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April 4, 2024

Geotechnical Report

Intrinsic Development

Brian Maenner
3622 Endeavor Ave. Ste. 101
Columbia, MO

The Village at Discovery Park Lot 6

At the intersection of NE Douglas & NW Colbern Rd
Lee's Summit, MO

OWN Proposal SP31-24-018
OWN Project 24SP30033

Report Prepared By:

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Brian Maenner
3622 Endeavor Ave. Ste. 101
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Re: Geotechnical Report
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Lee's Summit, MO

OWN Proposal: SP31-24-018 / Project: 24SP30033

Dear Brian,

We appreciate the opportunity to provide this Geotechnical Report for the above referenced project. We have recently changed our name from Anderson Engineering, Inc. to OWN, Inc. to better match our people! We are still the same exact team of dedicated employee owners, now just with a better name that celebrates who we are. We look forward to working on this project with you.

Please contact Cody White, or myself with any questions. Thank you for the opportunity to be of service.

Sincerely,

OWN, Inc.

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04/04/2024

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INTRODUCTION

This is the report on the results of a geotechnical investigation for the proposed project:

**New single-story animal hospital with parking and paving in Lot 6 of The Village at
Discovery Park (The Village), Lee's Summit, Missouri**

The purpose of this investigation was to perform an exploration of the subsurface soil conditions on the site and compile a report giving the findings of the exploration, logs of the borings, recommendations for the project above, and foundation design.

This investigation was performed for our client. The scope of our geotechnical investigation was detailed in our proposal and was to include drilling and sampling:

- The project proposal for the soils exploration includes 2 borings to 15 feet or auger refusal.
- An engineering report will be issued with the findings of the exploration and recommendations for site development, foundation design, and pavement design.
- An electronic copy of the report will be issued.

To accomplish the intended purpose of the geotechnical investigation, a study was conducted which consisted of (1) on-site borings to describe the subsurface conditions encountered in the borings with sampling of in-place soils; (2) laboratory analysis of the soil and rock samples obtained; and (3) an engineering analysis of the field drilling and laboratory data with an engineering report.

PROPOSED CONSTRUCTION

We understand the project will be located: see the attached sketch, and as described above. We understand or assume greater details about the development include:

- Buildings: Building 6 is planned to be a single story structure consisting of an animal hospital. Building 6 is planned to have a footprint of about 7,000 square feet
- Structure: Building 6 is assumed to be a wood or steel framed structure with masonry exterior
- Cut and fill: cut assumed to be 10-14 feet with no fill according to preliminary grading plans
- Foundations: shallow spread with assumed footing widths of 2-4 feet with concrete slab-on-grade

The analysis and recommendations contained in this report are based upon the above-mentioned information regarding the proposed structures. If these assumptions are not correct, OWN, Inc. should be contacted to review the recommendations in light of the correct structural information.



WORK PERFORMED

ON-SITE BORINGS: The borings were generally drilled per our proposal referenced above. The borings were laid out in the field by our personnel based on the preliminary site plan and boring locations as provided by you. A sketch showing the general locations of the borings was prepared from this information and is included in the attachments as a boring location sketch.

If elevations are shown on the boring logs they are approximate elevations only taken from the topographic survey for the site and rounded to the nearest 0.5 to 1 foot based on field observations. Boring locations should be verified prior to the beginning of construction.

Representative soil and rock samples were taken of the different soil and rock encountered in the borings. These soil and rock samples were tested for moisture content, Atterberg Limits, penetrometer strength readings, and/or unconfined compressive strength readings.

The logs of borings drilled in this exploration program show descriptions of soil and rock units encountered, as well as results of field and laboratory tests presented in the attachments.

Soil samples obtained during drilling activities were taken using the split spoon sampler. This sampler is used while performing the standard penetration test. This test, described in ASTM D1586, consists of driving a two-inch diameter split spoon sampler using a weight of 140 pounds with a free fall of 30 inches. The number of blows to drive the sampler each of three successive 6-inch increments of depth in advance of drilling was recorded and is presented on the boring logs. The sum of the last two blow counts is normally taken as the penetration value expressed in blows per foot. The soil sample obtained from the sampler is considered disturbed, however, it is useful for strata identification, natural moisture content, Atterberg Limits, penetrometer strength values, and/or occasional unconfined compressive strength values.

For this project we used: CME-550X, with an automatic hammer - for purposes of our assessment of penetration resistance, we used approximately 80% efficiency, if required, in transferring energy for hammer blows per foot. This would allow us to compare to industry standard correlations developed for hammer blow resistance if required.

LABORATORY TESTING

All samples were transported to OWN's materials laboratory for further evaluation and testing. Laboratory soil testing included the determination of natural soil moisture content, Atterberg limit values, penetrometer strength readings, and permeability. Laboratory test results on soil samples recovered from the borings are recorded on the Boring Log contained in the attachments.



GEOLOGY OF THE SITE

A review of geologic maps of the area reveal the site is underlain by the Kansas City Group. Late Pennsylvanian - Missourian Series - This geologic formation consists primarily of shale and limestone with minor constituents of coal and sandstone.

SOIL MAPS

The County Soil Resource Survey (from our OWN online GIS) and the USDA Web Soil Survey were researched for the project and the soils onsite generally agree with the natural soils found during the investigation. See the attachments for soil information found.

SOIL

County Soil Resource Survey for the site is primarily mapped as:

Greeton silty clay loam, 5 to 9 percent slopes: 30080

Sampsel silty clay loam 5 to 9 percent slopes: 10117

Sharpsburg silt loam 2 to 5 percent slopes: 10120

Parent Material, developed from:

Greeton: loess over residuum weathered from limestone and shale

Sampsel: residuum weathered from shale

Sharpsburg: loess

Restrictive features, bedrock:

Greeton: more than 80 inches

Sampse: more than 80 inches

Sharpsburg: more than 80 inches

Depth to water table:

Greeton: 12 to 30 inches

Sampse: 0 to 18 inches

Sharpsburg: 45 to 50 inches

Engineering properties for natural soils:

Greeton;

0 to 12 inches: silty clay loam

12 to 28 inches: silty clay loam, silty clay

28 to 30 inches: silty clay, silty clay loam

30 to 79 inches: clay, gravelly silty clay, silty clay

Sampse;

0 to 13 inches: silty clay loam

13 to 80 inches: silty clay loam, silty clay, clay

Sharpsburg;

0 to 6 inches: silt loam

6 to 16 inches: silty clay loam



16 to 46 inches: silty clay loam, silty clay
46 to 58 inches: silty clay loam, silty loam
58 to 79 inches: silt loam, silty clay loam

We drilled a nearby geotechnical project:
Project# 20KC10057: Highland Meadows, dated December, 2020.

In general we found:

Building Development Areas:

- Topsoil: dark brown topsoil damp to moist, medium firm to stiff, from 0 to 1 feet.
- Fill material: yellowish brown, lean to fat clay, CL-CH, with gray mottling damp to moist, stiff to very stiff, from 1 to 9.75-17 feet, Atterberg limits test showed LL= 45-61% with PI= 28-40%.
- 2nd deeper soil: yellowish brown shale, this was encountered in a weathered state, dense to very dense when fresh, from 5-15 feet to boring termination.
- 3rd deeper material: gray limestone fresh moderately strong moderately hard to hard, from 9.75-18.5 feet to boring termination.
- Groundwater was not encountered during drilling.

This past OWN project is generally similar to what the county soil survey reports.

VISUAL/ MAP AERIAL

The surface of the planned project area is generally:

- The site for The Village is approximately 40 acres, but is part of a much larger development. Building 6 is only one of the planned 14 structures to be built as part of The Village.
- At the time of drilling, the topsoil had been stripped and cuts were actively being completed in various locations of The Village. The pad sites for Buildings had been cut approximately 10-14 feet for Lot 6 prior to our arrival. Extensive grading activities were taking place during drilling operations.

QUAD MAP; AERIALS PHOTOS, GOOGLE STREET VIEW

A review of the Quadrangle Map and past aerial photos shows the site:

- Quadrangle maps show drainage to the northeast of Lot 6.
- According to historical aerials and quadrangle maps, this site was generally used for farming purposes from about the late 1950's to about 2018 and situated on a broad hill. From 2018 to the beginning of recent construction, it has been a partially wooded area.
- Significant changes in elevation were shown on topographic maps prior to the start of construction on the site.



GENERAL SUBSURFACE CONDITIONS

The subsurface conditions encountered at the boring locations are shown on the boring logs. The stratification lines shown on the boring log represent the approximate boundary lines between the soil layers; in-situ, the transition may be gradual. Characterizations of the soil layers on the boring log were made from observations of the auger cuttings and split spoon samples.

A modified slake test was conducted on the extremely weathered shale encountered at footing depths. Expansion and disaggregation of the samples began almost immediately upon immersion in water and was moderate to rapid. The disaggregation continued until the samples generally degraded to the soil particle size.

Below is a **generalized** description of the conditions encountered in the borings. The reader must refer to the boring logs and other attachments included with this report; there is more specific information in the logs and those documents. This information has been **simplified** to make it easier for the reader to grasp similarities in the borings; it should not be construed that this represents conditions throughout the site as soil conditions were only observed at the locations sampled and the soil conditions will vary from below, not only laterally but vertically from what is below and in the boring logs:

In general, we found: (see logs for details)

Building Development Areas:

- Topsoil: Had been stripped prior to arrival.
- 1st deeper soil:
Boring B-26, 0 to 13.5 feet: Grayish brown shaley lean to fat clay, CL, damp, very stiff to hard, friable
- 2nd deeper soil:
From 0-9.5 feet to 13.5-15 feet: Extremely weathered gray shale, damp, weathered to very stiff to hard, Friable, A modified slake test was conducted on the extremely weathered shale encountered at shallow depths. Expansion and disaggregation of the samples began almost immediately upon immersion in water and was moderate to rapid. The disaggregation continued until the samples generally degraded to the soil particle size.
- 3rd deeper material:
Boring B-27, Limestone, highly weathered, very weak, friable rock, over limestone bedrock. The limestone was generally encountered at depths of 10 feet and extended to the bottom of the borehole.
- Groundwater was not encountered during drilling.

Unified soil class was visually inspected during drilling activities and determined considering the Atterberg Limits and estimates of percent granular material present.



GROUNDWATER CONDITIONS

Groundwater was not encountered during drilling and should be planned for, especially in any deeper excavations, and in or near any drainage swales or near top of bedrock. It must be emphasized that the presence of perched groundwater in these soils can be encountered at any time and depth especially in fill soils, at the soil/rock interface, and near drainage swales. Rainfall and regional runoff will affect the groundwater conditions and the depths at which groundwater can be encountered will vary seasonally. As a result, the groundwater conditions encountered during construction may vary from those observed during this investigation.

The above is a generalized description of the conditions encountered in the borings. For more specific information, the reader should refer to the boring logs included in this report.

SUMMARY OF KEY SITE CONDITIONS AND CONCLUSIONS

A summary of the site and subsurface conditions considered pertinent to the site development and foundation design for the proposed facility are as follows:

1. Prior to construction, this site was generally used for farming purposes from about the late 1950's to about 2018 and situated on a broad hill. From 2018 to the beginning of recent construction, it has been a partially wooded area.
2. Extremely weathered shale was encountered at the surface in Boring B-27 and at about 13.5 feet in Boring B-26 with slaking properties. The shale has been classified as damp, hard, and friable in place. Upon disturbance, this material may lose its strength and become more unstable. Care should be taken to make sure this material stays dry.
3. Limestone was encountered in Boring B-27 at about 10 feet. This may affect excavations of footings and utilities.
4. Footings bearing on or near bedrock will settle less than areas that bear on fill, stiff natural soils, and especially friable, extremely weathered shale. This will lead to differential settlement. You should use rock cushions to help with this.
5. The removal of trees and their root balls can leave soils softer and wetter than other areas on site.

Considering the above and information we know about this site, the following conclusions are of concern to us:

1. It appeared that earthwork operations were actively taking place over nearly the entire area of Lot 6. As such, any unstable soils related to the past swales and farming operations that occurred on the site should not be encountered. In general, soils that would be expected to be encountered in swales or farmed areas were not



encountered. It is assumed that these soils were removed by the earthwork contractor, under the supervision of the materials testing firm.

2. Based on the slake testing, care should be taken not to expose the weathered shales to water during excavation and construction. If the shales are exposed to water in an excavation or trench, they will become unstable. These unstable materials will then be required to be removed from the foundation excavations.
3. No rock coring was conducted on the subject property. We suspect the limestone encountered in the bottom of the borings is massive bedrock beneath the overburden onsite. If foundations into rock become an option you must complete rock coring to establish bearing values and help identify the presence of voids, shelves and pinnacles in the rock foundations are to be founded in.

Based on soil sampling and laboratory testing and assuming that the site development recommendations provided below are followed, we conclude that the proposed development could be constructed on the subject property with conventional earthwork methods and use of spread foundations for buildings, as below.

RECOMMENDATIONS

SITE DEVELOPMENT

1. All site grading and excavations should be carefully observed for any DISTURBED soils, buried structures and/or soft/medium firm, unstable soils. Unstable soils often also include moist, medium firm soils.
2. Fat clays (CH) and Lean to Fat clays (CL-CH) with a plasticity index of 30 or more may be encountered at elevations where concrete slabs and pavements are anticipated to bear. If encountered, these soils should be removed for a depth of 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements and should be replaced per the site development recommendations of this report.
3. All pavement, topsoil/surface soil, any DISTURBED soils, surface soil with grass and roots, any buried root balls, tree roots, buried topsoil, and loose/soft/medium firm, and/or unstable soils should be stripped and removed from the construction areas down to stiff/medium dense, undisturbed, stable soils.
4. Controlled, compacted soil structural fill or granular base stone should be installed to bring the area to the proposed subgrade elevations. These materials should be submitted to OWN for approval.
5. Provisions must be made during construction to remove any water entering the excavation.



6. The shallow clays encountered in the borings contain considerable silt content. These soils can become unstable and pump under construction loads depending on their moisture condition at the time of construction. If pumping and/or rutting occur during work on the site, activity should be halted until the affected area can be over-excavated to firm soil or stabilized. Stabilization can normally be accomplished with aeration and re-compaction, the use of ground stabilization fabric, a working mat of existing clean coarse crushed stone, or admixture incorporation. The need for these measures will depend on the location, the soil, moisture, and weather conditions at the time of earthwork and can best be evaluated at that time. Due to the variability of encountered soils and a limited number of borings performed, provisions should be made in the construction documents to provide for some over-excavation of these soils depending on the time of year that the construction is performed for site development, foundations, and pavements.
7. Site work required to obtain final subgrade elevations for the proposed development should be performed using the following criteria. This may not be completely practical due to the narrow area to work in. You should contact us if alternative recommendations are needed:
 - a. After the removal of any topsoil, existing UNDOCUMENTED FILL, any debris, concrete, and any soft/medium firm and unstable soils and soils described in the Conclusions and paragraphs 1, 2, and 3 above, the subgrade should be proof rolled with a fully loaded tandem axle dump truck weighing at least 20 tons and examined by a representative of the Geotechnical Engineer prior beginning filling operation. Should soft, unstable or spongy areas be found in the subgrade at that point, they should be removed and replaced with controlled, compacted fill or shot rock.

If soft, unstable, or spongy areas are found during proof rolling the geotechnical engineer of record should be retained to provide recommendations for repair.
 - b. After proof rolling, and examined by a representative of the Geotechnical Engineer (OWN, Inc.), and approval, the upper 6 inches of exposed subgrade should be scarified, adjusted to -1 to +3 percent above optimum moisture, and compacted to at least 95 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698. This step is very important to minimize possible future softening and or swelling of subgrade soils.
 - c. Compacted fill could consist of structural soil fill, of low to moderate plasticity silty clays. The inorganic silty clay soils should have liquid limits less than 55 and a plasticity index of less than 35; except, as discussed in the Summary, for upper 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements, it should have a liquid limit than 45 and plasticity index less than 25 - this is LVC (Low Volume Change) material. For foundations, if exposed soil cannot be maintained in a moist condition, as verified by us, before concrete placement, then the upper 18 inches below the foundation should be LVC also.



On a case by case basis, soil with up to 30% or more chert content not meeting the above plasticity requirements can be considered for use as structural fill and approval by us. (It will require gradation and Atterberg Limits testing as a minimum; swell tests may also be required plus submittal to OWN)

- d. Large size rock greater than 3 inches inhibits fill compaction and should be generally excluded from structural fill.
- e. Structural fill for the building pad should be placed in no greater than 8 inch loose lifts and compacted to at least 98 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698. The compacted structural fill placed for the building pad should extend a minimum of 10 ft. beyond the outside edge of the footings.

Structural fill for the parking and drive areas should be placed in no greater than 8 inch loose lifts and compacted to at least 98 percent of maximum dry density as determined by Standard Proctor procedures as outlined in ASTM D698.

A testing frequency of at least one field density for each 2500 square feet of fill lift, but no less than 3 tests per lift is recommended within building areas. In pavement areas, the testing frequency may be one field density for each 5000 square feet of fill lift, but no less than 3 tests per lift.

- f. Moisture content of fill material should generally be controlled between 1% below and 3% above optimum as determined by ASTM D698.
 - g. Continuous field inspection and field density and moisture content tests should be performed on each lift of the fill to help ensure compliance with project specifications.
- 8. Because the surficial soils, without chert rock, on the site will become "spongy" under construction loads, they should be protected from either inundation or drying out. The entire area should be graded to provide adequate slopes and drainage systems to ensure movement of water around the site and away from the building and parking areas.
 - 9. The soils at the site are silty in nature and susceptible to erosion. Appropriate erosion control measures, such as site contouring during grading operations and siltation fences, should be used to keep eroded material on the site.
 - 10. All discharge from the guttering system of the proposed building and any off site discharges should not be allowed to soak into grassy areas by the building but should be carried away from the building areas. We recommend 5% slopes away from the building for the first 10 feet of grassed or landscaped areas.
 - 11. Grading, ditches, and drains must be designed into the site plan to move surface water rapidly around and away from the building area.



12. Fall and spring seasons in this area normally receive considerable rainfall and can present difficult drying conditions when periods of rainy, overcast weather persist. The workability of the silty clay soils found on the site that is suitable for use in fill construction is greatly affected by their moisture content. Every effort should be made to seal fill areas and grade them to drain before rainfall occurs. Areas that become wet will require effort and time to disc and aerate the soils to get them back to a workable condition. Depending on the weather conditions, it may be necessary for these areas to be cut out and replaced with suitable soils or soil and shot-rock combinations.
13. Construction performed during summer months which is typically drier weather would reduce subgrade preparation difficulties and associated costs.

FOUNDATION DESIGN

Foundation design for the proposed structures must consider two factors. Foundations should be designed so that maximum possible stresses transmitted to foundation soils and rock will not exceed allowable bearing pressures as computed from reliable shear strength data on the soil and/or rock.

In addition, foundations should be sized and founded to limit the maximum anticipated total or differential movements to magnitudes which can be tolerated by the planned structural system. Construction factors such as the installation of foundation units, excavation and fill placement difficulties and surface and groundwater conditions must also be considered.

1. For buildings where footings are bearing entirely on properly compacted fill and or on moist, stiff residual clay, may use a maximum allowable soil bearing pressure of up to 2,500 psf assuming that the site is prepared as recommended in this report.
2. Footing excavations should be examined to verify bearing capacity before the soil is compacted and reinforcing steel is placed.
3. After the footing excavations are completed and inspected by a representative of the Geotechnical Engineer, the bottom of the footing excavation should be cleaned of all loose soil. After inspection and cleaning, the bottom of the footing excavation should be thoroughly compacted with a mechanical tamper prior to installing reinforcing steel.
4. The recommended bearing pressure listed above, based on following the recommendations made in this report, should provide a minimum factor of safety of approximately 3 against bearing capacity failure.
5. Minimum footing dimensions of 30 inches for spread footings and 18 inches for continuous footings should be used.
6. Exterior footings should be found a minimum of 36 inches or 3 feet below finished exterior grade to help ensure being below frost penetration.



7. All footing excavations should be flat or level and well cleaned of all loose, wet soil or rock prior to concreting.
8. We recommend the ultimate coefficient of sliding friction between concrete foundations and natural, stiff clay soils or properly compacted clay soils is 0.35. The ultimate passive pressure for depths lower than 3 feet is 250 pcf, equivalent fluid pressure. We recommend you neglect the passive pressure from shallower depths due to environmental effects.
9. Removal of groundwater accumulated in excavations should be required prior to placement of concrete.
10. Careful inspection of excavations should be performed during construction to detect any unanticipated conditions such as voids, soft zones of soil, debris, filled mine prospect hole excavations, structures or other conditions that could affect the performance of the proposed structure foundation system. If such conditions are found, the project engineer should be notified before proceeding.
11. The strength and shrink-swell properties of the soil in the footing excavations will change if exposed to weather extremes. Every effort should be made to place concrete the same day as footing excavations. If protective measures are not taken on exposed footing excavations, additional excavation of disturbed soil may be required. Highly plastic, expansive clay that is allowed to dry, will often become stronger at that time, but the potential for excessive swell becomes more likely after the footing is placed.

EARTHWORK DURING INCLEMENT WEATHER

1. If wet conditions are encountered during the construction period, in addition to disking and aerating soils, or shot rock, chemical stabilization consisting of fly ash or a lime kiln dust such as Calciment could be used to stabilize the soil subgrade beneath the building pad and the parking areas.
2. Chemical stabilization should not take place if the ambient temperature is less than 45 degrees Fahrenheit.

EXCAVATIONS

1. Excavations into the soil overburden at the site should be able to be performed by conventional excavation techniques and heavy equipment available in this area although considerable effort and possible drilling and breaking may be required in hard or very dense layers of soil.
2. All excavation work should be carefully observed for soft, unstable soils and/or debris especially in any deep cut areas.



3. The contractor shall be responsible for designing the excavation slopes and/or temporary shoring and bracing. All trench excavations should meet the requirements specified in federal, state, and/or local safety regulations (e.g. the latest version of OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926). The effects of surcharge loads should also be considered in the design.
4. Soil types A, B, and C, as classified by OSHA Standards, are present at the project site.
5. The contractor should perform periodic inspections of all excavations to check for stability. Tension cracking, sloughing of the soils, unusually soft soil zones, or the bulging of soil at the toe of the slope indicate stability problems that should be investigated and corrected immediately. The contractor shall be responsible for the training and safety of all individuals entering trenches and working by excavated slopes.
6. Groundwater was not encountered during drilling and/or at the completion of drilling. NRCS reports shallow water, which may be perched. Groundwater can be encountered at any time and depth especially in these soils. As a result, the groundwater conditions encountered during construction may vary from those observed during this investigation.
7. Deeper cuts may require excavated slopes to be benched. The maximum height of the cut at the up-slope ridge of the bench is 4 feet. The overall slope should still comply with OSHA requirements.
8. Any highly plastic, CH subgrades, if encountered, should be excavated and covered the same day and not be allowed to dry out. Highly plastic soils that are allowed to dry out will shrink and swell considerably. This will affect and may damage overlying structures built over it. In our experience in this area, the depth of foundations at frost depth levels are generally deep enough to keep moisture levels relatively uniform from environmental changes. However, there is risk with putting slabs and other structures over highly plastic, CH soils (discussed earlier and below).

PAVEMENT DESIGN

1. Parking lots should be designed per the requirements of Lee's Summit *Unified Development Ordinance (UCO), Section 8.620. - Parking Lot Design*. Minimum pavement sections for Parking Lot Paving are provided in this section. For asphalt pavement, minimum pavement sections also include a stabilized subgrade consisting of six inches of granular base over geogrid OR six inches of granular base over six inches of chemically stabilized soil.
2. If chemical stabilization is chosen, pavement subgrades should generally be prepared as outlined in the City of Lee's Summit Design and Construction Manual *Section 2200 - APPENDIX for CHEMICAL STABILIZATION OF SOIL using CEMENT or LIME KILN DUST* and the SITE DEVELOPMENT section of this report.
 - a. For planning purposes, it is recommended that cement or lime kiln dust be applied at a rate of 10 percent by dry weight.



- b. A chemical stabilization design could be conducted to determine the minimum amount of chemical product needed to meet a specified strength requirement. This would require a sample of the desired chemical additive be provided for laboratory testing.
3. Just prior to paving, the pavement areas should be rough graded and then proof rolled with a loaded tandem axle dump truck. Subgrade areas that are disturbed and/or rutted during construction and backfilled trenches should be carefully observed during the proof rolling operations. Areas, where unstable or unsuitable conditions are found, should be cut out and replaced with controlled, compacted fill and re-proof rolled.
4. Minimum recommended pavement thicknesses per Section 8.620 are as follows:

Standard Duty Pavement:

Asphaltic Concrete: 1.5 Inches of Plant Mix Bituminous Surface Pavement
4.0 Inches of Plant Mix Bituminous Base Pavement
6.0 Inches of Crushed Limestone Base Rock
Geogrid or 6.0 inches of stabilized subgrade

Concrete: 6.0 inches of Concrete
4.0 inches of Crushed Limestone Base Rock

Heavy Duty Pavement:

Asphaltic Concrete: 1.5 Inches of Plant Mix Bituminous Surface Pavement
5.0 Inches of Plant Mix Bituminous Base Pavement
6.0 Inches of Crushed Limestone Base Rock
Geogrid or 6.0 inches of stabilized subgrade

Concrete: 6.0 inches of Concrete
4.0 inches of Crushed Limestone Base Rock

Heavy Duty Dumpster Pad Pavement:

Concrete: 7.0 Inches of Concrete
Concrete strength at 28 days should be a minimum of 4,000 psi.
7.0 Inches of Crushed Limestone Base Rock

The base rock sections above are based on the required Structural Number for the planned development traffic; they do not take into account the need for additional base rock thickness to facilitate construction. Additional base rock, especially for concrete sections, may need to be thicker to be able to support construction traffic prior to paving. Also, if specific traffic is known, these pavement sections should be checked. The minimums may need to be increased.

5. The Plant Mix Bituminous Pavement should meet the requirements of the Missouri Department of Transportation (MoDOT), Standard Specifications for Plant Mix Bituminous Pavement surface course (structural number coefficient = 0.42) as



described in Section 401-Type BP-2. The Plant Mix Bituminous Base mix should meet the requirements of Section 401 Plant Mix Bituminous Base (structural number coefficient = 0.34). The base rock (structural number coefficient = 0.14) can be constructed of compacted crushed limestone meeting the requirements of Section 304 for Aggregate Base Course. The maximum compacted thickness of any one layer of base rock material shall not exceed 6 inches with each lift compacted to 100% of maximum dry density as determined by ASTM D698 (Standard Proctor). The compacted thickness of a single layer of Plant Mix Bituminous Base Course shall be between 3 and 4 1/4 inches (except when a thinner layer thickness is specified) with each layer compacted to 95% of 50 blow Marshall Density (ASTM D1559). The compacted thickness of a single layer of Plant Mix Bituminous Pavement shall not exceed 2 inches for the surface course with each layer compacted to 98% of a laboratory specimen made in the proportions of the job-mix formula in accordance with AASHTO T167 or 96% of a laboratory specimen made in proportions of the job-mix formula in accordance with AASHTO T245.

6. Concrete pavements should meet the requirements of Section 502 of the MODOT standard specifications for Portland Cement concrete pavements. Concrete strength at 28 days should be a minimum of 4,000 psi.
7. Truck pad areas, where heavy trucks travel and park such as loading dock areas and areas in front of trash dumpsters should be constructed of 7 inches of concrete over 7 inches of base rock. For trash dumpsters, the concrete pad should be extended far enough to include the front and rear axles when lifting trash dumpsters.
8. Care must be taken to develop positive drainage across and from around the pavement edges. Water allowed to pond on or adjacent to pavements would increase the potential for moisture intrusion into the subgrade soils and could result in premature pavement failure.
9. The pavement sections given above are minimums for the design criteria. Periodic maintenance of the pavement is anticipated in the designs. A maintenance program that includes surface sealing, joint cleaning and sealing, and timely repair of cracks and deteriorated areas will increase the pavement's life.

SEISMIC CONDITIONS

1. For IBC 2018 purposes, this site should be considered a Site Class “C”.

CONCRETE FLOOR SLAB SUBGRADE PREPARATION

1. The concrete floor slab and other concrete slabs should be underlain by a minimum of 6 inches of compacted granular base course material having a maximum aggregate size of 1 1/2 inches and no more than 10% passing the #200 sieve. This granular layer should be compacted to at least 98% of maximum dry density and



within 2% of optimum moisture content, as determined by a Standard Proctor test, ASTM D 698.

The concrete slab stone subgrade should be smooth and free from irregularities in surface elevations, such as tire rutting, differences in surface elevations from passes of compaction equipment, and or use of open-graded stone without sand infilling or “choking” layer, etc. These surface elevation variations will provide areas for passive resistance to develop in the concrete during curing and restrained shrinkage cracks may occur.

2. Even after preparing the subgrade as detailed in the Site Development section of this report, it has been our experience that the concrete slab subgrades are often disturbed between completion of grading and slab construction due to weather, footing, and utility line installation, and other construction activities. For this reason, the subgrade should be evaluated by a geotechnical engineer just prior to installing the reinforcing for the slab. Areas judged by the geotechnical engineer to be unacceptable should be undercut and replaced with compacted crushed stone.
3. Highly plastic soils, if encountered, should not be within 24 inches below basestone for concrete slabs on grade and 12 inches below basestone for concrete pavements. Depending on final floor elevations, this may require over-excavation of highly plastic clays. Soils used to bring the area to subgrade should meet the criteria of the Site Development section.
4. Backfill against stem walls inside buildings should be made with a crushed limestone conforming to ASTM C33, Size 57, or equal, to minimize settlement potential. The stone should be wetted and compacted until no further consolidation is observed.
5. A vapor barrier consisting of a minimum of 6 mil polyethylene on the 6 inches of crushed base rock should be used immediately below the concrete floor slab.
6. The modulus of subgrade reaction for controlled, compacted fill of these silty clay soils with the above recommended granular base, and site development performed as recommended in this report would be 150 psi/in.

LIMITATIONS

This report has been prepared for the exclusive use of our client for specific application to the project discussed in accordance with generally accepted soils engineering practices common to the local area. This report must be read in its entirety. No other warranty, express or implied, is made. Issues beneath the ground are a significant source of issues in construction projects where risk cannot always be removed, though it can be handled. This geotechnical investigation is provided to aid in handling these risks.

Geotechnical investigation reports are unique to the specific project for which they are written. Factors considered in the preparation of this geotechnical investigation report include, but are not limited to, specific project information, specific site information, the soils encountered in the borings, and the client's risk level. This report is specifically prepared for



this project and any change in project or site information should be brought to our attention so that adjustments to recommendations can be made, if necessary. Also, this report should not be relied upon by anyone other than the client for which it is written without our prior approval.

The analyses and recommendations contained in this report are preliminary and are based on the data obtained from the referenced subsurface explorations. The borings indicate subsurface conditions only at the specific locations and time, and only to the depths penetrated. They do not necessarily reflect strata variations that may exist between such locations. Inferences are made between the conditions encountered in the borings and the validity of the recommendations is based in part on assumptions about the stratigraphy made by the geotechnical engineer. Such assumptions may be confirmed only during earthwork and foundation construction. If subsurface conditions different from those described are noted during construction, recommendations in this report must be re-evaluated.

It is advised that OWN be retained to consult with design team members and to review portions of drawings that are applicable to this geotechnical investigation report to limit the possibility of recommendations in this report being misunderstood by other members of the design team. It is advised that OWN, Inc., be retained to observe foundation installation and earthwork construction in order to help confirm that our assumptions and preliminary recommendations are valid or to modify them accordingly. OWN, Inc., cannot assume responsibility or liability for the adequacy of recommendations if it does not observe construction.

The scope of this evaluation was limited to an evaluation of the load carrying capacity and stability of the subsoils. Oil, hazardous waste, radioactivity, irritants, pollutants, molds, or other dangerous substances and conditions in the soil, groundwater or surface water within or beyond the site studied were not the subject of this report. Their presence and/or absence are not implied or suggested by this report, and should not be inferred. Any statements in this report regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

In the event that any changes in the nature, design, or location of the facilities are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing by OWN, Inc. OWN, Inc., is not responsible for any claims, damages, or liability associated with the interpretation of subsurface data or reuse of the subsurface data or engineering analyses without the express written authorization of OWN, Inc. An especially potent method for handling risks related to underground concerns, especially those that stem from unforeseen factors, is to retain the engineer who authored the report for inspections, observations, and or additional investigations. Before a client seeks to use a geotechnical report, they should always ask the geotechnical engineer to determine if the geotechnical report is still reliable in light of present site conditions.

Appendix I

Site Location Sketch
Soil Boring Location
Current Aerial Photograph

Appendix II

Log Legend
Unified Soil Classification System
Boring Logs

Appendix IIA

Research
Photos, etc. (if available)
Site Checklist (if included)
Additional Information (if available)



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Appendix I

Figures

- Site Location Sketch
- Soil Boring Location



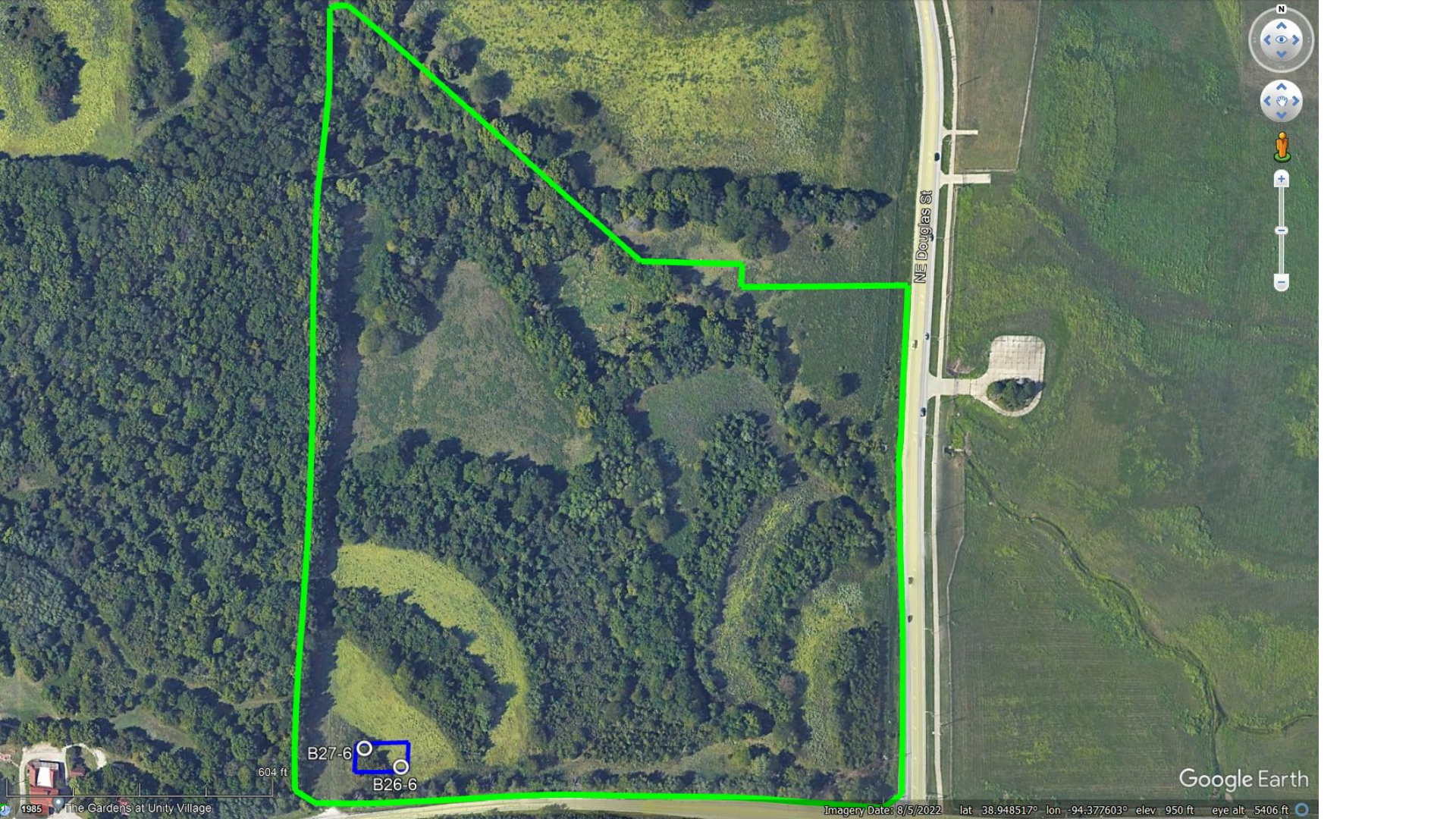
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Building 6 (SW corner) - Borings B-26 & B-27

Google Earth

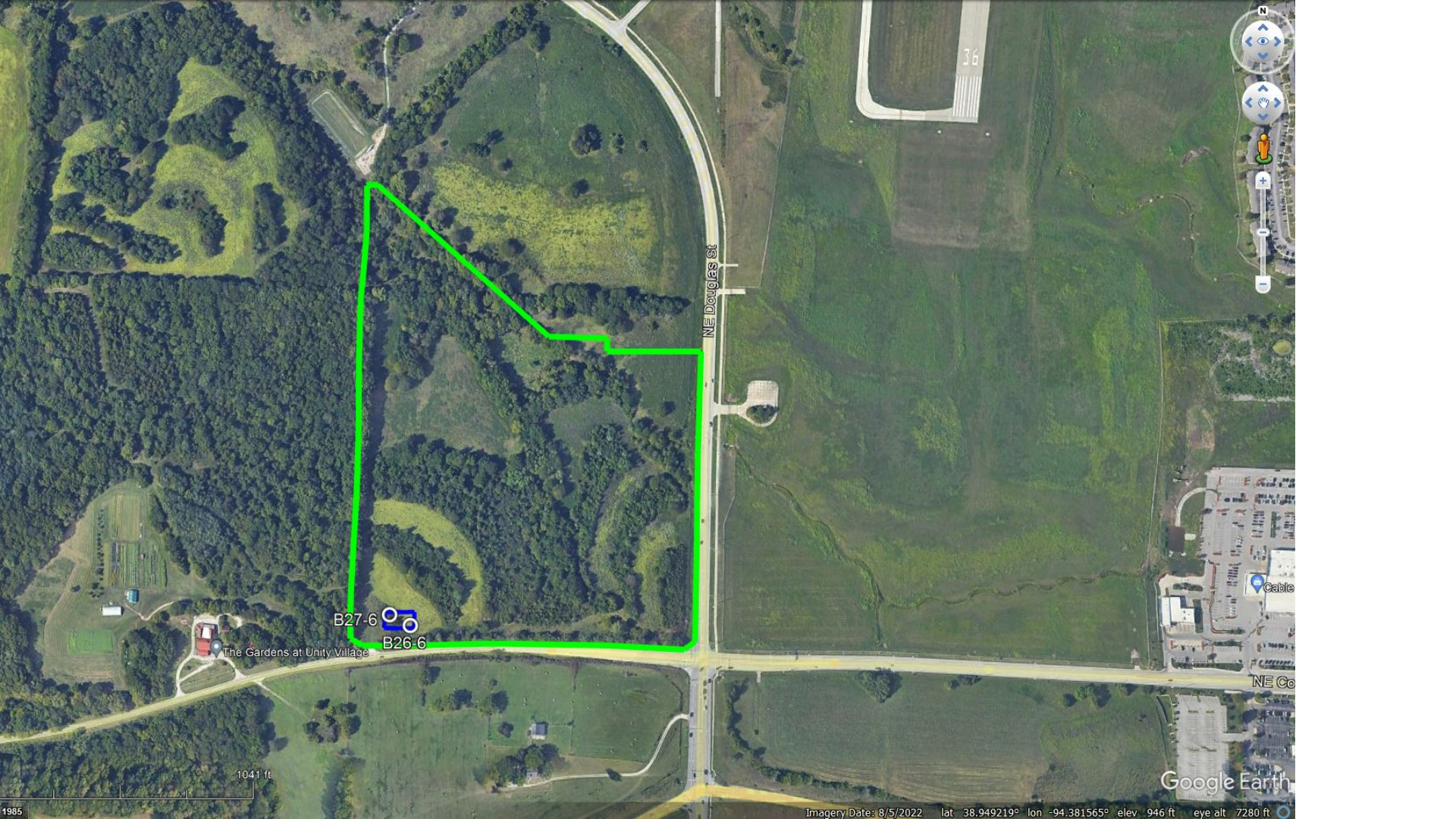
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Google Earth

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1985 The Gardens at Unity Village



NE Douglas St

36

B27-6

B26-6

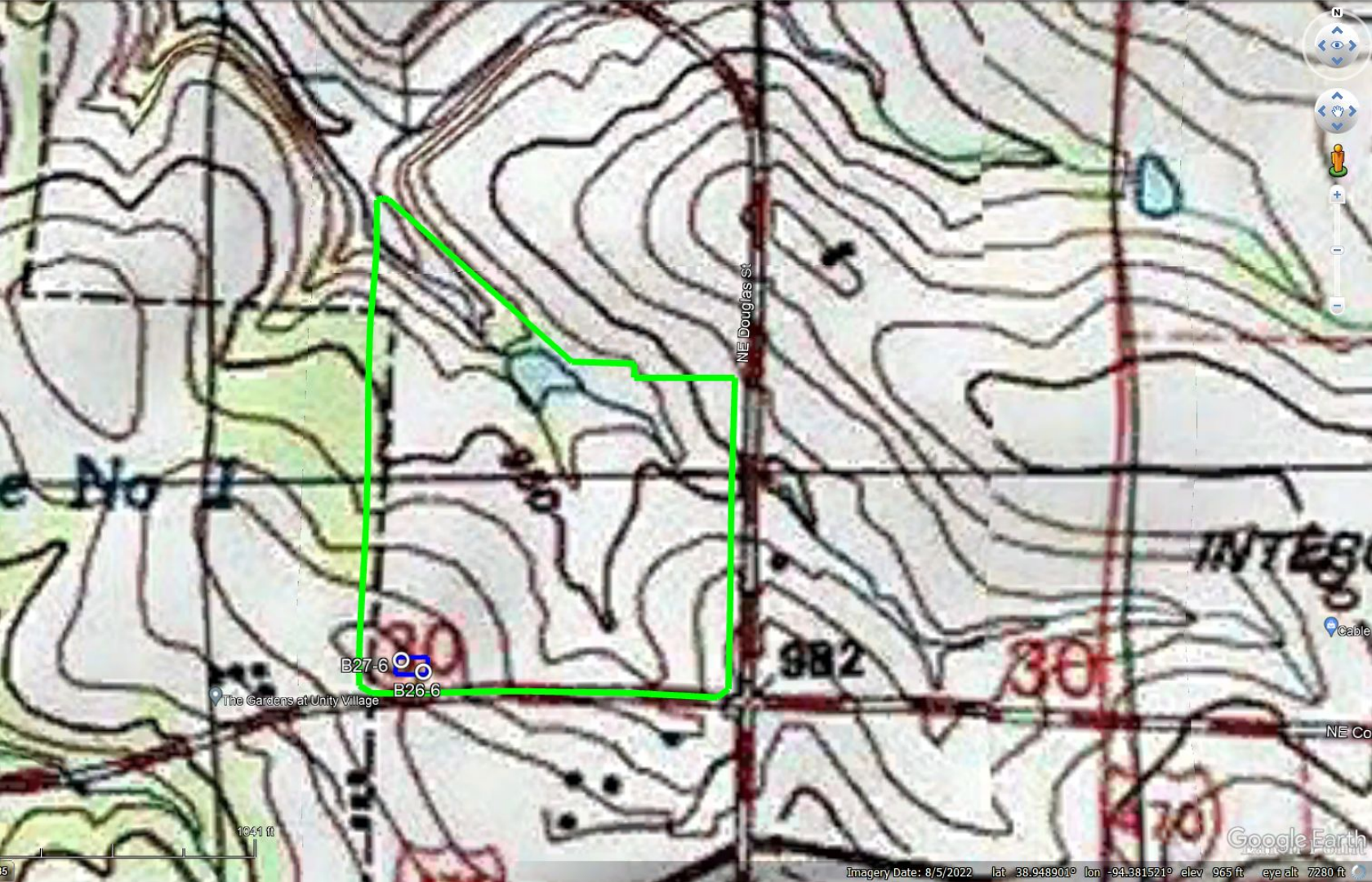
The Gardens at Unity Village

NE Co

1041 ft

Google Earth

Imagery Date: 8/5/2022 lat 38.949219° lon -94.381565° elev 946 ft eye alt 7280 ft



Appendix II

Borings

- Log Legend
- Unified Soil Classification System
- Boring Logs



Engineering beyond.™

BORING LOG LEGEND

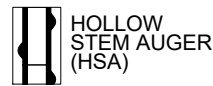
DRILLING & SAMPLING SYMBOLS

OWN, Inc.
3213 S. West Bypass
Springfield, MO 65807
417-866-2741

LITHOLOGIC SYMBOLS (Unified Soil Classification System)

	FILL
	UNSTABLE SOIL
	CL LOW PLASTICITY CLAY
	CH HIGH PLASTICITY CLAY
	ML LOW PLASTICITY SILT
	MH HIGH PLASTICITY SILT
	SW WELL GRADED SAND
	SP POORLY GRADED SAND
	SM SILTY SAND
	SC CLAYEY SAND
	GW WELL GRADED GRAVEL
	GP POORLY GRADED GRAVEL
	GM SILTY GRAVEL
	GC CLAYEY GRAVEL

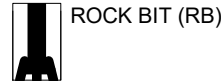
DRILLING



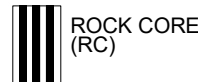
HOLLOW
STEM AUGER
(HSA)



SOLID STEM /
POWER
AUGER (SA /
PA)



ROCK BIT (RB)



ROCK CORE
(RC)

SAMPLING



SPLIT
SPOON (SS)



SHELBY
TUBE (ST)



AUGER

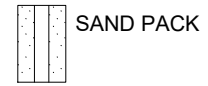


GRAB/BULK
(GS/BS)



ROCK CORE
(RC)

WELLS



SAND PACK



W/SLOTTED
CASING



CONC-
GROUT/FILL



BENT-
GROUT/SEAL



CEMENT/BENT
GROUT

AUGERS: Hollow Stem (HSA), Solid Stem (SSA), ROCK BIT: RB,
HAND AUGER: HA
ROCK CORE: with Diamond Bit (DB),
SPLIT SPOON: 2" O.D., SHELBY TUBE: 3" O.D.

____ LBS or ____ PSI next to DRILLING METHOD OR SHELBY TUBE
SAMPLER is down pressure to advance or sample at depth shown.

GENERAL NOTES

1. Classifications are based on the United Soil Classification System and ASTM D-2487 and D-2488. They include consistency, moisture, and color. field descriptions have been modified to reflect results of laboratory tests where deemed appropriate.

Fine grained soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: clays, if they are plastic, and silts if they are slightly plastic or non-plastic. Coarse grained soils have more than 50% of their dry weight retained on a #200 sieve; they are described as: sand, gravel, cobbles, or boulders. Other descriptions include: color, moisture, consistency for clays and silts, and relative density for granular soils. Geologic description of bedrock if encountered is also shown.

2. Surface elevations and horizontal locations, for borings, test pits, mapped data, GIS information, if provided, should be considered approximate or estimated. They are provided to illustrate the relative location of a sample location to other sample locations. Their accuracy for survey grade location should not be relied upon, unless they have been surveyed and specifically noted.

3. Descriptions on these boring logs apply only at the specific boring locations and at the time the borings were made. They are not guaranteed to be representative of subsurface conditions at other locations or times. Graphic descriptions are for illustrative purposes only. Authorized users must read the boring log, legend, and report.

ABBREVIATIONS

N	- BLOWS PER FOOT
LL	- LIQUID LIMIT (%)
PL	- PLASTIC LIMIT (%)
PI	- PLASTIC INDEX (%)
LI	- LIQUIDITY INDEX (%)
W	- MOISTURE CONTENT (%)
DD/WD	- DRY/WET DENSITY (PCF)
NP	- NON PLASTIC
-200	- % PASSING # 200 SIEVE
PP	- POCKET PENETROMETER (TSF)
	">" is greater than; "<" is less than
UC	- UNCONFINED COMPRESSION

PID	- PHOTOIONIZATION DETECTOR
ppm	- PARTS PER MILLION

▽ Water Level at Time
Drilling, or as Shown

▼ Water Level After
Drilling, or as Shown

▽ Water Level After 24
Hours, or as Shown

Water levels indicated on the Boring Logs are the levels measured in the borings at the time indicated. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with short term observations.

Key to Soil Symbols and Terms

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE-GRAINED SOILS: Sands and Gravels

Descriptive Terms	Relative Density	SPT Blow Count
Very loose	0 to 15 %	< 4
Loose	15 to 35 %	4 to 10
Medium dense	35 to 65 %	10 to 30
Dense	65 to 85 %	30 to 50
Very dense	85 to 100 %	> 50

FINE-GRAINED SOILS: Silts and Clays

Unconfined Compressive		
Descriptive Terms	Strength tsf	SPT Blow Count
Very soft	< 0.25	< 2
Soft	0.25 to 0.5	2 to 4
Medium firm	0.5 to 1.0	4 to 8
Stiff	1.0 to 2.0	8 to 15
Very stiff	2.0 to 4.0	15 to 30
Hard	> 4.0	> 30

SPT: Standard Penetration Test: Number of blows of 140 LB hammer falling 30 inches to drive a 2 inch O.D. (1-3/8 inch I.D.) Split-spoon sample (SS) the last 12 inches of an 18-inch drive (ASTM-1586).

COMPOSITION:

Sands and Gravels

Descriptive Terms	% FINES by Dry Weight
Trace	0 to 5 %
With	5 to 15%
Clayey, Silty	> 15%

Silts and Clays

Descriptive Terms	% COARSE by Dry Weight
Trace	0 to 15 %
With	15 to 30%
Sandy, Gravelly	> 30%

PLASTICITY

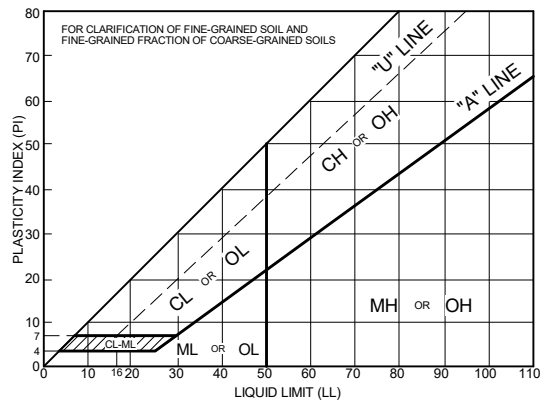
Descriptive Terms	Liquid Limit
Lean	< 50%
Fat	> 50%

Descriptive Terms	Plasticity Index
Non-plastic	0
Very Low	1 to 10%
Low	11 to 20%
Medium	21 to 30%
High	31 to 40%
Very High	> 40%

Major Divisions	Group Symbols	Typical Names	Laboratory Classification Criteria	Particle Size
Coarse-Grained soils (More than half the material is larger than No. 200 sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Sieve sizes #10 to #4 #40 to #10 #200 to #40
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	GM* d u	Silty gravels, gravel-sand-silt mixtures	mm 2.00 to 4.76 0.42 to 2.00 0.074 to 0.42
		GC	Clayey gravels, gravel-sand-silt mixtures	
	Sands with fines (Appreciable amount of fines)	SW	Well-graded sands, gravelly sands, little or no fines	Coarse Medium Fine
		SP	Poorly-graded sands, gravelly sands, little or no fines	
Fine-Grained soils (More than half the material is smaller than No. 200 sieve size)	Sands with fines (Appreciable amount of fines)	SM* d u	Silty sands, sand-silt mixtures	Silt Clay
		SC	Clayey sands, sand-clay mixtures	
	Silts and Clays (Liquid limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	mm 4.76 to 19.1 19.1 to 76.2 76.2 to 304.8 304.8 to 914.4
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		OL	Organic silts and organic silty clays of low plasticity	
	Silts and Clays (Liquid limit greater than 50)	MH	Inorganic silts, micaceous or disto-maceous fine sandy or silty soils, organic silts	mm 4.76 to 19.1 19.1 to 76.2 76.2 to 304.8 304.8 to 914.4
		CH	Inorganic clays of high plasticity, fat clays	
		OH	Organic clays of medium to high plasticity, organic silts	
Highly Organic Soils	Highly Organic Soils	Pt	Peat and other highly organic soils	mm 4.76 to 19.1 19.1 to 76.2 76.2 to 304.8 304.8 to 914.4

Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve) coarse-grained soils are classified as follows:

Less than 5 percent..... GW, GP, SW, SP
More than 12 percent..... GM, GC, SM, SC
6 to 12 percent..... Borderline cases requiring dual symbols**



Plasticity Chart

* Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg Limits: suffix d used when L.L. is 23 or less and the P.I. is 6 or less; the suffix is used when L.L. is greater than 26.

** Borderline classifications used for soils possessing characteristics of two groups are designated by combinations of groups symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

Key to Rock Symbols and Terms



LIMESTONE



DOLOMITE



SHALE



SILTSTONE



BROKEN ROCK



WEATHERED ROCK



HIGHLY WEATH. ROCK



CHERTY LIMESTONE



OOLITIC LIMESTONE



CHERTY DOLOMITE



SANDSTONE



CHERT



VOID



COAL

ROCK QUALITY DESIGNATION (RQD)

Description of Rock Quality

<u>Descriptive Terms</u>	<u>% RQD</u>
Very Poor	0 to 25 %
Poor	25 to 50%
Fair	50 to 75%
Good	75 to 90%
Excellent	90 to 100%

RQD is defined as the total length of sound core pieces 4 inches of greater in length, expressed as a % of the total length cored. RQD provides an indication of the integrity of the rock mass and relative extent of seams and bedding planes.

TERMS DESCRIBING WEATHERING, STRENGTH, OR HARDNESS

WEATHERING:

Descriptive Terms

Recognition

Extremely Weathered -	Material can be granulated by hand.
Highly Weathered -	More than half of the rock is decomposed; rock is weakened so that a 2 inch diameter sample can be broken readily by hand across rock fabric.
Moderately Weathered -	Rock is discolored, a minimum 2 inch diameter sample cannot be broken readily by hand across rock fabric.
Slightly Weathered -	Rock is slightly discolored, but not noticeably lower in strength than fresh rock.
Fresh -	Rock shows no discoloration, loss of strength, or other affect of weathering.

STRENGTH:

Recognition

Extremely Weak Rock -	Can be indented by thumb nail. May be broken by hand readily.
Very Weak Rock -	Can be peeled by pocket knife. Crumbles under firm blow with end of a rock hammer. May be broken by hand with difficulty.
Weak Rock -	Can be peeled by with difficulty with pocket knife.
Moderately Strong Rock -	Can be indented 5 mm (0.2 inches) with sharp end of pick.
Strong Rock -	Requires one hammer blow to fracture.
Very Strong Rock -	Requires many hammer blows to fracture.
Extremely Strong Rock -	Can only be chipped with hammer blows.

SCRATCH HARDNESS:

Descriptive Terms

Recognition

Soft -	Applicable only to plastic materials.
Friable -	Easily crumbled by hand, pulverized, or reduced to powder; too soft to be cut by pocket knife.
Low Hardness -	Can be gouged deeply or carved with a pocket knife.
Moderately Hard -	Can be readily scratched by knife blade; scratch leaves heavy trace of dust and is readily visible after powder has been blown away.
Hard -	Can be scratched with pocket knife only with difficulty; scratch produces little powder; traces of knife steel may be visible.
Very Hard -	Cannot be scratch with pocket knife; knife steel marks are left on surface.

*

**

GEOTECH BH AE COL GRAPHIC DRILL - AE CONCRETE GDT - 3/29/24 10:27 - H:\SHARED DRIVES\03A GINT\GINT SP3\PROJECTS\24SP30033 INTRINSIC DEVELOPMENT, THE VILLAGE OF DISCOVERY PARK, REMAINING LOTS, LEE'S SUMMIT, MO.GPJ



OWN, Inc.
3213 S. West Bypass
Springfield, MO 65807
Telephone: 417-866-2741
Fax: 417-866-2778

CLIENT INTRINSIC DEVELOPMENT
PROJECT NUMBER 24SP30033
DATE STARTED 3/5/24 **COMPLETED** 3/5/24
DRILLING CONTRACTOR OWN ATV-17
DRILLING METHOD Solid Stem Auger 4"
LOGGED BY JS-CH **CHECKED BY** GW
NOTES LOT 6

PROJECT NAME THE VILLAGE AT DISCOVERY PARK
PROJECT LOCATION LEE'S SUMMIT, MO
GROUND ELEVATION 974.06 ft **HOLE SIZE** 4 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING --- NO WATER
AT END OF DRILLING --- NO WATER
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth DRILLING METHOD	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PI / LI
0		GRAYISH BROWN SHALEY LEAN TO FAT CLAY, DAMP, VERY STIFF TO HARD, FRIABLE	0									
1			1	SS		4-7-11 (18)	16		15.6			
2		DAMP, HARD	2	SS		11-22-30 (52)	> 4.5		16.6			
3			3									
4		DAMP, HARD	4	SS		7-22-38 (60)	> 4.5		15.6			
5			5									
6		DAMP, HARD	6	SS		17-26-50 (76)	4.5		15.3			
7			7									
8			8									
9		DAMP, HARD	9	SS		30-50/4"	4.5		51.6	47	25	22 1.21
10			10									
11			11									
12			12									
13			13									
14		EXTREMELY WEATHERED DARK GRAY SHALE, DAMP, HARD, FRIABLE	14	SS		30-50/4"			39.8			
15			15									

Bottom of borehole at 15.0 feet.

GEOTECH BH AE COL GRAPHIC DRILL - AE CONCRETE GDT - 3/29/24 10:27 - H:\SHARED DRIVES\03A_GINT\GINT SP3\PROJECTS\24SP30033 INTRINSIC DEVELOPMENT, THE VILLAGE OF DISCOVERY PARK, REMAINING LOTS, LEE'S SUMMIT, MO.GPJ



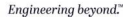
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Springfield, MO 65807
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CLIENT INTRINSIC DEVELOPMENT
PROJECT NUMBER 24SP30033
DATE STARTED 3/5/24 **COMPLETED** 3/5/24
DRILLING CONTRACTOR OWN ATV-17
DRILLING METHOD Solid Stem Auger 4"
LOGGED BY JS-CH **CHECKED BY** GW
NOTES LOT 6

PROJECT NAME THE VILLAGE AT DISCOVERY PARK
PROJECT LOCATION LEE'S SUMMIT, MO
GROUND ELEVATION 971.28 ft **HOLE SIZE** 4 inches
GROUND WATER LEVELS:
AT TIME OF DRILLING --- NO WATER
AT END OF DRILLING --- NO WATER
AFTER DRILLING ---

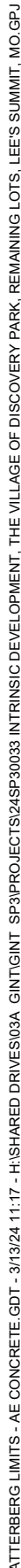
DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	Depth DRILLING METHOD	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	Unconfined Qu, (tsf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		
										LIQUID LIMIT	PLASTIC LIMIT	PI / LI
0		EXTREMELY WEATHERED GRAY SHALE, DAMP, WEATHERED TO VERY STIFF TO HARD	0									
1			1	SS		2-8-20 (28)	> 4.5		12.7			
2		DAMP, HARD	2	SS		20-30-50 (80)	> 4.5		12.1			
3			3									
4		DAMP, HARD	4	SS		10-34- 50/5"	4.5		12.2			
5		DAMP, HARD	5	SS		50/4"	4.5		10.6			
6			6									
7			7									
8			8									
9		DAMP, HARD	9	SS		35-50/3"	4.5		11.3			
10		HIGHLY WEATHERED, VERY WEAK ROCK, FRIABLE	10									
11		LIMESTONE, DRILLED WITH 1000 PSI PULL DOWN PRESSURE	11									

Bottom of borehole at 11.5 feet.



ATTERBERG LIMITS' RESULTS

PROJECT NAME THE VILLAGE AT DISCOVERY PARK REMAINING LOTS

PROJECT LOCATION LEE'S SUMMIT, MO[illegible]

Appendix IIa

Research



Engineering beyond.™

Map Layers



- ☐ Jasper Co Subdivisions ...
- > ☒ Water and Wetlands ...
- > ☐ Recreation ...
- > ☒ City of Joplin ...
- > ☒ Soils ...
- > ☒ Wells ...
- ▼ ☒ Geology ...
 - ☐ AR Geologic Units ...
 - ☐ AR Faults ...
 - ☐ KS Geologic Units ...
 - ☒ MO Geologic Units ...
 - ☐ OK Geologic Units ...
 - ☐ MO Depth to Bedrock (from MODNR) ...
 - ☐ MO Groundwater Depth ...
 - ☐ AR Ozarks Sinkholes ...
 - ☐ MO Sinkholes ...
 - ☐ COS, Sinkhole Boundary ...
 - ☐ Greene CO Sinkholes ...
 - ☐ Greene Co Sinkholes - 2020 ...

Zoom to

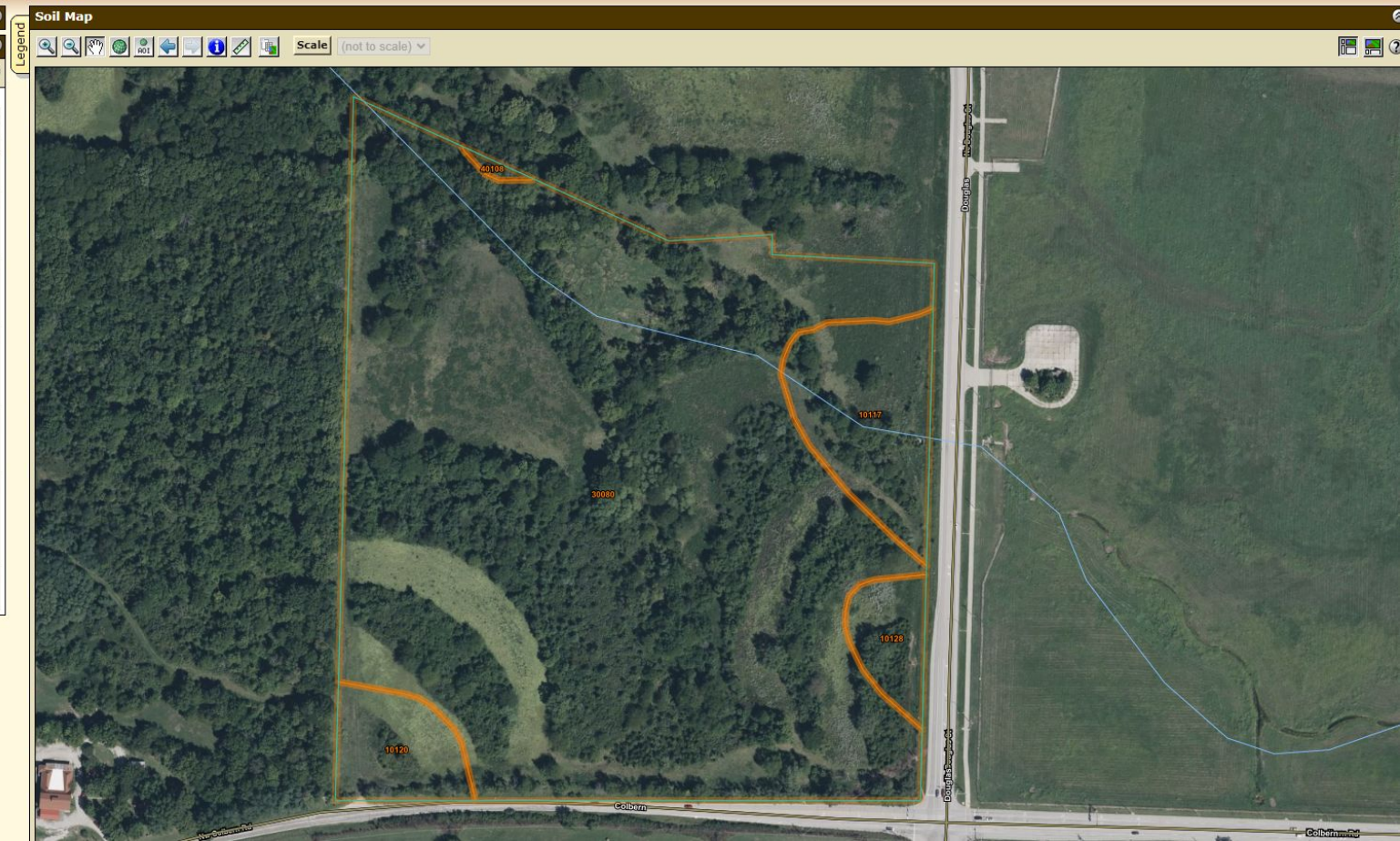
Name	Pkc: KANSAS CITY GROUP (Phanerozoic Paleozoic Carboniferous Pennsylvanian-Late [Upper Missourian])
Detailed Description	View

Kansas City Group

Cyclic deposits, limestone and shale with minor sandstone and coal.

State	Missouri
Name	Kansas City Group
Geologic age	Late Pennsylvanian-Upper Series-Missourian Stage
Lithologic constituents	Major Sedimentary > Clastic > Mudstone > Shale (Bed) Sedimentary > Carbonate > Limestone (Bed) Minor Sedimentary > Coal (Bed) Sedimentary > Clastic > Sandstone (Bed)
Stratigraphic units	Kansas City Group- (160ft. Max) includes Bronson Subgroup- Hertha FM, Ladore FM, Swope FM, Galesburg FM, Dennis FM. Linn Subgroup- Cherryvale FM, Drum FM, Chanute FM, Iola FM.(includes Raytown Limestone Member), Zarah Subgroup- Lane FM, Wyandotte FM(includes Argentine Limestone Member), Bonner Springs FM.

Jackson County, Missouri (MO095)			
Jackson County, Missouri (MO095)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10117	Sampsel silty clay loam, 5 to 9 percent slopes	2.6	7.2%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	1.4	3.8%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	0.9	2.5%
30080	Greenton silty clay loam, 5 to 9 percent slopes	31.0	86.3%
40108	Snead-Rock outcrop complex, warm, 14 to 30 percent slopes	0.1	0.2%
Totals for Area of Interest		36.0	100.0%



Jackson County, Missouri**10117—Sampsel silty clay loam, 5 to 9 percent slopes****Map Unit Setting**

National map unit symbol: 2qkzz

Elevation: 600 to 1,120 feet

Mean annual precipitation: 33 to 41 inches

Mean annual air temperature: 50 to 57 degrees F

Frost-free period: 177 to 220 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Sampsel and similar soils: 85 percent

Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampsel Setting

Landform: Hillslopes

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Side slope

Down-slope shape: Concave

Across-slope shape: Convex, concave

Parent material: Residuum weathered from shale

Typical profile

Ap - 0 to 13 inches: silty clay loam

Bt - 13 to 80 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat):

Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 0 to 18 inches

Frequency of flooding: None

Frequency of ponding: None

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C/D

Ecological site: R109XY010MO - Interbedded Sedimentary Upland Savanna

Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)

Hydric soil rating: No

Jackson County, Missouri**10120—Sharpsburg silt loam, 2 to 5 percent slopes****Map Unit Setting***National map unit symbol: 2yy7v**Elevation: 1,000 to 1,300 feet**Mean annual precipitation: 33 to 41 inches**Mean annual air temperature: 50 to 55 degrees F**Frost-free period: 177 to 220 days**Farmland classification: All areas are prime farmland***Map Unit Composition***Sharpsburg and similar soils: 90 percent**Minor components: 10 percent**Estimates are based on observations, descriptions, and transects of the mapunit.***Description of Sharpsburg****Setting***Landform: Hillslopes**Landform position (two-dimensional): Backslope**Landform position (three-dimensional): Interfluvium**Down-slope shape: Convex**Across-slope shape: Linear**Parent material: Loess***Typical profile***Ap - 0 to 6 inches: silt loam**A - 6 to 16 inches: silty clay loam**Bt1 - 16 to 22 inches: silty clay loam**Bt2 - 22 to 46 inches: silty clay loam**BC - 46 to 58 inches: silty clay loam**C - 58 to 79 inches: silty clay loam***Properties and qualities***Slope: 2 to 5 percent**Depth to restrictive feature: More than 80 inches**Drainage class: Moderately well drained**Runoff class: Medium**Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)**Depth to water table: About 45 to 50 inches**Frequency of flooding: None**Frequency of ponding: None**Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)**Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)***Interpretive groups***Land capability classification (irrigated): None specified**Land capability classification (nonirrigated): 3s**Hydrologic Soil Group: C**Ecological site: R109XY002MO - Loess Upland Prairie**Hydric soil rating: No*

Jackson County, Missouri

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9

Elevation: 640 to 1,120 feet

Mean annual precipitation: 35 to 41 inches

Mean annual air temperature: 50 to 57 degrees F

Frost-free period: 177 to 209 days

Farmland classification: Not prime farmland

Map Unit Composition

Greenton and similar soils: 90 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton**Setting**

Landform: Hillslopes

Landform position (two-dimensional): Shoulder

Landform position (three-dimensional): Interfluv

Down-slope shape: Convex

Across-slope shape: Convex

Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam

Bt - 12 to 28 inches: silty clay

2Bt - 28 to 30 inches: silty clay

2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat poorly drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat):

Moderately low to moderately high (0.06 to 0.20 in/hr)

Depth to water table: About 12 to 30 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C/D

Ecological site: R109XY002MO - Loess Upland Prairie

Hydric soil rating: No

Report — Chemical Soil Properties								
Jackson County, Missouri								
Map symbol and soil name	Depth	Cation-exchange capacity	Effective cation-exchange capacity	Soil reaction	Calcium carbonate	Gypsum	Salinity	Sodium adsorption ratio
	<i>In</i>	<i>meq/100g</i>	<i>meq/100g</i>	<i>pH</i>	<i>Pct</i>	<i>Pct</i>	<i>mmhos/cm</i>	
10117—Sampsel silty clay loam, 5 to 9 percent slopes								
Sampsel	0-13	26-36	—	5.6-7.3	0	0	0.0-2.0	0
	13-80	18-36	—	5.6-7.8	0	0	0.0-2.0	0
10120—Sharpsburg silt loam, 2 to 5 percent slopes								
Sharpsburg	0-6	21-23	—	5.6-7.3	0	0	0.0-2.0	0
	6-16	22-27	—	5.6-7.3	0	0	0.0-2.0	0
	16-22	27-32	—	5.1-6.5	0	0	0.0-2.0	0
	22-46	27-33	—	5.6-6.5	0	0	0.0-2.0	0
	46-58	19-27	—	5.6-7.3	0	0	0.0-2.0	0
	58-79	19-25	—	5.6-7.3	0	0	0.0-2.0	0
10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes								
Sharpsburg	0-17	18-29	—	5.1-6.5	0	0	0.0-2.0	0
	17-55	19-32	—	4.5-6.0	0	0	0.0-2.0	0
	55-60	17-29	—	5.6-6.5	0	0	0.0-2.0	0
Urban land	—	—	—	—	—	—	—	—
30080—Greenton silty clay loam, 5 to 9 percent slopes								
Greenton	0-12	22-31	—	5.6-6.0	0	0	0.0-2.0	0
	12-28	24-37	—	6.1-6.5	0	0	0.0-2.0	0
	28-30	26-36	—	6.6-7.3	0	0	0.0-2.0	0
	30-79	26-37	—	7.9-8.4	0-10	0	0.0-2.0	0

Report — Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk '*' denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Jackson County, Missouri

Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
10117—Sampsel silty clay loam, 5 to 9 percent slopes														
Sampsel	85	C/D	0-13	Silty clay loam	CL	A-6, A-7, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	95-98-100	90-95-100	35-43 -50	15-20-25
			13-80	Silty clay loam, silty clay, clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-99-100	95-98-100	52-64 -75	35-41-47
10120—Sharpsburg silt loam, 2 to 5 percent slopes														
Sharpsburg	90	C	0-6	Silt loam	CL, ML	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	93-97-100	41-44 -46	17-18-18
			6-16	Silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	93-97-100	41-45 -50	19-21-24
			16-22	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	94-98-100	47-51 -56	26-28-30
			22-46	Silty clay loam, silty clay	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	97-100-100	94-98-100	47-51 -56	26-29-32
			46-58	Silty clay loam, silt loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-100-100	93-99-100	35-41 -47	17-22-26
			58-79	Silt loam, silty clay loam	CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	96-99-100	92-97-100	35-40 -44	17-20-23
10128—Sharpsburg-Urban land complex, 2 to 5 percent slopes														
Sharpsburg	60	D	0-17	Silt loam	CL, ML	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	34-44 -46	11-18-18
			17-55	Silty clay loam, silty clay	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	39-50 -56	19-25-30
			55-60	Silt loam, silty clay loam	CH, CL	A-6, A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	100-100-100	95-98-100	37-51 -52	18-28-28
30080—Greenton silty clay loam, 5 to 9 percent slopes														
Greenton	90	C/D	0-12	Silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	88-98-100	86-96- 98	39-53 -56	19-26-28
			12-28	Silty clay loam, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	100-100-100	100-100-100	87-98-100	85-96-100	45-57 -63	25-33-37
			28-30	Silty clay, silty clay loam	CH, CL	A-7-6	0- 0- 0	0- 0- 0	100-100-100	95-96-100	87-95-100	84-93-100	49-57 -62	28-34-37
			30-79	Clay, gravelly silty clay, silty clay	CH	A-7-6	0- 0- 0	0- 0- 0	77-96-100	61-91-100	54-89-100	52-87- 98	49-61 -64	29-36-38