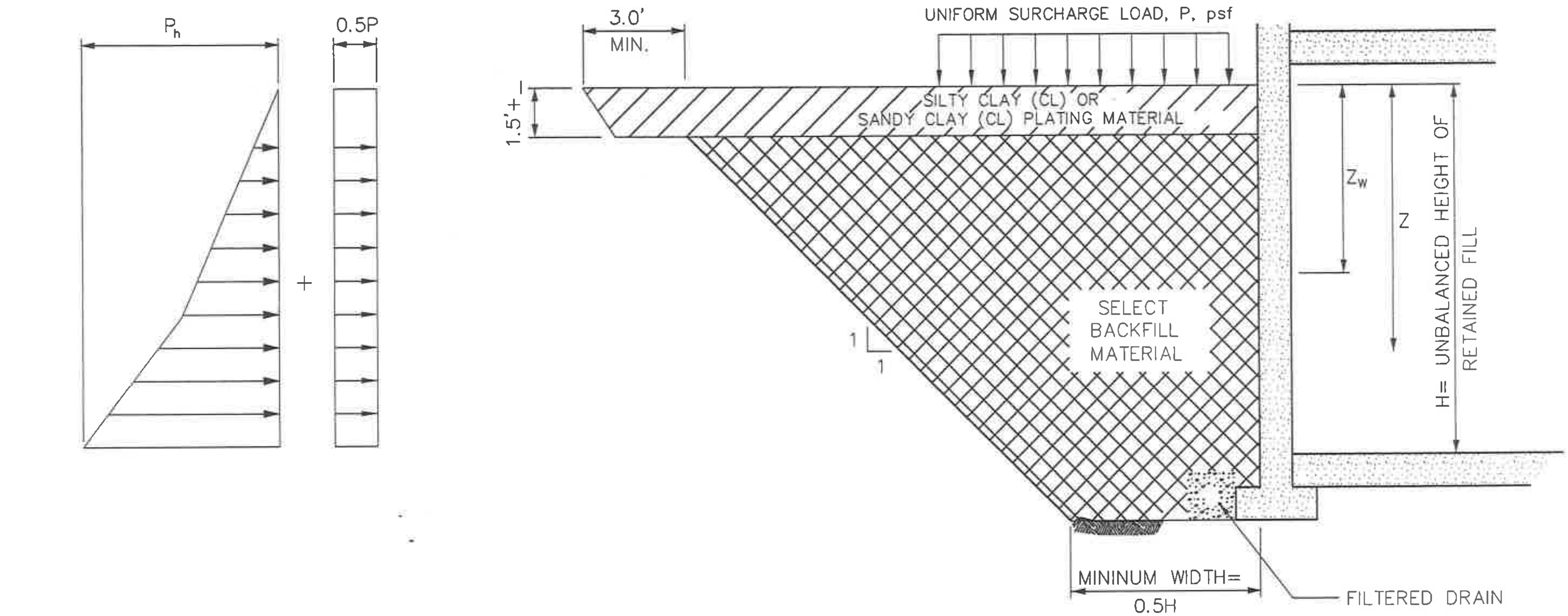
NOTES:
1) See Figure 2 for boring log legend.
2) Ground surface elevations at borings estimated from contours on Drawing No. C301 and should be considered approximate.
3) The ground line and stratum lines shown on profile are for illustration and may not accurately depict the ground and subsurface conditions between the boring locations.

SUBSURFACE SOIL PROFILE					
PROPOSED OUTPATIENT SERVICES CENTER VA MEDICAL CENTER JACKSON, MISSISSIPPI					
Job No.	140852	Date	1/13/15	Figure	8

BURNS COOLEY DENNIS, INC.



ALLOWABLE COMPRESSIVE CAPACITY CURVES
STRAIGHT-SIDED SHAFTS
PROPOSED OUTPATIENT SERVICES CENTER
VA MEDICAL CENTER
JACKSON, MISSISSIPPI



LATERAL PRESSURE IN lbs/sq ft		
BACKFILL TYPE	$0<Z\leq Z_w$	$Z_w<Z\leq H$
SANDS (SP) OR (SP–SM)	$P_h = 60Z$	$P_h = 60Z_w + 90(Z-Z_w)$

NOTE:

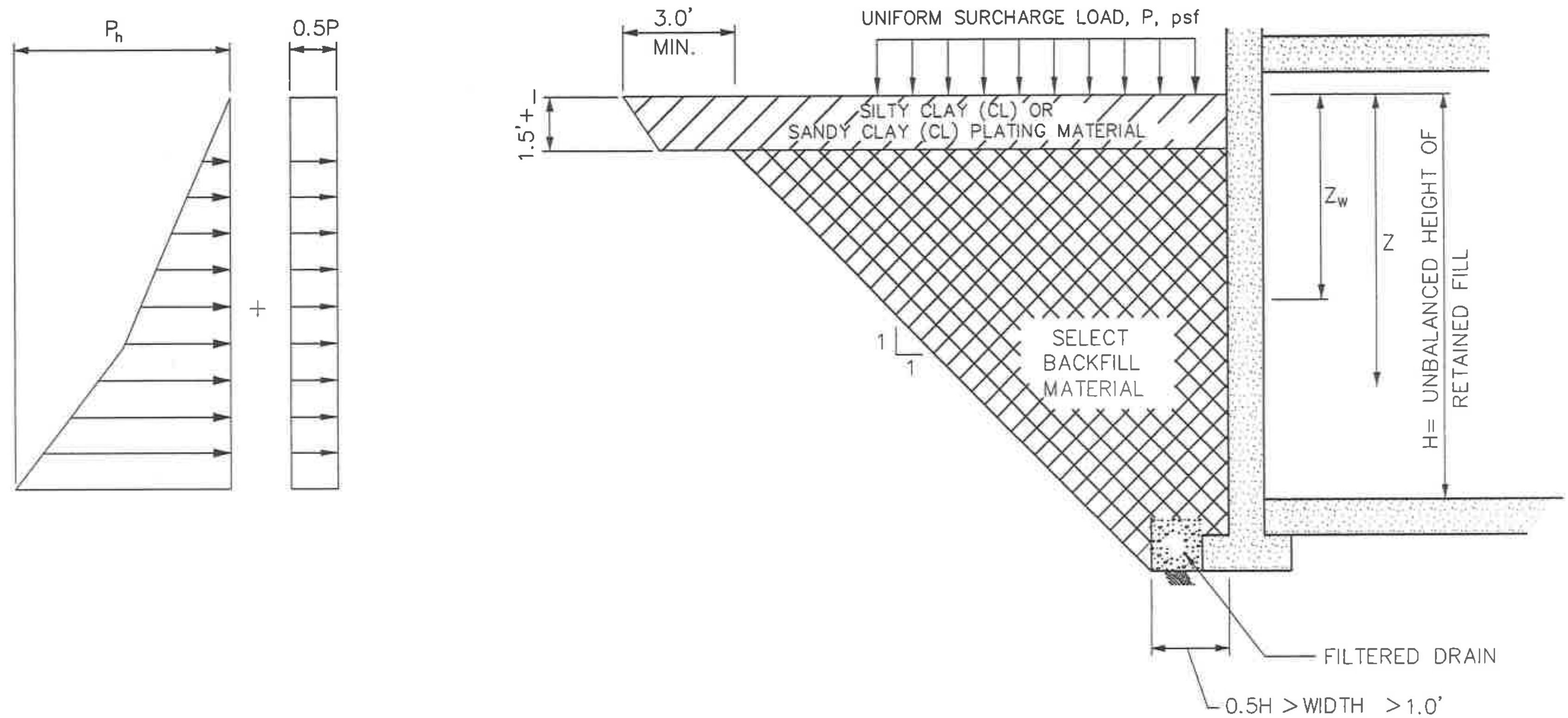
THE RECOMMENDED PRESSURES ARE BASED ON THE ASSUMPTION THAT INSUFFICIENT MOVEMENT OCCURS TO DEVELOP THE ACTIVE EARTH PRESSURE CONDITION.

Z_w IS THE DEPTH FROM THE TOP OF BACKFILL AT THE WALL TO THE GROUNDWATER LEVEL.

Z IS THE DEPTH BELOW THE TOP OF BACKFILL AT THE WALL TO THE POINT OF INTEREST.

DESIGN LATERAL EARTH PRESSURES – NON YIELDING WALL FOR EXCAVATION AS SHOWN BEHIND WALL

FIGURE 10



LATERAL PRESSURE IN lbs/sq ft

BACKFILL TYPE	$0<Z\leq Z_w$	$Z_w<Z\leq H$
SANDS (SP) OR (SP–SM)	$P_h = 90Z$	$P_h = 90Z_w + 105(Z-Z_w)$

NOTE:

THE RECOMMENDED PRESSURES ARE BASED ON THE ASSUMPTION THAT INSUFFICIENT MOVEMENT OCCURS TO DEVELOP THE ACTIVE EARTH PRESSURE CONDITION.

Z_w IS THE DEPTH FROM THE TOP OF BACKFILL AT THE WALL TO THE GROUNDWATER LEVEL.

Z IS THE DEPTH BELOW THE TOP OF BACKFILL AT THE WALL TO THE POINT OF INTEREST.

DESIGN LATERAL EARTH PRESSURES – NON YIELDING WALL FOR MINIMAL EXCAVATION BEHIND WALL

FIGURE 11