BUNNELL LAMMONS ENGINEERING

August 29, 2022

Mr. John David
Development Capital Investments
Post Office 46
Lake Lure, North Carolina 29301

Subject: **Report of Limited Geotechnical Exploration**
Angel of the Lake - Infantino
Angel of the Lake Road
Lake Lure, North Carolina
BLE Project No. J22-18371-01

Dear Mr. David:

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this report of limited geotechnical exploration for the subject project. This report has been performed generally as described in Bunnell-Lammons Engineering (BLE) Proposal No. P22-18243 dated July 19, 2022 and executed by you on July 22, 2022. The purpose of this exploration was to develop information about the site and subsurface soil conditions that could be used in evaluating the feasibility of prospective construction at the site. Project information is based on correspondence with you and our BLE's site reconnaissance.

Project Information

Project information is based on correspondence with you along with a review of a Sheet 1 dated June 15, 2022 prepared by Odom Engineering illustrating the location of the proposed dwelling. Additional project information was obtained from a review of publicly available aerial photography and our recent site visit performed during the limited geotechnical exploration.

The proposed residential dwelling is proposed to be constructed on a parcel of land (PIN 219458) off Angle of the Lake Road in Lake Lure, North Carolina. Initial plans are for construction of a two-story, residential, wood-framed structure that will daylight on the south side. The lower-level substructure is anticipated to consisted of cast-in-place concrete or structural masonry. The exterior facade is anticipated to be a combination of masonry and wood. Shallow foundation support is anticipated for the structure with the foundation bearing levels assumed to follow the existing topography. Based on our review of the plans, we understand the proposed structure will be located on an existing relatively level area and a septic system will be located to the southwest of the proposed structure on a descending slope.

Detailed foundation loads have not been provided. However, based on our experience on similar projects, we assume that the typical wall footing loads will not exceed 3 kips per lineal foot (klf). We also assume that no isolated columns are planned for the structure with the exception of isolated column foundations for exterior porch, which are anticipated to be lightly loaded. We also understand based on our correspondence that zoning regulations require that a geotechnical exploration be performed prior to the start of construction.

Field Exploration

Based on our previous correspondence, we understood that site access is was limited (no drill rigs or excavators) as such, a limited hand auger boring exploration was performed to evaluate the near subsurface conditions within the proposed location of the residential dwelling. Five hand auger borings with associated dynamic cone penetrometer testing were advanced to depths of between 3 feet and 4 feet below the existing subgrade elevation. The hand auger boring locations were selected based on the proposed locations shown on the provided drawing and were field located using the recently surveyed (by others) reference points (i.e., rebar or iron pipe). The approximate locations are shown on the attached Figure 1. The hand auger borings were advanced by manually twisting a sharpened steel auger into the soil. At regular intervals, the soils were evaluated with a dynamic cone penetrometer to provide quantitative data about the soil strength. The dynamic cone penetrometer (DCP) is an instrument composed of a conical point driven with blows from a 15-pound hammer falling 20 inches. The point is driven into the soil in three increments of 1-3/4 inches. The number of hammer blows required to drive each increment is recorded. The average number of blows of the final two increments is an index to soil strength and bearing capacity. The subsurface soils encountered were examined and classified by our field personnel. The Hand Auger Boring Records are presented in the Appendix of this report. Upon completion of the field-testing, the borings were backfilled using the soil cuttings. The boring locations referenced in this report and shown on the figures and field records should be considered approximate.

Site and Subsurface Conditions

The descriptions below provide a general summary of the subsurface conditions encountered. The test pit logs attached to this report contain detailed information recorded at each test pit location. The test pit logs are based on our engineering examination of the field samples collected during our exploration. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that the soil conditions will vary between test pit locations.

Existing Site Conditions

The proposed site is located at the end of Angel of the Lake Road. The property is surrounded by residential development. The site is currently undeveloped and appears to be largely in its natural condition, with the exception that a relatively level area located on the northern portion of the property (i.e., proposed house seat). Based on our limited observations, this relatively level area appears to have been previously graded by cutting into the adjacent east slope. As previously stated, the northern portion of the property is relatively level, but does slope slightly toward the north. The remainder of the site is typified by sloping terrain, sloping down to the west and south at inclinations visually estimated to ranging from 1.5:1 to 2:1 (Horizontal: Vertical) with some areas that were slightly steeper and/or flatter. The property is vegetated with mature deciduous and coniferous trees interspersed with underbrush. The ground cover generally consisted of leaf litter and decaying tree debris in the southern portion of the site with the northern portion of the site consisting of scattered crushed stone, weeds and bare soil areas.

There were no visible rock outcroppings within the proposed building footprint and there were also no apparent groundwater springs observed within the proposed building footprint, however, exposed rock was noted at the ground surface in the southern portion of the property. The rock outcroppings observed were slightly weathered and protruded anywhere from 2 feet to greater than 4 feet from the surrounding grade and were observed to be between 5 feet and over 15 feet square in visible exposed

area. The rock type observed has a gneiss character and was observed to be grey in color and was noted to be hard. Based on our knowledge, this rock is part of the Blue Ridge Escarpment. BLE would classify this rock as foliated, banded to non-banded biotite gneiss. We note that this is a large site, and we did not observe all surface conditions. As such, conditions differing from the above-described are plausible.

Evaluation of Existing Natural Slopes

The house will be constructed on a relatively level area with natural slopes located to the east and south. Our site reconnaissance did not encounter signs of slope instability (i.e., scarps, tension cracks, bulges or colluvial/landslide deposits) within the proposed general area of the house footprint. Although we did not observe evidence of slope instability in the site area, care should be taken to minimize disturbance of the existing slope. Site grading in mountainous areas such as at this site can have a significant impact on the stability of natural and manmade slopes. As such, site future grading should be limited to excavation as required to achieve the planned finished grade elevation. We recommend against the placement of fill on the natural slopes except as necessary behind foundation walls to achieve the planned finish floor elevation for the lower level. Fill placement and compaction recommendations are discussed later in this report.

Subsurface Conditions

Surface conditions at all five (5) hand auger boring locations generally consisted of a 3 to 6 inch thick layer of topsoil and roots. Beneath this surface material the hand auger borings generally encountered similar conditions, which consisted of soil interpreted to be fill soil underlain by soil interpreted to be residual soils typical of the Blue Ridge Physiographic Province. However, due to the disturbed conditions of the soil in the hand auger bucket, it was difficult to discern the difference between fill and residual soil. The fill and residual soils have similar appearance, and the transition was not readily identifiable. However, it appears that the approximate upper 1 to 2 feet is fill soil, based on our field interpretation and our recent site observations. Based on this limited site observation, we anticipate the existing fill soil may have been part of the grading activities associated with the adjacent roadway.

No compaction testing data or field records of this fill placement were available at the time this report was prepared. However, based on the dynamic cone penetrometer (DCP) data and probing, this existing fill soil received some compactive effort during placement. The encountered fill soils were also noted to be damp at the time of our field work. It should be noted that the content and quality of man-made fills can vary significantly, especially at sites that have been previously graded. A firmer soil layer was encountered underlying the soil interpreted as fill and may have been residual soil, but this was difficult to discern given the disturbed condition of the soil in the hand auger bucket. The DCP blow counts varied from 8 to 25 blows per increment in the possible residual soils indicating firm consistency/relative density. It was believed that all hand auger borings were terminated in residual soils

Ground water was not encountered within the depths of the hand auger borings at the time of drilling or when the borings were backfilled shortly after drilling. Ground-water levels may fluctuate several feet with seasonal and rainfall variations. Normally, the highest ground water levels occur in late winter and spring and the lowest levels occur in late summer and fall. Ground water levels may also fluctuate due to construction activity.

The descriptions above provide a general summary of the subsurface conditions encountered. The hand auger boring records contain detailed information recorded at each test location. These represent our interpretation of subsurface conditions based on engineering examination of the field samples. The lines designating the interfaces between various strata represent approximate boundaries and the transition between strata may be gradual. It should be noted that the soil conditions will vary between these locations. Upon completion of the field-testing, the borings were backfilled using the soil cuttings. The boring locations referenced in this report and shown on the figures and field records should be considered approximate.

In addition, we observed the several excavations located on the southwestern portion of the site, generally in the location of the proposed septic line. The excavations had been previously excavated by others and were thought to have been a part of the septic system permitting process. The excavations were about 3 feet to 4 feet in depth. Based on our limited observations of the soils in the excavations, the soil were interpreted to be residual soils, which were visually classified as silty sands and sandy silts.

Analysis and Design Recommendations

General Assessment

Based on our limited field exploration, it is anticipated that site grading and foundation construction can generally be accomplished using conventional construction approaches and standard building practices for the currently anticipated, lightly loaded dwelling within the depths explored. Shallow foundations appear to be a feasible approach to building support, provided all footings bear in firm or better residual soil. We recommend against the placement of fill on the natural slopes except as necessary behind foundation walls to achieve the planned finish floor elevation. Construction of the dwelling will primarily require excavation of the residual soils to get to the predicted subgrade elevation of between 1 to 3 feet. Based on the limited hand auger excavations and our experience, there is no indication that difficult excavation will be encountered (though it can never be ruled out completely). Site grading can also be significantly affected by prevailing weather during construction.

Foundations

Based on the limited field data obtained and assuming subsurface conditions encountered at the hand auger boring locations are representative of subsurface conditions elsewhere on the site, the residual soils such as those encountered at the bore locations should provide adequate support for a system of shallow foundations for the proposed structure. Foundations bearing in the firm and better residual soils may be sized for a uniform allowable bearing pressure of 2,000 psf subject to the criteria and site preparation recommendations in this report. We also recommend that foundations for the structure bear in residual soils and not fill soils. While we have not performed a detailed settlement analysis, we believe footings proportioned as described in this report will experience normal settlements. Normal settlements are a total settlement of no more than one inch, with differential settlements of a lesser magnitude.

We recommend that the minimum widths for individual column and continuous wall footings be 24 and 18 inches, respectively. The minimum widths are considered advisable to provide a margin of safety against a local or punching shear failure of the foundation soils. Exterior/perimeter footings should bear at least 30 inches below final exterior grade for embedment needed to develop the recommended allowable design bearing pressure and to provide frost protection. Exterior footings located on or near sloping terrain will need to be embedded deeper depending on the steepness of the

slope and should have at least 6 feet of soil cover measured horizontally from the bottom of the foundation to the slope face. Interior footings in heated spaces should bear at least 16 inches below the floor grade slab. The same protective embedment recommended for the interior and exterior spread footings should be used for the thickened perimeter and interior portions of a monolithic foundation slab, if such a slab is used in lieu of individual strip and spread footing foundations.

To verify that the soils encountered in footing excavations are similar to those encountered in the hand auger borings, we recommend that all foundation excavations be examined. Part of this examination should include checking the bearing soils with a dynamic cone penetrometer performed by an experienced engineering technician working under the direction of the BLE geotechnical engineer. Pending the results of the examination, it may be necessary to over-excavate some of the existing soils below foundations. The depth and size of any overexcavation would be determined by BLE while on-site. Foundation excavations near the natural slope should also be observed by the geotechnical engineer for evidence of conditions that could cause slope instability.

Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for long periods of time. Therefore, we recommend that, once each footing excavation is extended to final grade, the footing be constructed as soon as possible thereafter to minimize the potential for damage to the bearing soils. The foundation bearing area should be level or benched and free of loose soil, ponded water, and debris. Foundation concrete should not be placed on soils that have been disturbed by seepage. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom prior to placement of concrete. If the excavation must remain open overnight or if rainfall becomes imminent while the bearing soils are exposed, we recommend placement of a 2 to 4-inch thick "mud-mat" of "lean" (2,000 psi) concrete on the bearing soils before the placement of reinforcing steel for protection against softening.

Grade Slab

Grade slabs may be soil supported assuming that the site is prepared in accordance with the recommendations in this report. The grade slab should be jointed around columns and along footing supported walls so that the slab and foundations can settle differentially without damage. If slab thickness permits, joints containing dowels or keys may be used in the slab to permit lateral movement between parts of the slab without cracking or sharp vertical displacements. A layer of granular material, such as clean, #57 stone (minimum thickness 6 inches), should be placed immediately beneath the grade slab to provide a capillary barrier and to increase the load distribution capabilities. We recommend that a modulus of subgrade reaction value of 100 psi/inch or less be used for design of grade slab on subgrades prepared as recommended in this report. An appropriate vapor barrier should be incorporated in the grade slab design. Completed slabs should be protected from excessive surface moisture prior to and during periods of prolonged below-freezing temperatures to prevent subgrade freezing and resulting heave.

Cut Slopes

Based on our understanding of the limited project information at the time of reporting and our site reconnaissance, the following slope ratios (horizontal : vertical) are recommended for slopes without surcharge at the top. Please note these are provided for slopes less than 15 feet in height.

Type of Material	Temporary Slopes (Horizontal : Vertical)	Permanent Slopes (Horizontal : Vertical)
Residual Soil (cut)	1.5:1	2:1 or flatter
Partially Weathered Rock (cut)	1:1	1.5:1

Permanent slopes of 3:1 or flatter would be desirable for mowing. Slope stability analyses and evaluation should be performed on slopes higher than 15 feet. Such analyses are beyond the scope of the services associated with preparation of this preliminary report. Grading which results in slopes steeper than those in the preceding table may require the use of retaining walls. In addition, slopes that are higher than 15 feet may require benches to help reduce the erosion potential down the slope face. Cut slope surfaces should be protected from erosion by grassing or other means. We recommend that the face of slopes and embankments be protected by establishing vegetation as soon as practical after grading and that rainwater runoff be directed away from the slopes. Special netting should be considered to establish vegetation on steep slopes.

General Construction Recommendations

Clearing and Grubbing

Site preparation should include the removal of all unsuitable surface materials (surface vegetation, topsoil, and root systems) and disposed of offsite. Topsoil and organic soils may be stockpiled for later use in areas to be landscaped. Stripping depths and subgrade stabilization measures for fill placement will depend heavily on the prevailing weather at the time of construction.

Engineered Fill

Fill should be limited to backfilling below grade walls and foundations, if at all possible. Based upon our visual examination and experience with similar soil types, the on-site residual soils appear to be generally suitable for use as structural fill. Fill should be spread and compacted in horizontal lifts that are 8 inches or less in thickness. Fill should be uniformly compacted in thin lifts to at least 95 percent of the standard Proctor (ASTM D-698) maximum dry density. In addition, the upper 18 inches of subgrade fill beneath pavements and floor slabs and 24 inches below pavements subject to truck traffic should be compacted to at least 98 percent of the maximum dry density. As a rule, the moisture content of the fill soils should be maintained within plus or minus 3 percent of the optimum moisture content as determined from the standard compaction test. This provision may require the contractor to dry soils during periods of wet weather or to wet soils during dry periods. The fill soils should have a Plasticity Index (PI) of less than 30, and a standard Proctor maximum dry density (MDD) of no less than 90 pounds per cubic foot (pcf). Fill soils should contain no more than 3 percent organic matter by weight and should be well graded and not contain rocks larger than 3 inches in diameter.

The surface of compacted subgrade soils can deteriorate and lose its support capabilities when exposed to environmental changes and construction activity. Deterioration can occur in the form of freezing, formation of erosion gullies, extreme drying, and exposure for a long period of time or rutting by construction traffic. We recommend that the surfaces of floor slab and pavement subgrades that have deteriorated or softened be recompacted prior to construction of the floor slab or pavement. Additionally, any excavations through the subgrade soils (such as utility trenches) should be properly backfilled in compacted lifts. Recompaction of subgrade surfaces and compaction of backfill should be checked with a sufficient number of density tests to determine if adequate compaction is being achieved.

Secondary Design Considerations

The following items are presented for your consideration. These items are known to generally enhance performance of structural systems.

- Roof drainage should be collected by a system of gutters and downspouts and directed away from all structures and slopes.
- Site grading should result in positive drainage away from the structures. Water should not be allowed to pond around the structures or in such locations that would lead to saturation of pavement subgrade materials or foundations. A minimum slope of approximately ¼ to ½-inch per foot should provide adequate drainage.
- Backfill for utility lines should be placed in accordance with the recommendations for engineered fill to minimize the potential for differential settlement.

Limitations

Our limited evaluation of the existing soil conditions has been based on our understanding of the project information and field observations, as well as our experience on similar projects. The general subsurface conditions utilized in our evaluation have been based on interpolation of the subsurface data between the limited hand auger borings. If the project information is incorrect or the structure location (horizontal or vertical) and/or dimensions are changed, please contact us so that our recommendations can be reviewed. The methods used to explore the subsurface conditions do not provide sufficient data for evaluation of deeper soils within the zone of influence for the proposed structure. The discovery of site or subsurface conditions during construction which deviate from the data obtained for this evaluation should be reported to us for our evaluation. If loose or weak soils or deleterious materials are located below the limits of our testing, unacceptable total and differential settlements may occur in the completed structure.

It is possible that these widely spaced hand auger borings may not fully represent the conditions across the entire site, unexpected conditions, such as buried debris, loose/soft soils or partially weather rock and rock, can be present between the test locations.

Closing

We appreciate the opportunity to be of service to you. If you have any questions concerning our observations, conclusions and recommendations as presented in this report, please do not hesitate in contacting us.

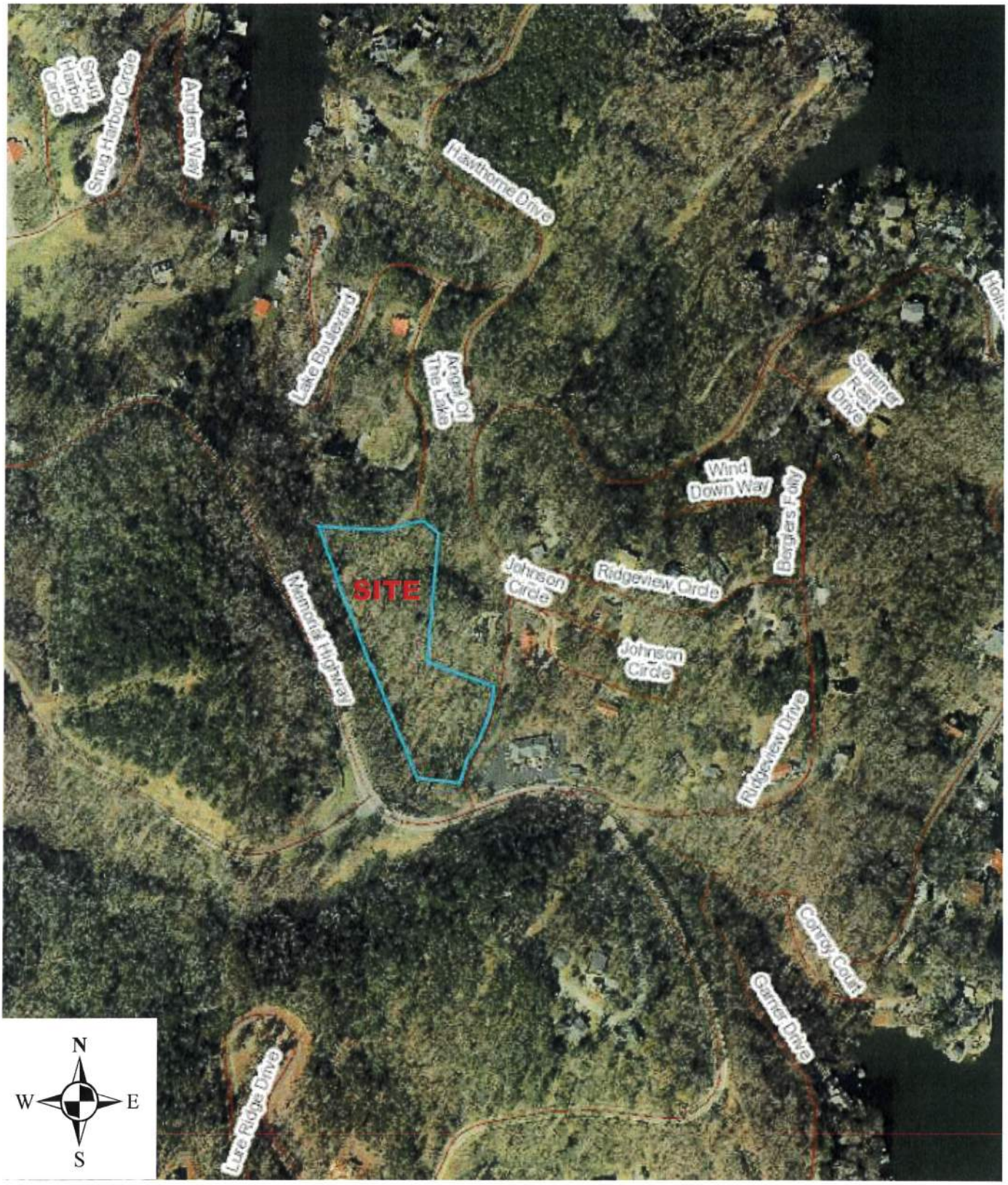
Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.
BLE NC License No. C-1538

Sam C. Interlicchia
Project Manager

NORTH CAROLINA PROFESSIONAL SEAL 023614 ENGINEER JAMES J. BELGER 8/29/22

James J. Belger, P.E.
Senior Engineer
North Carolina Registered 023614

Attachments: Hand Auger Boring Location Plan
Hand Auger Boring Logs



Reference: Rutherford GIS

No Scale

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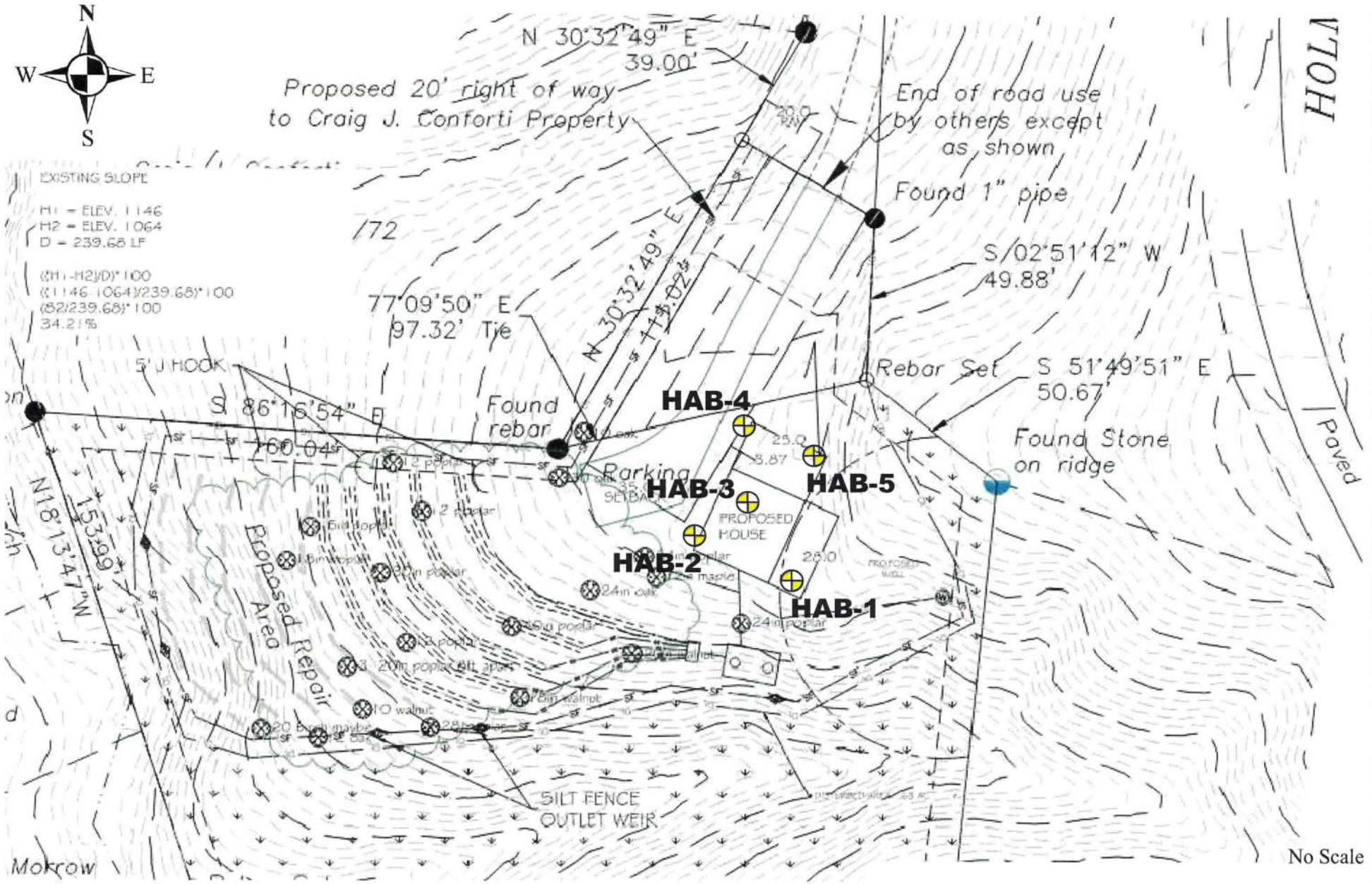
Site Location Map

Angel of the Lake Road
Lake Lure, North Carolina
BLE Project No. J22-18371-01

Date: Aug 2022

Figure No. 1



⊕ Approximate Hand Auger Boring Location

Reference: Portion of Sheet 1 Prepared by Odom

BLE BUNNELL LAMMONS ENGINEERING	Drawn By: SCI Date: Aug 2022	Angel of the Lake - Infantino Angel of the Lake Road Lake Lure, North Carolina BLE Project No. J22-18371-01	Hand Auger Boring Location Plan	Figure No. 2

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Hand Auger Boring Log

Job Name: Angel of the Lake		**Hand Auger Boring Number**: HAB-1	
Job Number: J22-18371-01		**Date Logged**: Aug 2022	
Approximate Surface Elevation: ---±		**Logged By**: SCI	
Depth		**Stratum Description**	**Dynamic Cone Penetrometer blows/increment (1st - 2nd - 3rd)**
From	**To**		
0	6"	Grass, topsoil & roots	---
6"	2.5'	Tan/Brown damp silty Sand (fill)	8-10-8 7-7-7
2.5'	3'	Brownish tan silty Sand (possible residuum)	10-25+
Hand auger boring terminated at 3 feet.			
Remarks and Notes: Groundwater not observed at time of excavation or backfilling. Bore hole backfilled with soil cuttings.			

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Hand Auger Boring Log

Job Name: Angel of the Lake		**Hand Auger Boring Number**: HAB-2	
Job Number: J22-18371-01		**Date Logged**: Aug 2022	
Approximate Surface Elevation: ---±		**Logged By**: SCI	
Depth		**Stratum Description**	**Dynamic Cone Penetrometer blows/increment (1st - 2nd - 3rd)**
From	**To**		
0	6"	Grass, topsoil & roots	---
6"	1.5'	Tan/Brown damp silty Sand (fill)	5-5-5
1.5'	4'	Brownish tan silty Sand w/scattered PWR (possible residuum)	5-7-7 11-10-11 9-10-14
Hand auger boring terminated at 4 feet.			
Remarks and Notes: Groundwater not observed at time of excavation or backfilling. Bore hole backfilled with soil cuttings.			

130 Oval Road, Suite 200, Arden, NC 28704 828.277.0100 828.277.0110 info@blecorp.com
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Hand Auger Boring Log

Job Name: Angel of the Lake		**Hand Auger Boring Number**: HAB-3	
Job Number: J22-18371-01		**Date Logged**: Aug 2022	
Approximate Surface Elevation: ---±		**Logged By**: SCI	
Depth		**Stratum Description**	**Dynamic Cone Penetrometer blows/increment (1st - 2nd - 3rd)**
From	**To**		
0	6"	Grass, topsoil & roots	---
6"	2'	Tan/Brown damp silty Sand (fill)	5-5-7
2'	3'	Brownish tan silty Sand (possible residuum)	5-7-7 6-7-6
Hand auger boring terminated at 3 feet.			

Remarks and Notes:
Groundwater not observed at time of excavation or backfilling.
Bore hole backfilled with soil cuttings.

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Hand Auger Boring Log

Job Name: Angel of the Lake		**Hand Auger Boring Number**: HAB-4	
Job Number: J22-18371-01		**Date Logged**: Aug 2022	
Approximate Surface Elevation: ---±		**Logged By**: SCI	
Depth		**Stratum Description**	**Dynamic Cone Penetrometer blows/increment (1st - 2nd - 3rd)**
From	**To**		
0	3"	Grass, topsoil & roots	---
3"	1'	Tan/Brown damp silty Sand (fill) w/scattered crushed rock	7-25+
1'	3'	Brownish tan silty Sand (possible residuum)	6-6-6 8-7-7
Hand auger boring terminated at 3 feet.			

Remarks and Notes:
Groundwater not observed at time of excavation or backfilling.
Bore hole backfilled with soil cuttings.

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Hand Auger Boring Log

Job Name: Angel of the Lake		**Hand Auger Boring Number**: HAB-5	
Job Number: J22-18371-01		**Date Logged**: Aug 2022	
Approximate Surface Elevation: ---±		**Logged By**: SCI	
Depth		**Stratum Description**	**Dynamic Cone Penetrometer blows/increment (1st - 2nd - 3rd)**
From	**To**		
0	3"	Grass, topsoil & roots	---
3"	1'	Tan/Brown damp silty Sand (fill)	4-4-7
1'	3'	Brownish tan silty Sand (possible residuum)	9-9-8 8-10-10
Hand auger boring terminated at 3 feet.			

Remarks and Notes:
Groundwater not observed at time of excavation or backfilling.
Bore hole backfilled with soil cuttings.