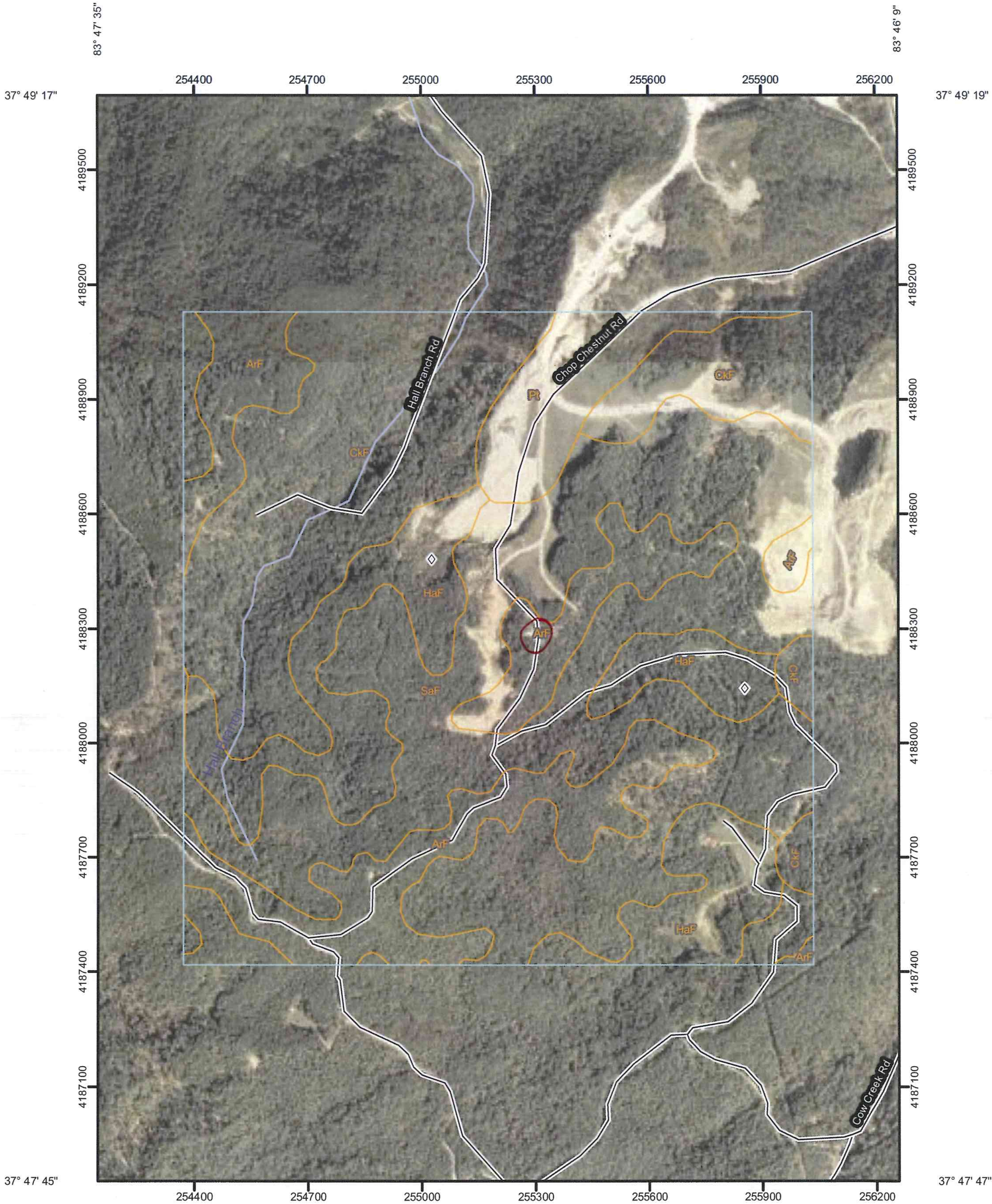
Appendix A

Soil Map—Powell and Wolfe Counties, Kentucky
(Powell County EOC Tower Site)



Map Scale: 1:13,600 if printed on A size (8.5" x 11") sheet.

Meters: 0, 100, 200, 400, 600

Feet: 0, 500, 1,000, 2,000, 3,000

N

Powell and Wolfe Counties, Kentucky

ArF—Alticrest-Ramsey-Rock outcrop complex, 20 to 65 percent slopes

Map Unit Setting

Landscape: Mountains
Elevation: 570 to 1,450 feet
Mean annual precipitation: 40 to 52 inches
Mean annual air temperature: 45 to 67 degrees F
Frost-free period: 161 to 206 days

Map Unit Composition

Alticrest and similar soils: 35 percent
Ramsey and similar soils: 30 percent
Rock outcrop: 15 percent
Minor components: 20 percent

Description of Alticrest

Setting

Landform: Ridges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy residuum weathered from sandstone

Properties and qualities

Slope: 20 to 40 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: B

Typical profile

0 to 10 inches: Sandy loam
10 to 38 inches: Sandy loam
38 to 42 inches: Unweathered bedrock

Description of Ramsey

Setting

Landform: Ridges
Landform position (two-dimensional): Summit

Landform position (three-dimensional): Mountaintop
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy residuum weathered from sandstone

Properties and qualities

Slope: 20 to 65 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.0 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 7e
Hydrologic Soil Group: D

Typical profile

0 to 3 inches: Fine sandy loam
3 to 18 inches: Gravelly sandy loam
18 to 22 inches: Unweathered bedrock

Description of Rock Outcrop

Setting

Landform: Ridges
Landform position (three-dimensional): Free face
Parent material: Sandstone

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 8

Minor Components

Gilpin

Percent of map unit: 4 percent

Lily

Percent of map unit: 4 percent

Helechawa

Percent of map unit: 4 percent

Rigley

Percent of map unit: 4 percent

Shelocta

Percent of map unit: 4 percent

Data Source Information

Soil Survey Area: Powell and Wolfe Counties, Kentucky
Survey Area Data: Version 12, Sep 17, 2012

GEOTECHNICAL EXPLORATION

PROPOSED HINKLE COMMUNICATIONS

RADIO SITE, CHOP CHESTNUT ROAD

POWELL COUNTY, KENTUCKY

Prepared for: **Powell County CSEPPM**

Thelen Project No.: **130865E**

THELEN ASSOCIATES, INC.

www.thelenassoc.com

Geotechnical • Testing Engineers

• 1398 Cox Avenue, Erlanger, Kentucky 41018-1002 / 859-746-9400 / Fax 859-746-7408

Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

THELEN ASSOCIATES, INC.
www.thelenassoc.com
Geotechnical • Testing Engineers
• 1398 Cox Avenue, Erlanger, Kentucky 41018-1002 / 859-746-9400 / Fax 859-746-9408
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

November 7, 2013

Powell County CSEPPM
56 Atkinson Street
P.O. Box 1237
Stanton, Kentucky 40380

Attention: Mr. Danny McCormick

Re: Geotechnical Exploration
Proposed Hinkle Communications
Radio Site, Chop Chestnut Road
Powell County, Kentucky

Gentlemen:

This report presents the results of the test boring and laboratory tests, and includes our geotechnical opinions and recommendations for design and construction of the proposed Hinkle Communications Radio Tower, Chop Chestnut Road, Powell County, Kentucky. It is our understanding that the sizing of the actual foundation diameter and embedment depth of the tower foundation will be determined by others. Our work was performed in accordance with our Proposal-Agreement K213218, dated September 26, 2013, and authorized by Mr. Danny McCormick of the Powell County Chemical Stockpile Emergency Preparedness Program Management (CSEPPM) on September 30, 2013.

1.0 SCOPE

The main purpose of this exploration is to determine the general subsurface profile at the site and to relate the engineering properties of the soils, that is their classification, strength and compressibility characteristics, to the proposed communications radio tower foundation design and to site development. The geotechnical work included drilling of test borings, laboratory testing, engineering analysis, and preparation of this report.

2.0 PROJECT CHARACTERISTICS

The proposed 300-foot tower will be situated on a parcel located on the west side of Chop Chestnut Road, Powell County, Kentucky. The originally proposed parcel layout and proposed access for this development are shown on a Site Plan sent to us by the client on October 8, 2013, which was the basis for our Boring Plan, drawing 130865E-1, included in the Appendix to this report.

The proposed site parcel has been graded flat and covered with crushed stone. As shown on the above mentioned site plan, from the north to the south and from the east to the west will be situated the following: a generator (120/240-volt 1PH 200-amp), a 11’ x 16’ precast concrete shelter, a free standing ice bridge, the 300’ RF Tower; and a 1000-gallon propane tank.

The parcel will be surrounded by an 8-foot-high chain link fence (with 3 rows of deterrent wiring on top), with two 12-foot entry gates, and a 4’ man gate along the east fence line. We understand that the centerline of the proposed communication tower will be at approximate coordinate location 37º 48’ 33.0”N, 83º 46’ 48.7”W. There are no existing structures currently at the Hinkle Tower site.

It is understood that the proposed new communications tower will be a 300-foot self supporting tower. The tower loadings have not yet been provided for this structure.

3.0 FIELD EXPLORATION

Our fieldwork for this project included the drilling of three (3) test borings, labeled Test Borings 1A, 1B and 1C. Test Borings 1A, 1B and 1C were completed on October 12, 2013. The client staked the Test Boring 1A location in the field at the center of the proposed tower. The locations of the referenced test borings are shown on the Boring Plan, Drawing 130836E-1, included in the Appendix to this report.

The test borings were made with a track-mounted drill rig advancing hollow-stem augers. Standard split spoon sampling was accomplished ahead of the augers following the procedures outlined in ASTM D1586. In addition to standard split spoon sampling at the test borings, the bedrock was cored using an NXM core barrel with a diamond-studded bit and with water used as a circulating fluid. Observations for groundwater were made in the borings during drilling and at the completion of drilling.

As the test borings were advanced, the Drilling Technician kept logs of the subsurface profile noting the soil types and stratifications, groundwater, standard penetration test results, and other pertinent data. Representative portions of the split-spoon samples were placed in labeled glass jars.

4.0 LABORATORY TESTING

Upon completion of the test borings, the recovered samples were transported to our Soil Mechanics Laboratory in Erlanger, Kentucky where they were visually reviewed and classified by the Project Geotechnical Engineer. Representative samples were selected for moisture content determinations and an Atterberg limits test. A summary Tabulation of Laboratory Tests is included in the Appendix to this report.

Based upon a visual review of the samples, pertinent laboratory test data and the Drilling Technician's field logs, the Project Geotechnical Engineer prepared the final test boring logs. The copies of these finalized logs are included in the Appendix along with the Soil and Rock Classification Sheets which summarize the terms and symbols used in preparation of the logs.

The dashed lines on the test boring logs identify the changes between soil types which were determined by interpolation between the samples and should be considered approximate. Only changes which occur within the samples can be precisely determined and are indicated by solid lines on the logs. The transition between soil types may be abrupt or gradual.

5.0 GENERAL SITE CONDITIONS

5.1 Surface Conditions

The project property is located on the west side of the street at 323-331 Chop Chestnut Road, the Hinkle Mountain site in Powell County, Kentucky. Currently, the area of the proposed parcel is relatively flat. The proposed communications tower location is planned in the western half of the area. The project site is covered with crushed stone.

5.2 Subsurface Conditions

Three (3) test borings were drilled at the proposed communications tower location. The general subsurface profile at this site consists of a sandy clay layer over conglomerate sandstone.

The surficial sandy clay layer consists of reddish brown moist stiff sandy clay with trace gravel, roots and iron oxide stains. The standard penetration resistance blow counts for the sandy clay material were 7-50/6" and 5-50/3" blows. Two (2) moisture content tests performed on representative samples of the sandy clay material yielded moisture content values of 11.6 and 16.7 percent. One (1) representative sample of the sandy clay material classified as a CL soil according to the USCS with a liquid limit of 29 percent and a plasticity index of 11 percent. The measured thicknesses of the sandy clay layers at Test Borings 1A and 1B are 1.2 and 1.3 feet, respectively.

The bedrock encountered in the test borings at the project site consisted of conglomerate sandstone of the Corbin Sandstone Member of the Lee Formation. The top of intact sandstone bedrock was encountered in the borings at depths of 1.3 and 1.2 feet below the ground surface, in Borings 1A and 1C, respectively. The sandstone bedrock was cored in Test Boring 1A from 2.5 to 22.7 feet and in Test Boring 1C from 5.0 to 15.0 feet. Unfortunately the rock-coring water washed the disintegrated samples away and as a result only a few inches of sandstone were recovered. Four (4) moisture content tests performed on representative samples of the disintegrated sandstone material yielded moisture content values of 2.5, 3.7, 4.1 and 4.7 percent.

Conglomerate sandstone is light-gray and weathers reddish to light brown and grayish orange; locally iron stained. The sandstone is mostly very fine to medium grained, containing 0 to 50 percent pebbles, generally more conglomeratic near the base of the foundation; pebbles, dominantly 1/8 to 1/2 inch, but as much as 2 inches in diameter, subrounded to rounded, composed of colorless to white quartz and lesser amounts of gray chert. The unit generally is well cemented; in part friable, weathering to gravelly sand. Mostly in planar and trough sets, as much as 8 feet thick, of low- and high-angle crossbeds; in part in thin horizontal beds; at the top, the bedrock grades to ripple bedded sandstone and siltstone; bedding locally obscure. Limonite is common in diffuse and banded impregnations and in siliceous concretions, locally concentrated at the base of the unit. The unit contains sparse iron-stained molds of woody fragments.

6.0 WATER LEVEL OBSERVATIONS

Test Borings 1A and 1B were noted to be dry during the drilling. Test Boring 1C was noted to retain rock-coring water at the completion of drilling to a depth of 4.4 feet. Test Boring 1A had caved and was dry at a depth of 5.4 feet. Based on our local experience, periodic groundwater seepage can occur as perched water within sandy soils, at the native soil/bedrock interface, and along sandstone bedding planes within the bedrock.

7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 General

The conclusions and recommendations of this report have been derived by relating the general principles of the discipline of Geotechnical Engineering to the proposed construction outlined by the Project Characteristics section of this report. Because changes in surface, subsurface, climatic, and economic conditions can occur with time and location, we recommend for our mutual interest that the use of this report be restricted to this specific project.

Our understanding of the proposed design and construction is based on the documents provided to us at the time this report was prepared and which are referenced in the Project Characteristics section of this report. We recommend that our office be retained to review the final design documents, plans, and specifications to assess any impact changes, additions or revisions in these documents may have on the conclusions and recommendations of this Geotechnical Report. Any changes or modifications which are made in the field during the construction phase which subsequently alter structure locations, infrastructure or other related site work should also be reviewed by our office prior to their implementation.

If conditions are encountered in the field during construction which vary from the facts of this report, we recommend that our office be contacted immediately to review the changed conditions in the field and make appropriate recommendations.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, bedrock, surface water, groundwater or air, on or below or around this site.

We have performed the test borings and laboratory tests for our evaluation of the site conditions and for the formulation of the conclusions and recommendations of this report. We assume no responsibility for the interpretation or extrapolation of the data by others.

Based upon the results of the test borings, a visual examination of the samples, the laboratory tests, our understanding of the proposed construction, and our experience as Consulting Soil and Foundation Engineers in Kentucky, we have reached the following conclusions and make the following recommendations.

7.2 Site Preparation

It is anticipated that no new pavements will be required for the proposed communications tower facility. It is also expected that no cutting or filling will be necessary for site development. Should the existing crushed stone base break down during construction, the stone will have to be removed, any underlying soft or yielding soils undercut, and then the surface restored with new compacted and tested fill placed in accordance with the following paragraph.

All utility trench excavations required for the proposed installation should also be backfilled with compacted and tested fill. All materials used as trench backfill should be moisture conditioned to within 2 percent below to 3 percent above the optimum moisture content for compaction and should be placed in shallow level layers, 6 to 8 inches in thickness, with each layer thoroughly compacted to densities not less than 95 percent, ASTM D698. All granular materials used as pipe bedding and backfill should be compacted with vibratory equipment to densities not less than 95 percent, ASTM D698, or 75 percent of relative density, ASTM D4253 and ASTM D4254, whichever is applicable. Under no conditions should any backfill be flushed in an attempt to obtain compaction.

7.3 Communications Tower Foundations

The test borings indicates that the general subsurface profile consists of the surface crushed stone and/or a thin layer of stiff sandy clay, and then the conglomerate sandstone of the Lee Formation.

The stability of the proposed three-legged tower will be controlled by vertical downward dead loads and live loads in compression. In an earthquake event or during strong wind conditions, one or two of the three legs of the communications tower will experience tension or pull-out forces while the other leg(s) will remain in increased compression. An appropriately sized foundation for vertical bearing may not be able to handle the high tension forces. The surface clayey soils are not competent to use soil skin friction to resist any of the leg pull-out forces. Therefore, we recommend that the tower be supported on end-bearing drilled shafts or deepened foundations in the Lee Formation sandstone, and augmented as needed with shaft bells or with anchors to assist in obtaining the required tension capacity. We recommend the following options or combinations thereof to satisfy the criteria of both compression forces and uplift:

- Extend the deepened mat foundation or drilled shaft length beyond that required for bearing capacity and use the skin friction of the extra length to develop the tension capacity.
- Design additional anchors in the sandstone below the bearing elevation of the mat or drilled shaft to obtain addition tension capacity.
- Design drilled shaft bells.
- Design a group of shafts with a pier cap under each tower leg.

Based on the results of our test borings, we have developed the following tower foundations geotechnical design parameters.

Table 1. Communications Tower Foundation Design Parameters

Depth (Feet)	Description	Allowable End Bearing Pressure (psf)	Ultimate Skin Friction (psf)	Ultimate Passive Pressure (psf)
0-2.0	Stiff Sandy Clay	Ignore	Ignore	Ignore
2.0-4.0	Strong Sandstone	4,000	250	3,000
4.0-10.0	Strong Sandstone	10,000	350	4,000
10.0-22.7	Strong to Very Strong Sandstone	20,000	500	8,000

The upper two feet of soil should be ignored for any resistances due to potential effects of frost action, drilling disturbance and soil moisture changes. This is also the accepted depth for frost penetration in the Powell County area. The provided Allowable End Bearing Pressure in the table has a factor of safety of at least 3. The Ultimate Skin Friction and Ultimate Passive Resistance values provided above should have an appropriate factor of safety applied based upon the analysis used to evaluate capacities.

We recommend that the shafts be drilled straight and plumb, with a relatively level bearing surface. The bottoms of the shafts should be adequately cleaned of all loosened or disturbed materials prior to the placement of steel and concrete.

We recommend that the installation of the drilled shafts be reviewed by the Project Geotechnical Engineer or his representative in order to determine whether the design criteria is being met.

If bells at the bottom of shaft are used to not only take the vertical gravity loads, they can also be used to anchor the pier in the ground to resist uplift live loads. Thus, the bell takes the vertical gravity load, but also serves as an anchor. Belling of piers may be performed by a specialty drilling machine, or by hand excavating in a cased hole.

Bell construction into rock should be obtained by approved methods, such as drilling, coring, chipping and/or chopping. Blasting should not be permitted in confined areas where such blasting may cause damage to casing, or affect the surrounding soil and rock properties.

The sides of the bell should slope at an angle of not less than 60 degrees from the horizontal for shafts. The thickness at the edge of the bell should be at least 6 inches. The diameter of the bell should not exceed three times the diameter of the shaft. The foundation contractor should be required to provide a positive means of demonstrating that the belled section has not caved in and is clean of loosened material.

Bell bottoms should be reasonably flat. Downhole observation is advisable to check the bell shape, dimensions, and concentricity, and verify that the bell roof and shaft walls are stable. The geotechnical field representative should make actual measurements to see that the bell meets the specification requirements. When shaft and bell entry is not considered safe, special remote or indirect measuring procedures should be required.

Caps if used over multiple shafts should have sufficient depth to accommodate development of the vertical reinforcement from the shaft and the dowels or anchor bolts for the column leg.

7.4 Equipment Foundations

It is our opinion that the proposed equipment foundations (generator, storage shelter and new propane tank) may be supported on backhoe excavated spread footings. It will be necessary for these foundations to penetrate any low-density surface layer of the native profile and to bear in the native sandstone. Such footings can be proportioned based on an allowable bearing pressure of 4,000 psf, full dead and full live load, in accordance with Table 1. We recommend that continuous footings have a width of not less than 18 inches and isolated column footings should be at least 2 feet square.

All exterior footings and footings of unheated space should bear at least 24 inches below final exterior grades to provide for adequate protection from frost. We recommend that footing excavations be made to neat lines and grades so that concrete can be placed directly against the banks of the excavations without forming.

It is recommended that the bottoms of all footings be located no higher than a 2 horizontal to 1 vertical line drawn outward and upward from the bottom of another footing or any paralleling or nearly paralleling utility trench unless the specific footing to footing, or footing to utility relationship is evaluated.

All loose, soft, wet, and dry-crusted materials should be removed from the bottoms of the footing excavations immediately prior to concrete placement. If said conditions develop prior to concrete placement, reinforcing steel should be removed so that the bearing surfaces can be properly cleaned so as to expose moist strong sandstone.

We recommend that good surface drainage be provided during and after construction to prevent the ponding of water in or around the foundations. Final grading in grass or landscaped areas should slope down and away from the structures at a 5 percent minimum for at least 10 feet, and then at least 2 percent thereafter. All pavements should drain away from the structures at a minimum of 2 percent.

We recommend that all footing excavations be reviewed by the Project Geotechnical Engineer or his representative prior to the placement of reinforcing steel and concrete to confirm that the bearing materials and bearing surfaces are consistent with the recommendations contained herein.

7.5 Excavation and Erosion Considerations

The Contractor should be responsible for the stability and safety of all excavations and should exercise all necessary precautions to shore, slope, case or otherwise maintain stable banks in accordance with all federal, state and local regulations, as well as in accordance with OSHA requirements.

Straw bales and/or silt fences should be staked across areas of concentrated runoff to minimize soil being carried off of the site and onto the adjacent properties. Scarified areas should be seeded and strawed, paved or otherwise protected from erosion as soon as possible after disturbance.

7.6 Seismicity

The general subsurface profile at this site consists of surficial sandy clays over the Lee Formation sandstone.

Based on the borings and on our interpretation of the KBC and its approved amendments to date, it is our opinion that the seismic parameters shown in Table 2 below will be applicable to the proposed communications tower structure:

Table 2. Seismic Parameters Applicable to the Communications Tower Structure:

Category/ Parameter	Designation/ Value	Notes
Occupancy Category	IV	Assumed value, to be confirmed by the Owner and Structural Engineer (see the 2006 IBC Table 1604.5)
S_S	0.248 g	Lat. 37° 48' 33"N/Long. 83° 46' 48.7"W County: Powell
S_1	0.085 g	
Site Class	C	Per the 2006 IBC Table 1613.5.2
F_a	1.0	Per the 2006 IBC Table 1613.5.3(1)
F_v	1.0	Per the 2006 IBC Table 1613.5.3(2)
S_{MS}	0.248 g	Per the 2006 IBC Equation 16-37
S_{M1}	0.085 g	Per the 2006 IBC Equation 16-38
S_{DS}	0.165 g	Per the 2006 IBC Equation 16-39
S_{D1}	0.057 g	Per the 2006 IBC Equation 16-40
Seismic Design Category	A	Per the 2006 IBC Tables 1613.5.6(1) and 1613.5.6(2)

8.0 CLOSURE

We are enclosing with this report a reprint of "Important Information About Your Geotechnical Engineering Report" published by ASFE, Professional Firms Practicing in the Geosciences, which our firm would like to introduce to you at this time.

We appreciate the opportunity of consulting with you on this project. Should you have any questions regarding this report, please do not hesitate to contact us. We look forward to following through with you on this project by providing the necessary construction review and testing services.

Respectfully submitted,
THELEN ASSOCIATES, INC.

Lubomir D. Peytchev, P.E.
Staff Geotechnical Engineer

Donald B. Thelen, P.E.
Principal Geotechnical Engineer

LDP/DBT:tmk
130865E

Copies submitted: 2 – Client

<u>APPENDIX</u>

ASFE Report Information

Tabulation of Laboratory Tests

Boring Plan, Drawing 130865E-1

Test Boring Logs

Soil Classification Sheet

Rock Classification Sheet

Important Information about Your

Geotechnical Engineering Report

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

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

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

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

Read the Full Report

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

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

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

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

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

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

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

Subsurface Conditions Can Change

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

Most Geotechnical Findings Are Professional Opinions

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

A Report's Recommendations Are *Not* Final

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

A Geotechnical Engineering Report Is Subject to Misinterpretation

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

Do Not Redraw the Engineer's Logs

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

Give Contractors a Complete Report and Guidance

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

Read Responsibility Provisions Closely

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

Geoenvironmental Concerns Are Not Covered

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

Obtain Professional Assistance To Deal with Mold

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

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

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

ASFE
THE BEST PEOPLE ON EARTH

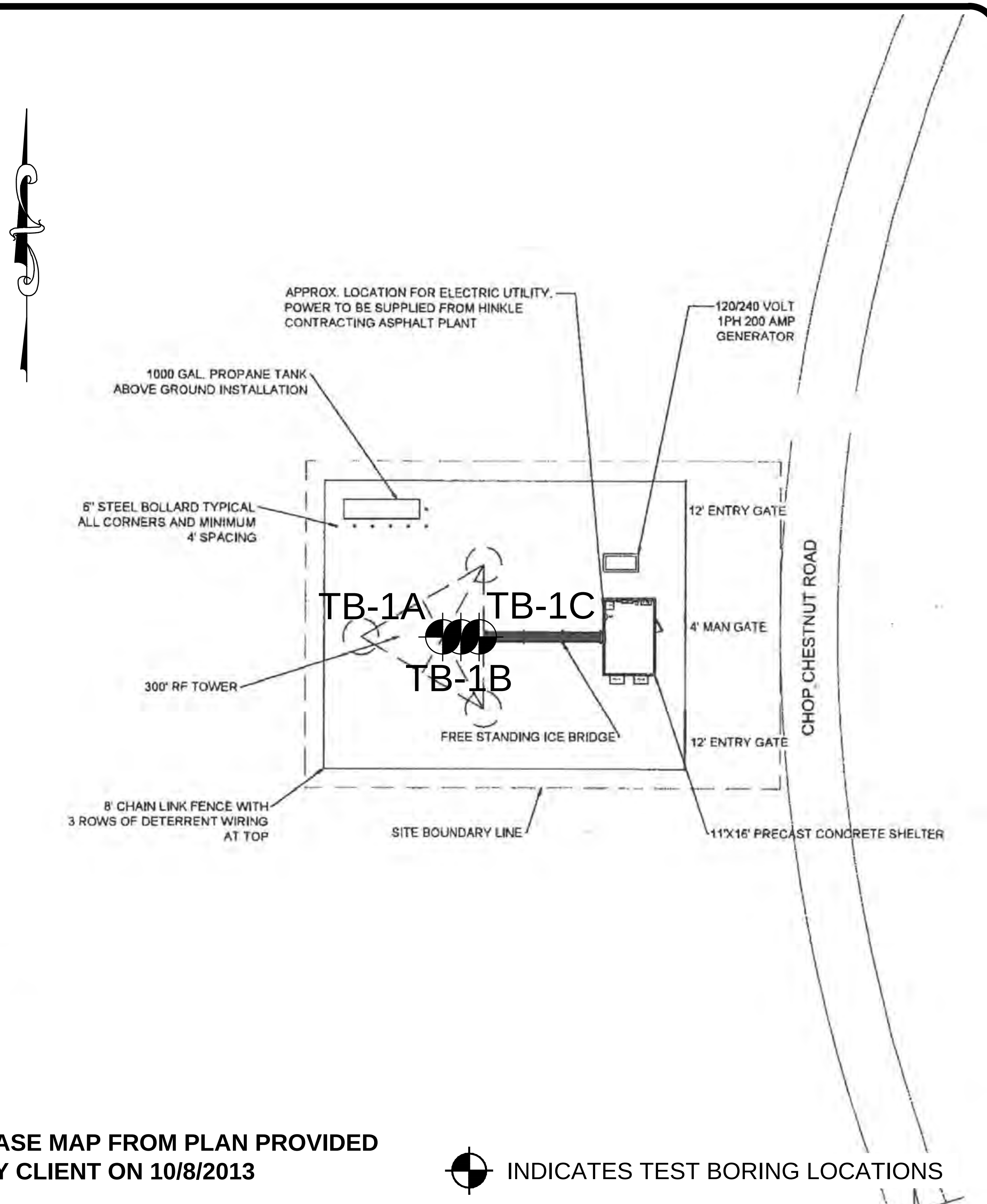
8811 Colesville Road/Suite G106, Silver Spring, MD 20910
Telephone: 301/565-2733 Facsimile: 301/589-2017
e-mail: info@asfe.org www.asfe.org

THELEN ASSOCIATES, INC.
1398 COX AVENUE
ERLANGER, KENTUCKY 41018-1002

GEOTECHNICAL EXPLORATION
PROPOSED HINKLE TOWER
POWELL COUNTY, KENTUCKY
130865E

TABULATION OF LABORATORY TESTS

Boring Number	Sample Number	Depth, ft.		Moisture Content, %	Atterberg Limits, %			USCS Classification
		From	To		LL	PL	PI	
1A	1	0.0	1.3	11.6	29	18	11	CL
	4	4.5	4.7	2.5				
1B	1	0.0	1.2	16.7				
	3	5.0	5.2	3.7				
	5	10.0	10.4	4.2				
	7	15.0	15.2	4.1				



BASE MAP FROM PLAN PROVIDED BY CLIENT ON 10/8/2013

INDICATES TEST BORING LOCATIONS

THELEN ASSOCIATES, INC.
Geotech •
125 Trade Street, Suite D, Lexington, KY 40511 / 859-226-0761
Erlanger, Kentucky • Cincinnati, Ohio • Dayton, Ohio

BORING PLAN

Client: Powell County Fiscal Court
Project: Proposed Hinkle Tower
Location: Powell County, Kentucky
Scale: 1"=30' | Date: 10/16/2013 | Drawing No.: 130865E-1

THELEN ASSOCIATES, INC.
Geotechnical Testing Engineers
• 1398 Cox Avenue, Erlanger, KY 41018-1002 / 859-746-9400 / Fax 859-746-9408
www.thelenassoc.com
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

LOG OF TEST BORING

CLIENT: Powell County Fiscal Court
BORING #: 1A
PROJECT: Geotechnical Exploration, Proposed Hinkle Tower
Powell County, Kentucky
PROJECT #: 130865E
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Drawing 130856E-1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
	Ground Surface	0.0	0						
	Reddish brown moist stiff sandy CLAY, trace gravel, roots (CL).	1.3		I	1A 1B	DS	5-7-50/6"	18	100
	Brown, reddish brown and gray moist weathered SANDSTONE (bedrock).	2.5		I	2	DS	50/6"	5	83
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)		5	I	3	DS	50/2"	2	100
		12.7	10	I	4	RC		9	6
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)	17.7	15	I	5	RC		0	0
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)	22.7	20	I	6	RC		0	0
	Bottom of test boring at 22.7 feet.		25						
			30						

Datum: --	Hammer Weight: 140 lb.	Hole Diameter: 8 in.	Drill Rig: TD-4 CME 850X
Surface Elevation: --	Hammer Drop: 30 in.	Rock Core Diameter: 1.875 in.	Foreman: J. Smith
Date Started: 10/12/2013	Pipe Size: 2 in. O.D.	Boring Method: HSA-3.25	Engineer: L. Peytchev
Date Completed: 10/12/2013			

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Caved Dry @ 5.4 ft.
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

THELEN ASSOCIATES, INC.
Geotechnical Testing Engineers
• 1398 Cox Avenue, Erlanger, KY 41018-1002 / 859-746-9400 / Fax 859-746-9408
www.thelenassoc.com
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

LOG OF TEST BORING

CLIENT: Powell County Fiscal Court
BORING #: 1B
PROJECT: Geotechnical Exploration, Proposed Hinkle Tower
Powell County, Kentucky
PROJECT #: 130865E
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Drawing 130856E-1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
	Ground Surface	0.0	0						
	Reddish brown moist stiff sandy CLAY, trace gravel, roots, iron oxide stains.	1.2		I	1	DS	5-5-50/3"	12	80
	Reddish brown and dark reddish brown moist weathered strong SANDSTONE (bedrock).	2.8		D	2	DS	50/4"	3	75
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)		5	D	3	DS	50/3"	2	67
				D	4	DS	50/4"	4	100
			10	D	5	DS	50/5"	3	60
				D	6	DS	50/4"	3	75
		15.2	15	D	7	DS	50/3"	3	100
	Split spoon refusal and bottom of test boring at 15.2 feet.		20						
			25						
			30						

Datum: --
Hammer Weight: 140 lb.
Hole Diameter: 8 in.
Drill Rig: TD-4 CME 850X
Surface Elevation: --
Hammer Drop: 30 in.
Rock Core Diameter: --
Foreman: J. Smith
Date Started: 10/12/2013
Pipe Size: 2 in. O.D.
Boring Method: HSA-3.25
Engineer: L. Peytchev
Date Completed: 10/12/2013

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: Dry
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

THELEN ASSOCIATES, INC.
Geotechnical Testing Engineers
• 1398 Cox Avenue, Erlanger, KY 41018-1002 / 859-746-9400 / Fax 859-746-9408
www.thelenassoc.com
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

LOG OF TEST BORING

CLIENT: Powell County Fiscal Court
BORING #: 1C
PROJECT: Geotechnical Exploration, Proposed Hinkle Tower
Powell County, Kentucky
PROJECT #: 130865E
PAGE #: 1 of 1
LOCATION OF BORING: As shown on Boring Plan, Drawing 130856E-1

ELEV.	COLOR, MOISTURE, DENSITY, PLASTICITY, SIZE, PROPORTIONS DESCRIPTION	Strata Depth (feet)	Depth Scale (feet)	Sample Condition	Sample Number	Sample Type	SPT* Blows/6" / Rock Core RQD (%)	Recovery (in.)	Recovery (%)
	Ground Surface	0.0	0						
	Augered to 5.0 feet and sampled. See Boring 1B for description to 5 feet.	5.0							
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)	10.0	5	I	1	RC		0	0
	Light gray, reddish to light brown and grayish orange slightly moist, strong to very strong unweathered thin bedded to thick bedded fine to coarse-grained well cemented conglomerate SANDSTONE, trace silt seams and sparse iron stained molds of wood fragments. (Corbin Sandstone Member of Lee Formation)	15.0	10	I	2	RC		0	0
	Split spoon refusal and bottom of test boring at 15.0 feet.		15						
			20						
			25						
			30						

Datum: --	Hammer Weight: 140 lb.	Hole Diameter: 8 in.	Drill Rig: TD-4 CME 850X
Surface Elevation: --	Hammer Drop: 30 in.	Rock Core Diameter: 1.875 in.	Foreman: J. Smith
Date Started: 10/12/2013	Pipe Size: 2 in. O.D.	Boring Method: HSA-3.25	Engineer: L. Peytchev
Date Completed: 10/12/2013			

BORING METHOD
HSA = Hollow Stem Augers
CFA = Continuous Flight Augers
DC = Driving Casing
MD = Mud Drilling

SAMPLE TYPE
PC = Pavement Core
CA = Continuous Flight Auger
DS = Driven Split Spoon
PT = Pressed Shelby Tube
RC = Rock Core

SAMPLE CONDITIONS
D = Disintegrated
I = Intact
U = Undisturbed
L = Lost

GROUNDWATER DEPTH
First Noted: None
At Completion: 4.4 ft.
After: --
Backfilled: Immediately

* SPT = Standard Penetration Test - Driving 2" O.D. Sampler 18" with 140-Pound Hammer Falling 30"; Count Made at 6" Intervals

THELEN ASSOCIATES, INC.
www.thelenassoc.com
Geotechnical • Testing Engineers
• 1398 Cox Avenue, Erlanger, Kentucky 41018-1002 / 859-746-9400 / Fax 859-746-9408
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

SOIL CLASSIFICATION SHEET

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	- 5 blows/ft. or less
Loose	- 6 to 10 blows/ft.
Medium Dense	- 11 to 30 blows/ft.
Dense	- 31 to 50 blows/ft.
Very Dense	- 51 blows/ft. or more

Relative Properties

Descriptive Term	Percent
Trace	1 – 10
Little	11 – 20
Some	21 – 35
And	36 – 50

Particle Size Identification

Boulders	- 8 inch diameter or more	
Cobbles	- 3 to 8 inch diameter	
Gravel	- Coarse	- 3/4 to 3 inches
	- Fine	- 3/16 to 3/4 inches
Sand	- Coarse	- 2mm to 5mm (dia. of pencil lead)
	- Medium	- 0.45mm to 2mm (dia. of broom straw)
	- Fine	- 0.075mm to 0.45mm (dia. of human hair)
Silt		- 0.005mm to 0.075mm (Cannot see particles)

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency	Field Identification	Unconfined Compressive Strength (tons/sq. ft.)
Very Soft	Easily penetrated several inches by fist	Less than 0.25
Soft	Easily penetrated several inches by thumb	0.25 – 0.5
Medium Stiff	Can be penetrated several inches by thumb with moderate effort	0.5 – 1.0
Stiff	Readily indented by thumb but penetrated only with great effort	1.0 – 2.0
Very Stiff	Readily indented by thumbnail	2.0 – 4.0
Hard	Indented with difficulty by thumbnail	Over 4.0

Classification on logs are made by visual inspection.

Standard Penetration Test – Driving a 2.0" O.D., 1 3/8" I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30 inches. It is customary to drive the spoon 6 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6 inches of penetration on the drill log (Example – 6/8/9). The standard penetration test results can be obtained by adding the last two figures (i.e. 8+9=17 blows/ft.). Refusal is defined as greater than 50 blows for 6 inches or less penetration.

Strata Changes – In the column "Soil Descriptions" on the drill log, the horizontal lines represent strata changes. A solid line (————) represents an actually observed change; a dashed line (— — — —) represents an estimated change.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

THELEN ASSOCIATES, INC.
www.thelenassoc.com
Geotechnical • Testing Engineers
• 1398 Cox Avenue, Erlanger, Kentucky 41018-1002 / 859-746-9400 / Fax 859-746-9408
Offices
Erlanger, Kentucky
Lexington, Kentucky
Cincinnati, Ohio
Dayton, Ohio

ROCK CLASSIFICATION SHEET

ROCK WEATHERING

Descriptions	Field Identification
Unweathered	No visible sign of rock material weathering, perhaps slight discoloration on major discontinuity surfaces.
Weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker externally than it its fresh condition.
Highly Weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Residual Soil	All rock material is decomposed and/or disintegrated to soil. The original mass structure is still largely intact with bedding planes visible, and the soil has not been significantly transported.

ROCK STRENGTH

Descriptions	Field Identification	Uniaxial Compressive Strength (psi)
Extremely Weak	Indented by thumbnail	40-150
Very Weak	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife.	150-700
Weak	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer.	700-4,000
Medium Strong	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with a single blow of a geological hammer.	4,000-7,000
Strong	Specimen requires more than one blow of a geological hammer to fracture.	7,000-15,000
Very Strong	Specimen requires many blows with a geological hammer to fracture.	15,000-36,000
Extremely Strong	Specimen can only be chipped with geological hammer.	>36,000

BEDDING

Descriptive Term	Bed Thickness
Massive	> 4 ft.
Thick	2 to 4 ft.
Medium	2 in. to 2 ft.
Thin	< 2 in.

Figure 1: West-facing view of proposed tower site on Hinkle Construction rock quarry

Figure 2: North-facing view looking north along Chop Chestnut Road on Hinkle Construction rock quarry

Figure 3: East-facing view across Chop Chestnut Road at cemetery on Hinkle Construction rock quarry

Figure 4: South-facing view of forested area on Hinkle Construction rock quarry