SUBSURFACE INVESTIGATION &
FOUNDATION RECOMMENDATIONS

NORTHERN KENTUCKY UNIVERSITY
ALBRIGHT RECREATION CENTER EXPANSION
HIGHLAND HEIGHTS, KENTUCKY

Prepared for:
NORTHERN KENTUCKY UNIVERSITY, INC.
HIGHLAND HEIGHTS, KENTUCKY

Prepared by:

ALT & WITZIG ENGINEERING, INC.
WEST CHESTER, OHIO

APRIL 3, 2012 **PROJECT NO.: 12CN0021**

Alt & Witzig Engineering, Inc.
6205 Schumacher Park Drive • West Chester, Ohio 45069
Phone: (513) 777-9890 • www.altwitzig.com

April 3, 2012

Northern Kentucky University, Inc.
726 Lucas Administrative Center
Highland Heights, Kentucky 41099
ATTN: Mr. Rob Knarr, P.E.

RE: Subsurface Investigation &
Foundation Recommendations
Northern Kentucky University
Albright Recreation Center
Highland Heights, Kentucky
Alt & Witzig File: 12CN0021

Gentlemen:

In compliance with your request, we have conducted a subsurface investigation and evaluation for the above referenced project. It is our pleasure to transmit herewith three (3) bound copies and one digital (pdf) copy of our report.

The results of our subsurface investigation and evaluations indicate that the soils at this site consist of predominately lean and fat clays and shale bedrock of various degrees of weathering. Bearing pressures, approximate foundation depths, and other design recommendations are presented herein.

Often, because of design and construction details that occur on a project, questions arise concerning the soil conditions. If we can give further service in these matters, please contact us at your convenience.

Respectfully,

ALT & WITZIG ENGINEERING, INC.

Robert Smith

Robert Smith, P.E.
Project Manager

Patrick A Knoll

Patrick A. Knoll, P.E.

STATE OF KENTUCKY
PATRICK A.
KNOLL
18878
LICENSED
PROFESSIONAL ENGINEER

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EXECUTIVE SUMMARY

The purpose of this subsurface investigation was to determine the various soils profile components, the engineering characteristics of the subsurface materials, and to provide criteria for use by the design engineers and architects in performing foundation design for the proposed addition to be constructed at the existing facility in Highland Heights, Kentucky.

Preliminary design plans indicate that the addition will consist of a two-story building with load bearing walls. The size and configuration of the site and location of the soil borings are shown on the enclosed boring location plan.

Our recommendations are based upon twelve (12) borings that were performed at the site. Upon completion of these borings, laboratory tests were performed on the samples to determine their classification and strength characteristics.

Predominately, our borings encountered medium stiff to hard lean and fat clay across the site. Bedrock was noted at a depth of six (6) to twenty-three (23) feet below grade. The bedrock ranged from a brown and gray highly weathered or clayey shale to a weathered shale.

Borings generally indicated dry conditions during and upon completion, of boring operations. However, a delayed water level of three (3) to twenty-three (23) feet was noted across the site. Due to the existing campus all holes were backfilled at completion of operations due to safety concerns.

Conventional spread and continuous wall footings, or any combination of these foundations can be used to support the proposed structure that will be constructed at this site. A net allowable bearing pressure of 12,000 psf would be applicable to design conventional spread and continuous wall footings, placed on the brown weathered shale bedrock at an elevation of 844 to 860. If the foundations were extended into the gray weathered shale, a higher net allowable bearing pressure of 30,000 psf can be used at an elevation of 832 to 854. A table has been provided in this report with more detailed information on elevation and bearing capacity. As noted above, fill will be encountered and undercutting to a depth of approximately six (6) feet below finished grade should be anticipated along the area of the buried ravine. The ravine was noted by our investigation on the northeast corner of the proposed structure in the area of boring B-3.

Due to the expansive nature of the gray shale bedrock, footings should be protected from weather conditions and should be placed the same day excavation occurs. This might require the last six (6) inches of the excavation to occur just before steel and concrete placement. If seepage is identified at the time of excavation it will be necessary to excavate the base of the footing and place a lean concrete mat immediately on the soils.

Foundations must also be constructed such that undermining of adjacent footings and/or lateral loading of adjacent footings located at different elevations is avoided. If it is necessary to construct the new foundations within the "influence area" of the existing structure, shoring or underpinning of the existing structure will be necessary to allow for construction. If the existing footings are supported on the bedrock, as anticipated, excavations should not be closer than ½:1 (H:V) to the bottom of the footing. However, personnel should be on-site to continually monitor the excavation to determine if weathering of the excavation is occurring. If severe weathering is noted it will be necessary to flatten the slope. The lateral loads applied by the existing footing should be considered in design of the proposed foundation. Additionally, flexible joints must be designed between the two buildings (existing and proposed) to accommodate for differential settlements. Also, additional control joints should be placed to reduce the effect of differential settlement caused by differing foundation soils, i.e. fill, natural soils, and rock.

Due to the expansive gray shales that exist in the building area, modifications to the existing subgrade will be required for the floor slab area. Since the gray shale will be exposed over the majority of the site, three options are outlined in this report for the preparation of the subgrade for the basement floor slab. In addition, preliminary recommendations for the intramural fields and preparation of short term and long term long slopes are provided.

This Executive Summary provides a summation of the concerns and recommendations of the Subsurface Investigation conducted at the Site. The following final report describes the expanded discussion of our conclusions and recommendations.

SUBSURFACE INVESTIGATION

AND

FOUNDATION RECOMMENDATIONS

INTRODUCTION

General

This report presents the results of a foundation investigation for the proposed addition to be constructed at the Albright Recreation Center on the campus of Northern Kentucky University in Highland Heights, Kentucky. This investigation was conducted for NKU.

Authorization to perform this investigation was in the form of a proposal prepared by Alt & Witzig Engineering, Inc. and notice to proceed from Mr. Rob Knarr of NKU.

The scope of this investigation included a review of geological maps of the area; a review of geologic and related literature; a reconnaissance of the immediate site; subsurface exploration; field and laboratory testing; and engineering analysis and evaluation of the materials.

The purpose of this subsurface investigation was to determine the various soils profile components, the engineering characteristics of the subsurface materials and to provide criteria for use by the design engineers and architects in preparing the foundation design for the proposed addition.

FIELD INVESTIGATIONS

Scope

Field investigations to determine the engineering characteristics of the foundation materials included a reconnaissance of the project site, drilling twelve (12) borings as located on the boring location plan. Standard penetration tests with soil samples retained in the standard split-spoon sampler were also performed during drilling operations. The apparent groundwater level at each boring location was also determined.

Drilling and Sampling Procedures

The soil borings were performed with a drilling rig equipped with a rotary head. Conventional hollow-stem augers were used to advance the holes. Representative samples were obtained employing split-spoon sampling procedures in accordance with ASTM Procedure D-1586.

Field Tests and Measurements

Penetration Tests During the sampling procedure, standard penetration tests were performed at regular intervals to obtain the standard penetration value of the soil. The standard penetration value is defined as the number of blows a 140-pound hammer, falling 30 inches, is required to advance the split-spoon sampler one (1) foot into the soil. The results of the standard penetration tests indicate the relative density and comparative consistency of the soils, and thereby provide a basis for estimating the relative strength and compressibility of the soil profile components.

Groundwater Measurements In relatively impervious soils, such as those on this site, the groundwater elevation is difficult and often impossible to accurately determine. The exact location of the water table should be anticipated to fluctuate somewhat depending upon normal seasonal variations in precipitation and surface runoff.

Rock Core At boring locations B-2, B-8, and B-9 samples of the bedrock materials were obtained using rock coring procedures in general accordance with ASTM D-2113. The equipment used to obtain the cores was a conventional "NX" double tube core barrel system with a diamond cutting bit.

Ground Surface Elevation The elevation of the ground surface shown on the boring logs was determined by Bayer Becker using conventional leveling techniques. All depths and elevations referred to in this report are referenced from the existing ground surface at each boring location. Also, the borings were field located by the survey/site engineer as shown on the proposed site layout and grading plan.

LABORATORY INVESTIGATIONS

In addition to the field investigations, a supplemental laboratory investigation was conducted to ascertain additional pertinent engineering characteristics of the foundations for the proposed construction of the new Albright Recreation Center.

Samples of the cohesive soil from the split-spoon-sampling device were frequently tested in unconfined compression by use of a calibrated spring testing machine. In addition, a calibrated soil penetrometer was used as an aid in determining the strength of the soil. The values of the unconfined compressive strength as determined on soil samples from the split-spoon sampling must be considered, recognizing the manner in which they were obtained since the split-spoon sampling techniques provide a representative but somewhat disturbed soil sample.

The types of soils encountered in the borings were classified according to accepted ASTM methods and are described in detail on the boring logs. Testing included Particle Size Analysis tests in accordance with ASTM D422, Atterberg Limit testing in accordance with ASTM D4318, and Moisture content tests in accordance with ASTM D2216.

A representative sample of the shale, from the approximate depth of the proposed foundation, was used for free-swell testing. This included saturating the sample for several days in water and measuring the vertical expansion of the specimen with a digital gage. Also, samples from the anticipated foundation depth were gathered and taken to the University of Cincinnati for X-ray analyses. X-ray analyses provides a detailed description of the clay minerals composing the shale.

DESCRIPTION OF SITE

Site Location

The Albright Recreation Center is located on the campus of Northern Kentucky University in Highland Heights, Kentucky. Specifically, the addition will be located on the south side of the existing recreation center at the intersection of Kenton Road and Johns Hill Road. The location of the site is shown on the enclosed Site Location Map presented in the Appendix.

Site Topography and Drainage

In the area of the proposed addition the surface of the site is relatively flat with an estimated relief of two (2) to six (6) feet across the site. Surface runoff predominately drains to western and southern portions of the site. In the area of the proposed intramural fields, on the south side of Johns Hill Road, greater relief on the order of ten (10) to one-hundred (100) feet exists.

Groundcover in the area of the addition consisted of a gravel parking lot. In the area of the intramural fields the site consisted of a large mound of uncontrolled fill from a recent campus addition and heavily forested areas. The surrounding area is heavily developed with paved roadways, overhead and underground utilities, and the NKU campus.

Subsurface Conditions

The description of the subsurface conditions provided here is a broad overview of the conditions at the boring locations. Refer to the boring logs for specific subsurface information.

Albright Recreation Center Based on the information obtained at the boring locations, soils predominately consist of fat clay (CH) and lean clay (CL) soils below the existing gravel parking surface. These soils were noted to depths of six (6) to nine (9) feet below grade at the majority of the borings. However, boring B-3 did note differing subsurface conditions. At boring B-3, fill was noted to a depth of twelve (12) feet below grade at which similar natural soils were encountered to a depth of twenty-three (23) feet below grade. Based on a review of the previous report for this area by G.J.

Thelen and a review of the grades in this area prior to construction of the recreation center, it appears that a large ravine was filled for construction of the building and parking lot. Therefore, the fills noted by our boring are most likely from the filling of this ravine. An additional area of fill was noted at boring B-9 to a depth of seven (7) feet below grade.

The consistency of the natural cohesive soils, based on the standard penetration test (SPT) N-value criteria, were generally medium stiff and stiff within the upper elevations. The observed moisture content of the cohesive soils tested ranged from 11.4% to 24.4%. Based on results of Atterberg limit determinations, the cohesive soils are of low to moderately high plasticity based on plasticity indices (PI) ranging from 18 to 27. The results of these tests are provided on the attached logs and/or summary sheets.

Below the natural soils and fills, bedrock was encountered at depths ranging from approximately six (6) to twenty-three (23) feet (El 844.2 to 860.1) below the existing ground surface. Based on observations of the split-barrel samples and core samples, the underlying bedrock generally consisted of variably weathered shale with a low to moderate percentage of limestone. Based on core samples collected at the structure borings, RQD values (i.e., a measure of the rock quality) ranged from 27% to 77%, indicating relatively poor to good quality. X-ray testing of the soils found that the shallow brown weathered shale is absent of pyritic material while the deeper shale consists of trace pyritic material. In addition, the shale predominately consists of Illite and Chlorite clay minerals. This would indicate that the shales are low to moderately expansive. However, a free swell test, using a representative sample from the rock coring and a digital gauge with an accuracy of 1/1,000 inch, indicated a 5.1% expansion in the gray shale sample tested. Also, previous testing provided to us has indicated an expansion of the shale on the order of 6.1%. Based on these results, it is our opinion that the gray shale should be considered expansive.

Groundwater level observations made during, at completion, and up to 24 hours after the completion are noted on the boring logs. All borings indicated dry conditions during and upon completion of operations with exception to boring B-3. Boring B-3 indicated a water level of thirty-two (32) feet below grade at completion. The water encountered at this boring is most likely a result of the buried ravine that exists in this area. Water level observations taken several to twenty-four (24) hours after completion indicated dry conditions across the majority of the site. However, water was noted at borings B-3, B-6, and B-9 at a level of twenty-nine (29) feet, nine (9) feet, and three (3) feet below grade for these borings, respectively. It should be noted that short-term ground water level readings made in boreholes are not necessarily a reliable indication of the ground water level; fluctuations in the groundwater levels will occur due to changes in precipitation, infiltration, run-off, and other hydrogeological factors.

Intramural Fields Borings B-10 and B-11 were performed on the south side of Johns Hill Road for the proposed Intramural Fields. It should be noted that boring B-11 was offset to avoid the large fill mound. The exact composition of the mound is unknown, however, it is anticipated to consist of naturally occurring clay and shale placed in an uncontrolled manner. It appears that similar lean and fat clay soils exist in this area as well. These soils were noted to the termination depth of boring B-10 at eleven (11) feet and to a depth of thirteen (13) feet below grade at boring B-10.

The consistency of the natural cohesive soils, based on the standard penetration test (SPT) N-value criteria, were generally medium stiff and stiff within the upper elevations. The observed moisture content of the cohesive soils tested ranged from 13.7% to 26.6%.

Below the natural soils bedrock was noted at boring B-11 at a depth of thirteen (13) feet below grade. Based on observations of the split-barrel samples, the underlying bedrock consisted of highly weathered shale to the termination depth of this boring at sixteen (16) feet below grade.

Groundwater level observations made during, at completion, and up to 24 hours after the completion are noted on the boring logs. The borings indicated dry conditions during and at completion of operations. Twenty-four (24) hours after completion dry conditions were noted at B-10 and a water level of ten (10) feet below grade was noted at boring B-11. It should be noted that short-term ground water level readings made in boreholes are not necessarily a reliable indication of the ground water level and fluctuations in the groundwater levels will occur due to changes in precipitation, infiltration, run-off, nearby wells, and other hydrogeological factors.

Boring B-12 The exact use of the this area has not been determined and this boring is included with this report for future use. As can be seen from the enclosed boring significantly different soil conditions exist in this area. Generally, medium stiff silty clay was noted to a depth of seven (7) feet below grade. At this depth medium stiff moist silt was encountered to a depth of eighteen (18) feet below grade. Medium stiff clay consisting of completely weathered shale was noted to the termination depth of this boring. It is recommended that further analysis of this area be performed once plans have been produced for the use of this portion of the site.

Seismic Requirements

An evaluation of the seismic site class has been performed. The Kentucky Building Code indicates that the seismic site class is determined by averaging soil conditions within the top 100 feet. This evaluation is based on boring data obtained to the top of bedrock. Based on the information obtained, the curing Building Code guidelines indicate that the site be classified as a Site Class B.

FOUNDATION DISCUSSION AND RECOMMENDATIONS

Project Description

Design plans indicate that the new addition will be constructed on the south side of the existing Albright Health Center. The building will be a two-story structure of the approximate size, configuration, and location as shown on the enclosed boring location plan. The new structure will consist of steel frame and a combination of precast concrete panels, glass curtain walls, and metal panels similar to previous construction on campus.

Design plans have not been finalized, however, it is anticipated that the structure will be constructed into the existing hillside so that the second floor will be at grade in the rear of the structure. Therefore, the finished floor elevation of the basement will be at 850. This will place the structure 12 to 15 feet below existing grade.

For our analysis, it is assumed that the structure will be heavily loaded with the structural loads transferred to the soils by conventional spread footings and continuous wall footings, if possible. Maximum column loads within this structure are anticipated to be on the order of 200 kips with wall loads in the range of 6 kips per lineal foot or less.

Foundation Discussions

Based on the finished floor elevation provided to us, it is anticipated that the structure will be placed within the gray weathered shale bedrock at all locations with the exception to the area of the buried ravine. Our boring B-3 noted deeper bedrock on the northeast corner of the structure. Since the ravine appears to have crossed the building area, some variation in bedrock elevation should be expected. All footings must be placed on the gray or brown weathered shale bedrock. Therefore, in the northeast corner of the structure undercutting to a depth of six (6) feet below proposed finished floor elevation would be anticipated. By placing the structure on similar material this will limit differential settlement within the structure.

Conventional spread and continuous wall footings, or any combination of these foundations can be used to support the proposed structure that will be constructed at this site. A net allowable bearing pressure of 12,000 psf would be applicable to design conventional spread and continuous wall footings, placed on the brown weathered shale bedrock at an elevation of 844 to 860. If the foundations were extended into the gray weathered shale a higher net allowable bearing pressure of 30,000 psf can be used at an elevation of 832 to 854. The following table illustrates the anticipated elevation and bearing capacity at each boring location:

Boring	Elevation of q_a= 12,000 psf	Elevation of q_a= 30,000 psf
B-1	854.2	850.2*
B-2	860.1	853.1*
B-3	844.2†	832.2
B-4	857.1	850.1*
B-5	858.3	851.3*
B-6	855.9	849.9*
B-7	858.4	854.4*
B-8	853.0‡	847.0
B-9	856.8	852.8*

* Indicates a boring location that will be at or below this elevation by design.
† Undercutting to the this depth will be required at boring B-3.
‡ Boring B-8 will be at this approximate elevation by design.

As noted above, fill will be encountered and undercutting to a depth of approximately six (6) feet below finished grade should be anticipated along the area of the buried ravine. The ravine was noted by our investigation on the northeast corner of the proposed structure.

Due to the expansive nature of the bedrock footings should be protected from weather conditions and should be placed the same day excavation occurs. This might require the last six (6) inches of the excavation to occur just before steel and concrete placement. If seepage is identified at the time of excavation it will be necessary to excavate the base of the footing and place a lean concrete mat immediately on the soils.

The above-recommended bearing pressure is a "net allowable soil pressures". In utilizing these net allowable pressures for dimensioning footings, it is necessary to consider only those loads applied above the finished floor elevation. All foundation excavations should be inspected by a representative of AWEI to assure that adequate bearing soils exist in the base of all footings. At the time of footing inspections, Housel Penetration Tests or other approved tests can be performed on these foundation soils. Where footing excavations must be undercut to achieve adequate bearing material, a low strength concrete (1,500 psi compressive strength) can be placed to re-establish design bottom of footing elevation.

Foundations must also be constructed such that undermining of adjacent footings and/or lateral loading of adjacent footings located at different elevations is avoided. If it is necessary to construct the new foundations within the "influence area" of the existing structure, shoring or underpinning of the existing structure will be necessary to allow for construction. If the existing footings are supported on the bedrock, as anticipated, excavations should not be closer than ½:1 (H:V) to the bottom of the footing. However, personnel should be on-site to continually monitor the excavation to determine if weathering of the excavation is occurring. If severe weathering is noted it will be necessary to flatten the slope. The lateral loads applied by the existing footing should be considered in design of the proposed foundation. Additionally, flexible joints must be designed between the two buildings (existing and proposed) to accommodate for differential settlements. Also, additional control joints should be placed to reduce the effect of differential settlement caused by differing foundation soils, i.e. fill, natural soils, and rock.

Floor Slab Recommendations

Due to the expansive shales that exist in the building area, modifications to the existing subgrade will be required. Since the shale will be exposed over the majority of the site the following options should be considered for preparation of the subgrade:

Option 1 would include undercutting two (2) feet below proposed finished grade and replacing the shale with compacted dense graded aggregate (DGA). The DGA should be compacted in two 12 inch lifts to a minimum 98% of maximum dry density. A four (4) inch socket drain tile should be placed around the perimeter of the undercut area prior to the placement of the DGA and outleted to a convenient location.

Option 2 would include undercutting to a depth of six (6) inches and replacing with lean concrete. The lean concrete should have a minimum compressive strength of 1000 psi.

Option 3 would include sealing the exposed shale surface with a bituminous binder to limit the change in moisture of the underlying shale bedrock. The bituminous cover should be covered with at least four (4) inches of compacted dense graded aggregate. The DGA should be added soon after completion of the bituminous cover to limit damage during the addition of the aggregate.

Each option above should be weighed for cost implications and feasibility for construction. The best option will be the one that is most economical and ease of placement. With any of the above options it will be required to perform the operation in stages so that the improvement can be performed in a timely manner. This is required so that the shales moisture content remains constant throughout. If during the modification the shale bedrock should become wetted or allowed to dry additional, undercutting to a level of similar natural in-situ moisture level will be required.

After the building area has been prepared, a four (4) inch compacted granular fill should be placed immediately beneath the floor slab for Options 2 and 3. Additional stone will not be required for Option 1. This compacted granular fill will provide a uniform surface for construction of the slab and minimize capillary rise from the subgrade into the slab.

Lateral Earth Pressures on Basement Walls

The basement will be placed twelve (12) to fifteen (15) feet below grade at an elevation of 850. The amount of pressure exerted by the backfill on the walls depends upon the height of the wall, drainage provisions, type of backfill, and method of placing the backfill.

The present soil profile predominately consists of clays and uncontrolled fills from the existing site grade to the anticipated depth of the basement. Excavation into the shales will be time consuming and will require a large excavator and possibly a pneumatic hammer or ripper bar.

To allow for construction of the backfill material without potential over-stressing or damage to the wall, a well-graded sand and gravel should be used for backfill within ten (10) feet of the back of the wall. In order to minimize the potential of precipitation entering into this system, it is recommended that a cohesive clay cap be constructed from the surface to two (2) feet below final grade. For design purposes, it is recommended that a coefficient of earth pressure of 0.65 be used for structurally designing the subsurface walls.

Assuming the unit weight of the backfill is 120 pcf, a k_o = 0.65 would correspond to an equivalent fluid pressure of 78 pcf per foot of wall height. This equivalent fluid pressure would increase linearly from 0 psf at ground surface to a maximum at the bottom of the basement. The above pressures are applicable during a fully drained condition. If loads such as parking, floor slab or footing loads are placed adjacent to the walls, then the structural design of the walls must include these surcharge loads in addition to the lateral earth pressure.

Minor difficulty should be anticipated during the excavation and construction of the proposed basement due to groundwater. Water infiltration will occur within existing and abandoned utilities and water could be encountered within the fill and ravine area noted by boring B-3. A permanent subsurface drainage system should be installed around the perimeter of the basement. This subsurface drainage system should be incorporated into the granular backfill at the base of the lower level footings.

The perimeter drainage system should consist of a four (4) inch perforated drain tile placed adjacent to the footings for the basement. At least twenty-four (24) inches of clean (washed) gravel be placed around the drain tile. The subsurface drainage system should be connected to a sump area inside of the basement or gravity drained to the storm system, if possible.

Also, all basement areas should be waterproofed to minimize potential seepage of groundwater into the basement area. Furthermore, the weathered shale material is not permitted for use as backfill material within or around the structure.

Intramural Field

Borings B-10 and B-11 were performed for the proposed new intramural fields to be constructed on the south side of John Hills Road. Clay was encountered beneath the topsoil to a depth of three (3) to seven (7) feet below grade. At this depth moist clay with limestone was encountered to the termination depth of boring B-10 and to a depth of thirteen (13) feet at boring B-11. Boring B-11 then encountered weathered shale bedrock to the termination depth of this boring. Groundwater was not encountered in this area during or at completion of operations. However, twenty-four (24) hours after completion a water level of ten (10) feet was noted at boring B-11. The shallow cohesive soils will provide an adequate subgrade if proper site and compaction procedures are maintained. It is suggested that the field be elevated slightly above existing grade in order to provide positive drainage from the field. Final grading of this area should be reviewed before construction to verify that adequate drainage will be provided to this area and that slopes are designed properly.

GENERAL CONSTRUCTION CONSIDERATIONS

Site Preparation

It is recommended that excessively organic topsoils and loose materials be stripped from the construction areas and wasted or stockpiled for later use. Because of the gravel and wide variety of structures and ground cover, the exact depth of stripping/undercutting should be determined by a representative of the soils engineer in the field at the time of all excavation operations.

It is recommended that after the above mentioned stripping has been performed, the exposed subgrade should be proofrolled with equipment approved by the geotechnical engineer. This proofrolling will determine areas where modification of the subgrade will be necessary. Modification techniques have been outlined previously in this report. Most areas of the site are anticipated to require modification. It is recommended that a representative of the soils engineer be present for an inspection during the proofrolling phase of this project.

After the existing subgrade soils are excavated to design grade, proper control of subgrade compaction and fill, and structural fill replacement should be maintained by a representative of the soils engineer as per the "Recommended Specifications for Compacted Fills and Backfills", presented in the Appendix of this report; thus minimizing volume changes and differential settlements which are detrimental to behavior of shallow foundations, floor slabs and pavements.

Groundwater

Because of the low groundwater level, little difficulty during foundation and utility excavations is anticipated. However, depending upon the weather conditions while excavations are open, seepage from surface runoff may occur into shallow excavations. Since these foundation materials tend to soften when exposed to free water, every effort should be made to keep the excavations dry should groundwater be encountered.

If minor seepage does occur, conventional sump pump should be sufficient to dewater this particular area. A gravity drainage system, sump pumps, or other conventional dewatering procedures should be sufficient for dewatering purposes. It is also recommended that all concrete be placed the same day as the excavation is made to minimized difficulties with precipitation and groundwater infiltration.

Proposed Short Term Cut and Fill Slopes

For temporary excavations through the stiff natural clayey soils for utilities and foundations, slopes of 1H:1V may be performed. However, because these slopes are very sensitive to changes in weather conditions, these excavations must be monitored very carefully for changes. It is recommended that excavations utilizing these steepened slopes not remain open for longer than a period of one (1) to two (2) days. If construction requires excavations be left open for periods of longer than one (1) to two (2) days, slopes should be flattened to 2H:1V to minimize the potential problems with the slope excavations in the clay soils during construction. For excavations within the shale bedrock in areas that are not near existing foundations short term slopes of ¼:1 (H:V) can be performed. If excavations are near existing foundations, roadways, or utilities and are the structure is supported on the bedrock, excavations should not be closer than ½:1 (H:V) to the bottom of the structure. These slopes should be carefully monitored for weathering during construction; if weathering of the bedrock is observed it will be necessary to flatten the bedrock cuts. Also, sump pumps should be anticipated for the excavations to control seepage and surface runoff. For cuts into the weathered shale a temporary slope of near vertical can be used.

Preparation of Long Term Slopes

Tests performed on these soils indicate that design slopes of 3H:1V may be used in the clayey soils across the site. Preparation of the subgrade on slopes steeper than 4:1 (horizontal to vertical) includes stripping of topsoil and soft materials and benching (stepping) in order to integrate new fill into the natural soil. Any fill placed on or at the top of the existing slopes by the excavator should be under the supervision of the soil engineer. At no time should loose fill material be placed upon the existing slopes without the approval of the soil engineer and owner.

Also, changes in conditions such as cuts at the bottom of the slope, redirected drainage patterns, and construction activities will have a direct influence on the performance of the slope. Thus it will be necessary to use proper erosion control methods, both temporarily and permanently. All drainage should be restricted from the slopes and directed towards protected channels or pipes.

A slope stability analysis has not been performed for any construction at this site. Once a grading plan has been produced, it should be reviewed to determine if additional subsurface investigation and recommendations would be required.

SUMMARY

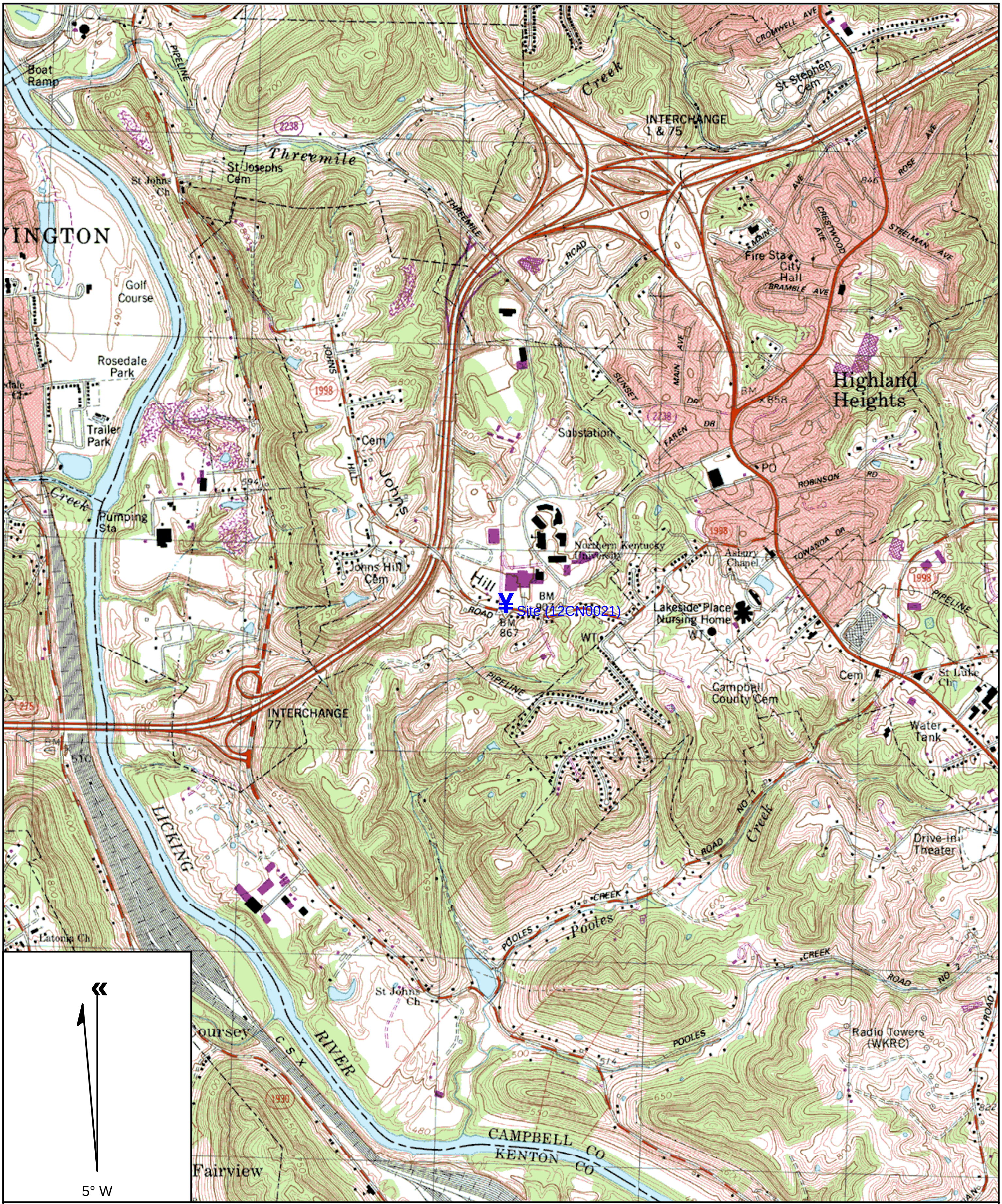
A subsurface exploration and evaluation of the foundation conditions has been conducted for the proposed Albright Recreation Center at the NKU Campus in Highland Heights, Kentucky. Soils generally consist of lean and fat clay to shale bedrock of varying degrees of weathering. Foundation design criteria have been suggested and possible design and construction problems have been discussed in this report. In addition, once the final finished floor elevation has been determined and grading information for the intramural fields has been produced it should be provided to Alt & Witzig Engineering for further evaluation.

The exploration and analysis of the foundation conditions reported herein is considered in sufficient detail and scope to form a reasonable basis for final design. The recommendations submitted are based on the available soil information and the preliminary design details furnished by the engineers for the proposed structure. Any revision in the plans for the proposed structure from those enumerated in this report should be brought to the attention of the soils engineer so that he may determine if changes in the foundation recommendations are required.

APPENDIX

RECOMMENDED SPECIFICATIONS FOR COMPACTED FILLS AND BACKFILLS

All fills shall be formed from material free of vegetable matter, rubbish, large rock, and other deleterious material. Prior to placement of fill, a sample of the proposed fill material should be submitted to the soil engineer for his approval. The fill material should be placed in layers not to exceed eight (8) inches in loose thickness and should be sprinkled with water as required to secure specified compactions. Each layer should be uniformly compacted by means of suitable equipment of the type required by the materials composing the fill. Under no circumstances should a bulldozer or similar tracked vehicles be used as compacting equipment. Material containing an excess of water so the specified compaction limits cannot be attained should be spread and dried to a moisture content that will permit proper compaction. All fill should be compacted to the specified percent of the maximum density obtained in accordance with ASTM density Test D 698 (100 percent of maximum dry density in the building and roadway areas or as indicated in this report). Should the results of the in-place density tests indicate that the specified compaction limits are not obtained; the areas represented by such tests should be reworked and retested as required until the specified limits are reached.

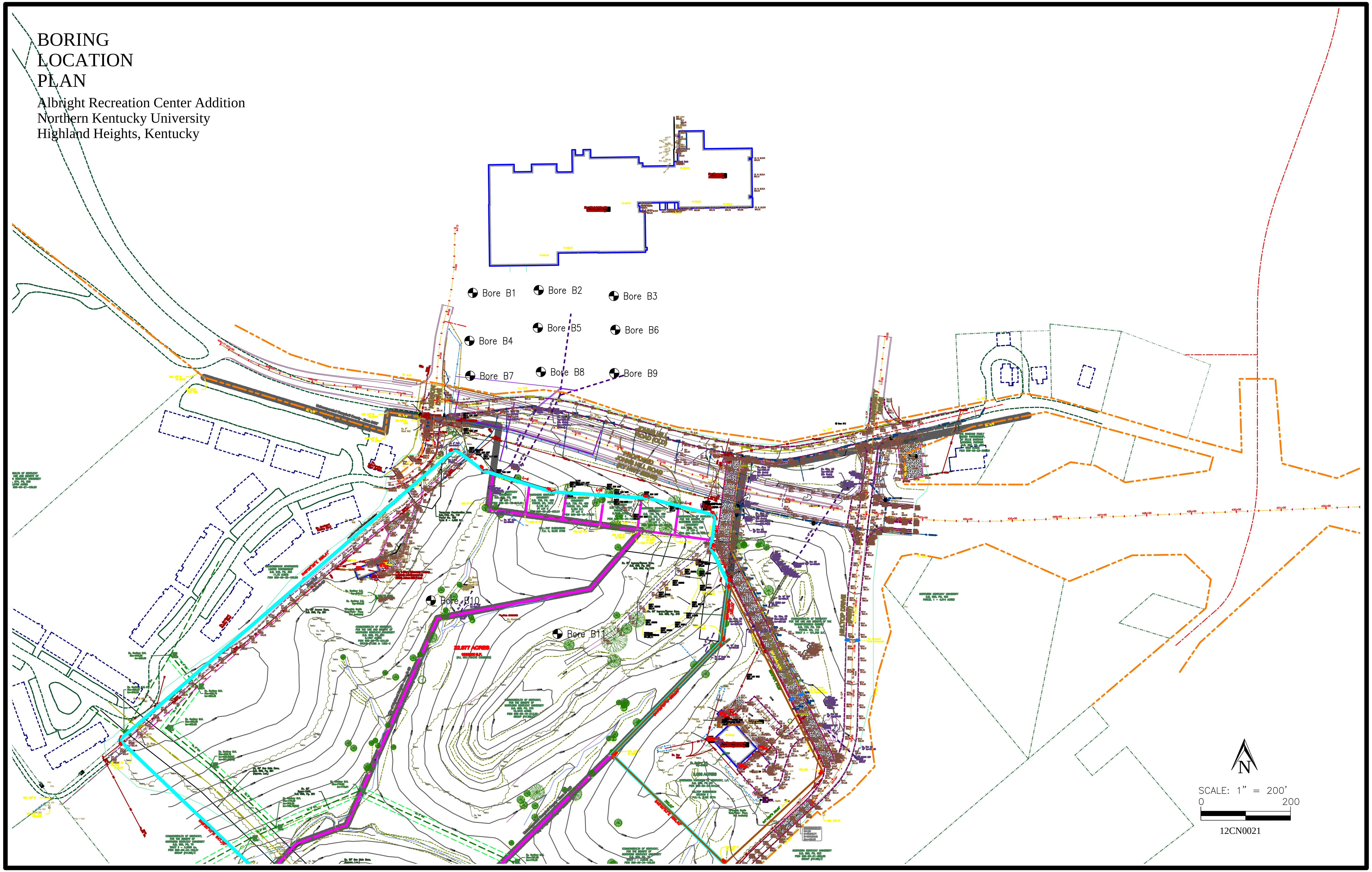


Name: NEWPORT
Date: 2/21/2012
Scale: 1 inch equals 2000 feet

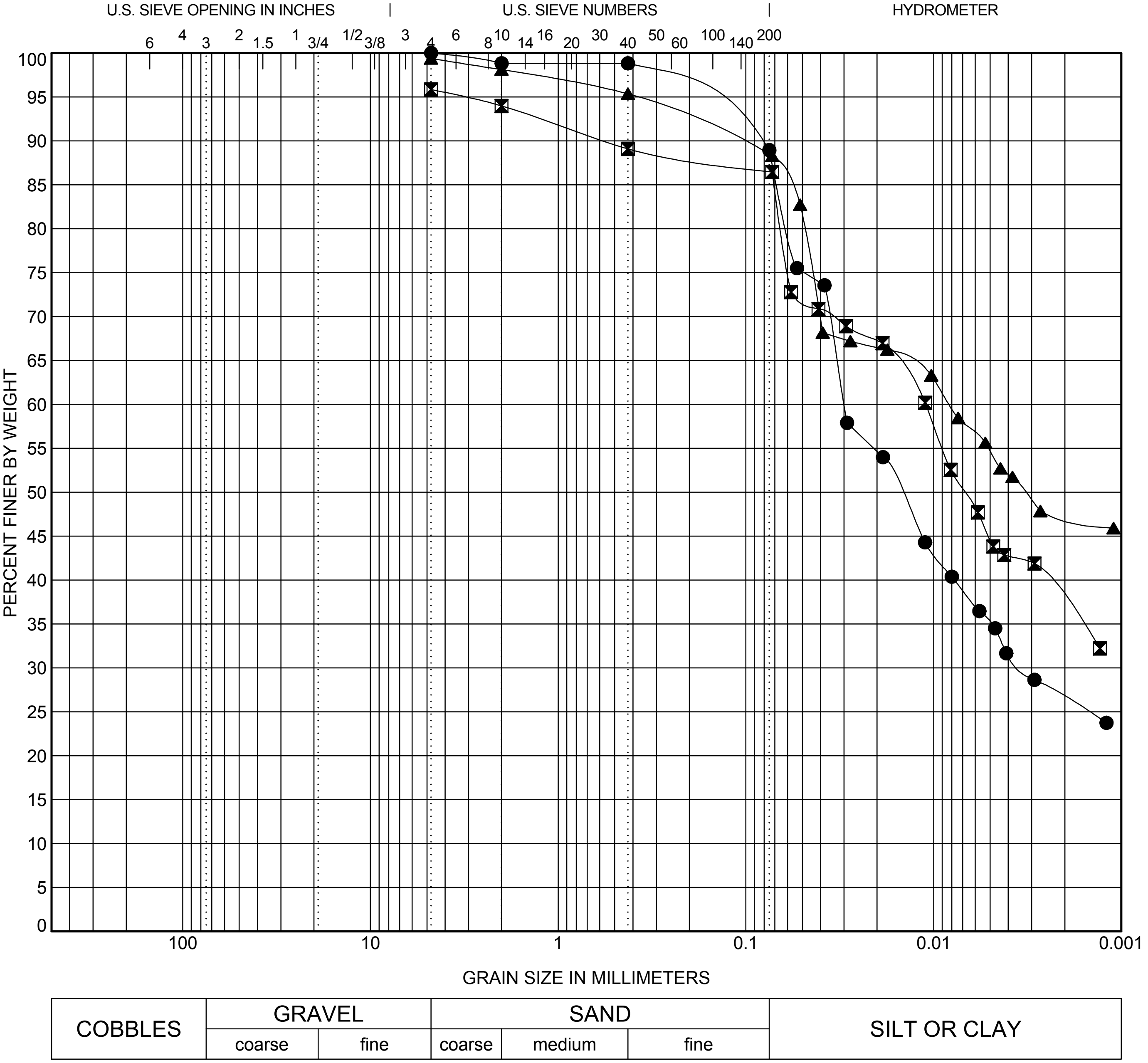
Location: 039° 01' 41.1" N 084° 28' 02.0" W
Caption: Site Location Map 12CN0021
NKU Albright Recreation Center Addition
Highland Heights, Kentucky

BORING LOCATION PLAN

Albright Recreation Center Addition
Northern Kentucky University
Highland Heights, Kentucky



12CN0021



	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**B-1**	**2.0 to 3.5**	**FAT CLAY(CH)**	**52**	**25**	**27**		
☒	**B-1**	**7.0 to 8.5**	**LEAN CLAY(CL)**	**39**	**21**	**18**		
▲	**B-4**	**2.0 to 3.5**	**LEAN CLAY(CL)**	**44**	**20**	**24**		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-1**	**2.0 to 3.5**	**4.75**	**0.03**	**0.003**		**0.0**	**11.1**	**62.4**	**26.6**
☒	**B-1**	**7.0 to 8.5**	**4.75**	**0.011**				**9.3**	**49.1**	**37.4**
▲	**B-4**	**2.0 to 3.5**	**4.75**	**0.008**				**10.9**	**41.2**	**47.2**

Alt & Witzig Engineering
6205 Schumacher Park Drive
Cincinnati, Ohio 45069
Telephone: 513-777-9890
Fax:

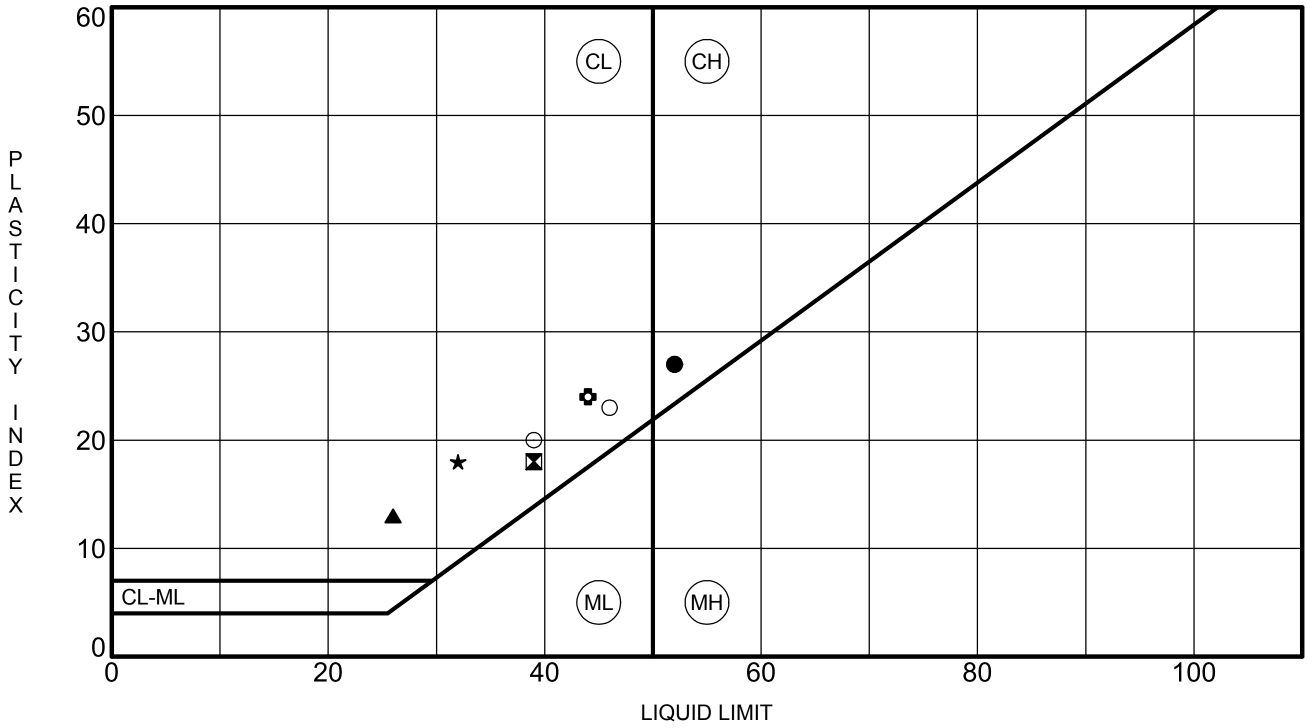
GRAIN SIZE DISTRIBUTION

Project: NKU Albright Recreation Center Addition

Location: Highland Heights, KY

Number: 12CN0021

A&W GRAIN SIZE USCS 12CN0021.BORING.GPJ US EVAL.GDT 3/23/12



	Specimen Identification	LL	PL	PI	Fines	Classification
●	**B-1 - 2.0 to 3.5**	**52**	**25**	**27**	**89**	
⧗	**B-1 - 7.0 to 8.5**	**39**	**21**	**18**	**87**	
▲	**B-12 - 4.5 to 6.0**	**26**	**13**	**13**		
★	**B-2 - 9.5 to 11.0**	**32**	**14**	**18**		
⊙	**B-3 - 2.0 to 3.5**	**39**	**19**	**20**		
✿	**B-4 - 2.0 to 3.5**	**44**	**20**	**24**	**88**	
○	**B-5 - 2.0 to 3.5**	**46**	**23**	**23**		

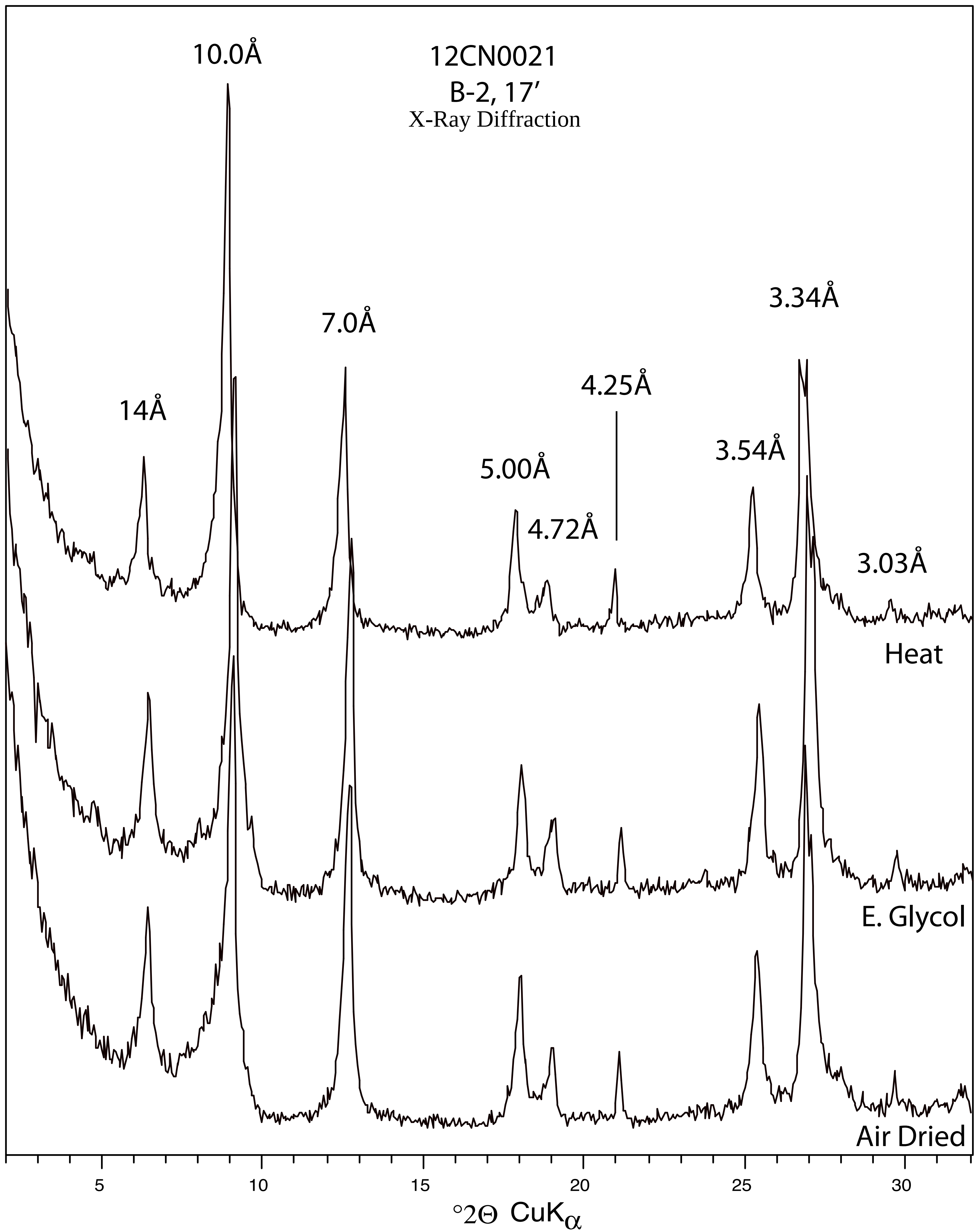
Alt & Witzig Engineering
6205 Schumacher Park Drive
Cincinnati, Ohio 45069
Telephone: 513-777-9890
Fax:

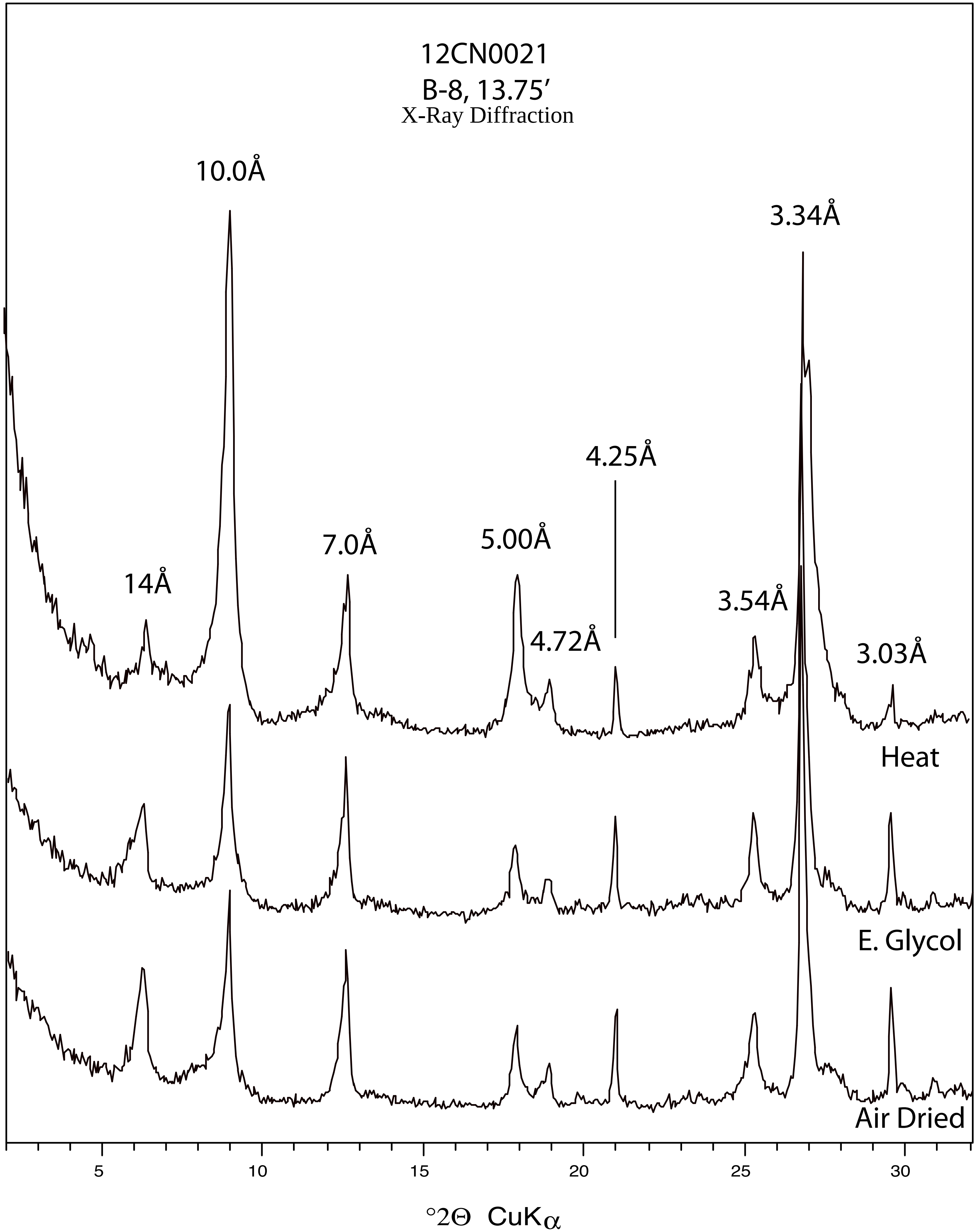
ATTERBERG LIMITS RESULTS

Project: NKU Albright Recreation Center Addition

Location: Highland Heights, KY

Number: 12CN0021


12CN0021
B-2, 17′
X-Ray Diffraction
10.0Å
14Å
7.0Å
5.00Å
4.72Å
4.25Å
3.54Å
3.34Å
3.03Å
Heat
E. Glycol
Air Dried
5
10
15
20
25
30
°2Θ CuKα


12CN0021
B-8, 13.75′
X-Ray Diffraction
10.0Å
3.34Å
4.25Å
7.0Å
5.00Å
14Å
4.72Å
3.54Å
3.03Å
Heat
E. Glycol
Air Dried
5
10
15
20
25
30
°2Θ CuKα

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**
PROJECT NAME **NKU Albright Recreation Center Addition**
PROJECT LOCATION **Highland Heights, KY**

BORING # **B-1**
Alt & Witzig File No. **12CN0021**
Northing 556775.095 Easting 1578797.188

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**
Date Completed **2/8/12**
Boring Method **HSA**
Driller **J.Roark**
Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2** in.
Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 866.2	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
865.9	Gravel	0.3										
	Brown, Fat CLAY (CH)			1	SS			10	2.1	2.3	24.4	LL=52% PL=25 PI=27%
862.2		4.0										
	Brown, Lean CLAY Some Silt Seams		5	2	SS			16		4.5	18.9	
859.2		7.0										
	Brown Mottled Gray Shaley CLAY Some Limestone (CL)			3	SS			18		4.5	15.6	LL=39% PL=21% PI=18%
857.2		9.0										
	Brownish Gray Clayey Shale (Completely Weathered)		10	4	SS			34	4.5		16.4	
854.2		12.0										
	Brown to Gray Highly Weathered Shale Some Limestone			5	SS			50/2				
852.2		14.0										
	Gray Weathered Shale and Limestone		15	6	SS			50/2				
				7	SS			50/2				
847.7		18.5										
	End of Boring at 18.5 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*
▼ After *5* hours *Dry ft.*
Caved After *5* hours at *8.5 ft*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

BORING # **B-2**

PROJECT NAME **NKU Albright Recreation Center Addition**

Alt & Witzig File No. **12CN0021**

PROJECT LOCATION **Highland Heights, KY**

Northing 556781.195 Easting 1578944.108

DRILLING and SAMPLING INFORMATION

Date Started **2/7/12**
Hammer Wt. **140** lbs.
Date Completed **2/7/12**
Hammer Drop **30** in.
Boring Method **HSA**
Spoon Sampler OD **2** in.
Driller **J.Roark**
Rig Type **D-50 Truck**

					TEST DATA							
STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 867.1	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
866.7	Gravel	0.4										
	Brown, Fat CLAY			1	SS			15	3.0	4.0	18.0	
863.1		4.0										
	Brown Shaley CLAY		5	2	SS			24	7.5	4.5	17.4	
860.1		7.0										
	Brown Clayey Shale and Limestone (Completely Weathered)			3	SS			90		4.5	8.5	LL=32% PL=14% PI=18%
857.1		10.0	10	4	SS			50/4			7.1	
	Gray Highly Weathered Shale and Limestone											
855.6		11.5		5	RC							Rock Core #1: 11.5'-16.5' REC=97% RQD=72%
	Gray Weathered Shale Some 2" Limestone Seams		15									
850.1		17.0		6	RC							Rock Core #2: 16.5'-21.5' REC=93% RQD=77%
	Gray Shale Some 2"-7" Limestone Seams		20									
845.6		21.5										
	End of Boring at 21.5 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

BORING # **B-3**

PROJECT NAME **NKU Albright Recreation Center Addition**

Alt & Witzig File No. **12CN0021**

PROJECT LOCATION **Highland Heights, KY**

Northing 556768.146 Easting 1579111.565

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**

Date Completed **2/8/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 867.2	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
866.9	Gravel	0.3										
865.2	Brown CLAY with Limestone Fragments and Trace Asphalt (Fill)	2.0										
				1	SS			20		4.3	15.6	LL=39% PL=19% PI=20%
	Brown CLAY with Limestone and Trace Gravel (Fill)		5	2	SS			17		2.5	19.0	
860.2		7.0										
				3	SS			11		1.0	22.1	
	Dark Brown and Brown CLAY Trace Organics and Limestone (Fill)		10	4	SS			9		1.5	28.6	
855.2		12.0										
	Brown CLAY with Light Brown Silt Seams and Some Limestone		15	5	SS			17		3.0	24.9	
849.2		18.0										
	Brown CLAY and Limestone		20	6	SS			50/1		3.0		
844.2		23.0										
	Brown Highly Weathered Shale		25	7	SS			37		4.5		
							▼					
839.2		28.0										
							◪					
			30	8	SS			50/1		4.5	15.1	
	Grayish Brown Weathered Shale and Limestone						▽					
							○					
			35	9	SS			50/2				
831.2		36.0										
	End of Boring at 36 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *34.5 ft.*
▽ At Completion *32 ft.*

▼ After 6 hours *27 ft.*
◪ Caved After 6 hours at *29 ft*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-4**

Alt & Witzig File No. **12CN0021**

Northing 556668.21 Easting 1578789.624

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**

Date Completed **2/8/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 866.1	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
865.5	Gravel	0.6										
864.1	Brown Peppered Black, Fat CLAY	2.0										
				1	SS			19		4.5	19.3	LL=44% PL=20% PI=24%
862.1	Brown, Lean CLAY Some Light Brown Silt Seams (CL)	4.0										
			5	2	SS			31		4.5	14.5	
				3	SS			50/5		4.5		
857.1	Brown Shaley CLAY and Limestone	9.0										
			10	4	SS			50/3		4.5	6.9	
				5	SS			50/1				
			15	6	SS			50/2				
849.1	Gray Weathered Shale Some Limestone	17.0										
				7	SS			50/1				
847.6	Gray Shale and Limestone	18.5										
	End of Boring at 18.5 feet											

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Groundwater
- ○ During Drilling *Dry ft.*
- ⊻ At Completion *Dry ft.*

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- DC - Driving Casing
- MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-5**

Alt & Witzig File No. **12CN0021**

Northing 556697.332 Easting 1578942.243

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**

Date Completed **2/8/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 865.3	Strata Depth	Depth Scale	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
864.6	Gravel	0.7									
863.3	Brown Silty CLAY with Gravel	2.0									
				1	SS		26	6.2	4.5	17.2	LL=46% PL=23% PI=23%
	Brown Shaley CLAY		5	2	SS		17	5.4	4.5	20.0	
858.3		7.0									
				3	SS		60		4.5	13.7	
	Brown Highly Weathered Shale Some Limestone		10	4	SS		50/2		4.5		
				5	SS		50/2				
851.8		13.5									
	Gray Weathered Shale and Limestone		15	6	SS		50/4				
849.3		16.0									
	Gray Shale			7	SS		50/5				
846.8		18.5									
	End of Boring at 18.5 feet										

Sample Type

- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*

⊻ At Completion *Dry ft.*

Boring Method

- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- DC - Driving Casing
- MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

BORING # **B-6**

PROJECT NAME **NKU Albright Recreation Center Addition**

Alt & Witzig File No. **12CN0021**

PROJECT LOCATION **Highland Heights, KY**

Northing 556692.676 Easting 1579115.087

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**

Date Completed **2/8/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 865.9	Strata Depth	Depth Scale	Sample No.	Sample Type	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
865.5	Gravel	0.4									
	Brown and Dark Brown, Fat CLAY			1	SS		8		2.0	24.4	
861.9		4.0									
	Brown, Lean CLAY and Limestone		5	2	SS		45		4.5	20.6	
858.9		7.0									
	Brown Highly Weathered Shale (Limestone at 10')			3	SS		26		4.5	17.3	
						▼					
			10	4	SS	◩	93				
852.9		13.0									
	Gray Weathered Shale		15	5	SS		50/5				
849.9		16.0									
	Gray Shale and Limestone			6	SS		50/4				
			20	7	SS		50/4				
844.9		21.0									
	End of Boring at 21 feet										

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

▼ After *7* hours *9 ft.*
◩ Caved After *7* hours at *10 ft*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-7**

Alt & Witzig File No. **12CN0021**

Northing 556590.302 Easting 1578791.323

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**

Date Completed **2/8/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
	SURFACE ELEVATION 865.4											
864.9	Gravel	0.5										
863.4	Brown Silty CLAY Trace Gravel	2.0										
				1	SS			37		4.5	19.3	
			5	2	SS			43		4.5	12.5	
859.4	Brown Shaley CLAY Some Limestone	6.0										
				3	SS			90		4.5	15.3	
856.4	Brownish Gray Highly Weathered Shale	9.0										
			10	4	SS			50/5			9.0	
854.4	Gray Weathered Shale	11.0										
				5	SS			50/3				
			15	6	SS			50/2				
849.4	Gray Shale and Limestone	16.0										
				7	SS			50/4				
846.9	Gray Shale	18.5										
	End of Boring at 18.5 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
⊻ At Completion *Dry ft.*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**
PROJECT NAME **NKU Albright Recreation Center Addition**
PROJECT LOCATION **Highland Heights, KY**

BORING # **B-8**
Alt & Witzig File No. **12CN0021**
Northing 556598.936 Easting 1578949.068

DRILLING and SAMPLING INFORMATION

Date Started **2/7/12**
Date Completed **2/7/12**
Boring Method **HSA**
Driller **J.Roark**
Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2** in.
Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 863.0	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
862.5	Gravel	0.5										
861.0	Brown Silty CLAY	2.0										
				1	SS			40		4.5	11.4	
859.0	Brown Shaley CLAY and Limestone	4.0										
			5	2	SS			33		4.5	18.4	
856.0	Brown, Lean CLAY	7.0										
				3	SS			50/3	7.5	4.5	14.0	
			10	4	SS			50/5		4.5	13.5	
				5	RC							Rock Core #1: 14'-19' REC=78% RQD=38%
847.5	Brown Highly Weathered Shale (Some Limestone at 10')	15.5	15									
843.5	Gray Weathered Shale Some 1"-2" Limestone Seams	19.5		6	RC							Rock Core #2: 19'-24' REC=92% RQD=27%
			20									
839.0	Gray Limestone and Shale	24.0										
	End of Boring at 24 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
⊻ At Completion *Dry ft.*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-9**

Alt & Witzig File No. **12CN0021**

Northing 556596.105 Easting 1579112.656

DRILLING and SAMPLING INFORMATION

Date Started **2/8/12**
Date Completed **2/8/12**
Boring Method **HSA**
Driller **J.Roark**
Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2** in.
Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 864.8	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
864.2	Gravel	0.6										
860.8	Brown Shaley CLAY Some Limestone (Fill)	4.0		1	SS		▼	51		4.5	13.6	
857.8	Brown and Dark Borwn CLAY Some Limestone (Very Moist) (Fill)	7.0	5	2	SS		◩	43		2.3	14.7	
854.8	Gray Weathered Shale (Some Limestone at 9 feet)	10.0		3	SS			50/3		4.5	17.4	
854.5	Limestone	10.3	10	4	RC							Rock Core #1: 10'-15' REC=92% RQD=47%
849.8	Gray Shale with 1"-3" Limestone Seams	15.0	15									
	End of Boring at 15 feet											

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

▼ After *8* hours *3 ft.*
◩ Caved After *8* hours at *5.5 ft*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-10**

Alt & Witzig File No. **12CN0021**

Northing 556089.376 Easting 1578703.695

DRILLING and SAMPLING INFORMATION

Date Started **2/7/12**

Date Completed **2/7/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 813.0	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
812.8	TOPSOIL	0.2										
810.0	Brown and Dark Brown CLAY (Fill)	3.0		1	SS			10		2.5	22.9	
	Brown CLAY and Limestone		5	2	SS			50/2				
				3	SS			33				
802.0		11.0	10	4	SS			50/0				
	End of Boring at 11 feet											

Sample Type
- SS - Driven Split Spoon
- ST - Pressed Shelby Tube
- CA - Continuous Flight Auger
- RC - Rock Core
- CU - Cuttings
- CT - Continuous Tube

Groundwater
- ○ During Drilling *Dry ft.*
- ▽ At Completion *Dry ft.*
- ▼ After *24* hours *Dry ft.*
- Caved After *24* hours at *8.5 ft*

Boring Method
- HSA - Hollow Stem Augers
- CFA - Continuous Flight Augers
- DC - Driving Casing
- MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**
PROJECT NAME **NKU Albright Recreation Center Addition**
PROJECT LOCATION **Highland Heights, KY**

BORING # **B-11**
Alt & Witzig File No. **12CN0021**

Northing 556015.024 Easting 1578986.094

DRILLING and SAMPLING INFORMATION

Date Started **2/7/12**
Date Completed **2/7/12**
Boring Method **HSA**
Driller **J.Roark**

Hammer Wt. **140** lbs.
Hammer Drop **30** in.
Spoon Sampler OD **2** in.
Rig Type **D-50 Truck**

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 846.8	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
846.6	TOPSOIL	0.2										
843.8	Brown CLAY	3.0		1	SS			16		2.5	26.6	
839.8	Brown, Lean CLAY Some Silt Seams	7.0	5	2	SS			46		4.5	13.7	
				3	SS			50/2				
833.8	Brown Shaley CLAY and Limestone	13.0	10	4	SS		▼	50/3				
830.8	Brown Highly Weathered Shale Some Limestone	16.0	15	5	SS			50/1		4.5	9.5	
	End of Boring at 16 feet											

Sample Type
SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater
○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*
▼ After *24* hours *10 ft.*
Caved After *24* hours at *10.5 ft*

Boring Method
HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

RECORD OF SUBSURFACE EXPLORATION

Alt & Witzig Engineering, Inc.

CLIENT **Northern Kentucky University**

PROJECT NAME **NKU Albright Recreation Center Addition**

PROJECT LOCATION **Highland Heights, KY**

BORING # **B-12**

Alt & Witzig File No. **12CN0021**

Northing 556483.795 Easting 1579607.537

DRILLING and SAMPLING INFORMATION

Date Started **2/7/12**

Date Completed **2/7/12**

Boring Method **HSA**

Driller **J.Roark**

Hammer Wt. **140** lbs.

Hammer Drop **30** in.

Spoon Sampler OD **2** in.

Rig Type **D-50 Truck**

TEST DATA

STRATA ELEV.	SOIL CLASSIFICATION SURFACE ELEVATION 905.2	Strata Depth	Depth Scale	Sample No.	Sample Type	Sampler Graphics Recovery Graphics	Ground Water	Standard Penetration Test, N - blows/foot	Qu-tsf Unconfined Compressive Strength	PP-tsf Pocket Penetrometer	Moisture Content % *Unit Weight (pcf)*	Remarks
905.0	TOPSOIL	0.2										
	Red Brown Silty CLAY			1	SS			14		3.5	24.4	
			5	2	SS			9		1.0	22.2	LL=26% PL=13% PI=13%
898.2		7.0										
				3	SS			11		1.5	20.7	
			10	4	SS		▼	16		3.0		
	Brown, Moist SILT											
			15	5	SS			15		3.8		
887.2		18.0										
	Brown Shaley CLAY		20	6	SS			18		4.0		
884.2	End of Boring at 21 feet	21.0										

Sample Type

SS - Driven Split Spoon
ST - Pressed Shelby Tube
CA - Continuous Flight Auger
RC - Rock Core
CU - Cuttings
CT - Continuous Tube

Groundwater

○ During Drilling *Dry ft.*
▽ At Completion *Dry ft.*

▼ After *24* hours *11 ft.*
Caved After *24* hours at *12.5 ft*

Boring Method

HSA - Hollow Stem Augers
CFA - Continuous Flight Augers
DC - Driving Casing
MD - Mud Drilling

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System is used to identify the soil unless otherwise noted.

SOIL PROPERTY SYMBOLS

N:	Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2 inch O.D. split-spoon.
Qu:	Unconfined compressive strength, TSF
Qp:	Penetrometer value, unconfined compressive strength, TSF
Mc:	Water content, %
LL:	Liquid limit, %
PL:	Plastic limit, %
Dd:	Natural dry density, PCF
● :	Apparent groundwater level at time noted after completion

DRILLING AND SAMPLING SYMBOLS

SS:	Split-spoon - 1 3/8" I.D., 2" O.D., except where noted
ST:	Shelby tube - 3" O.D., except where noted
AU:	Auger sample
DB:	Diamond bit
CB:	Carbide bit
WS:	Washed sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION

TERM (NON-COHESIVE SOILS)	BLOWS PER FOOT
Very loose	0 - 4
Loose	5 - 10
Firm	11 - 30
Dense	31 - 50
Very Dense	Over 50

TERM (COHESIVE SOILS)	Qu (TSF)
Very soft	0 - 0.25
Soft	0.25 - 0.50
Medium	0.50 - 1.00
Stiff	1.00 - 2.00
Very Stiff	2.00 - 4.00
Hard	4.00+

PARTICLE SIZE

Boulders	8 in.(+)	Coarse Sand	5 mm-0.6 mm	Silt	0.075 mm - 0.005 mm
Cobbles	8 in. - 3 in.	Medium Sand	0.6mm-0.2 mm	Clay	0.005mm(-)
Gravel	3 in. - 5 mm	Fine Sand	0.2mm-0.075 mm		