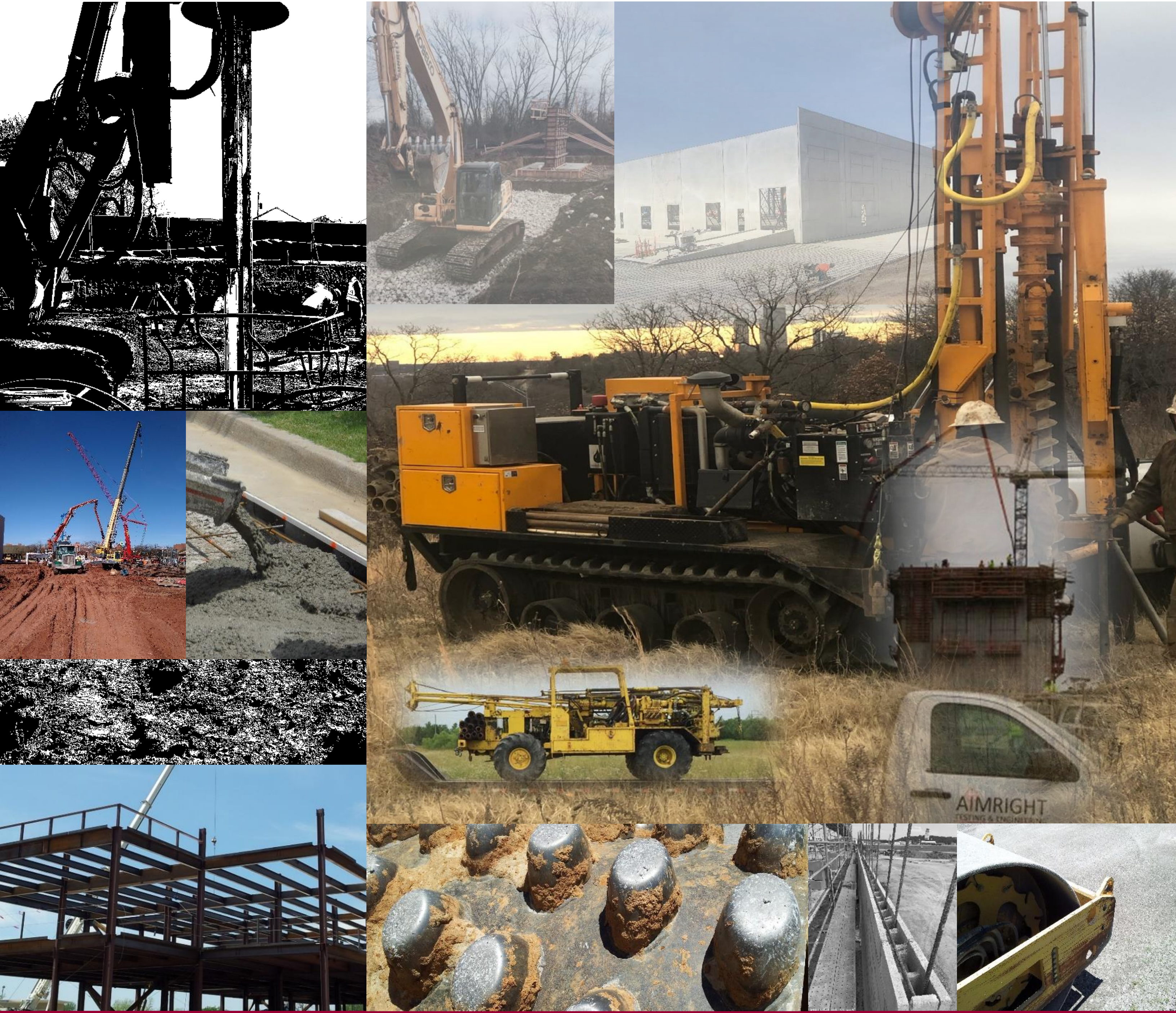

GEOTECHNICAL ENGINEERING REPORT

AIMRIGHT Project No. 16250424
May 23, 2024

Cherokee Nation Little Flock Church Restoration

Prepared for:
CJC Architects, Inc.

May 23, 2024

CJC Architects, Inc.
1401 S Denver Ave, Ste B
Tulsa, OK 74119
(918) 582-7129

Attn: Tim Boeckman, A.I.A., President
tboeckman@cjcarchitects.com

Re: Geotechnical Engineering Report
Project No. 16250424
Cherokee Nation Little Flock Church Restoration
14210 EW 8 Rd, Coffeyville, OK 74072

It has been a pleasure serving you on this project. AIMRIGHT is pleased to submit this Geotechnical Engineering Report for the proposed construction planned at the referenced site. This report presents the findings of the geotechnical exploration and presents recommendations for design for the project.

We appreciate the opportunity to provide geotechnical consultation services for the subject project. We look forward to serving as your geotechnical engineer and construction materials testing laboratory for the remainder of this and future projects. Please do not hesitate to contact us with any concerns or questions regarding this report.

Respectfully submitted,

AIMRIGHT Testing & Engineering, LLC
CA No. 5794 (exp. 6/30/24)
Justin J. Boyd Jr., PE
Engineering Manager
jboyd@aimrighttesting.com
(918) 392-8041

LICENSED PROFESSIONAL ENGINEER
JUSTIN J. BOYD JR.
05/23/2024
25921
OKLAHOMA

Project Description

We understand that a 1-story historic structure will be re-assembled on the referenced site. The final design layout has not been completed, but preliminary a site layout was provided.

The site is generally grass covered with few trees and mostly level with minimal elevation differences across the site. Cut/fill depths have not been finalized; however, we estimate that cut/fill of approximately 0.5 to 1.5 feet may be required to reach the final site elevations.

The structure is anticipated to be supported by a concrete slab-on-ground and shallow foundation system. Information regarding estimated structural loading conditions was not provided; however, we utilized maximum column loads of 9 kip and wall loads of 1.5 kip per linear foot in our engineering analyses.

Scope of Services

The primary purpose of this report is to provide geotechnical engineering recommendations for the proposed site development. Our Scope of Services consisted of the following:

1. Drilling one (1) soil test boring (boring) to depths of approximately 10 feet.

2. Performing laboratory testing of selected soil samples obtained from the boring.

3. Providing engineering analysis and preparation of this report discussing, in general, project description, our scope, exploration, testing, analysis, and recommendations.

The Boring Location Plan, Boring Log, and other supporting data are presented in the Appendices to this report. Our Scope of Services did not include a survey of boring location and elevation, rock coring, quantity estimates, preparation of plans or specifications, slope stability analysis, or the identification and evaluation of environmental aspects of the project site.

AIMRIGHT located the boring in the field by making measurements from known existing site features. No claim is made as to the accuracy of the location shown on the Boring Location Plan, and they should be considered approximate.

The boring was advanced using an ATV-mounted drill rig equipped with an automatic hammer and rotary continuous flight augers. Representative soil samples were obtained using a standard 2-inch outside diameter split-barrel sampler in general compliance with the Standard Penetration Testing (SPT) method of the American Society of Testing and Materials (ASTM) D1586 standard to evaluate the consistency and general engineering properties of the subsurface soils.

The number of blows required to drive the split-barrel sampler three (3) consecutive 6-inch increments is recorded, and the blows of the last two 6-inch increments are added to obtain the SPT N-value in blows per foot (bpf) representing the penetration resistance of the soil. At regular intervals within the borings, split-spoon samples were visually classified based on texture and plasticity.

During the drilling process, all encounters with groundwater, if any, were recorded. Upon completion of drilling, the boring was backfilled per OWRB requirements.

The samples obtained from the geotechnical exploration were transported to the AIMRIGHT laboratory where representative samples were selected for testing. Testing consisted of Atterberg limits, sieve analysis, and determination of moisture content in general accordance with the ASTM testing procedures.

Laboratory Testing

Laboratory tests were conducted on selected samples in general accordance with ASTM standards. The laboratory testing performed for this project consisted of Atterberg Limits (ASTM D4318), Sieve Analysis – No. 200 Sieve Wash Method (ASTM D1140), and Moisture Content (ASTM D2216) testing. The test results are presented on the Boring Log and the results are summarized below.

Boring No.	Depth Interval (ft)	Moisture Content (%)	Finer than No. 200 Sieve (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index
B-1	0 to 1.5	19.6	40.4	42	27	15

Subsurface Conditions

The subsurface conditions outlined below represent a general interpretation of the boring data using normally accepted geotechnical engineering judgments. The transitions between soil strata are usually less distinct than shown on the Boring Log.

Stratum	Depth Interval	General Description of Materials
Surface	4 inches	organic laden soils (topsoil) sampled as silty sand/sandy silt with organics and root matter
Native Soils	0.3 to 1.5 feet	medium dense sand
Weathered Rock	1.5 to 3+ feet	highly to slightly weathered, soft to hard limestone

Auger refusal was encountered at a depth of approximately 3 feet and is defined as material that could not be penetrated with the drill rig equipment which may have been caused by rock, large boulders, rock ledges, lenses, seams, or the top of parent bedrock.

Groundwater

Groundwater was not encountered during or at the completion of drilling in any of the borings. Water traveling through soil and rock is often unpredictable and may be present at shallow depths. Due to the seasonal changes in groundwater and the unpredictable nature of groundwater paths, groundwater levels will fluctuate. As such, groundwater levels at other times of the year may be different than those described in this report.

Generally, the highest groundwater levels occur in late winter and early spring and the lowest levels in late summer and fall. Therefore, it is necessary during construction to be observant for groundwater seepage in excavations to assess the situation and make necessary changes. Where applicable, the contractor should determine the actual groundwater levels at the time of construction.

Site Preparation and Earthwork

Before proceeding with construction, AIMRIGHT recommends conducting a pre-grading meeting to discuss recommendations as outlined in this report. Where appropriate, existing utilities beneath the construction footprints should be properly abandoned; or, should be removed and backfilled with properly compacted engineered fill as outlined in this report.

Any existing structures, pavements, site elements, foreign stockpiles, topsoil/vegetation, wet, soft, or loose soils and any other deleterious non-soil materials should be removed to a minimum distance of 5 feet beyond the structure footprints.

Upon completion of required excavations, proof-rolling of the subgrade with a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight should then be performed. Proof-rolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. The proof-rolling observation is an opportunity for the geotechnical engineer to locate inconsistencies intermediate of our boring locations in the existing subgrade.

All unsuitable materials observed during the evaluation and proof-rolling operations should be over-excavated and replaced with compacted fill or stabilized in place. The possible need for, and extent of over-excavation and/or in-place stabilization required can best be determined by the geotechnical engineer at that time.

The upper 8 inches of the existing subgrade in construction areas shall then be scarified, moisture-conditioned and re-compacted to at least ninety-five percent (95%) of the maximum dry density and within ±2 percentage points of the optimum moisture content as determined by a Standard Proctor (ASTM D698). The moisture content and compaction shall be maintained prior to beginning any fill or aggregate placement and/or construction. Depending on weather conditions prior to and during construction, the near surface soils may need moisture-conditioning to sufficiently enable adequate scarifying and compaction.

We note that some of the near surface materials (i.e., silty clayey sand, sandy silt, silty clay, silt, etc.) will often exhibit shearing as open subgrades under wheel loads and will not hold up well to construction activities, especially during wet periods. A layer of aggregate base or crushed stone quickly placed after subgrade preparation and verification will help confine the subgrade soils and reduce imminent disturbance from construction activities.

Excavation Difficulties

Highly to slightly weathered, soft to hard limestone was encountered in the boring beginning at depths of approximately 1.5 feet and extending down to the termination depths.

Auger refusal was encountered at a depth of approximately 3 feet.

We anticipate the near-surface soils above these depths at the site can be excavated with pans, scrapers, backhoes, and front-end loaders using conventional means and methods.

Our experience indicates rock in a weathered, boulder, and/or massive form may vary erratically in location and depth within the referenced site. Therefore, there is always a potential that these materials could be encountered at shallower depths between the boring locations and should be anticipated during construction.

Installation or excavation of proposed subgrade, foundations, or underground utilities (depending on layout and planned bottom elevations) within some portions of the site will likely require jackhammering, coring, ripping, or other suitable methods to remove these materials.

Site Drainage

An important aspect to consider during development of this site is surface water control. During the initiation of grading operations, we recommend that the grading contractor take those steps necessary to enhance surface flow and promote rapid clearing of rainfall and runoff water following rain events.

It should be incumbent on the contractor to maintain favorable site drainage during construction to minimize deterioration of otherwise stable subgrades.

Permanent positive drainage should be provided around the perimeter of the structures to minimize moisture infiltration into the foundation and/or subgrade soils. We recommend areas adjacent to the structures be provided with a fall of at least 6 inches for the first 10 feet outward from the structure areas.

All grades must provide effective drainage away from the structures during and after construction. Water permitted to pond next to the structures can result in unacceptable differential floor slab movements and cracked slabs and/or walls.

After construction, AIMRIGHT recommends verifying final grades to document that effective drainage has been achieved. Grades around the structures should also be periodically inspected and adjusted as necessary, as part of the structure's maintenance program.

Sprinkler mains and spray heads should be located a minimum of 5 feet away from the structure lines. Low-volume, drip style landscape irrigation should not be used near the structures.

Roof runoff should be collected in drains or gutters. Roof drains and downspouts should be discharged onto pavements which slope away from the structures or downspouts should be extended a minimum of 10 feet away from the structures.

Fill Material

A sample of each material type should be submitted to the geotechnical engineer for evaluation. Frozen material should not be used, and fill should not be placed on a frozen subgrade.

All fill material in structural areas (including utility backfill) should be placed in continuous, horizontal lifts having a maximum pre-compacted thickness of 9 inches. Aggregate base should have a maximum pre-compacted thickness of 6 inches; and fill compacted with hand-held or smaller-sized equipment having a maximum pre-compacted thickness of 4 to 6 inches.

Each lift should be compacted to at least ninety-five percent (95%) of the maximum dry density and within ±2 percentage points of the optimum moisture content as determined by a Standard Proctor (ASTM D698), unless noted otherwise and maintained throughout construction activities.

A minimum of two (2) field tests to determine in-place density and moisture content should be performed per lift for each 2,000 sf within structural footprints.

Engineered Fill

Engineered fill should consist of approved materials that are free of organic matter and debris, exhibit a maximum plasticity index (PI) of 18, maximum liquid limit (LL) of 40, and a maximum rock size of 3.0 inches.

Native Soils

Native soils could be used as fill; whereby, upon re-use, the soils meet the requirements for engineered fill as stated in this report. Soils that do not meet engineered fill requirements may be exposed during earthwork activities. AIMRIGHT recommends conducting additional soil sampling and laboratory testing of any excavated or cut native soils during completion of grading activities to determine characteristics prior to beginning placement in structural areas.

Slab-on-ground Design

The structure subgrades should be prepared as described in this report. Four (4) inches or more of granular base should be placed over the final soil subgrade and shall meet the requirements outlined below.

Minimum Finer than 1.5-in Sieve	100%
Maximum Finer than No. 200 Sieve	15%
Maximum Plasticity Index	6

The modulus of subgrade reaction, k, values illustrated below are based on a 30-inch diameter plate load test.

k, at soil subgrade	100 psi/in
k, w/ 4 inches of Granular Base	125 psi/in

At the time of concrete placement, the granular base should be moist, but free of any self-draining water. If floor coverings are susceptible to moisture damage by moist floor conditions (capillary moisture), a vapor retarder should be placed below the slab-on-ground in accordance with the most recent addendum to ACI 302.1R-04 / 302.2R-06 and other current industry recommendations for use and placement of vapor retarders.

Shallow Foundation Design

The project structural engineer should determine the final foundation sizes based on the actual design loads, building code requirements, and other structural considerations. Structure foundations may be designed utilizing the following parameters.

Maximum Wall Loads	1.5 kip/ft
Maximum Column Loads	9 kip
Approved Bearing Material	native soils/rock
Net Allowable Bearing Pressure (FS ≥ 2.5)	3,000 psf
Total Unit Weight, γ	100 to 115 pcf
Coefficient of Sliding Friction, μ	0.33 to 0.38
Angle of Friction, ø	25°
Rankine Passive Earth Pressure Coefficient, K_p	2.46
Minimum Footing Embedment	24 inches
Minimum Wall Footing Width	12 inches
Minimum Column Footing Width	24 inches
Estimated Total Settlement	≤ 1 inch
Estimated Differential Settlement	≤ ½ inch
2018 IBC Earthquake Loads Site Class	C

The recommended net allowable bearing pressure is based on foundations within approved bearing materials and is the pressure more than the minimum surrounding overburden pressure at the footing base elevation.

Values provided for material encountered at the site and/or anticipated import material that are prepared in accordance with this report are illustrated, however, actual parameters are dependent on bearing material placed and/or exposed during construction. Values are provided for guidance and should only be utilized by experienced engineers and designers. Exclude total passive pressure resistance within 2 feet of the adjacent lowest final site elevation.

Minimum depth applies to both perimeter footings and foundations in unheated areas. Minimum depth will provide frost protection and reduce the potential for moisture variation below the bearing level. Interior foundations should extend at least 12 inches below the final adjacent subgrade to provide minimum confinement.

The magnitude of the settlements will be highly influenced by the variation in excavation requirements across the structure footprint, the distribution of loads, and the variability of underlying soils.

Shallow Foundation Construction

All exposed foundation subgrades should be re-compacted, observed, evaluated, and verified for the design soil bearing pressure by the geotechnical engineer after excavation and prior to concrete placement. This evaluation should include, as a minimum, Dynamic Cone Penetrometer (DCP) testing at the planned bearing elevations at intervals of no less than 35 feet and extending to depths of at least 3 feet below the bearing elevations.

If unsuitable material is encountered during foundation bearing grade testing and inspections (DCP Testing), foundations should; 1) extend deeper to a more suitable bearing material and bear directly on this material; 2) extend deeper to a more suitable bearing material and backfill with lean concrete to the designed bottom of footing elevation (see Figure 1); 3) extend deeper to a more suitable bearing material and backfilled with engineered fill (see Figure 2). If option 3 is selected, the over-excavation should extend laterally to a minimum of ⅔ of the total depth of excavation.

To reduce differential settlement, it is imperative to ensure that all shallow foundations bear on a minimum of 12 inches of similar material. Where applicable, to prevent a "point-load" bearing condition where the newly placed engineered fill or native soils adjoins weathered rock within wall/column footings, we recommend over-excavating the weathered rock to a minimum depth of 12 inches within the entire length of the wall/column footing and backfilling with properly compacted engineered fill. Alternatively, the engineered fill and/or native soils may be over-excavated down to the weathered rock and backfilled with lean concrete to the designed bearing elevation as illustrated in Figure 1.

Foundation excavations must be maintained in a drained/de-watered condition throughout the foundation construction process and water should not be allowed to pond in any excavation. Excavations for footings should be made in such a way as to provide bearing surfaces that are firm and free of loose, soft, wet, or otherwise disturbed soils.

Foundations should be concreted as soon as practical after they are excavated, and concrete should also not be placed on frozen or saturated subgrades. When applicable, it is recommended that a 2 to 4-inch-thick "mud mat" of lean concrete be placed on the bearing soils to help protect the bearing surface from rainfall or adverse construction activities.

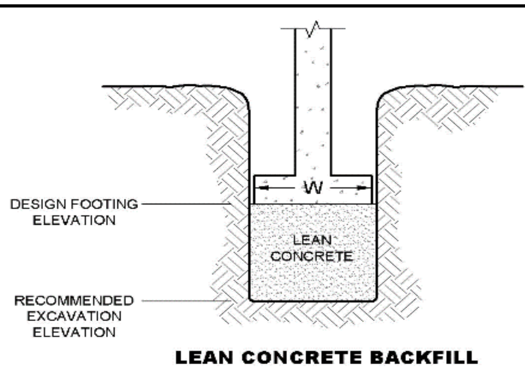

Figure 1

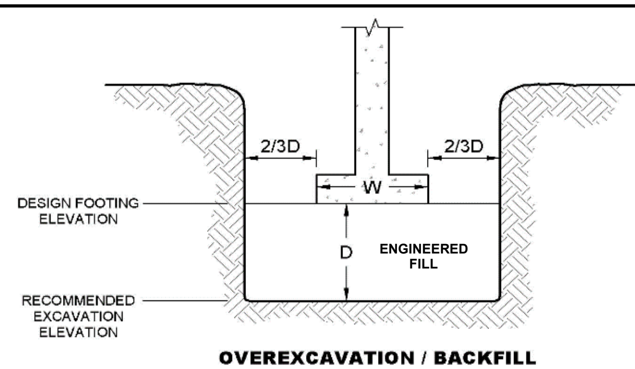

Figure 2

Note: Figures are shown for convenience and excavations shall be conducted with appropriate safety requirements.

Construction Monitoring

We recommend that all earthwork construction be monitored by an experienced engineering technician at AIMRIGHT. Monitoring should include site preparation, subgrade earthwork, engineered fill earthwork, structure foundation systems, conventional and/or structural slabs.

Monitoring will allow AIMRIGHT to confirm the soil conditions on site and evaluate the recommendations presented within this report. If at the time of construction, our recommendations are inappropriate for the project, monitoring will allow us to remediate the recommendations at that time to better serve the project.

Monitoring during construction will also allow for the testing of all construction materials for the project. This includes but is not limited to:

✓subgrade inspection and density testing,
✓structural area fill placement density testing,
✓foundation bearing grade observations and testing,
✓structural and reinforcing steel inspection,
✓concrete testing, and
✓asphaltic concrete testing, as applicable.

We recommend that AIMRIGHT be retained to provide these services based upon our current familiarity with the project subsurface conditions, and the provided intent of the geotechnical recommendations pertaining to the proposed development.

Limitations

The recommendations are based on our observations at the site, interpretation and analysis of the field and laboratory data obtained during this exploration, assumed loads, and our experience with previous exploration and testing with similar projects. Soil penetration data have been used to estimate an allowable bearing pressure and associated settlement using established correlations. Subsurface conditions in unexplored locations may vary from those encountered.

Determination of an appropriate foundation system for a given structure is dependent on the proposed structural loads, soil conditions, and construction constraints such as proximity to other structures, etc. The subsurface exploration aids the geotechnical engineer in determining the soil stratum appropriate for structural support. This determination includes considerations regarding both allowable bearing pressure and compressibility of the soil strata. In addition, since the method of construction greatly affects the soils intended for structural support, consideration must be given to the implementation of suitable methods of site preparation, fill compaction, and other aspects of construction.

The recommendations provided are based in part on project information provided to us and they only apply to the specific project and site discussed in this report. If our statements or assumptions concerning the location and design of this project contain incorrect information, or if additional information is available, you should convey the correct or additional information to us and retain us to review our recommendations. We can then modify our recommendations if they are inappropriate for the proposed project. In the event changes are made in the proposed design/construction plans, the recommendations presented in this report shall not be considered valid unless reviewed by AIMIRIGHT and modified or verified in writing.

Regardless of the thoroughness of the geotechnical exploration, there is always a possibility that subsurface conditions will be different from those at a specific boring location and that conditions will not be as anticipated by the designers or contractors. In addition, the construction process may itself alter soil conditions. Therefore, experienced geotechnical personnel should observe and document the construction procedures used and the conditions encountered. Unanticipated conditions and inadequate procedures should be reported to the design team along with timely recommendations to solve the problems created. The conclusions and recommendations presented in this report were derived in accordance with standard geotechnical engineering practices and no other warranty is expressed or implied.

APPROXIMATE BORING LOCATIONS

BORING LOCATION PLAN

PROJECT NO.: 16250424
SOURCE: Aerial Imagery/Provided Layout

PROJECT: Cherokee Nation Little Flock Church Restoration
CLIENT: CJC Architects, Inc.

AIMRIGHT TESTING & ENGINEERING

AIMRIGHT TESTING & ENGINEERING

LOG OF BORING B-1

PROJECT: Cherokee Nation Little Flock Church Restoration
CLIENT: CJC Architects, Inc. **PROJECT NO.:** 16250424
PROJECT LOCATION: 14210 EW 8 Rd, Coffeyville, OK 74072
LOCATION: see Boring Lcoation Plan **ELEVATION:** N/A
DRILLER: R. Melton **LOGGED BY:** Holden W. **DRILLING RIG:** D-50 ATV
DRILLING METHOD: Rotary Continuous Flight Augers **DATE:** 5/14/24
DEPTH TO WATER> INITIAL: Dry **AT COMPLETION:** Dry **CAVING>** None

Depth (feet)	Sampler Type	Description	Graphic	USCS Symbol	SPT N-value (bpf)	Groundwater	Moisture Content	% < #200	Liquid Limit	Plastic Limit	Plasticity Index
0		TOPSOIL - 4 inches									
0.333		CLAYEY SAND w/ trace sandstone fragments medium dense, dark brown, moist		SC	16		19.6	40.4	42	27	15
1.5		LIMESTONE highly to slightly weathered soft to hard, light gray, moist			22 50/2.0						
3					50/1.0						

Auger refusal encountered at 3 ft.
Boring terminated at 3.083 ft.

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

KEY TO SYMBOLS

Symbol	Description
Strata Symbols	
	Topsoil
	Clayey Sand
	Limestone
Misc. Symbols	
	Auger Refusal
Soil Samplers	
	Standard Penetration Test