Southern Geotechnical Consultants

REPORT
OF
SUBSURFACE EXPLORATION

PROPOSED BANKS COUNTY 911 TOWER
BANKS COUNTY, GEORGIA
PROJECT NO. 10324G, REPORT NO. 17006

Southern Geotechnical Consultants

July 29, 2011

Banks County Board of Commissioners
150 Hudson Ridge
Suite 1
Homer, Georgia 30547

Attention: Ms. Deidra Moore, Director, GAMEM, CFM

Subject: Subsurface Exploration
Proposed Banks County Fire Station No. 410 911 Tower
Banks County, Georgia
SGC Project No. 10324G, Report No. 17006

Ladies and Gentlemen:

Southern Geotechnical Consultants (SGC), LLC has completed a geotechnical exploration for your project. We conducted this in general accordance with our discussions on July 18 and 19, 2011. This report presents our understanding of the project, our findings, and our conclusions and geotechnical engineering recommendations. After you have reviewed our report, we recommend either a meeting or a telephone conference to discuss our recommendations.

SGC appreciates the opportunity to be of service to Banks County. We look forward to helping you through project completion. Please contact us if you have any questions.

Respectfully submitted,

Southern Geotechnical Consultants, LLC

Rodney Clark
Project Manager

A. Glenn Moates, III, P.E., P.G.
Senior Geotechnical Engineer/Geologist
Reg. Ga. Nos. 23774, 920

RC/AGM/ads

Enclosures

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1.0 INTRODUCTION

1.1 GENERAL

SGC, LLC conducted a subsurface exploration for the proposed Banks 911 EMS Tower to be located at Fire Station No. 410 in Banks County, Georgia. Our services were provided in general accordance with the work scope outlined in our discussions. The purpose of our work was to explore the subsurface soil, rock, and groundwater conditions, and to provide recommendations for earthwork, foundations, and related construction design. This report explains our understanding of the project, documents our findings, and presents our conclusions and engineering recommendations.

1.2 REPORT SUMMARY

We have evaluated the subsurface soil, rock, and groundwater conditions with respect to the proposed Banks 911 EMS Tower and assess that the proposed tower can be founded on a conventional shallow foundation system. Also, as an alternative to shallow foundations, the tower can be supported on a deep foundation. Also, we anticipate difficult excavation associated with the removal of high consistency residual soils; however, no partially weathered rock or hard rock was encountered in our boring within the depth drilled. More detailed discussions concerning the aforementioned summary items are included in the body of this report.

2.0 PROJECT INFORMATION

As part of the improvements to the EMS system in Banks County, a new elevated tower is planned for the Grady Fire Station located at 2348 Damascus Road in Homer, Georgia. As indicated in the field, the site of the tower is along the south side of the existing station. We understand that the tower will be between 120 and 160 feet in height and will be a single support tower. Also, we understand that current plans are for the support to utilize either a large spread footing or a drilled pier foundation. No other information concerning structural loads or tolerances has been provided at this time. For the sake of this report we have assumed a maximum compressive load on the order of 250 kips or less and uplift and lateral loads on the order of 30 to 50 kips or less. If these are incorrect we should be notified so that we can make any changes in our recommendations as appropriate.

3.0 PUBLISHED SITE INFORMATION

3.1 SITE CONDITIONS

The project site consists of the existing Grady Fire Station along Damascus Road and the site is characterized as gently sloping to the east/southeast. Topographic relief across the site is estimated at less than 5 feet. While not provided, we expect cuts and fills associated with the project to be minimal, and limited to the construction of the supports, and possibly an equipment building.

3.2 SITE GEOLOGY

The project site is in Georgia's Piedmont physiographic province. The undisturbed upland soils of this area are residuum formed by the in-place chemical weathering of the parent metamorphic and igneous rocks. A common residual soil profile consists of upper clayey strata that transition with depth into less clayey, coarser grained soils with varying mica content. Separating the completely weathered soil overburden from the unaltered parent rock is a transition zone normally composed of alternating layers of very dense or hard soil and rock locally referred to as *partially weathered rock*. Partially weathered rock retains much of the appearance and fabric of the parent rock formations and exhibits penetration resistances in excess of 100 blows per foot (bpf).

The weathering processes that formed the overburden soils and partially weathered rock are extremely variable, depending on such factors as rock mineralogy, past groundwater conditions, and the tectonic history (joints, faults, igneous intrusions, etc.) of the specific site area. Differential weathering of the rock mass results in extremely erratic subsurface conditions, evidenced by abrupt changes in soil type and consistency in relatively short horizontal and vertical distances. Depths to rock can be irregular and isolated boulders, discontinuous rock layers, or rock pinnacles can be present within the overburden and transition zones.

Fill is material placed by man in conjunction with construction or disposal activities. Fill can be composed of many differing soil types from various sources and can also include debris from building demolition, organics, topsoil, trash, etc. The engineering properties of fill soils depend primarily on their composition, density, and moisture content. We assume, based upon the past land use, that no documentation concerning fill placement at the site is available for review.

4.0 EXPLORATION METHODS

The procedures used by SGC for field sampling and testing are according to ASTM procedures and established engineering practice. The Appendix contains brief descriptions of the procedures used in this exploration.

4.1 FIELD EXPLORATION

One soil test boring was performed during our exploration. Our representative located the boring at the location marked by the county representatives. The ground surface elevations are identified on the boring records and were inferred from the provided topographic data provided to us.

The samples obtained during the exploration were returned to our laboratory and were reviewed by a member of our staff. The purposes of this review were to check the field classification, visually estimate the relative percentages of the soil's constituents (sand, clay, etc.) and identify pertinent structural features such as foliation planes, slickensides, etc. The stratification lines shown on the boring records represent the approximate boundaries between soil types and the transition may be gradual.

5.0 SUBSURFACE CONDITIONS

5.1 BORINGS

5.1.1 Soil Test Boring

Within the footprint of the proposed central pedestal of the elevated tower, Boring No. B-1 was extended to a depth of 30 feet below the existing grade. The approximate location of the boring is shown on Plate 1 in the Appendix. Initially the boring penetrated an approximate 2-inch thick topsoil layer. Beneath the topsoil the boring encountered high consistency residual soils. The residual soil penetrated is generally described as a very firm to hard red-brown to brown sandy silt with varying clay and mica content. Standard penetration resistance values in the residual soils sampled range from 16 to 41 blows per foot (bpf). No partially weathered rock or auger refusal was encountered in the boring at the depth drilled.

For more detailed descriptions, please refer to our boring records in the Appendix.

5.2 GROUNDWATER

No groundwater was encountered in the borings at the depths penetrated at the time of the exploration. As such, we do not expect that groundwater will significantly impact the construction budget. However, given the presence of relatively shallow partially weathered rock and hard levels in portion of the site, it is possible that a "perched" groundwater table could be encountered as part of site development. Perched groundwater conditions could impact the site's soil moisture content during and just after a rainfall event and require the use of French drains and/or granular drainage layers to help control impact. Soils excavated from near or below a "perched" groundwater level will likely have to be spread and dried in order to attain satisfactory moisture content for adequate soil compaction.

6.0 CONCLUSIONS

We base the following conclusions on the project information provided to us and the results of the geotechnical exploration. The following information describes our conclusions concerning this site with respect to the proposed construction.

- We understand that no utilities are present in the area of the proposed tower. Nevertheless if any previously unkown or discovered existing utilities are encountered within the footprint of the proposed structure they should be abandoned, relocated (if necessary), and the existing backfill removed and replaced with new compacted soil structural fill.

- Based upon the boring data, excavation associated with hard rock is not expected to significantly impact construction. However, we caution that variations in the subsurface conditions can be present and that very high consistency residual soils were encountered in the boring.

- Based upon the data provided and our assumptions concerning loading and the boring data, we feel that support of the tower structure on shallow or deep foundations. For any associated structure such as an equipment building or pad founded on undisturbed residual soils we recommend use of a maximum allowable net soil bearing pressure of 3,000 psf to size the foundations.

- Soil forces may be used to resist both uplift and lateral loads from the tower anchor supports, and to resist lateral loads from the tower pedestal.

- All new soil fill placed as part of the new construction should be compacted to at least 95 percent of its standard Proctor maximum dry density (ASTM D698). If encountered any existing soils containing topsoil, wood fragments or other debris, while not found in the borings, should be wasted off site or used in landscape or non-structural areas.

- Based upon the preliminary boring data we currently anticipate a site classification of "D" will be applicable to the proposed elevator tower site.

7.0 RECOMMENDATIONS

7.1 SITE PREPARATION

Initially, the surface materials should be stripped to prepare the site for construction. After the site is prepared, areas that are to receive fill should be evaluated by a member of our staff by hand auger borings, probings and observing proofrolling with a heavily loaded dump truck or similar piece of rubber-tired equipment. Proofrolling consists of applying repeated passes to the subgrade with this equipment. Any materials judged to deflect excessively under the wheel loads and which cannot be densified by continued rolling should be undercut to more stable soils before placing fill.

7.2 FILL CONSTRUCTION

After the previously discussed subgrade preparation, areas to receive fill may be brought to the design subgrade levels with structural fill. Structural fill is defined as inorganic natural soil with a plasticity index less than 30, and maximum particle sizes of 4-inches or less. Structural fill should be constructed by placing fill soils in relatively thin (4- to 8-inch thick) layers which are compacted to at least 95 percent of the soil's maximum dry density as determined by the standard Proctor compaction test (ASTM D698).

Soil moisture contents can be affected by weather conditions during the construction period, and either wetting or drying of soils may be necessary to achieve the recommended compaction criterion. If the site is graded during wet weather, it may not be possible to dry on-site soils sufficiently to obtain the recommended degree of compaction. As a practical consideration, such materials may have to be modified by blending them with a material such as lime or hauled off site and replaced by select materials from off-site borrow pits. Any off-site materials should also conform to the recommended structural fill criteria.

In-place density testing must be performed to determine that the previously recommended compaction is achieved. Since only a limited amount of fill is expected, we recommend that these tests be performed on a full-time basis during fill placement. The testing frequency can be determined by our personnel based on the area to be tested, the grading equipment used, and the construction progress. Field density tests should be performed at vertical intervals of 18- to 24-inches or less as the fill is constructed. We recommend that the density tests be performed by a qualified technician working under the direction of a registered geotechnical engineer.

7.3 EXCAVATION CONDITIONS

Our experience indicates that overburden soils with penetration resistances of 30 bpf or less can generally be excavated using conventional large earthmoving equipment. Our boring data does indicate the existence of dense or hard soils (penetration resistance at or greater than 30 bpf within relatively shallow depths of the existing grade. Also, we note that based upon our experience with the geology of the Banks County area subsurface conditions at the site can vary drastically over relatively short distances. Therefore, we expect that a large tracked backhoe may be required to make any needed footing and/or utility excavations needed for the tower.

As previously indicated no partially weathered rock was encountered in our boring and no hard rock or auger refusal was encountered within the depths drilled. However, if rock is encountered, we have included in the Appendix an example definition of rock, which we have found, helps minimize disputes as to what materials should be classified as rock. You may want to include this or a similar definition in the project specifications.

7.4 FOUNDATION RECOMMENDATIONS

7.4.1 Equipment Pad

The exploration findings indicate that any support building or equipment pad footings can be supported at nominal depths in new compacted structural fill or undisturbed residual soils. We recommend a maximum allowable net soil bearing pressure of 3,000 pounds per square foot be used to size equipment pad footings. We recommend foundation widths of not less than 24-inches wide for rectangular footings and not less than 18-inches wide for continuous footings to facilitate hand cleaning of footing subgrades disturbed by the excavation process. All footing bottoms should be at least 12-inches below the lowest adjacent exterior grade for protection against frost penetration.

All footing excavations must be evaluated by a representative of our firm to observe field conditions in light of our reported design recommendations. We can also provide geotechnical guidance to the owner's design team if any previously unforeseen foundation conditions are encountered during construction.

Footing excavation often produces a thin veneer of disturbed soil at the footing subgrade. We recommend that this disturbed soil be hand cleaned prior to placing reinforcing steel. Furthermore, the footing bottom should be free of all fall-in prior to placing concrete.

The strength properties of soil exposed at the footing subgrade will change if exposed to wetting, drying, or freezing. Every effort should be made to place concrete the same day as an excavation is completed. If a foundation subgrade is left open for more than one day, it should be covered with polyethylene sheeting. If inclement weather is expected, a lean (1,000 psi) concrete veneer about 3-inches thick should be placed on the exposed subgrade. Excavation of disturbed soil may be required if these protective measures are not implemented.

7.4.2 Tower Foundation Recommendations

The findings of this exploration indicate that the proposed tower can be supported on either a spread footing placed in undisturbed residual soils or a drilled pier foundation system. The following will discuss the recommendations concerning both options.

7.4.2.1 Shallow Foundation Recommendations

The exploration findings indicate that the tower can be supported by a shallow foundation excavated into high consistency undisturbed residual soils as encountered in our soil test boring. We recommend a maximum allowable net soil bearing pressure of 3,000 pounds per square foot be used to the tower footings. All other recommendations as applicable and outlined in report Section 7.4.1 concerning shallow foundations for the Equipment Pad remain applicable.

In addition to the weight of concrete, soil forces may be used to resist uplift. The weight of a compacted soil wedge over the footings may be used to resist uplift forces. To compute the soil weight, we recommend that a unit weight of 100 pcf be used. This unit weight assumes that the soil placed over the footings will be compacted to at least 95 percent of its standard Proctor maximum dry density. To resist uplift, the volume of soil may be assumed to be a truncated prism extending upward from the footing bottom. This volume can be computed using an angle of 20 degrees.

Friction between the concrete footing and underlying soil and passive earth pressure soil adjacent to the pole footings may be used to resist shear. We recommend that a unit weight of 100 pcf and a friction coefficient of 0.4 be used. The passive wedge can be computed based on an angle of internal friction of 28 degrees and a unit weight of 100 pcf.

We recommend that the tower footing be evaluated by a representative of our firm to observe field conditions in light of our reported design recommendations. At that time, we can also provide geotechnical guidance to the owner's design team should any unforeseen foundation problems develop during construction.

Excavation for the tower footing will create a thin veneer of disturbed soil at the footing subgrade. We recommend that the disturbed soil be selectively hand cleaned prior to placing reinforcing steel. Furthermore, the footing bottom should be free of all fall-in prior to placing concrete.

The strength properties of soil exposed at the footing subgrade will change if exposed to weather extremes. Every effort should be made to place concrete the same day as excavation is completed. If subgrades are to be left open for more than one day, they should be covered with polyethylene sheeting. If inclement weather is expected, a lean (1,000 psi) concrete veneer about 3 inches thick should be placed over the exposed subgrade. If these protective measures are not implemented, excavation of disturbed soil may be required.

7.4.2.2 Drilled Pier Foundation Recommendations

In addition to a shallow foundation option, it is possible to support the tower on a drilled pier foundation. We note that no loads have been provided nor were any undisturbed soil samples authorized to be collected during the time of drilling the site to develop site specific laboratory testing. Nevertheless, based on the performed subsurface exploration, we expect that any drilled piers would be terminated in undisturbed high consistency residual soil and, therefore, an end bearing pressure of 3,000 psf can be used to size the drilled shafts. In addition, the ultimate side shear capacity between the residual soil and the cast-in-place concrete pier can be computed using a value of 0.5 kips per square foot (ksf).

We recommend that the shaft be with a drill capable of a down force (crowd) of at least 50,000 pounds and a torque of at least 83,000 foot-pounds Hughes LLDH or equivalent. We recommend that rock auger refusal is defined as a penetration rate of no greater than 6-inches in 15 minutes when the machine is equipped with a rock auger with carbon steel *Kennametal* teeth. In most instances, this refusal criterion will be met on rock capable of sustaining an 80 to 100 ksf bearing pressure.

When the specified pier depth is reached, a temporary steel casing should be placed in the shaft to retain soil, reduce groundwater inflow, and protect workmen and inspectors. Once completed, the bottom of the shaft should be hand cleaned to remove loose soil and/or broken rock. If the pier is extended to bedrock, then an air percussion probe hole at least 1½-inches in diameter should be installed to a depth of at least one and one-half times the shaft diameter.

After bottom cleaning and probe hole drilling, the shaft bottom should be observed by one of our representatives. Our representative will visually assess the shaft bottom and as appropriate evaluate the materials underlying the shaft bottom via a hook pointed steel rod inserted into a probe hole drilled into bedrock or if bedded in residual soils using a shallow hand auger with associated penetrometer tests. He will then recommend either acceptance or shaft deepening to support the structural loads.

We note that no groundwater was encountered in our borings. Therefore, we do not expect that groundwater will impact construction within the depths drilled. If however the design dictates that the drilled shaft extend deeper than drilled then it is possible that groundwater will be encountered. If groundwater is encountered it will require that the shaft be extended to auger refusal so as to limit any degradation of the exposed bottom materials prior to the time that the shaft can be prepped and concrete placed. We note that any groundwater encountered will have to be controlled by pumping up until the time that concrete can be placed into the shaft.

It has been our experience that placing concrete by free-fall does not affect the structural integrity of the member, provided the concrete does not to strike either the excavation perimeter or the reinforcing steel and that no more than about 2-inches of water are on the bottom of the shaft prior to placing concrete. The maximum aggregate size should be limited to ¾-inches and the concrete slump should range from 5- to 7-inches.

The specifications should require that the contractor have at least the calculated volume of concrete present on the job site prior to beginning to fill the shaft. We recommend this requirement to minimize the likelihood that delays during the concreting operations could impair shaft continuity. We recommend that the appropriate building codes be used in the design of the shafts. Additional references are ACI 336.3R, *Suggested Design and Construction Procedures for Pier Foundations,* and ACI 336.1, *Standard Specification for Construction of End Bearing Drilled Piers.*

7.5 EXISTING UTILITIES

Based on our understanding of the utilities marked at the site and the site plan provided to us, no existing utilities are expected to impact the planned construction. Nevertheless if any existing utilities previously unkown are encountered they should be abandoned, relocated (if necessary), and the existing backfill removed and replaced with new compacted soil structural fill. Where existing utility lines are removed, we recommend that the excavated trench be evaluated by one of our representatives prior to backfilling. At this time, any additional soft backfill identified should be removed. If the existing utility line is to be left in place beneath the planned structure footprint, we recommend that the existing backfill be evaluated by one of our representatives to determine if it is satisfactory for support of the structure. This evaluation should include test pits excavated along the alignment of the utility trench to check the compaction and composition of the fill. Any backfill not meeting the structural fill criteria previously outlined will need to be removed and replaced with new compacted soil structural fill. In addition, we recommend that any utility line left in place beneath the construction area be evaluated to determine if it would be impacted by additional structural loads.

Any utility lines to be abandoned should be filled with a lean non-shrink grout. We recommend that prior to grouting, the volume of the line be determined and the downslope termination point in the line be plugged. The grouting of the line should begin at the plugged end by use of a grout tube extending the full length of the line to prevent voids from forming as grout is placed. We recommend that a representative of our firm be present to monitor the grouting operations.

7.6 SLOPES

We anticipate temporary earth slopes will be required during site grading and building construction. Generally, permanent cut and fill slopes should be inclined no steeper than 2H:1V and temporary slopes no steeper than 1½H:1V. These slope recommendations are based on our previous experience with similar conditions since no detailed slope stability analysis was performed to justify steeper slopes. If topsoil is used in fill slopes and has not been compacted to the 95 percent standard Proctor criterion, a flatter inclination should be used.

Any utility trenches which may be constructed will need to be sloped or shored to comply with appropriate government safety requirements. Please be aware that our firm is not involved in job site safety and that the contractor is solely responsible for stable temporary excavations.

7.7 FLOOR SLAB

If an equipment building or pad is used in the design, the floor slab for the building may be supported directly on undisturbed residual soils or new compacted structural fill. Since groundwater was encountered at least 10 feet below the proposed finished floor elevation, we believe that an underslab drainage layer is optional. In finished areas, the subgrade should be covered by an effective vapor barrier to reduce the possibility of slab dampness due to soil moisture. Where accessible, the subgrades should be proofrolled with a loaded dump truck or other heavy rubber-tired equipment in the presence of a geotechnical engineer prior to concrete placement. Areas judged to deflect excessively should be undercut to expose firm soils and the undercut areas should be backfilled with crushed stone or soil compacted as described for structural fill.

7.8 SEISMIC DESIGN CONSIDERATIONS

Based on the 2000 International Building Code (IBC 2000), the soil conditions encountered at the elevated tower, we calculate the site to have a site Soil Classification of "D".

8.0 FOLLOW-UP SERVICES

Our services should not end with the submission if this geotechnical report. SGC should be kept involved throughout the design and construction process to main continuity and to verify that our recommendations are properly interpreted and implemented. To achieve this, we should review project plans and specifications with the designers to see that our recommendations are fully incorporated. We also should be retained to monitor and test the site preparation and foundation construction.

Site preparation and foundation construction will be a critical aspect of this project. Our familiarity with the site and with the foundation recommendations will make us a valuable part of your construction quality assurance team. In addition, a qualified engineering technician should observe and test all structural concrete, masonry, and steel. Only experienced, qualified persons trained in geotechnical engineering and familiar with foundation construction should be allowed to monitor and test foundation installation. Normally, full-time monitoring of the site work and foundation installation is appropriate. SGC strongly recommends that such service be provided under direct contract with the client to prevent conflict of interest.

9.0 LIMITATIONS OF REPORT

This report has been prepared for the exclusive use of Banks County and their designers for specific application to this project. Our conclusions and recommendations have been prepared using generally accepted standards of geotechnical engineering practice in the State of Georgia. No other warranty is expressed or implied. SGC is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Our conclusions and recommendations are based on the design information furnished to us, the data obtained from this geotechnical exploration, the assumptions outlined herein, and our experience. They do not reflect variations in the subsurface conditions in this geologic region. If such variations are found during construction, re-evaluating our conclusions and recommendations will be necessary.

If changes are made in the overall design, elevations, structural loads, or location of the building or parking areas, the recommendations contained in this report will not be considered valid unless our firm has reviewed the changes and modified or verified our recommendations in writing. You should give us the opportunity to review the foundation plans, the grading plans, and the applicable portions of the project specifications when the designers complete the design. This review will allow us to check whether these documents are consistent with the intent of our recommendations.

The boring records present of interpretation of the subsurface conditions at specific boring locations at the time of our exploration. The stratification lines represent the approximate boundary between soil types. The actual transition may be more gradual then implied.

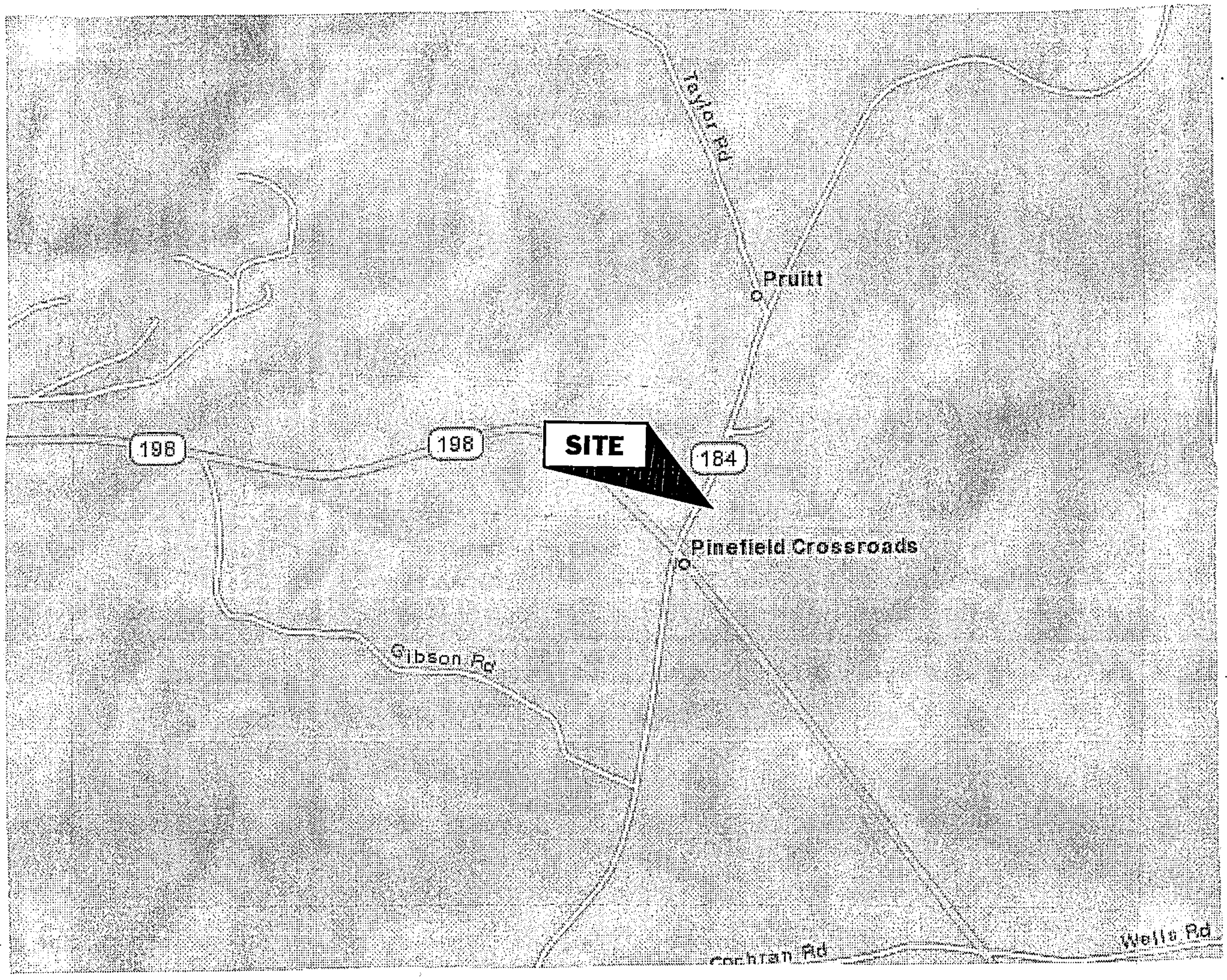
APPENDIX

SITE/BORING LOCATION PLAN

TEST BORING RECORDS

ROCK DEFINTION

FIELD PROCEDURES



DATE:	DRAWN BY:	SCALE:	REPORT NO.:	PROJECT NO.:	PLATE NO.:
7/29/2011	RC	NTS	17006	10324G	1

Southern Geotechnical Consultants

SITE LOCATION PLAN
BANKS COUNTY FIRE STATION NO. 410 911 TOWER
2348 DAMASCUS ROAD
HOMER, GEORGIA

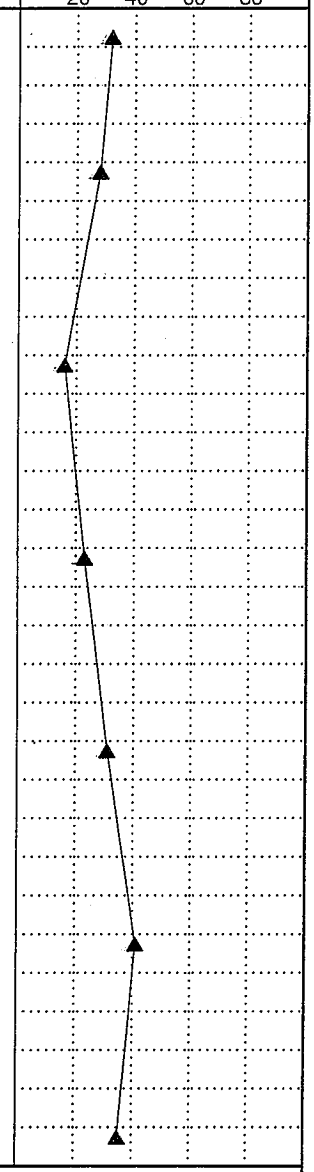
Southern Geotechnical Consultants, LLC
2660 White Sulphur Road
Gainesville, Georgia 30501
770.536.5220 phone

BORING NUMBER 1

CLIENT Banks County Board of Commissioners
PROJECT NAME Banks County Fire Station No. 410 911 Tower
PROJECT NUMBER 10324G, 17006
PROJECT LOCATION Banks County, Georgia
DATE STARTED 7/26/11 **COMPLETED** 7/26/11
GROUND ELEVATION **HOLE SIZE**
DRILLING CONTRACTOR Drilling Solutions
GROUND WATER LEVELS:
DRILLING METHOD Rope & Cathead
AT TIME OF DRILLING ---
LOGGED BY MAW **CHECKED BY** AGM
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		**TOPSOIL**					
		(ML) **RESIDUUM** - VERY FIRM TO DENSE REDDISH BROWN SLIGHTLY MICACEOUS SANDY SILT			15-16-16 (32)		
5					12-13-15 (28)		
		(SM) VERY STIFF TAN AND BROWN MICACEOUS SILTY SAND			6-8-8 (16)		
10							
15					14-12-11 (23)		
		(SM) HARD BROWNISH TAN, WHITISH TAN AND BROWN MICACEOUS SILTY SAND			29-21-10 (31)		
20							
25					10-13-28 (41)		
30					26-16-19 (35)		

▲ SPT N VALUE ▲
20 40 60 80
PL MC LL
20 40 60 80
☐ FINES CONTENT (%) ☐
20 40 60 80



BORING TERMINATED AT 30 FEET
Bottom of borehole at 30.0 feet.

ROCK DEFINITION

We suggest that *Rock* be defined as the following:

General Excavation:

Any material which cannot be excavated with a single-tooth ripper drawn by a crawler tractor having a draw bar pull rated at not less than 56,000 pounds (Caterpillar D8K or equivalent) or excavated by a front-end loader with a minimum bucket breakout force of 25,600 pounds (Caterpillar 977 or equivalent).

Trench Excavation:

Any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 33,010 pounds (Caterpillar 225B or equivalent).

INTRODUCTION

SGC, LLC. performs tests in general accordance with the American Society for Testing and Materials (ASTM) or the United States Army Corps of Engineers procedures. These procedures are generally recognized as the basis for uniformity and consistency of test results in the geotechnical engineering profession. All work is initiated and supervised by qualified engineers. Our tests are performed by skilled technicians trained in either ASTM or Corps procedures. Our equipment is well maintained, and our laboratory equipment is calibrated at least yearly.

Subsequent portions of this Appendix present briefly describe of our testing procedures. Where applicable, we have referenced these procedures to either ASTM or the Corps of Engineers standards which contain specific descriptions of apparatus, procedures, reporting, etc.

Annual Book of ASTM Standards, Section 4, Volumes 4.08 and 4.09: Soil and Rock. American Society for Testing and Materials, Latest Edition

EM 1110-2-1803. Subsurface Investigations, Soils, Chapter 3. U.S. Army Corps of Engineers, 1972.

EM 1110-1-1801, Geological Investigations. U.S. Army Corps of Engineers, 1978.

EM 1110-2-1907, Soil Sampling. U.S. Army Corps of Engineers, 1972.

EM 1110-1-1802, Geophysical Exploration. U.S. Army Corps of Engineers, 1979.

EM 1110-2-1906, Laboratory Soils Testing. U.S. Army Corps of Engineers, 1970.

SOIL TEST BORING, ASTM D-1586

The borings were made with a hollow-stem auger powered by a 125-horsepower drill rig. At regular intervals, soil samples were obtained through the hollow augers with a standard 1.4-inch I.D., 2.0-inch O.D. split-tube sampler.

The sampler was initially seated 6 inches to penetrate any loose cuttings; then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated as the *standard penetration resistance*. Penetration resistance, when properly evaluated, is an index to soil strength and density.

In the field, the driller logged and described the samples as they were obtained. Representative portions of each soil sample were then sealed in labeled glass jars and transported to our laboratory. The samples were examined by a graduate geotechnical engineer or engineering geologist to visually check the field descriptions. Boring data, including sample intervals, penetration resistances, soil descriptions, and groundwater level are shown on the attached Test Boring Records.

CORRELATION OF STANDARD PENETRATION RESISTANCE WITH RELATIVE COMPACTNESS AND CONSISTENCY

Sand and Gravel

Standard Penetration Resistance Blows/Foot	Relative Compactness
0-4	Very Loose
5-10	Loose
11-20	Firm
21-30	Very Firm
31-50	Dense
Over 50	Very Dense

Silt and Clay

Standard Penetration Resistance Blows/Foot	Consistency
0-1	Very Soft
2-4	Soft
5-8	Firm
9-15	Stiff
16-30	Very Stiff
31-50	Hard
Over 50	Very Hard