



DRAFT Preliminary Geotechnical Exploration Report

Alexandria Residential Development
10743 South Licking Pike
Alexandria, Kentucky 41011

Prepared for

Maronda Homes, LLC
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January 21, 2022

PSI Project No. 01111634



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January 21, 2022,

Mr. John Konovodoff
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Dublin, Ohio 43016

**Re: DRAFT Preliminary Geotechnical Exploration Report
Alexandria Residential Development**
10743 South Licking Pike
Alexandria, Kentucky 41011
PSI Project No. 01111634

Dear Mr. Konovodoff:

Thank you for choosing Professional Service Industries, Inc. (PSI), an Intertek company, as your consultant for the Alexandria Residential Development project. The information you requested is attached. PSI performed the preliminary geotechnical engineering study that you requested in general accordance with our agreement dated December 23, 2021. PSI transmits one copy with this letter.

We thank you for your business and we look forward to finding ways to grow our partnership, expand our services, and continue Building Better Together.

Respectfully submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.

Zackary V. Bishop
Staff Geologist

James R Swindler Jr., P.E.
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Paul S. Hundley, P.E.
Principle Consultant

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1 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

Table 1 summarizes, in chronological order, the Project Authorization History for the services performed and represented in this report by Professional Service Industries, Inc. (PSI).

TABLE 1 – PROJECT AUTHORIZATION HISTORY

DOCUMENT AND REFERENCE	DATE	REQUESTED/PROVIDED BY
Request for Proposal	December 17, 2021	Mr. Kevin A. Brett of LSSE Civil Engineers and Surveyors
PSI Proposal No.: 0111-361983	December 21, 2021	James Swindler and Paul Hundley of PSI, Inc.
Project Authorization	December 23, 2021	Mr. John Konovodoff of Maronda Homes, LLC

1.2 PROJECT DESCRIPTION

According to the provided documents and information, the project involves the design and construction of a new residential development located at 10743 South Licking Pike in Alexandria, Campbell County, Kentucky. PSI understands that the project includes 106 lots with associated asphalt paved roads and detention/retention basins. The project site is currently utilized as agricultural land with a two-story residential home located on the western side of the property adjacent to South Licking Pike. No loading or other structural information was provided at the time of this report.

Table 2 lists the material and information provided for this project.

TABLE 2 – DOCUMENTS PROVIDED BY LSSE CIVIL ENGINEERS AND SURVEYORS

DESCRIPTION OF MATERIAL	PROVIDER/SOURCE	DATE
Project Location Map	LSSE Civil Engineers and Surveyors	December 10, 2021
Concept Plan	LSSE Civil Engineers and Surveyors	December 2021

The geotechnical recommendations presented in this report are based on the available project information for the proposed project site and the subsurface materials described in this report. If any of the information noted in the project description is incorrect, please inform PSI in writing so that revisions to the recommendations presented in this report can be made, if necessary. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to explore the subsurface conditions at the site to prepare recommendations for foundations and residential roads for the proposed construction. PSI's contracted scope of services included drilling six soil test borings at the site to planned approximate depths of 20 feet below the existing ground surface, select laboratory testing, and preparation of this geotechnical report. This report briefly outlines the testing procedures, presents available project information, describes the site and subsurface conditions, and presents recommendations regarding the following:



- A general assessment of area geology based on our local knowledge and study of available geological literature
- General location and description of materials encountered in the borings which may interfere with construction progress or structure performance, including existing fills, cobbles/boulders, or organic soils
- Identification of water levels encountered at the time of drilling and recommendations for dewatering if required
- Fill including the selection of materials for use and procedures for placement
- Swell potential of surface soil based on the laboratory tests, and recommendations, if any, for potentially swelling soils
- Site preparation as needed for support of foundations, floor slabs, and pavements
- Foundation system evaluations and the assessment of the feasibility of utilizing shallow foundations
- Design parameters required for the foundation system, including allowable bearing pressure, minimum foundation width, foundation bearing levels, and estimated total and differential settlements
- Retaining wall drainage and construction requirements
- Lateral earth pressures for design including the retaining wall design coefficients for active, passive and "at rest" conditions
- Attachments including a boring location drawing, and boring logs

The scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on, below, or around this site. Any statements in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

PSI's scope also did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminants in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. Maronda Homes, LLC (Client) should be aware that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. The Client should also be aware that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or reoccurrence of mold amplification.



2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE LOCATION AND DESCRIPTION

The site for the proposed development is located near 10743 South Licking Pike in Alexandria, Campbell County, Kentucky. The site latitude and longitude are approximately 38.9071° N and 84.3901° W, respectively.

Based on historical aerial photography dating to 1985, the proposed site has been utilized as agricultural land and has seen no recognizable development. However, similar residential developments have been constructed in neighboring plots of land along the eastern side of Alexandria Pike to the immediate northeast of the project site. During our review of available historical aerial photography, construction of a neighboring residential development began and was completed sometime during 1993 and 2003. The project site is bordered on the western side by South Licking Pike and Alexandria Pike to the East. More agricultural land can be found to the north and south of the property.

No topographical map was provided to PSI at the time of this report. However, based on visual observation, the site slopes downward from southwest to northeast and maximum relief across the site is approximately 85 to 95 feet.

2.2 SITE GEOLOGY

The proposed site is in the Ancestral Licking River System. The Ancestral Licking River System is a well documented 303-mile-long tributary of the Ohio River in northeastern Kentucky. The river and its tributaries drain much of the region of northeastern Kentucky between the watersheds of the Kentucky River to the west and the Big Sandy River to the east and is composed largely of clay, silt, sand, and gravel.

The project site is underlain largely by pre-Illinoian lacustrine and fluvial deposits associated with the Ancestral Licking River System within the central and eastern portions of the project site at its lower elevations. These deposits can be described as containing clay, silt, sand, and gravel; light brownish-gray, yellowish-gray, and light brown, and in some areas containing abundant gravel.

In the western portions of the project site, where the topographically higher elevations occur, Ordovician-age shale and limestone formations belonging to the Kope Formation and the Fairview Formation are underlying the soils in these areas and make up approximately the western third of the property. The Kope Formation consists of 75 to 80 percent shale and 20 to 25 percent limestone, whereas the Fairview Formation contains 50 percent shale and 50 percent limestone.

2.3 KARST TOPOGRAPHY

This project site is located near “undefined karst potential” regions, encroaching from the west and east, per the Kentucky Geologic Survey (KGS) Map Service. This means that the region may be prone to solution activity within the soluble carbonate bedrock. Sinkhole development at this site may result from raveling or movement of soil fines from the soil overburden by infiltrating water flowing downward to the poor-quality bedrock media where the rock mass has partially dissolved in the geologic past creating solution channels, clay-filled joints, and voids. Thus, a sinkhole may consist of a relatively localized weathered feature or a larger feature resulting from a collapse within a void formed in the overburden during migration of the soil fines. Sinkhole activity could also be present along bedrock fracture zones or along geologic contacts.



Sinkholes may still occur in areas where there is no discernable surface expression. It is recommended that monitoring of the area be maintained for possible sinkhole activity during construction.

2.4 NATIONAL RESOURCES CONSERVATION SERVICE (NRCS) DESKTOP SOIL SURVEY

As a supplement to this Preliminary Geotechnical Exploration Report, a desktop survey was conducted using the National Resources Conservation Service (NRCS) United States Department of Agriculture website. This website contains a historical soil survey database collected over many years. The survey is limited to surface soils. The database identifies individual soils by map unit symbols and names. Each map unit is then further described by physical and chemical properties of the soil and rated in categories such as water table, drainage, suitability for roadway and building construction and other categories. The results of this Preliminary Geotechnical Exploration do correlate well with the NRCS Soil Report. The NRCS report indicates loamy soil types in the upper horizon whereas the soil types tested in this preliminary report were Sandy Lean Clays (CL) Clayey Sand (SC) soil types in accordance with the Unified Classification System. PSI recommends reading though the report for further information about the soil and water conditions on the site. The table below summarizes the findings for each Subcategory, Application, and Rating. The report is included in the Appendix for reference.

Soil Information Category	Category/Rating			
	Subcategory	Application	Rating	Rating Range
Suitabilities and Limitations	Building Site	Lawns and Landscaping	Very Limited	Very, Somewhat Limited
	Building Site	Corrosion of Concrete	Low	Low, Moderate
	Building Site	Corrosion of Steel	High	High
	Building Site	Dwellings w/ Basements	Very Limited	Very Limited
	Building Site	Shallow Excavations	Very Limited	Very Limited
	Building Site	Local Roads and Streets	Very Limited	Very Limited
	Sanitary Facilities	Septic Tank Adsorption Fields	Very Limited	Very Limited
Physical Property	Liquid Limit	% by Weight all layers	30.7-51.3	
	Plasticity Index	% by Weight all layers	10.5 - 29.5	
	Percent Clay	% by Weight all layers	24.6-43.6	
Soil Properties and Qualities	Representative Slope	Roadway Subgrade	1.0-25.0	
	Soil Slippage	Group Index	Low - High	Low, High
	AASHTO Group Class	Roadway Subgrade	A-4, A-6, A-7-6	A-4, A-6, A-7-6
	Unified Soil Class	Building Construction	CL, CL-ML	CL, CL-ML
	Subsidence	Building Construction	0	0, unrated

The presence of the Eden Silty Clay Loam, EdE2 (CL) are located in the southwest portion of the site (see NRCS soil map in Appendix) and may cause some difficulties for high slip potential. High slip potential soils should be limited to the amount of cutting and filling unless slope stability analysis is performed. The general soil types are highly plastic and exhibit high volume change with changes in water content. When high plasticity soils remain at the surface, a chemical stabilization treatment is beneficial to improve the soil support value for pavements and floor slabs and to reduce the potential volume changes that can occur with changes in water content.

2.5 SUBSURFACE CONDITIONS

The site subsurface conditions were explored with six soil test borings within the proposed development area on January 5, 2022. The test borings were terminated at approximate depths of 11 to 20 feet. The boring locations and planned depths were selected by PSI based on preliminary site plans provided by the client.



Approximate surface elevations obtained from Google Earth are shown on the boring logs in the Appendix. The actual surface elevations at the boring locations should be surveyed prior to construction activities.

The borings were advanced utilizing 3¼- inch inside diameter, hollow stem auger drilling methods. Soil samples were obtained at 2.5-foot intervals in the top 10 feet and at 5-foot intervals thereafter during the drilling process. Drilling, sampling, and laboratory testing were accomplished in general accordance with ASTM procedures. The laboratory test results are included in each boring log. A description of the classification system and the results of the laboratory tests are included in the Appendix.

At the time of the field exploration, the boring locations were covered with grass and small vegetation underlain by topsoil, which measured approximately 6 to 12 inches thick in the borings. Surface material thicknesses should be expected to vary across the site.

Beneath the topsoil, native cohesive and non-cohesive soil types were encountered, with non-cohesive soils predominantly in the upper horizons and cohesive soils predominantly in the lower soil horizons. The non-cohesive soils were present to an approximate depth of 3 to 14 feet and were as loose to medium dense, brown; moist, silty sands (SM) or clayey sands (SC) with varying amounts of black oxide staining, roots, rock fragments and gravel. In the lower soil horizon, cohesive soils were present at approximate depths of 3 to 20 feet and can be described as stiff to hard, shades of brown and/or gray; moist, sandy lean clay (CL). Sandy fat clay (CH) was present in boring B-02 at depths of 14 to 20 feet, which included varying amounts of roots, black oxide staining and limestone and shale rock fragments. Undocumented fill was not encountered in any boring locations; however, it should be noted that undocumented fill could be present in other areas across the project site that test borings were not drilled.

The preceding subsurface descriptions are of a generalized nature to highlight the major subsurface stratification features and material characteristics. The boring logs included in the Appendix should be reviewed for specific information at individual boring locations. These records include soil descriptions, stratifications, penetration resistances, and locations of the samples and laboratory test data. The stratifications shown on the boring logs represent the conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials and the actual transition may be gradual. Water level information obtained during field operations is also shown on these boring logs. The samples that were not altered by laboratory testing will be retained for 60 days from the date of this report and then will be discarded.

Table 3 briefly summarizes the range of results from the field and laboratory testing programs. The SPT N_{60} - values presented in the table are the measured blow counts normalized to a drill rig hammer energy transfer efficiency of 60 percent. The General Notes section included in the Appendix shows the correlation between SPT N values and the relative density and consistency of coarse-grained and fine-grained soils, respectively. Please refer to the attached boring logs and laboratory data sheets for more specific information.



TABLE 3 – SUMMARY OF SPT N₆₀ VALUES, MOISTURE CONTENT & GROUND WATER LEVELS

Top of Soil Sampling Depth (ft)	SPT N ₆₀ Values (blows/ft)							Top of Soil Sampling Depth (ft)	Moisture Content (%)						
	B-01	B-02	B-03	B-04	B-05	B-06	Average		B-01	B-02	B-03	B-04	B-05	B-06	Average
1.0	5	11	9	8	8	12	9	1.0	31	22	24	25	22	27	25
3.5	15	27	SSR	17	9	15	17	3.5	25	20	8	19	34	28	22
6.0	12	25	85	29	9	12	29	6.0	33	24	14	16	31	29	25
8.5	45	20	80	SSR	12	15	34	8.5	16	26	14	9	34	29	21
13.5	68	15		SSR	SSR	69	51	13.5	6	32		16	11	17	16
18.5	SSR	12			SSR	SSR	12	18.5	16	30			0	13	15
Groundwater Level Reading and Borehole Caving Depth (ft)															
Water Level Encountered While Drilling									NE	NE	NE	NE	NE	NE	
Water Level Encountered Upon Completion									NE	NE	NE	NE	NE	NE	
Caving Depth after Casing Withdrawal									NE	NE	NE	NE	NE	NE	

SRR - Split Spoon Refusal

NE - Not Encountered

High Moisture Content

2.6 WATER LEVEL MEASUREMENTS

Groundwater was not encountered in the borings during drilling activities or upon completion.

In fine-grained glacial soils, the depth of the soil color change from brown to gray can be an indicator of the prevailing groundwater level. Above the prevailing groundwater level, fine-grained soils oxidize to a brown color.

The groundwater level at the site, as well as perched water levels and volumes, will fluctuate based on variations in rainfall, snowmelt, evaporation, surface run-off and other related hydrogeologic factors. The water level measurements presented in this report are the levels that were measured at the time of PSI's field activities. Please refer to the preceding table for water level measurements at each boring.

2.7 LABORATORY TEST RESULTS

2.7.1 SOIL CLASSIFICATION

Laboratory testing was performed on representative split-spoon samples obtained during drilling. Moisture content tests and visual engineering classification were conducted on the soil samples. Classification testing, including Atterberg limits and grain size analysis (#200 washed sieve), was conducted on samples representing



four different soil stratifications. The classification test results in accordance with the Unified Soil Classification System (USCS) are summarized in Table 4.

TABLE 4 – SUMMARY OF LABORATORY INDEX TEST RESULTS

Sample Location	Sample Depth (ft)	Moisture Content (%)	Atterberg Limits			Percent Fineness	USCS Soil Classification
			LL	PL	PI		
B-01	1.0-2.5	31	40	33	7	49.9	Silty Sand (SM)
B-03	8.5-10.0	14	44	24	20	68.3	Sandy Lean Clay (CL)
B-04	3.5-5.0	19	56	32	24	46.2	Silty Sand with Gravel (SM)
B-06	6.0-7.5	29	59	24	35	25.1	Clayey Sand (SC)

2.7.2 CALIFORNIA BEARING RATIO

Standard Proctor and California Bearing Ratio (CBR) testing was performed on a bulk sample obtained within a depth of 2 to 3 feet below the existing grade between borings B-02 and B-03 in the planned pavement area. The laboratory test results are pending. This report will be updated when the testing is completed.



3 GEOTECHNICAL EVALUATION

3.1 GEOTECHNICAL DISCUSSION

There are six primary geotechnical-related concerns at this site which can affect the performance of the foundations and pavements of this project. The following summarizes these concerns:

- Aeration and drying of some of the wetter on-site soils may be required during site grading and compacting operations. Reducing the moisture content of the clay soils may be necessary to achieve proper compaction and establish stable subgrade conditions. Depending on the time of year for the construction, chemical stabilization may be required.
- High plasticity “fat” clay material was encountered in boring B-02 at an approximate depth of 14 to 20 feet below existing grade. High plasticity clay has a high shrink/swell potential under fluctuating moisture conditions. In the areas where the foundations and floor slabs are to be located, a minimum of 24 inches of non-expansive material is recommended between the proposed slab-on-grade or foundations and expansive material. In the areas of pavement, a minimum of 12 inches of non-expansive material is recommended between the pavement section and the expansive material. Alternatively, fly ash or lime stabilizing the subgrade is an acceptable method to reduce the shrink/swell potential.
- Weathered shale bedrock was encountered within in one of the borings at auger refusal. It is not clear if the elevation of the weathered shale bedrock will be within 5 feet of the anticipated finished floor elevations of the structures. The expansion potential of the shale may be mitigated by reducing the oxidation and wetting potential by sealing to prevent contact with air and water with an impervious layer. If foundation or floor slab excavations will extend into the shale material, the exposed surface must be coated in bitumen and a clay cap must be placed on the same day the shale surface is cut. The backfill material should be placed as outlined in the Site Preparation section of this report. Clay caps should be protected against desiccation. Sidewalls of excavations are also potential exposure surfaces and should also be sealed. Foundation concrete should be placed on the day of excavation and should be placed “neat” against excavations in the shale.
- There are existing structures located across the site. At the time of this report, it was unknown to PSI if the proposed structures will overlay the existing building footprints. Old foundations, septic systems, basements, and other items may be encountered during the construction process. Prior to construction activities, all foundations, underground structures, and building materials from the previous/existing buildings should be removed from the site. All excavations created during the demolition process should be backfilled with compacted and tested structural fill or flowable fill. A representative of the Geotechnical Engineer of Record should be on site to review the underlying material to determine if it is suitable for the planned construction.
- Although not encountered during this geotechnical exploration, construction activities on the adjacent properties may have resulted in the placement of undocumented fill in the vicinity of the site. Any undocumented fill encountered during construction activities should be removed to stiff native soil. The undocumented fill material may be suitable for use as structural fill pending approval from the Geotechnical Engineer or their representative.
- During the site reconnaissance visit, PSI observed that the site was partially covered by brush and mature trees. Care should be taken when removing the root systems of the trees in the proposed structures and pavement areas. These root systems should be removed entirely from the building areas to prevent settlement over time from the decay of the organic material. All excavations created to remove the trees should be backfilled with compacted and tested structural fill material as outlined in the Site Preparation section of this report.



3.2 MODERATE/HIGH PLASTICITY CLAY

High plasticity “fat” clays are present in the project area that may expand and shrink, thereby possibly impacting the proposed construction. In severe cases, movement and distress to footings and foundation walls can occur. It is PSI’s opinion that the fat clay should be removed within a depth of 24 inches of foundations or slabs and within 12 inches of pavements. The removed material should be replaced with compacted and tested low plasticity structural fill. The building foundations could then be designed to bear upon the structural fill.

3.3 EXISTING/PREVIOUS STRUCTURES AND UNDOCUMENTED FILL

Structures are/have been located on the site based on the site reconnaissance and historical aerial photos. It is unknown if the previous foundations have been removed. If encountered, the previous foundations should be removed in their entirety and the excavation backfilled with compacted and tested structural fill. Considering construction has occurred nearby the site, it is possible that areas of additional fill and/or buried construction debris deposits that were not identified by the boring program could be encountered at this site. The presence of undocumented fill introduces a design and construction risk due to the potential for excessive and/or non-uniform settlement. To reduce the settlement risk, PSI recommends that any undocumented fill encountered be removed from the structure areas and replaced with structural fill. Structural fill should meet the requirements and be prepared as recommended in the Site Preparation section of this report.

3.4 SOIL COMPACTION

Since this site contains fine and coarse-grained soils, it may become difficult to achieve the desired compaction of the soils due to high moisture contents. The soils may need to be scarified and dried to a moisture content that will facilitate compaction in accordance with the structural fill requirements of this report. Lime, kiln dust, or fly ash (or an engineered combination thereof) modification may be necessary to expedite the work and achieve the required level of soil compaction.



4 GEOTECHNICAL RECOMMENDATIONS

The following geotechnical related recommendations have been developed based on the subsurface conditions encountered and PSI's understanding of the proposed development. Should changes in the project criteria occur, a review must be made by PSI to determine if modifications to our recommendations will be required.

4.1 SITE PREPARATION

PSI recommends that asphalt, concrete, topsoil, vegetation, roots, soft, organic, frozen, or unsuitable soils in the construction areas be stripped from the site and either wasted or stockpiled for later use in non-structural areas. In addition, all foundations and slabs from previous/existing structures should be completely removed within the proposed building footprints and within 24 inches of proposed pavements. A representative of the geotechnical engineer should determine and document the depth of removal at the time of construction.

In this region, these otherwise competent clay-type soils can undergo a significant loss of stability when construction activities are performed during wetter portions of the year. PSI anticipates that the soils in the project area can become easily disturbed if subjected to conventional rubber tire or narrow track-type equipment. Soils that become disturbed would need to be excavated and replaced; however, this remedial excavation may expose progressively wetter soils with depth, thus compounding the problem condition. Thus, a normal approach to subgrade preparation may not be possible. Appropriate wide-track equipment selection should aid in minimizing potential disturbance.

After stripping to the proposed subgrade level, as required, the building areas should be proof rolled with a loaded tandem-axle dump truck or similar heavy rubber-tired vehicle, typically with an axial load greater than nine tons. Soils that are observed to rut or deflect excessively (typically greater than one inch) under the moving load should be undercut and replaced with properly compacted, tested, and documented low plasticity fill material. The proof rolling and undercutting activities should be witnessed by a representative of the geotechnical engineer and should be performed during a period of dry weather. If the earthwork activities take place during wet seasons, lime stabilization of the subgrade soils may be required prior to engineered fill placement. Care should be taken during construction activities not to allow excessive drying or wetting of exposed soils. The subgrade soils should be scarified and compacted to at least 98 percent of the material's standard Proctor maximum dry density, in general accordance with ASTM procedures, to a depth of at least 12 inches below the surface. New fill for building structures, asphalt, and concrete should not be placed on frozen ground.

Highly plastic fat clays should be removed where they occur within a depth of 24 inches beneath proposed slabs, foundations, or lightly loaded structural features and 12 inches beneath proposed pavements. The removed material should then be replaced with a low plasticity compacted and tested structural fill. Alternatively, class "C" fly ash or lime-treatment of the high plastic clay can be performed to reduce the plasticity index, improve workability, promote drying, and reduce shrink/swell potential. A representative of PSI's geotechnical engineer should observe the subgrade soils, perform plasticity index tests, and estimate the approximate extent of the exposed fat clays. If it is desirable to modify the fat clays with a commercially available class "C" fly ash or lime product, PSI recommends that actual application amounts be set by conducting a laboratory class "C" fly ash or lime series test. The geotechnical engineer's representative should observe the remediation procedures for compliance with the project plans and specifications.



After subgrade preparation and observation have been completed, fill placement required to establish grade may begin. Low-plasticity structural fill materials placed beneath the lightly loaded structural features or slabs should be free of organic or other deleterious materials and have a maximum particle size of three inches. Low-plasticity soils for this site are defined as having a liquid limit less than forty-five and plasticity index between ten and twenty. A representative of PSI should be on-site to observe, test, and document the placement of the fill. If the fill is too dry, water should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Close moisture content control will be required to achieve the recommended degree of compaction. Modification of the soils using admixtures such as lime, fly ash, kiln dust or cement may be necessary if wet or cool season earthwork is necessary.

Fill should be placed in maximum loose lifts of eight inches and compacted to at least 98 percent of the material's standard Proctor maximum dry density, and within a range of the optimum moisture content as designated in Table 5, as determined in general accordance with ASTM procedures. Each lift of compacted-engineered fill should be tested and documented by a representative of the geotechnical engineer prior to placement of subsequent lifts. The edges of compacted fill should extend a minimum of five (5) feet beyond the building footprint, or a distance equal to the depth of fill beneath the footings, whichever is greater. The measurement should be taken from the outside edge of the footing to the toe of the excavation prior to sloping.

Granular engineered fill should be placed as backfill in the areas where large compaction equipment cannot be used, (i.e., utility trenches, shallow foundation excavations, etc.). PSI recommends the use of material meeting the requirements of Kentucky Transportation Cabinet (KYTC) Item #302, Dense Graded Aggregate (DGA), for use as granular engineered fill. Engineered fill should be placed in accordance with the recommendations stated in this section of the report. It may be more cost effective to backfill the trenches with flowable fill.

The fill placed should be tested and documented by a geotechnical technician and directed by a Geotechnical Engineer to evaluate the placement of fill material. It should be noted that the Geotechnical Engineer of record can only certify the testing that is performed, and the work observed by that engineer or by staff in direct report to that engineer. The fill should be evaluated in accordance with Table 5.

Trench backfills that may contain shale and/or limestone must adhere to Appendix B "Geotechnical Exploration and Earthwork Construction Requirements", provided by the Campbell County, Kentucky guidelines for Geotechnical Explorations Outside of Right-of-Way and Within Right-of-Way in the appendix of this geotechnical investigation report.

Tested fill materials that do not achieve either the required dry density or moisture content range shall be recorded, the location noted, and reported to the Contractor and Owner. A re-test of that area should be performed after the Contractor performs remedial measures.



TABLE 5 – MOISTURE DENSITY PARAMETERS

MATERIAL TESTED	PROCTOR TYPE	MINIMUM % DRY DENSITY	PLACEMENT MOISTURE CONTENT % RANGE	FREQUENCY OF TESTING
Structural Lean Clay Fill (Cohesive)	Standard	98	-1 to +3	1 per 5,000 ft ² of fill placed / lift
Structural Fill (Granular)	Standard	98	-2 to +2	1 per 5,000 ft ² of fill placed / lift
Random Fill (non-load bearing)	Standard	90	-3 to +3	1 per 6,000 ft ² of fill placed / lift
Utility Trench Backfill	Standard	95	-1 to +3	1 per 150 lineal foot / lift

Relative Density as determined in general accordance with ASTM D4253 and D4254. Minimum 2 tests per lift.

4.2 FOUNDATION RECOMMENDATIONS

It is PSI's opinion that the planned construction can be supported on conventional spread-type footing foundations bearing on the naturally occurring lean clay or on properly compacted, tested, and documented low plasticity structural fill. Spread footings for building columns and continuous footings for bearing walls can be designed for net allowable soil bearing pressures of 2,000 pounds per square foot (psf) when supported by the native soils or compacted and tested structural fill as outlined in this report. These values are based on assumed dead load plus design live load and contain a safety factor of 3. If it is desired for the planned foundations to bear on properly compacted, tested, and documented fill, the geotechnical engineer should be allowed to review the material to determine its consistency with the recommended bearing pressures. PSI recommends a minimum dimension of 24 inches for square footings and 16 inches for continuous footings to reduce the possibility of a local bearing capacity failure.

Exterior footings and footings in unheated areas should be located at a depth of 32 inches or deeper below the final exterior grade to provide adequate frost protection. If the buildings are to be constructed during the winter months or if footings will likely be subjected to freezing temperatures after foundation construction, then the footings should be protected from freezing. PSI recommends that interior footings be a minimum depth of eighteen inches below the finished floor elevation.

The foundation excavations should be observed and documented by a representative of PSI prior to steel or concrete placement to determine that the foundation materials are consistent with the materials discussed in this report, and therefore can support the design loads. Soft or loose soil zones encountered at the bottom of the footing excavations should be removed to the level of suitable natural soils and replaced with adequately compacted structural fill. Fill placed below the foundations where unsuitable materials are removed should extend one foot outside the limits for every one foot in thickness between the intended bearing surface and the underlying, suitable natural soils. Cavities formed because of excavation of soft or loose soil zones should be backfilled with lean concrete or dense graded compacted crushed stone.

After opening, footing excavations should be observed, and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond on or adjacent to the excavation. If possible, the foundation concrete



should be placed during the same day the excavation is made. If it is required that footing excavations remain open for more than one day, then they should be protected to reduce evaporation or entry of moisture.

Based on the known subsurface conditions and site geology, laboratory testing and experience, PSI anticipates that properly designed and constructed footings supported on the recommended materials should experience total and differential settlement between adjacent columns of less than one inch and $\frac{3}{4}$ inch, respectively.

4.3 EARTHQUAKE AND SEISMIC DESIGN CONSIDERATION

Please note that the project site is located within a municipality that employs the 2018 Kentucky Building Code, Second Edition. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site.

Part of the 2018 Kentucky Building Code seismic procedure references the International Building Code, 2015 Edition, to evaluate seismic forces and requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface.

To define the Seismic Site Class for this project, and as proposed, PSI has interpreted the results of our soil test borings drilled within the project site and estimated appropriate soil properties below the base of the borings to a depth of 100 feet. The estimated soil properties were based upon borings drilled on this site, data available in published geologic reports and the Kentucky Geological Survey's water well data base, as well as our experience with subsurface conditions in the general site area.

Based on the depth to rock and the estimated shear strength of cohesive soil /standard penetration test values of granular soil at the boring locations, Site Class "D" is recommended. The USGS-NEHRP probabilistic ground motion values near latitude 38.9071 ° N and longitude -84.3901 ° W are presented in Table 6. These values were determined by accessing the Structural Engineers Association of California Office of Statewide Health Planning and Development website Seismic Design Maps to determine site coefficients and parameters for seismic design. The use of this tool requires the input of the building "Risk Category". For estimating purposes, PSI has used Risk Category II. The structural engineer should determine the actual Risk Category and make changes to the seismic design coefficients and parameters as appropriate.

TABLE 6 – SEISMIC PARAMETERS

PERIOD (seconds)	2% PROBABILITY OF EVENT IN 50 YEARS (g%)	SITE COEFFICIENTS	MAX. SPECTRAL ACCELERATION PARAMETERS	DESIGN SPECTRAL ACCELERATION PARAMETERS	
0.2 (S_s)	15.3	$F_a = 1.6$	$S_{MS} = 0.244$	$S_{DS} = 0.163$	$T_0 = 0.156$
1.0 (S_1)	0.08	$F_v = 2.4$	$S_{M1} = 0.192$	$S_{D1} = 0.128$	$T_s = 0.784$

4.4 FLOOR SLAB RECOMMENDATIONS

It is PSI's opinion that the floor slabs can be grade supported on properly compacted, tested and documented low plasticity structural fill or on native stiff or better undisturbed lean clay. Proof rolling, as discussed earlier in this report, should be accomplished to identify soft or unstable soils that should be removed from the floor slab



areas prior to fill placement and/or floor slab construction. These soils should be replaced with properly compacted structural fill as described earlier in this report.

PSI recommends that a minimum four-inch thick compactible, trimmable granular mat be placed beneath the floor slab to enhance drainage. This material should conform to KYTC #302 Dense Graded Aggregate (DGA) specifications. The soil surface shall be graded to drain away from the building without low spots that can trap water prior to placing the granular drainage layer. Polyethylene sheeting should be placed to act as a vapor retarder where the floor will be in contact with moisture sensitive equipment or products such as tile, wood, carpet, etc., as directed by the design engineer. The decision to locate the vapor retarder in direct contact with the slab or beneath the layer of granular fill should be made by the design engineer after considering the moisture sensitivity of subsequent floor finishes, anticipated project conditions, and the potential effects of slab curling and cracking. The floor slabs should have an adequate number of joints to reduce cracking resulting from differential movement and shrinkage.

For subgrade prepared as recommended and properly compacted fill, a modulus of subgrade reaction, k value, of 120 pounds per cubic inch (pci) may be used in the grade slab design based on correlation to values typically resulting from a 1 ft. x 1 ft. plate load test. However, depending on how the slab load is applied, the value should be geometrically modified. The value should be adjusted for larger areas using the following expression for cohesive and cohesionless soil:

Modulus of Subgrade Reaction, $k_s = \left(\frac{k}{B}\right)$ for cohesive soil and $k_s = k * \left(\frac{B+1}{2B}\right)^2$ for cohesionless soil

where: k_s = coefficient of vertical subgrade reaction for loaded area,

k = coefficient of vertical subgrade reaction for 1 square foot area, and

B = effective width of area loaded, in feet

The precautions listed below should be followed for construction of slab-on-grade pads. These details will not reduce the amount of movement but are intended to reduce potential damage should some settlement of the supporting subgrade take place. Some increase in moisture content is inevitable because of development and associated landscaping. However, extreme moisture content increases can be largely controlled by proper and responsible site drainage, building maintenance and irrigation practices.

- Cracking of slab-on-grade concrete is normal and should be expected. Cracking can occur not only because of heaving or compression of the supporting soil and/or bedrock material, but also because of concrete curing stresses. The occurrence of concrete shrinkage crack, and problems associated with concrete curing may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement, finishing, and curing, and by the placement of crack control joints at frequent intervals, particularly where re-entrant slab corners occur. The American Concrete Institute (ACI) recommends a maximum panel size (in feet) equal to approximately three times the thickness of the slab (in inches) in both directions. For example, joints are recommended at a maximum spacing of twelve feet based on having a four-inch slab. PSI also recommends that the slab be independent of the foundation walls. Using fiber reinforcement in the concrete can also control shrinkage cracking.
- Areas supporting slabs should be properly moisture conditioned and compacted. Backfill in all interior and exterior water and sewer line trenches should be carefully compacted to reduce the shear stress in the concrete extending over these areas.

Exterior slabs should be isolated from the building. These slabs should be reinforced to function as independent units. Movement of these slabs should not be transmitted to the building foundation or superstructure.



4.5 BELOW-GRADE RETAINING WALLS

Below-grade retaining walls were not indicated on the plan provided for our use, however retaining walls should be designed to resist lateral earth pressures. Lateral earth pressure is developed from the soils present within a wedge formed by the vertical below-grade retaining wall and an imaginary line extending up and away from the bottom of the wall at an approximate 45° angle. The lateral earth pressures are determined by multiplying the vertical applied pressure by the appropriate lateral earth pressure coefficient K. If the walls are rigidly attached to the structure and not free to rotate or deflect at the top, PSI recommends designing the walls for the “at-rest” lateral earth pressure condition using K_0 . Walls that are permitted to rotate and deflect at the top can be designed for the active lateral earth pressure condition using K_a . Passive pressure can be determined using K_p , with a factor of safety of 2.0. Recommended parameters for use in below grade walls are summarized in Table 7.

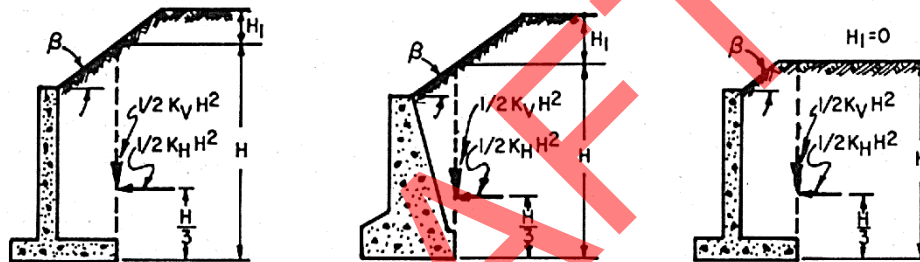
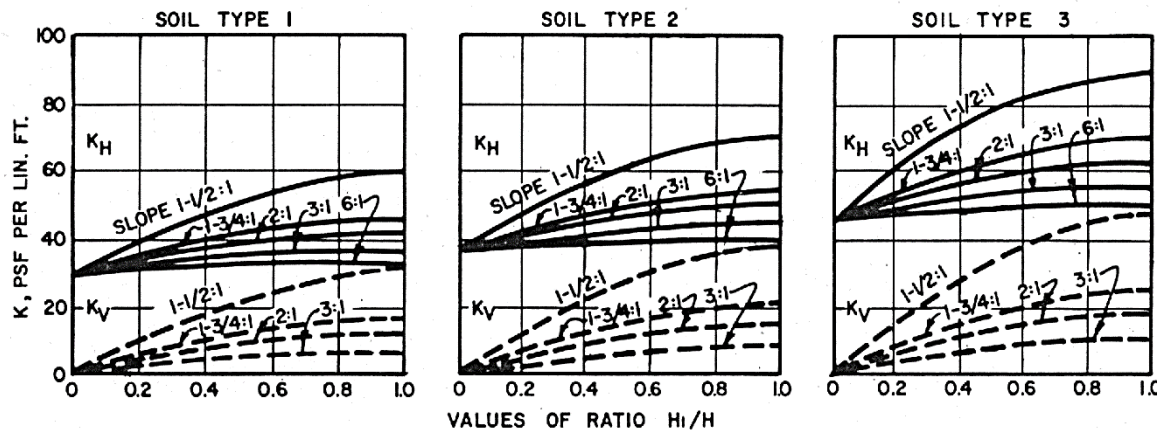
TABLE 7 – RECOMMENDED PARAMETERS FOR USE IN BELOW-GRADE (RETAINING, BASEMENT) WALL DESIGN

Material Type	Drained Friction Angle (ϕ')		Total Unit Weight (PCF)
1) Lean Clay (in-situ)	22°		120
2) Lean Clay (conditioned and compacted)	24°		130
3) Granular Soils (clean crushed limestone)	36°		143
Groundwater Elevation	At bottom of the wall		At bottom of the wall
Parameters Specific to Soil Type	1	2	3
Friction Factor for Base, μ	0.20	0.23	0.36
Coefficient of Active Pressure (K_a) *	0.45	0.42	0.26
Coefficient of Passive Pressure (K_p) *	2.20	2.37	3.85
Coefficient of At-Rest Pressure (K_0) *	0.63	0.59	0.41

* Earth pressure coefficients valid for level backfill conditions with no surcharge.

The values presented in the preceding table were calculated based on positive foundation drainage being provided to prevent the buildup of hydrostatic pressure. If surface loads are placed near the walls, such as foundation or traffic loads, they should be designed to resist an additional uniform lateral load of one-half of the vertical surface loads. An “equivalent fluid” pressure can be obtained from the preceding chart by multiplying the appropriate K-factor times the total unit weight of the soil. This applies to unsaturated conditions only. If a saturated “equivalent fluid” pressure is needed, the effective unit weight (total unit weight minus unit weight of water) should be multiplied times the appropriate K-factor and the unit weight of water added to that resultant. However, PSI does not recommend that earth retaining walls be designed with a hydrostatic load and that drainage should be provided to relieve the pressure.

The design of below grade walls should include the effects of geometry and loading conditions. Figure 1 consists of charts from NAVFAC 7.02 concerning slopes in the grade at the top of below grade wall. Depending on the geometry of the site, the lateral loading on the below grade wall should be modified according to these charts.



Soil Type 1 – Clean Sand and Gravel, GW, GP, SW, SP
Soil Type 2 – Dirty Sand and Gravel of Restricted Permeability, GM, GM-GP, SM-SP, SM
Soil Type 3 – Stiff Residual Silts and Clays, Silty Fine Sands, Clayey Sands and Gravels: CL, ML, CH, MH, SM, SC, GC

FIGURE 1 – SLOPES AT THE TOP OF BELOW-GRADE WALLS

4.5.1 RETAINING WALL FOUNDATION

It is PSI's opinion that planned retaining walls can be supported on spread-type footing foundations bearing on **properly placed, compacted and tested low plasticity structural fill**. The geotechnical engineer should be allowed to review the fill material to verify its consistency with the recommended bearing pressures. Continuous footings for retaining walls can be designed for an allowable soil bearing pressure of 2,000 pounds per square foot (psf) when used for the building structure. If it is determined that a retaining wall structure will be utilized for applications outside of the building structure, PSI should be notified to evaluate the soil conditions in the proposed retaining wall area to determine the applicable allowable soil bearing pressure.

If it is desired to extend the footings through the native soils to bear on the gray shale bedrock, PSI recommends that the shale be over excavated by approximately 2 feet, the exposed shale surface coated in bitumen and capped with clay. The foundations could then bear directly on the clay cap. PSI estimates a net allowable soil bearing pressure of 4,000 psf for continuous footings bearing on the sealed and capped shale bedrock as outlined above, if the backfill material meets the material properties used in the analysis. Samples of the material must be provided well in advance of construction to allow testing to be performed to confirm the values.

The foundation excavations should be observed and documented by a representative of PSI prior to steel or concrete placement to assess that the foundation materials are consistent with the materials discussed in this report. Soft or loose soil zones encountered at the bottom of the footing excavations, should be removed to the level of suitable



natural soils, and replaced with adequately compacted and tested structural fill. Fill placed below the foundations where unsuitable materials are removed should extend 1 foot outside the limits for every 1 foot in thickness between the intended bearing surface and the underlying, suitable natural soils.

After opening, footing excavations should be observed, and concrete placed as quickly as possible to avoid exposure of the footing bottoms to wetting and drying. Surface run-off water should be drained away from the excavations and not be allowed to pond. If possible, the foundation concrete should be placed during the same day the excavation is made. If it is required that footing excavations be left open for more than one day, they should be protected to reduce evaporation or entry of moisture.

4.5.2 BELOW-GRADE RETAINING WALL BACK-DRAIN

PSI recommends that the retaining wall be adequately water-proofed and be provided with a wall back-drain system. One possible drainage system is shown in Figure 2 and would include:

1. A four- or six-inch diameter perforated drain tile at the bottom of the backfill properly sized to collect seepage water with the tile connected to a suitable means of disposal.
2. Clean washed, half-inch or one-inch gravel classified as "GP" surrounding the drain tile and placed within twelve inches of the wall.
3. Non-woven four ounce per square yard geotextile between the drainage material and the on-site soils or backfill to prevent infiltration of fine-grained soils into the drain tile, granular drainage blanket, or granular backfill.

As an alternative, a geocomposite drain material can be placed between the retaining wall and the backfill soils. Underdrains, sub-drains and underslab drains presented in this report will not prevent moisture vapor that can cause mold growth.

The placement of a limited amount of granular material behind a below-grade wall does not appreciably change the coefficient of lateral earth pressure acting on that wall. The lateral earth pressure acting on a below-grade structure is a function of the weight of the soil that exists above the theoretical plane projecting up from the base of the wall. The soil above this plane is held in place by two forces, the strength of the soil itself and the lateral resistance of the below-grade wall. Therefore, a thin layer of granular material behind the wall is of little consequence on the forces acting on the wall.

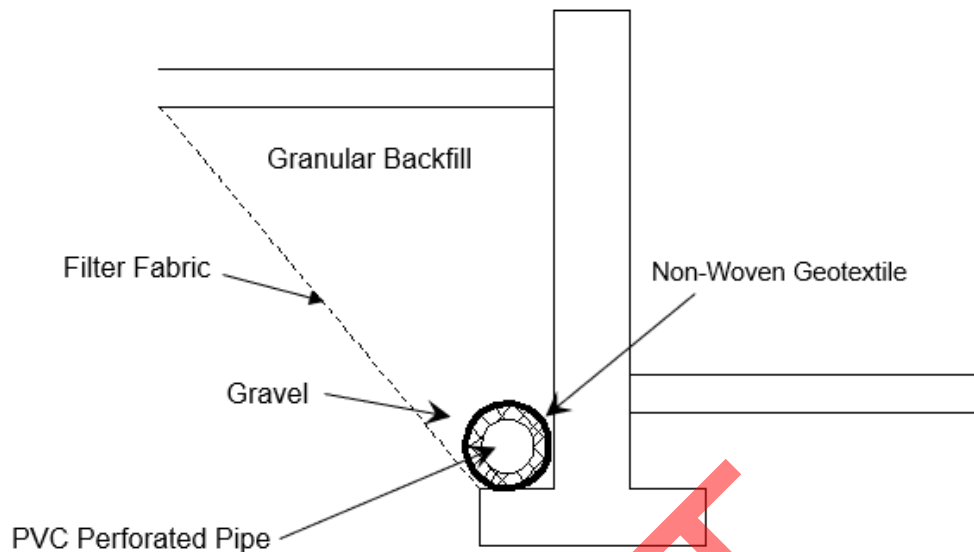


FIGURE 2 – BELOW-GRADE WALL BACKDRAIN

4.5.3 BELOW-GRADE RETAINING WALL BACKFILL AND COMPACTION

Backfill of the proposed retaining walls may consist of low plastic soils or granular material. PSI suggests using granular material to provide improved drainage and to reduce lateral pressures on the walls resulting from water pressure. The backfill materials should be placed in lifts that do not exceed eight inches in loose thickness. The lift thickness may need to be reduced immediately behind the walls to achieve the desired amount of compaction without overstressing the wall with the compaction process.

Backfill should be placed in thin lifts and mechanically compacted to at least 98 percent of the materials' maximum dry density and within 2 percent of the optimum water content as determined by the standard Proctor test. PSI advises performing field density tests on the backfill to monitor compliance with the recommendations provided. Care should be exercised during the backfilling operation to prevent overstressing and damaging the walls.

4.6 DETENTION BASINS

The planned detention basins should be excavated below grade following the excavation and slope recommendation portions of this report. If an earthen embankment or berm is constructed to provide additional freeboard, the fill should be placed and compacted in accordance with the structural fill portions of this report. The berm or embankment crest width should be a minimum of 10 feet wide. If the height of the berm or embankment is greater than 5 feet above original ground, the embankment may have to be evaluated in accordance with the Kentucky Energy and Environment Cabinet Dam Safety regulations.

Where detention basins are excavated to a depth that intersects a more permeable layer or a rock interface, it may be required to line the pond with an impermeable layer. The impermeable layer can be a geosynthetic or constructed of natural material. Considering the basin is for detention, the liner should consist of a two-foot impervious clay layer. The top two feet of native clays should be scarified and compacted to a minimum 98 percent of the ASTM D-698 maximum dry density within 0 to plus 3 percentage points of optimum moisture content.

If natural low permeable materials are not available, the following amendment method can be used. Typically, a relatively impermeable layer (less than 1×10^{-7} cm/sec permeability) is necessary to maintain a stable pond or



to detain the water for an appreciable period of time. PSI recommends that permeable sand and silt layers be covered with a geosynthetic membrane or a minimum of 12 inches of properly compacted material that has a permeability of less than 1×10^{-7} cm/sec. Where the slope or basin is exposed to a water surface or fluctuating water surface, PSI recommends at least 12 inches of vegetative supporting soils that will both support a grass growth for erosion protection and provide protection for the impermeable layer from mud cracking and drying out. Where the sustained pool of water exceeds 10 feet of water, the impermeable layer should be increased by 0.1 feet for each foot of sustained pool elevation. PSI recommends that the impermeable layer be increased by 50 percent at the intersection of the slopes with the bottom of the basin, at the location of penetrations into the basin, and over predominate geologic features such as fracture planes, joints, and other discontinuities.

4.7 UTILITIES TRENCHING

Excavation for utility trenches shall be performed in accordance with OSHA regulations as stated in 29 CFR Part 1926. It should be noted that utility trench excavations have the potential to degrade the properties of the adjacent fill materials. Utility trench walls that can move laterally can lead to reduced bearing capacity and increased settlement of adjacent structural elements and overlying slabs.

Backfill for utility trenches is as important as the original subgrade preparation or structural fill placed to support either a foundation or slab. Therefore, it is imperative that the backfill for utility trenches be placed to meet the project specifications for the structural fill of this project. PSI recommends that flowable fill or lean mix concrete be utilized for utility trench backfill. If on-site soils are placed as trench backfill, the backfill for the utility trenches should be placed in four- to six-inch loose lifts and compacted to a minimum of 95 percent of the maximum dry density achieved by the standard Proctor test. The backfill soil should be moisture conditioned to be within 2 percent of the optimum moisture content as determined by the standard Proctor test. Up to four inches of bedding material placed directly under the pipes or conduits placed in the utility trench can be compacted to the 95 percent compaction criteria with respect to the standard Proctor. Compaction testing should be performed for every 200 cubic yards of backfill place or each lift within 200 linear feet of trench, whichever is less. Backfill of utility trenches should not be performed with water standing in the trench.

Trench backfills that may contain shale and/or limestone must adhere to Appendix B "Geotechnical Exploration and Earthwork Construction Requirements", provided by the Campbell County, Kentucky guidelines for Geotechnical Explorations Outside of Right-of-Way and Within Right-of-Way in the appendix of this geotechnical investigation report.

4.8 SILTATION CONTROL

The Clean Water Act, implemented in 1990, includes a federal permit program called the National Pollutant Discharge Elimination System (NPDES). This program requires that projects sites more than one acre or are part of a development which exceeds one acre be covered under a permit. This typically includes the development of a storm water pollution prevention plan (SWPPP) as well as periodic inspections (typically once a week plus after significant rainfall). PSI is available to assist with these services.

4.9 PAVEMENT DESIGN RECOMMENDATIONS

PSI's scope of services included performing subgrade sampling and CBR testing of the existing subgrade to determine its suitability for supporting residential traffic loads. The CBR testing has not been completed and this report will be updated when those results have been received.



4.9.1 PAVEMENT SUBGRADE PREPARATION

Pavement design will include proper preparation of subgrade sectors, careful design of the pavement area drainage systems and utilization of an aggregate base course with asphalt concrete or concrete surface course. Preparation of pavement subgrades should be in accordance with recommendations outlined in the Site Preparation and Engineered Fill sections of the report. Please note that compaction of the upper twelve inches of the subgrade to 98 percent of the Maximum Dry Density obtained in accordance with ASTM D-698 is recommended in the parking lot pavement area to increase the subgrade strength. Granular engineered fill is recommended in these areas if fill is planned. Careful attention will be required in fine grading the subgrade surfaces to eliminate undulations and depressions that would tend to collect water.

The edges of compacted fill should extend a minimum two feet beyond the edges of the pavement, or a distance equal to the depth of fill beneath the pavement, whichever is greater. The measurement should be taken from the outside edge of the pavement to the toe of the excavation prior to sloping. If preparation is conducted during cool, wet seasons, geogrid and aggregate materials may be required to stabilize the subgrade.

PSI recommends that the exposed surface be proof rolled, and any soft areas removed. Compaction of fill materials intended to support pavement should meet or exceed 98 percent of the maximum dry density as determined by ASTM D698 (Standard Proctor). The moisture content at the time of compaction should be within 3 percent of the optimum value. Any removed soils should be replaced with compacted structural fill to arrive at the desired grade.

4.9.2 PAVEMENT DRAINAGE & MAINTENANCE

PSI recommends pavements to be sloped to provide rapid surface drainage. Water allowed to pond on or adjacent to the pavement could saturate the subgrade and cause premature deterioration of the pavements, and removal and replacement may be required. **It must be emphasized that if water can pond beneath or adjacent to the pavement, then freeze-thaw cycles will cause subsequent heaving of the pavement section (and ultimately failure).** Consideration should be given to the use of interceptor drains to collect and remove water collecting in the granular base. The interceptor drains could be incorporated with the storm drains of other utilities located in the pavement areas.

Periodic maintenance of the pavement should be anticipated. This should include sealing of cracks and joints and by maintaining proper surface drainage to avoid ponding of water on or near the pavement areas. Underdrains, sub-drains and underslab drains presented in this report will not prevent moisture vapor that can cause mold growth.



5 CONSTRUCTION CONSIDERATIONS

PSI should be retained to provide observation and testing of construction activities involved in the foundation, earthwork, and related activities of this project. PSI cannot accept responsibility for conditions that deviate from those described in this report, nor for the performance of the foundation system if not engaged to also provide construction observation and testing for this project.

5.1 MOISTURE SENSITIVE SOILS/WEATHER RELATED CONCERNS

The upper fine-grained soils encountered at this site will be sensitive to disturbances caused by construction traffic and to changes in moisture content. During wet weather periods, increases in the moisture content of the soil can cause significant reduction in the soil strength and support capabilities. In addition, soils that become wet may be slow to dry and thus significantly retard the progress of grading and compaction activities. It will, therefore, be advantageous to perform earthwork and foundation construction activities during dry weather.

5.2 DRAINAGE AND GROUNDWATER CONSIDERATIONS

PSI recommends that the Contractor determine the actual groundwater levels at the site at the time of the construction activities to assess the impact groundwater may have on construction. Water should not be allowed to collect in the foundation excavation, on floor slab areas, or on prepared subgrades of the construction area either during or after construction. Undercut or excavated areas should be sloped toward one corner to facilitate removal of collected rainwater, groundwater, or surface runoff. Positive site drainage should be provided to reduce infiltration of surface water around the perimeter of the building and beneath the floor slabs. The grades should be sloped away from the building and surface drainage should be collected and discharged such that water is not permitted to infiltrate the backfill and floor slab areas of the building.

5.3 EXCAVATIONS

In Federal Register, Volume 54, Number 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, Subpart P". This document was issued to better enhance the safety of workers entering trenches or excavations. It is mandated by this federal regulation that excavations, whether they be utility trenches, basement excavation or footing excavations, be constructed in accordance with the new OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's "responsible person", as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

PSI is providing this information solely as a service to our client. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state, and federal safety or other regulations. A trench safety plan was beyond the scope of our services for this project.



6 GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason is the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned. The engineering recommendations presented in the preceding section constitutes PSI's professional estimate of those measures that are necessary for the proposed structure to perform according to the proposed design based on the information generated and referenced during this evaluation, and PSI's experience in working with these conditions.

DRAFT



7 ADDITIONAL STUDY

The recommendations provided in this report are preliminary and should not be used for final foundation design. A final geotechnical exploration should be performed prior to final foundation design. The final geotechnical exploration should include additional soil test borings appropriate to the final site layout, additional laboratory testing, and additional engineering analysis based upon the structures and loading conditions.

Client acknowledges that it has approved this limited scope of work to be performed by PSI, and that PSI will not be conducting geotechnical drilling and sampling for subdivision lots, nor is any such drilling or sampling that may be conducted on a particular lot, whether that lot is identified now or in the future, intended to provide any opinions on the geotechnical performance of said lot or any structure placed on such lot. All geotechnical and mass grading work performed is preliminary, and due to the inherent variability in mass grading techniques and results, is expressly insufficient for the construction of any structure absent a site-specific geotechnical investigation, sampling or testing. PSI shall have no responsibility or liability for the geotechnical performance of any specific residential lot.

DRAFT



8 REPORT LIMITATIONS

The recommendations submitted are based on the available subsurface information obtained by PSI and design details furnished by Maronda Homes, LLC. If there are revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI should be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI will not be responsible for the impact of those conditions on the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are more complete, the geotechnical engineer should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations. This report has been prepared for the exclusive use of Maronda Homes, LLC for the specific application to the proposed Alexandria Residential Development project located in Alexandria, Kentucky.

DRAFT



APPENDIX

Aerial Vicinity Map
Karst Potential Map
Boring Location Plan
Boring Logs
Laboratory Test Results
General Notes
Soil Classification Chart
NRCS Soil Resource Report
Structural Engineers Association of California Seismic Loads
Campbell County Appendix B – Geotechnical Exploration and Earthwork Construction Requirements

DRAFT

AERIAL VICINITY MAP



7843 Palace Drive Cincinnati OH 45249
phone 513-489-1460 fax 513-489-1470

AERIAL VICINITY MAP

PSI PROJECT No.:	01111634
Project:	Alexandria Residential Development
Location:	10743 South Licking Pike Alexandria, Kentucky 41011

KARST POTENTIAL MAP

Very High

High

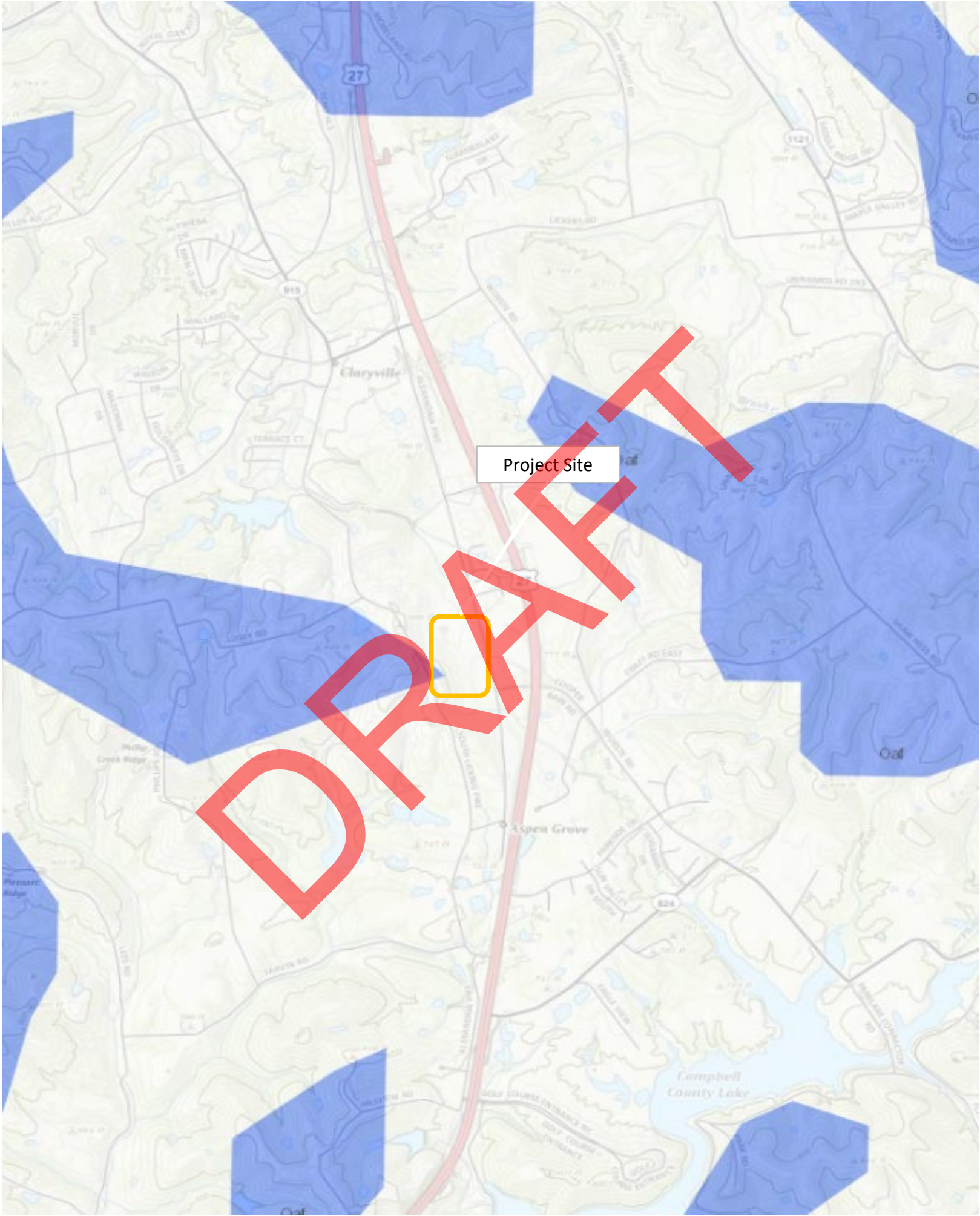
Medium

Low

Non-Karst

Documented Sinkhole

LiDAR-derived Sinkhole



intertek

psi

7843 Palace Drive Cincinnati OH 45249

phone 513-489-1460 fax 513-489-1470

KARST POTENTIAL MAP	
PSI PROJECT No.:	1111634
Project:	Alexandria Residential Development
Location:	10743 South Licking Pike Alexandria, Kentucky 41011

BORING LOCATION PLAN

SOURCE: Concept Plan, LSSE

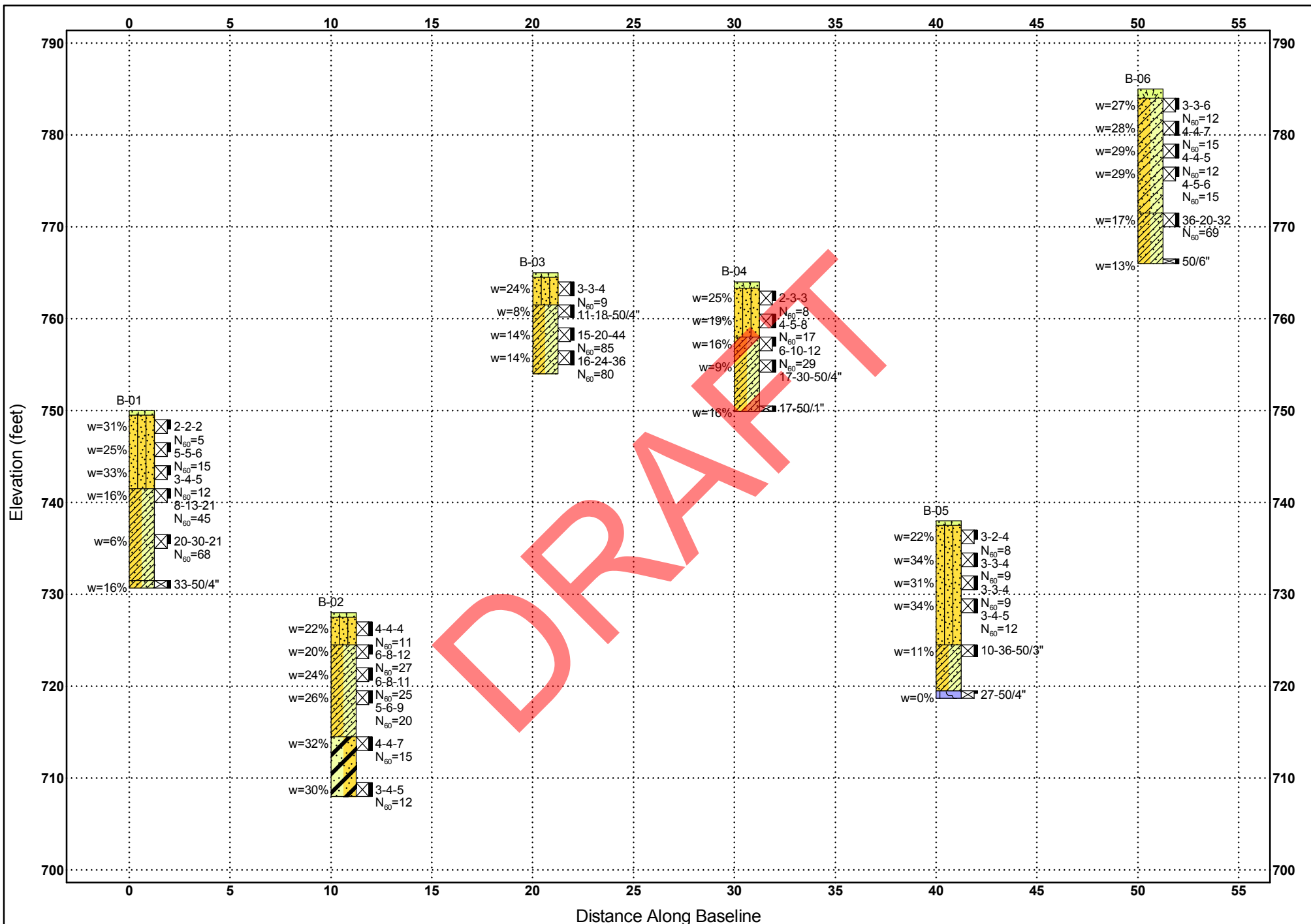
DATE: December 1, 2021



7843 Palace Drive Cincinnati OH 45249
phone 513-489-1460 fax 513-489-1470

BORING LOCATION PLAN

PSI Project No.: 01111634
Project: Alexandria Residential Development
Location: 10743 South Licking Pike
Alexandria, Kentucky 41011



DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 19.3 ft BENCHMARK: N/A ELEVATION: 750 ft LATITUDE: 38.9085° LONGITUDE: -84.3923° STATION: N/A OFFSET: N/A REMARKS: N ₆₀ denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-01 Water BORING LOCATION: WEST OF LOT 17 PROPOSED DETENTION BASIN	
--	--	--	--	---	--

Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Sample N	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
						TOPSOIL (6 INCHES) LOOSE TO MEDIUM DENSE, BROWN, MOIST, SILTY SAND, WITH TRACE BLACK OXIDE STAINING AND TRACE ROCK FRAGMENTS		2-2-2 N ₆₀ =5	31	X Moisture ▲ Qu □ PL + LL	LL = 40 PL = 33 Fines=49.9%
745	5		1	12		SM	5-5-6 N ₆₀ =15	25			
			2	12			3-4-5 N ₆₀ =12	33			
740	10		3	12			8-13-21 N ₆₀ =45	16			
			4	12							
735	15		5	12		CL	20-30-21 N ₆₀ =68	6			
			6	10							
						HARD, LIGHT BROWN, MOIST, SANDY LEAN CLAY WITH TRACE LIMESTONE FRAGMENTS					
						HARD, BROWN AND GRAY, MOIST, SANDY LEAN CLAY WITH TRACE SHALE FRAGMENTS AUGER REFUSAL AT 19.3 FEET; BORING TERMINATED	CL	33-50/4"	16		

	Professional Service Industries, Inc. 7843 Palace Drive Cincinnati, OH 45249 Telephone: (513) 489-1460	PROJECT NO.: 01111634 PROJECT: Alexandria Residential Development LOCATION: 10743 South Licking Pike Alexandria, Kentucky 41011
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DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 20.0 ft BENCHMARK: N/A ELEVATION: 728 ft LATITUDE: 38.9083° LONGITUDE: -84.39° STATION: N/A OFFSET: N/A REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-02 Water BORING LOCATION: WITHIN ROADWAY BETWEEN LOTS 93 & 23	
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Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Sample N	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
0						TOPSOIL (6 INCHES)					
						MEDIUM DENSE, BROWN TO ORANGE BROWN, MOIST, SILTY SAND WITH TRACE ROOTS	SM	4-4-4 $N_{60}=11$	22	X Moisture ▲ Qu ⊗ PL * LL	
725						VERY STIFF, BROWN AND GRAY, MOIST, SANDY LEAN CLAY WITH TRACE ROOTS AND BLACK OXIDE STAINING		6-8-12 $N_{60}=27$	20		
5								6-8-11 $N_{60}=25$	24		
720							CL	5-6-9 $N_{60}=20$	26		
10											
715						STIFF, BROWN, MOIST, SANDY FAT CLAY		4-4-7 $N_{60}=15$	32		
15							CH				
710								3-4-5 $N_{60}=12$	30		
20						BORING TERMINATED AT 20 FEET					

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DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 11.0 ft BENCHMARK: N/A ELEVATION: 765 ft LATITUDE: 38.9076° LONGITUDE: -84.3908° STATION: N/A OFFSET: N/A REMARKS: N_{60} denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-03 Water BORING LOCATION: WITHIN ROADWAY WEST OF LOT 101	
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Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
0		TOPSOIL (6 INCHES)								
		LOOSE, BROWN, MOIST, SILTY SAND WITH TRACE ROOTS	1	18		SM	3-3-4 $N_{60}=9$	24	X Moisture PL LL 0 25 50	
760	5	HARD, LIGHT BROWN, MOIST, SANDY LEAN CLAY WITH TRACE LIMESTONE FRAGMENTS	2	16			11-18-50/4"	8	X Moisture PL LL 0 2.0 4.0	
			3	16		CL	15-20-44 $N_{60}=85$	14		
755	10		4	18			16-24-36 $N_{60}=80$	14	X Moisture PL LL 0 2.0 4.0	LL = 44 PL = 24 Fines=68.3%
		AUGER REFUSAL AT 11 FEET; BORING TERMINATED								

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DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 14.1 ft BENCHMARK: N/A ELEVATION: 764 ft LATITUDE: 38.9058° LONGITUDE: -84.3906° STATION: N/A OFFSET: N/A REMARKS: N ₆₀ denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-04 Water BORING LOCATION: WITHIN IN ROADWAY BETWEEN LOTS 45 & 72	
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Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Sample N	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
0						TOPSOIL (8 INCHES)				N in blows/ft @ X Moisture PL LL STRENGTH, tsf ▲ Qu * Qp	
760	4		1	12		LOOSE TO MEDIUM DENSE, BROWN, MOIST, SILTY SAND WITH GRAVEL AND TRACE ROOTS	SM	2-3-3 N ₆₀ =8	25	 	
755	9		2	18		VERY STIFF TO HARD, LIGHT BROWN TO OLIVE BROWN, MOIST, SANDY LEAN CLAY WITH TRACE LIMESTONE FRAGMENTS AND TRACE BLACK OXIDE STAINING	CL	4-5-8 N ₆₀ =17	19	 	LL = 56 PL = 32 Fines=46.2%
750	14		3	12				6-10-12 N ₆₀ =29	16	 	
			4	16				17-30-50/4"	9	 	
			5	7		AUGER REFUSAL AT 14.1 FEET; BORING TERMINATED		17-50/1"	16	 	

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DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 19.3 ft BENCHMARK: N/A ELEVATION: 738 ft LATITUDE: 38.9062° LONGITUDE: -84.3894° STATION: N/A OFFSET: N/A REMARKS: N ₆₀ denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-05 Water ▽ ▽ ▽ BORING LOCATION: WITHIN LOT 56	
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Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Sample N	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
						TOPSOIL (6 INCHES) LOOSE TO MEDIUM DENSE, DARK BROWN, MOIST, SILTY SAND WITH TRACE ROOTS				N in blows/ft @ X Moisture PL LL STRENGTH, tsf ▲ Qu * Qp	
735	3		1	12			SM	3-2-4 N ₆₀ =8	22		
5	2		18				3-3-4 N ₆₀ =9	34			
730	3		18				3-3-4 N ₆₀ =9	31			
10	4		18				3-4-5 N ₆₀ =12	34			
725	15		5	15		HARD, LIGHT BROWN TO BROWN, MOIST, SANDY LEAN CLAY WITH TRACE LIMESTONE FRAGMENTS	CL	10-36-50/3"	11		
720			6	3		WEATHERED LIMESTONE (AUGERED) AUGER REFUSAL AT 19.3 FEET; BORING TERMINATED		27-50/4"	0		

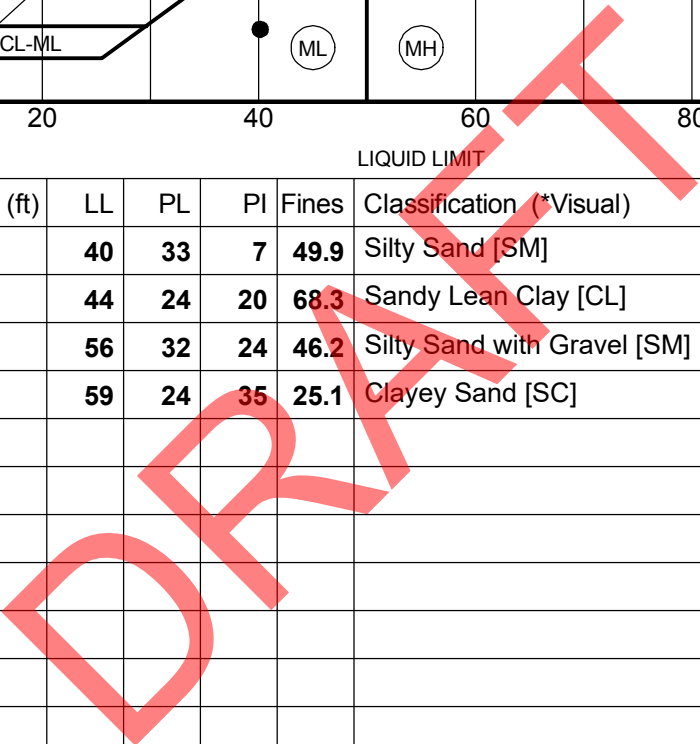
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 Cincinnati, OH 45249
 Telephone: (513) 489-1460

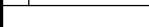
PROJECT NO.: 01111634
PROJECT: Alexandria Residential Development
LOCATION: 10743 South Licking Pike
 Alexandria, Kentucky 41011

DATE STARTED: 1/5/22 DATE COMPLETED: 1/5/22 COMPLETION DEPTH: 19.0 ft BENCHMARK: N/A ELEVATION: 785 ft LATITUDE: 38.9049° LONGITUDE: -84.3895° STATION: N/A OFFSET: N/A REMARKS: N ₆₀ denotes the normalization to 60% efficiency as described in ASTM D4633.		DRILL COMPANY: CENTRAL STAR DRILLING DRILLER: TS LOGGED BY: BS DRILL RIG: DIEDRICH D-50 DRILLING METHOD: Hollow Stem Auger SAMPLING METHOD: SS HAMMER TYPE: Automatic EFFICIENCY: 80% REVIEWED BY: J. SWINDLER		BORING B-06 Water ▽ ▾ ▽ BORING LOCATION: WITHIN ROADWAY BETWEEN LOTS 49 & 63	
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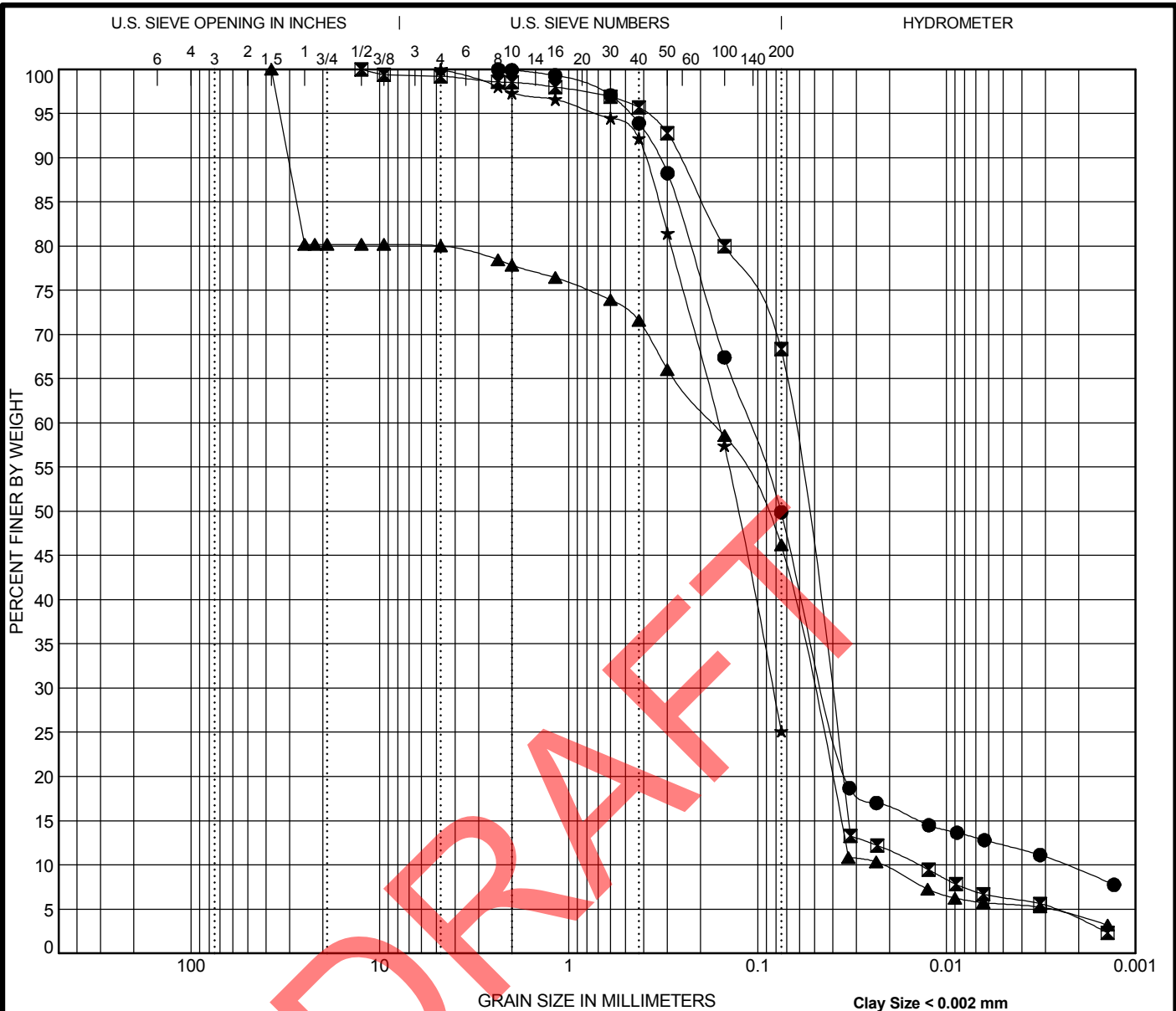
Elevation (feet)	Depth, (feet)	Graphic Log	Sample No.	Sample N	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft @	Additional Remarks
0						TOPSOIL (12 INCHES)				X Moisture PL LL STRENGTH, tsf ▲ Qu * Qp	
			1	14		MEDIUM DENSE, DARK BROWN, MOIST, CLAYEY SAND		3-3-6 N ₆₀ =12	27		
			2	18				4-4-7 N ₆₀ =15	28		
780	5		3	18			SC	4-4-5 N ₆₀ =12	29		
			4	12				4-5-6 N ₆₀ =15	29		
775	10										
			5	18		HARD, LIGHT BROWN, MOIST, SANDY LEAN CLAY WITH LIMESTONE FRAGMENTS		36-20-32 N ₆₀ =69	17		LL = 59 PL = 24 Fines=25.1%
770	15						CL				
			6	6		AUGER REFUSAL AT 19 FEET; BORING TERMINATED		50/6"	13		

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PSI Job No.: 01111634
Project: Alexandria Residential Development
Location: 10743 South Licking Pike
Alexandria, Kentucky 41011



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	LL	PL	PI	Cc	Cu
● B-01 1.8	Silty Sand [SM]	40	33	7	7.34	47.02
☒ B-03 9.3	Sandy Lean Clay [CL]	44	24	20	1.87	4.68
▲ B-04 4.3	Silty Sand with Gravel [SM]	56	32	24	0.70	7.77
★ B-06 6.8	Clayey Sand [SC]	59	24	35		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● B-01 1.8	2.36	0.112	0.044	0.002	0.0	50.1	40.5	9.4
☒ B-03 9.3	12.5	0.066	0.042	0.014	0.8	30.9	64.6	3.7
▲ B-04 4.3	37.5	0.171	0.051	0.022	19.9	33.9	42.1	4.0
★ B-06 6.8	4.75	0.162	0.083		0.0	74.9	25.1	



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GRAIN SIZE DISTRIBUTION

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PSI Job No.: 01111634
Location: 10743 South Licking Pike
Alexandria, Kentucky 41011



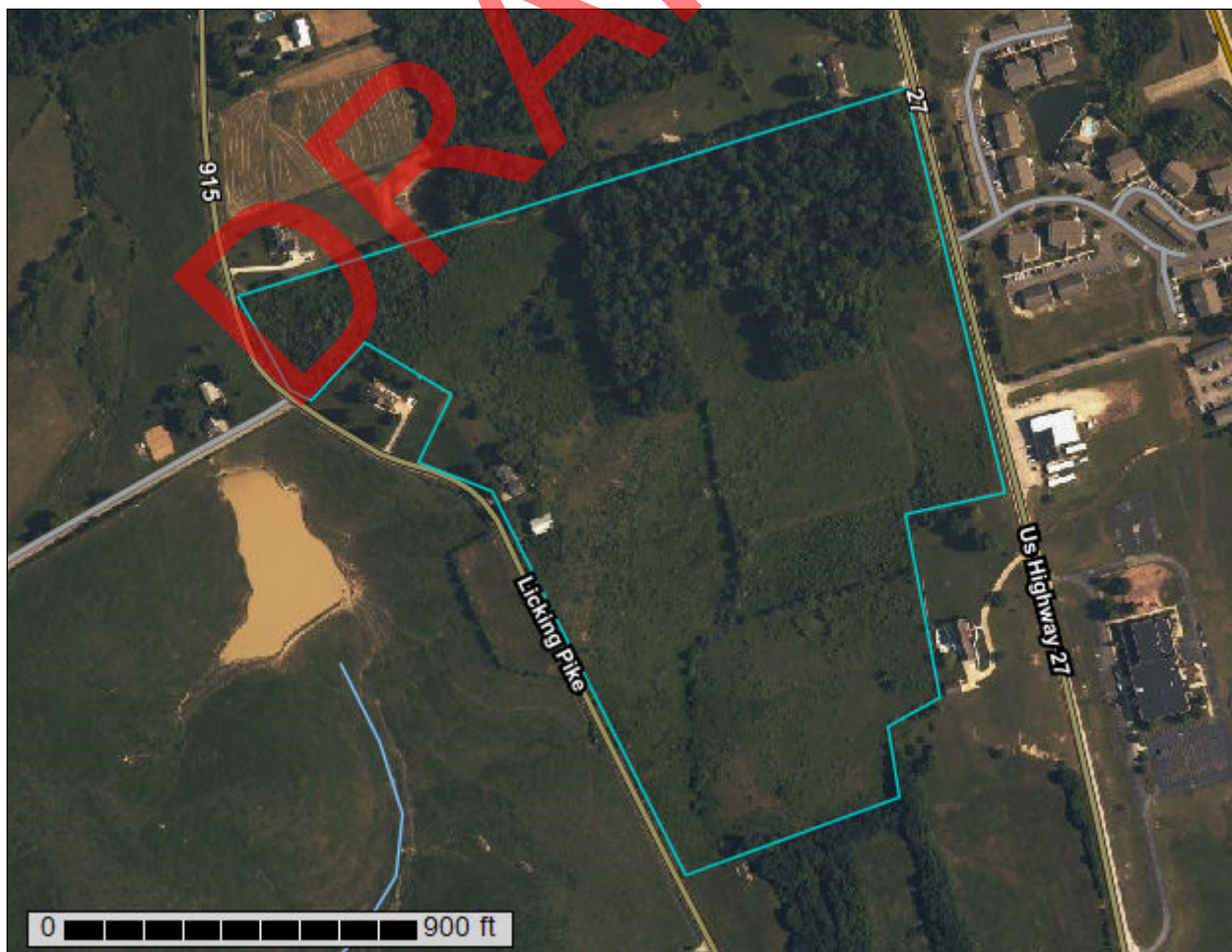
United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Boone, Campbell, and Kenton Counties, Kentucky



January 20, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

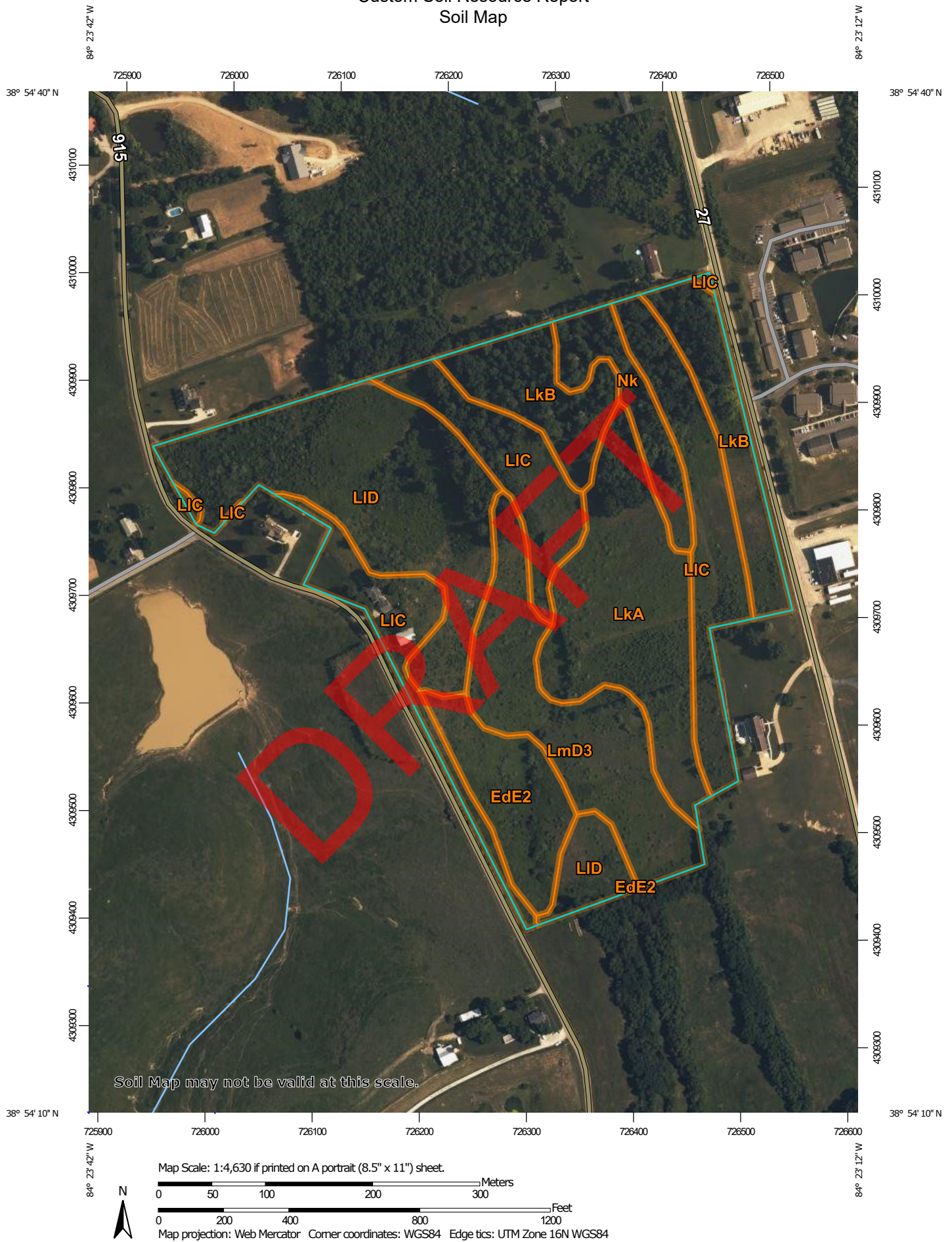
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Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

DRAFT

Custom Soil Resource Report Soil Map



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone, Campbell, and Kenton Counties, Kentucky
Survey Area Data: Version 20, Sep 8, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	2.2	4.7%
Totals for Area of Interest		46.5	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit

descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Boone, Campbell, and Kenton Counties, Kentucky

EdE2—Eden silty clay loam, 20 to 35 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2vp37

Elevation: 430 to 920 feet

Mean annual precipitation: 37 to 51 inches

Mean annual air temperature: 43 to 65 degrees F

Frost-free period: 161 to 205 days

Farmland classification: Not prime farmland

Map Unit Composition

Eden, eroded, and similar soils: 85 percent

Minor components: 15 percent

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

Description of Eden, Eroded

Setting

Landform: Hills

Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Clayey residuum weathered from calcareous siltstone and/or clayey residuum weathered from limestone and shale

Typical profile

Ap - 0 to 6 inches: silty clay loam

Bt - 6 to 18 inches: silty clay

BC - 18 to 24 inches: flaggy silty clay

Cr - 24 to 34 inches: bedrock

Properties and qualities

Slope: 20 to 35 percent

Depth to restrictive feature: 20 to 40 inches to paralithic bedrock

Drainage class: Well drained

Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 20 percent

Available water supply, 0 to 60 inches: Very low (about 2.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: D

Hydric soil rating: No

Minor Components

Faywood, eroded

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Lowell, eroded

Percent of map unit: 6 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Fairmount, eroded

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F121XY001KY - Shallow Limestone Residuum Backslopes
Hydric soil rating: No

LkA—Licking silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: lJg0
Elevation: 460 to 760 feet
Mean annual precipitation: 37 to 48 inches
Mean annual air temperature: 44 to 63 degrees F
Frost-free period: 161 to 199 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Licking and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Licking

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread

Custom Soil Resource Report

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Clayey, calcareous lacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam

H2 - 7 to 20 inches: silty clay loam

H3 - 20 to 54 inches: silty clay

H4 - 54 to 66 inches: clay

Properties and qualities

Slope: 0 to 2 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well drained

Runoff class: 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 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 2w

Hydrologic Soil Group: C/D

Hydric soil rating: No

Minor Components

Wheeling

Percent of map unit: 3 percent

Hydric soil rating: No

Captina

Percent of map unit: 3 percent

Hydric soil rating: No

Other soils

Percent of map unit: 2 percent

Hydric soil rating: No

Lawrence

Percent of map unit: 2 percent

Hydric soil rating: No

LkB—Licking silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: lkg1

Elevation: 450 to 830 feet

Custom Soil Resource Report

Mean annual precipitation: 37 to 48 inches
Mean annual air temperature: 44 to 63 degrees F
Frost-free period: 161 to 199 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Licking and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Licking

Setting

Landform: Stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Clayey, calcareous lacustrine deposits

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 20 inches: silty clay loam
H3 - 20 to 54 inches: silty clay
H4 - 54 to 66 inches: clay

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: 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 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 2 percent
Hydric soil rating: No

Lawrence

Percent of map unit: 2 percent
Hydric soil rating: No

Rossmoyne

Percent of map unit: 2 percent
Hydric soil rating: No

Wheeling

Percent of map unit: 2 percent

Hydric soil rating: No

Captina

Percent of map unit: 2 percent

Hydric soil rating: No

LIC—Licking silty clay loam, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: llg2

Elevation: 450 to 860 feet

Mean annual precipitation: 37 to 48 inches

Mean annual air temperature: 44 to 63 degrees F

Frost-free period: 161 to 199 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Licking and similar soils: 85 percent

Minor components: 15 percent

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

Description of Licking

Setting

Landform: Stream terraces

Landform position (three-dimensional): Riser

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Silty alluvium over clayey, calcareous lacustrine deposits

Typical profile

H1 - 0 to 7 inches: silty clay loam

H2 - 7 to 20 inches: silty clay loam

H3 - 20 to 54 inches: silty clay

H4 - 54 to 66 inches: clay

Properties and qualities

Slope: 6 to 12 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Moderately well 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 18 to 36 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 10 percent

Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C/D

Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 5 percent

Hydric soil rating: No

Wheeling

Percent of map unit: 5 percent

Hydric soil rating: No

Captina

Percent of map unit: 5 percent

Hydric soil rating: No

LID—Licking silty clay loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: llg3

Elevation: 450 to 860 feet

Mean annual precipitation: 37 to 48 inches

Mean annual air temperature: 44 to 63 degrees F

Frost-free period: 161 to 199 days

Farmland classification: Not prime farmland

Map Unit Composition

Licking and similar soils: 80 percent

Minor components: 20 percent

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

Description of Licking

Setting

Landform: Stream terraces

Landform position (three-dimensional): Riser

Down-slope shape: Convex

Across-slope shape: Linear

Parent material: Silty alluvium over clayey, calcareous lacustrine deposits

Typical profile

H1 - 0 to 7 inches: silty clay loam

H2 - 7 to 20 inches: silty clay loam

H3 - 20 to 54 inches: silty clay

H4 - 54 to 66 inches: clay

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well 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 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C/D
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 5 percent
Hydric soil rating: No

Captina

Percent of map unit: 5 percent
Hydric soil rating: No

Markland

Percent of map unit: 5 percent
Hydric soil rating: No

Negley

Percent of map unit: 5 percent
Hydric soil rating: No

LmD3—Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)

Map Unit Setting

National map unit symbol: ljg4
Elevation: 470 to 850 feet
Mean annual precipitation: 37 to 48 inches
Mean annual air temperature: 44 to 63 degrees F
Frost-free period: 161 to 199 days
Farmland classification: Not prime farmland

Map Unit Composition

Markland, severely eroded, and similar soils: 80 percent
Minor components: 20 percent

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

Description of Markland, Severely Eroded

Setting

Landform: Stream terraces
Landform position (three-dimensional): Riser
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Silty alluvium over clayey, calcareous lacustrine deposits

Typical profile

H1 - 0 to 4 inches: silty clay
H2 - 4 to 28 inches: silty clay
H3 - 28 to 80 inches: silty clay loam

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well 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 36 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 5 percent
Hydric soil rating: No

Captina

Percent of map unit: 5 percent
Landform: Stream terraces
Hydric soil rating: No

Negley

Percent of map unit: 5 percent
Hydric soil rating: No

Licking

Percent of map unit: 5 percent
Hydric soil rating: No

Nk—Newark silt loam (0 to 2 percent slopes, occasionally flooded)

Map Unit Setting

National map unit symbol: lJg9
Elevation: 450 to 940 feet
Mean annual precipitation: 37 to 48 inches
Mean annual air temperature: 44 to 63 degrees F
Frost-free period: 161 to 199 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Newark, occasionally flooded, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newark, Occasionally Flooded

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed fine-silty alluvium

Typical profile

H1 - 0 to 9 inches: silt loam
H2 - 9 to 32 inches: silt loam
H3 - 32 to 60 inches: silt loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.57 to 1.98 in/hr)
Depth to water table: About 12 to 18 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B/D
Hydric soil rating: No

Minor Components

Nolin

Percent of map unit: 2 percent

Custom Soil Resource Report

Hydric soil rating: No

Lindside

Percent of map unit: 2 percent

Hydric soil rating: No

Woolper

Percent of map unit: 2 percent

Hydric soil rating: No

Huntington

Percent of map unit: 2 percent

Hydric soil rating: No

Poorly drained soils

Percent of map unit: 2 percent

Landform: Flood plains

Down-slope shape: Concave

Across-slope shape: Concave

Hydric soil rating: Yes

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Soil Information for All Uses

Suitabilities and Limitations for Use

The Suitabilities and Limitations for Use section includes various soil interpretations displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each interpretation.

Building Site Development

Building site development interpretations are designed to be used as tools for evaluating soil suitability and identifying soil limitations for various construction purposes. As part of the interpretation process, the rating applies to each soil in its described condition and does not consider present land use. Example interpretations can include corrosion of concrete and steel, shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping.

Lawns, Landscaping, and Golf Fairways

This interpretation rates soils for their use in establishing and maintaining turf for lawns and golf fairways and ornamental trees and shrubs for residential or commercial landscaping. Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. Golf fairways are subject to heavy foot traffic and some light vehicular traffic. Cutting or filling may be required.

The ratings are based on the use of soil material at the site, which may have been altered by some land smoothing. Irrigation may or may not be needed and is not a criterion in rating. The ratings are based on the soil properties that affect plant growth and trafficability after vegetation is established. The properties that affect plant growth are reaction; depth to a water table; ponding; depth to bedrock or a cemented pan; the available water capacity in the upper 40 inches; the content of salts, sodium, or calcium carbonate; and sulfidic materials. The properties that affect trafficability are flooding, depth to a water table, ponding, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer. The suitability of the soil for traps, tees, roughs, and greens is not considered in the ratings.

Custom Soil Resource Report

Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. Soils that are subject to flooding are limited by the duration and intensity of flooding and the season when flooding occurs. In planning for lawns, landscaping, or golf fairways, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

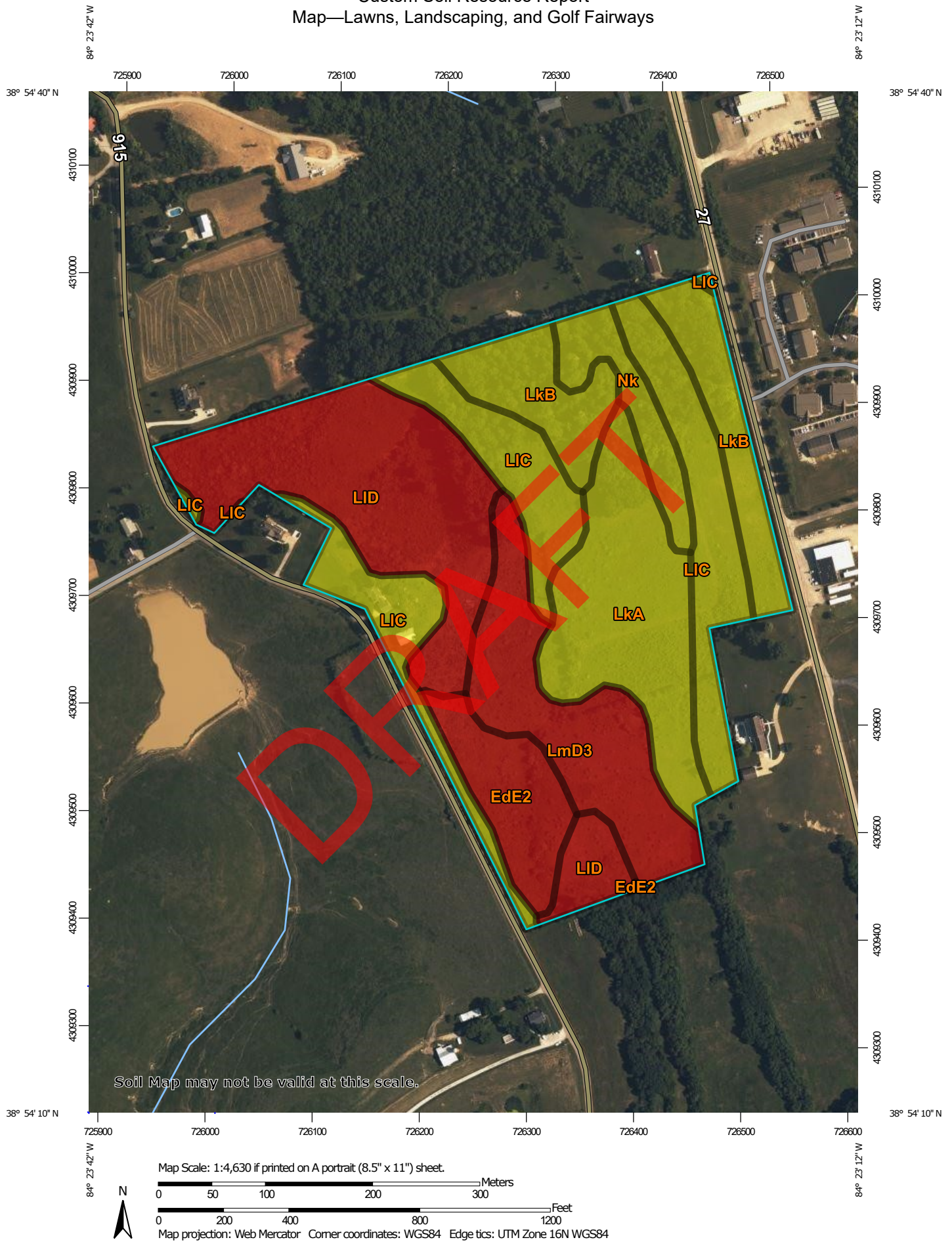
Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report

Map—Lawns, Landscaping, and Golf Fairways



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

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Web Soil Survey URL:
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Survey Area Data: Version 20, Sep 8, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Custom Soil Resource Report

Tables—Lawns, Landscaping, and Golf Fairways

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Very limited	Eden, eroded (85%)	Slope (1.00)	3.2	6.9%
				Droughty (0.93)		
				Depth to bedrock (0.90)		
				Dusty (0.06)		
			Faywood, eroded (6%)	Slope (1.00)		
				Depth to bedrock (0.54)		
				Dusty (0.06)		
				Droughty (0.04)		
			Lowell, eroded (6%)	Slope (1.00)		
				Dusty (0.06)		
			Fairmount, eroded (3%)	Depth to bedrock (1.00)		
				Slope (1.00)		
				Droughty (1.00)		
				Large stones content (1.00)		
				Too clayey (1.00)		
LkA	Licking silt loam, 0 to 2 percent slopes	Somewhat limited	Licking (90%)	Low exchange capacity (0.75)	7.4	15.9%
				Depth to saturated zone (0.56)		
				Dusty (0.06)		
LkB	Licking silt loam, 2 to 6 percent slopes	Somewhat limited	Licking (90%)	Low exchange capacity (0.75)	5.8	12.6%
				Depth to saturated zone (0.56)		
				Dusty (0.06)		
LIC	Licking silty clay loam, 6 to 12 percent slopes	Somewhat limited	Licking (85%)	Low exchange capacity (0.75)	10.4	22.3%
				Depth to saturated zone (0.56)		
				Dusty (0.06)		
				Slope (0.04)		
LID	Licking silty clay loam, 12 to 20 percent slopes	Very limited	Licking (80%)	Slope (1.00)	11.1	23.9%
				Low exchange capacity (0.75)		

Custom Soil Resource Report

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Depth to saturated zone (0.56)		
				Dusty (0.06)		
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Very limited	Markland, severely eroded (80%)	Slope (1.00)	6.4	13.7%
				Too clayey (1.00)		
				Dusty (0.06)		
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Somewhat limited	Newark, occasionally flooded (90%)	Depth to saturated zone (1.00)	2.2	4.7%
				Flooding (0.60)		
				Low exchange capacity (0.50)		
				Dusty (0.06)		
Totals for Area of Interest					46.5	100.0%

Rating	Acres in AOI	Percent of AOI
Somewhat limited	25.8	55.5%
Very limited	20.7	44.5%
Totals for Area of Interest	46.5	100.0%

Rating Options—Lawns, Landscaping, and Golf Fairways

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

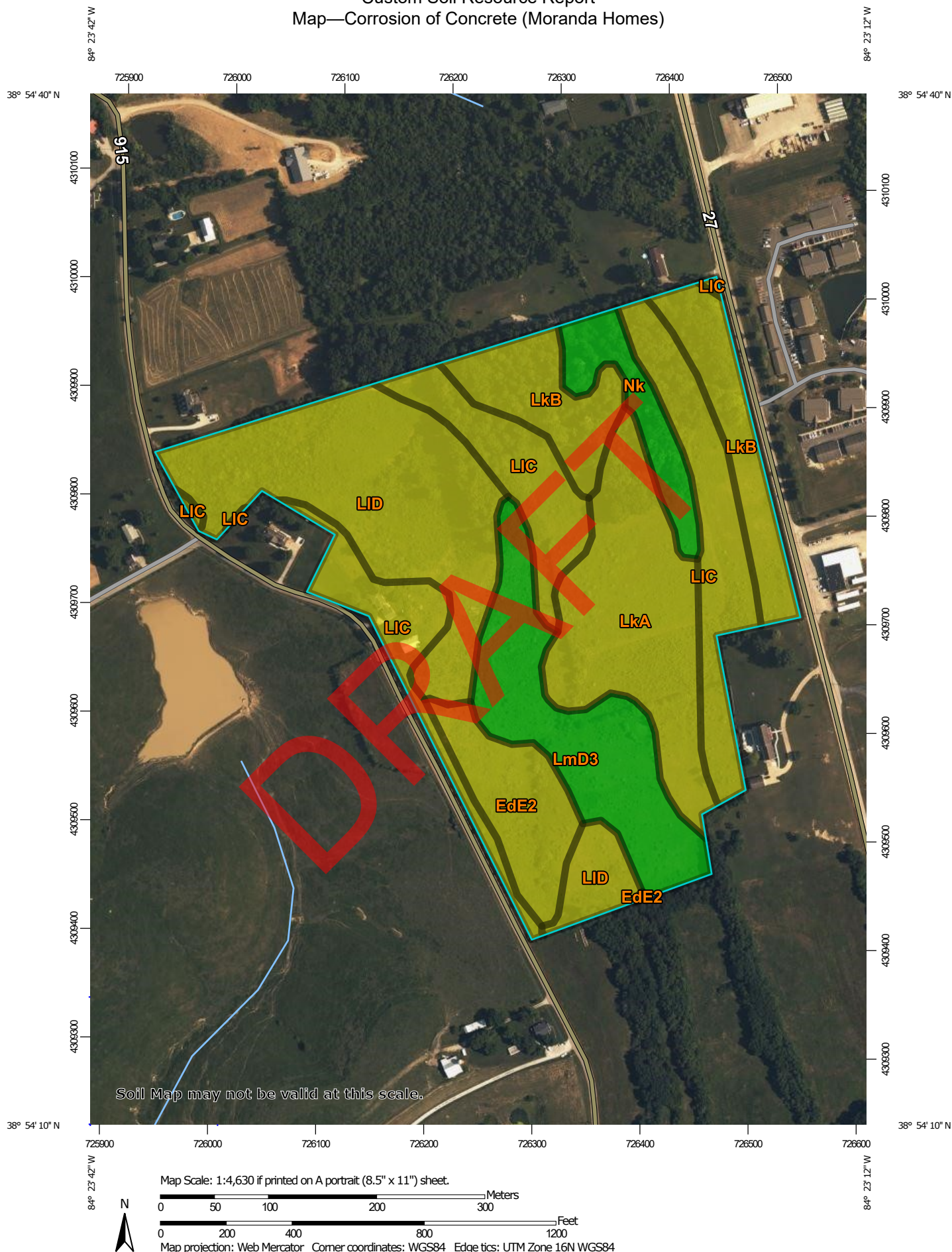
Tie-break Rule: Higher

Corrosion of Concrete (Moranda Homes)

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the concrete in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report
Map—Corrosion of Concrete (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  High
-  Moderate
-  Low
-  Not rated or not available

Soil Rating Lines

-  High
-  Moderate
-  Low
-  Not rated or not available

Soil Rating Points

-  High
-  Moderate
-  Low
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone, Campbell, and Kenton Counties, Kentucky
Survey Area Data: Version 20, Sep 8, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—Corrosion of Concrete (Moranda Homes)

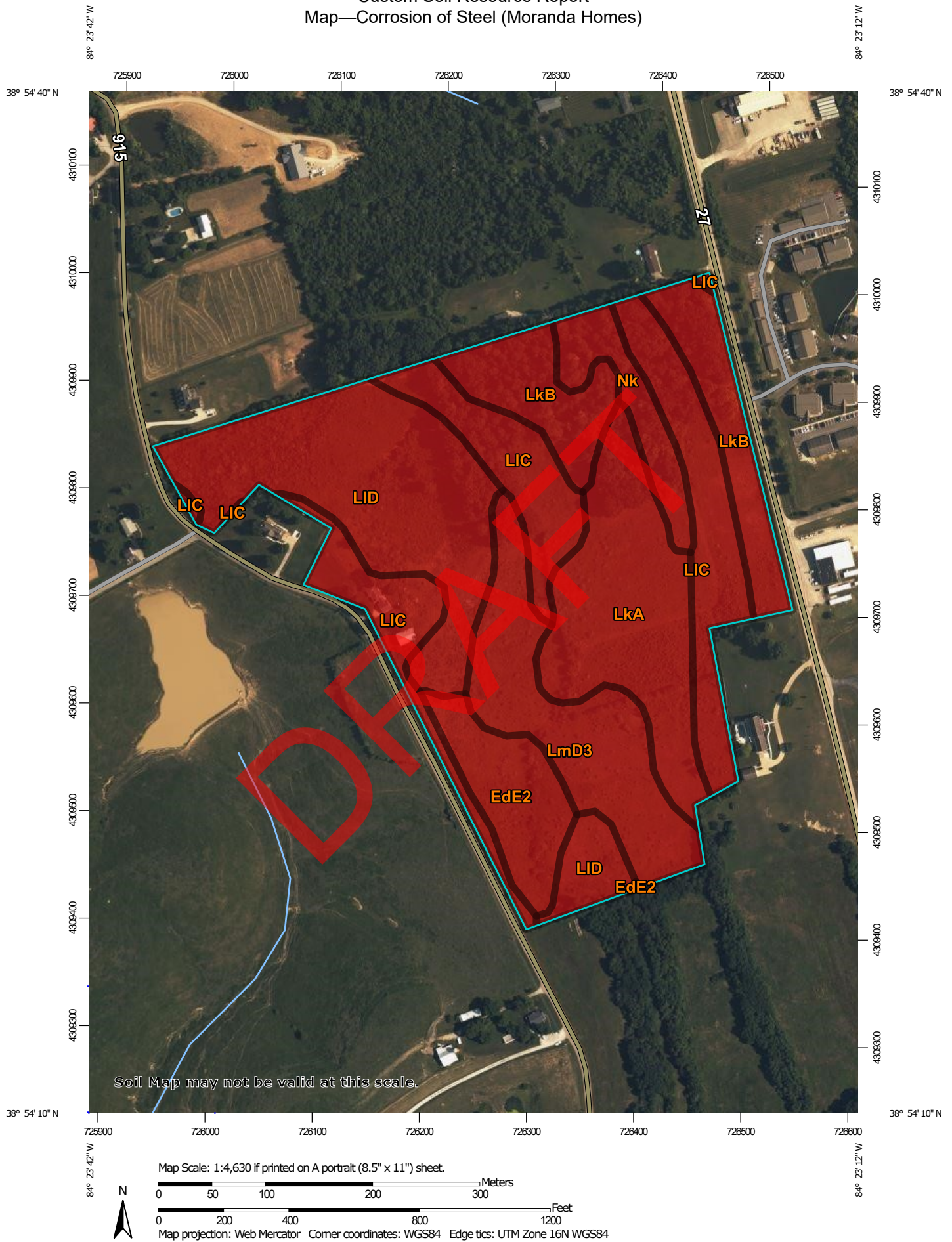
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Moderate	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	Moderate	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	Moderate	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	Moderate	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	Moderate	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Low	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Low	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Corrosion of Concrete (Moranda Homes)*Aggregation Method: Dominant Condition**Component Percent Cutoff: None Specified**Tie-break Rule: Higher***Corrosion of Steel (Moranda Homes)**

"Risk of corrosion" pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel in installations that are entirely within one kind of soil or within one soil layer.

The risk of corrosion is expressed as "low," "moderate," or "high."

Custom Soil Resource Report
Map—Corrosion of Steel (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

 High
 Moderate
 Low
 Not rated or not available

Soil Rating Lines

 High
 Moderate
 Low
 Not rated or not available

Soil Rating Points

 High
 Moderate
 Low
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

MAP INFORMATION

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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Table—Corrosion of Steel (Moranda Homes)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	High	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	High	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	High	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	High	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	High	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	High	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	High	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Corrosion of Steel (Moranda Homes)*Aggregation Method: Dominant Condition**Component Percent Cutoff: None Specified**Tie-break Rule: Higher***Dwellings With Basements (Moranda Homes)**

Dwellings are single-family houses of three stories or less. For dwellings with basements, the foundation is assumed to consist of spread footings of reinforced concrete built on undisturbed soil at a depth of about 7 feet.

The ratings for dwellings are based on the soil properties that affect the capacity of the soil to support a load without movement and on the properties that affect excavation and construction costs. The properties that affect the load-supporting capacity include depth to a water table, ponding, flooding, subsidence, linear extensibility (shrink-swell potential), and compressibility. Compressibility is inferred from the Unified classification of the soil. The properties that affect the ease and amount of excavation include depth to a water table, ponding, flooding, slope, depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, and the amount and size of rock fragments.

Custom Soil Resource Report

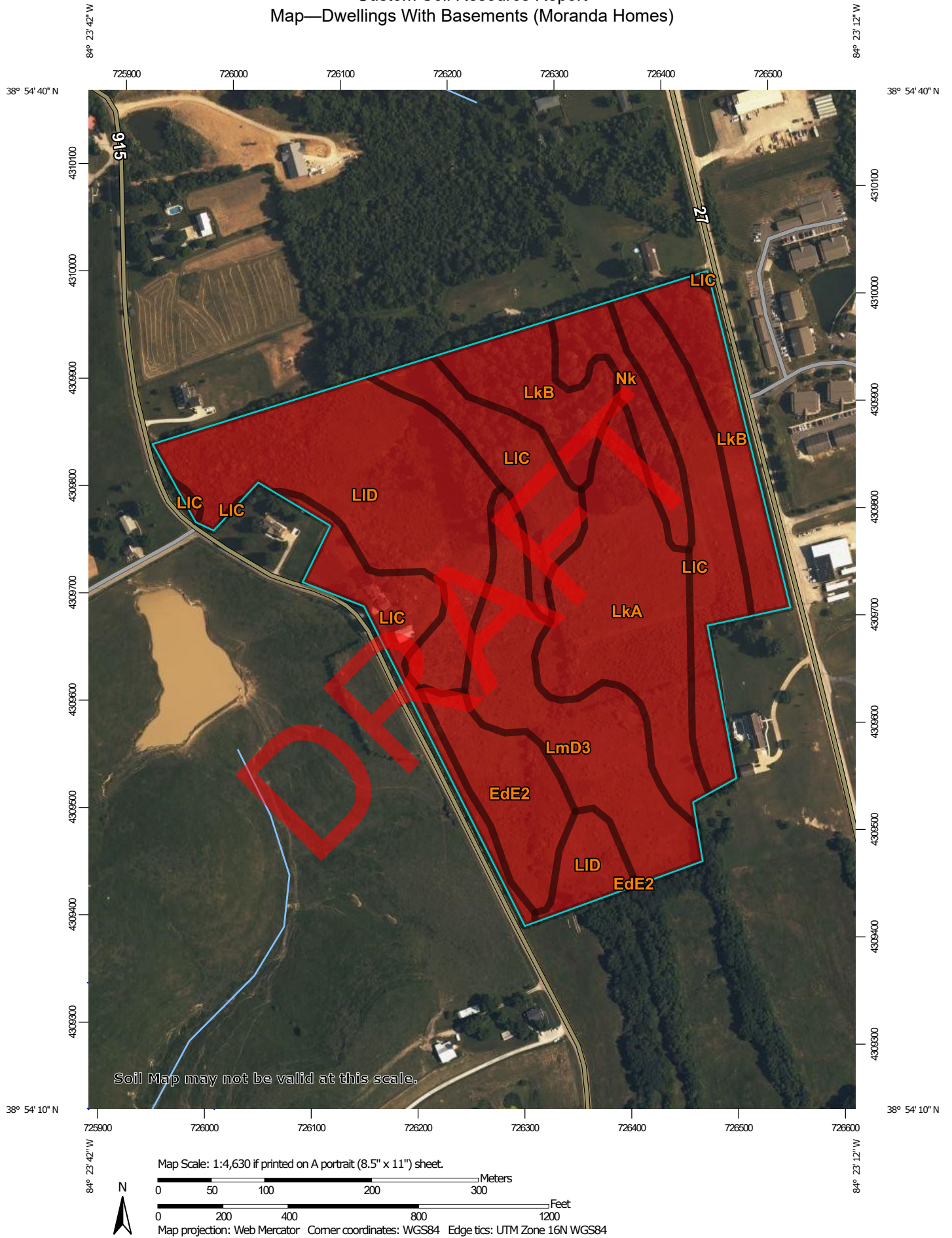
The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

Custom Soil Resource Report
Map—Dwellings With Basements (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

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Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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Tables—Dwellings With Basements (Moranda Homes)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Very limited	Eden, eroded (85%)	Slope (1.00)	3.2	6.9%
				Depth to soft bedrock (0.90)		
				Shrink-swell (0.19)		
			Faywood, eroded (6%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Depth to hard bedrock (1.00)		
			Lowell, eroded (6%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Depth to hard bedrock (0.18)		
			Fairmount, eroded (3%)	Slope (1.00)		
LkA	Licking silt loam, 0 to 2 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	7.4	15.9%
				Shrink-swell (1.00)		
LkB	Licking silt loam, 2 to 6 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	5.8	12.6%
				Shrink-swell (1.00)		
LIC	Licking silty clay loam, 6 to 12 percent slopes	Very limited	Licking (85%)	Depth to saturated zone (1.00)	10.4	22.3%
				Shrink-swell (1.00)		
				Slope (0.04)		
LID	Licking silty clay loam, 12 to 20 percent slopes	Very limited	Licking (80%)	Depth to saturated zone (1.00)	11.1	23.9%
				Shrink-swell (1.00)		
				Slope (1.00)		

Custom Soil Resource Report

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Very limited	Markland, severely eroded (80%)	Shrink-swell (1.00)	6.4	13.7%
				Slope (1.00)		
				Depth to saturated zone (0.35)		
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Very limited	Newark, occasionally flooded (90%)	Flooding (1.00)	2.2	4.7%
				Depth to saturated zone (1.00)		
Totals for Area of Interest					46.5	100.0%

Rating	Acres in AOI	Percent of AOI
Very limited	46.4	100.0%
Totals for Area of Interest	46.5	100.0%

Rating Options—Dwellings With Basements (Moranda Homes)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Shallow Excavations (Moranda Homes)

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for graves, utility lines, open ditches, or other purposes. The ratings are based on the soil properties that influence the ease of digging and the resistance to sloughing. Depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, the amount of large stones, and dense layers influence the ease of digging, filling, and compacting. Depth to the seasonal high water table, flooding, and ponding may restrict the period when excavations can be made. Slope influences the ease of using machinery. Soil texture, depth to the water table, and linear extensibility (shrink-swell potential) influence the resistance to sloughing.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot

be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

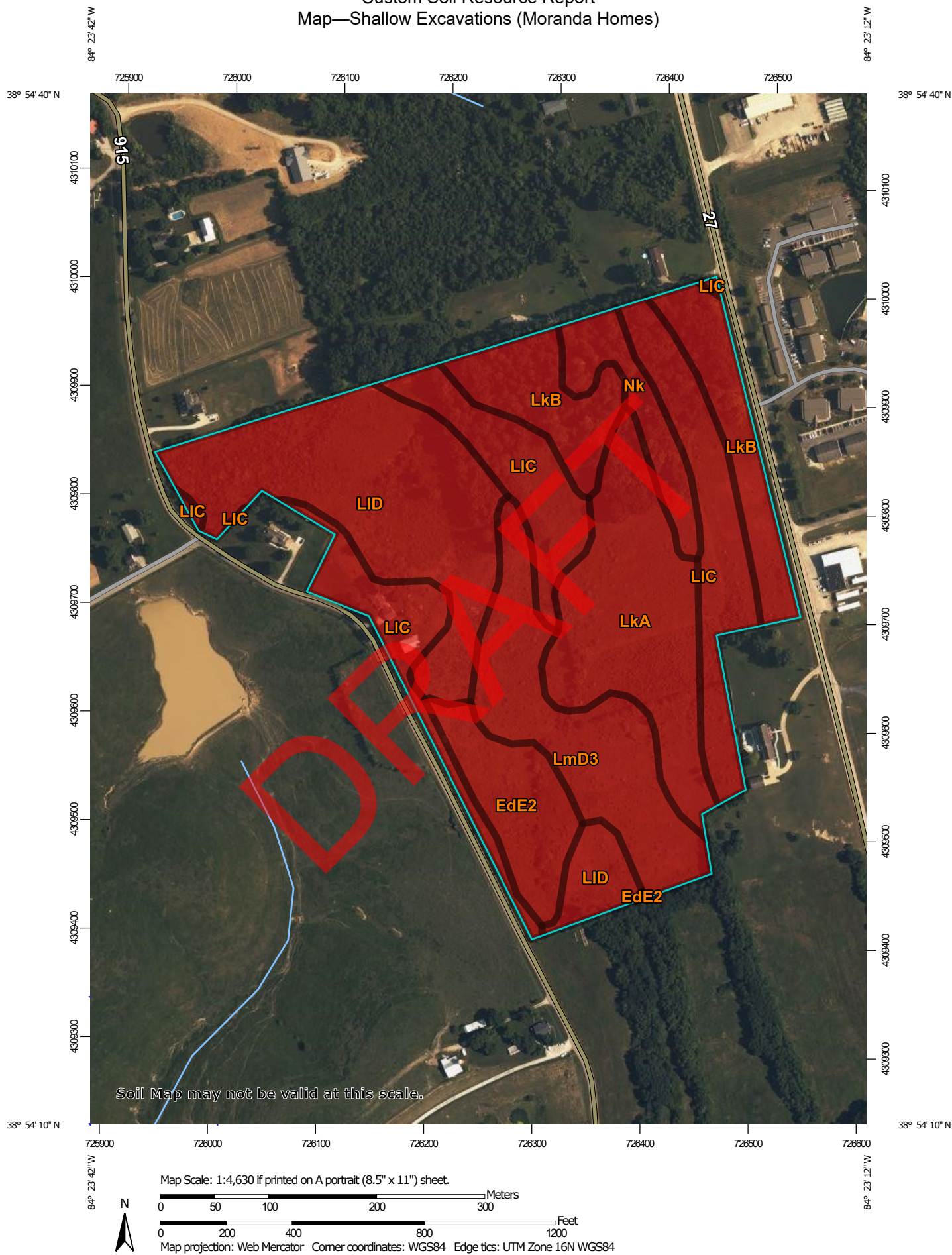
Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

DRAFT

Custom Soil Resource Report
Map—Shallow Excavations (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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DRAFT

Tables—Shallow Excavations (Moranda Homes)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Very limited	Eden, eroded (85%)	Slope (1.00)	3.2	6.9%
				Depth to soft bedrock (0.90)		
				Too clayey (0.13)		
				Dusty (0.06)		
				Unstable excavation walls (0.01)		
			Faywood, eroded (6%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Too clayey (0.32)		
				Dusty (0.06)		
				Unstable excavation walls (0.01)		
			Lowell, eroded (6%)	Slope (1.00)		
				Too clayey (0.59)		
				Depth to hard bedrock (0.18)		
				Unstable excavation walls (0.06)		
				Dusty (0.06)		
			Fairmount, eroded (3%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Large stones (0.74)		
				Dusty (0.06)		
				Unstable excavation walls (0.01)		
LkA	Licking silt loam, 0 to 2 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	7.4	15.9%
				Too clayey (0.50)		
				Unstable excavation walls (0.25)		
				Dusty (0.06)		

Custom Soil Resource Report

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
LkB	Licking silt loam, 2 to 6 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	5.8	12.6%
				Too clayey (0.50)		
				Unstable excavation walls (0.25)		
				Dusty (0.06)		
LIC	Licking silty clay loam, 6 to 12 percent slopes	Very limited	Licking (85%)	Depth to saturated zone (1.00)	10.4	22.3%
				Too clayey (0.50)		
				Unstable excavation walls (0.25)		
				Dusty (0.06)		
				Slope (0.04)		
LID	Licking silty clay loam, 12 to 20 percent slopes	Very limited	Licking (80%)	Depth to saturated zone (1.00)	11.1	23.9%
				Slope (1.00)		
				Too clayey (0.50)		
				Unstable excavation walls (0.25)		
				Dusty (0.06)		
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Very limited	Markland, severely eroded (80%)	Slope (1.00)	6.4	13.7%
				Unstable excavation walls (0.51)		
				Depth to saturated zone (0.35)		
				Too clayey (0.28)		
				Dusty (0.06)		
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Very limited	Newark, occasionally flooded (90%)	Depth to saturated zone (1.00)	2.2	4.7%
				Flooding (0.60)		
				Dusty (0.06)		
				Unstable excavation walls (0.01)		
Totals for Area of Interest					46.5	100.0%

Rating	Acres in AOI	Percent of AOI
Very limited	46.4	100.0%
Totals for Area of Interest	46.5	100.0%

Rating Options—Shallow Excavations (Moranda Homes)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Local Roads and Streets (Moranda Homes)

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or soil material stabilized by lime or cement; and a surface of flexible material (asphalt), rigid material (concrete), or gravel with a binder. The ratings are based on the soil properties that affect the ease of excavation and grading and the traffic-supporting capacity. The properties that affect the ease of excavation and grading are depth to bedrock or a cemented pan, hardness of bedrock or a cemented pan, depth to a water table, ponding, flooding, the amount of large stones, and slope. The properties that affect the traffic-supporting capacity are soil strength (as inferred from the AASHTO group index number), subsidence, linear extensibility (shrink-swell potential), the potential for frost action, depth to a water table, and ponding.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

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Custom Soil Resource Report

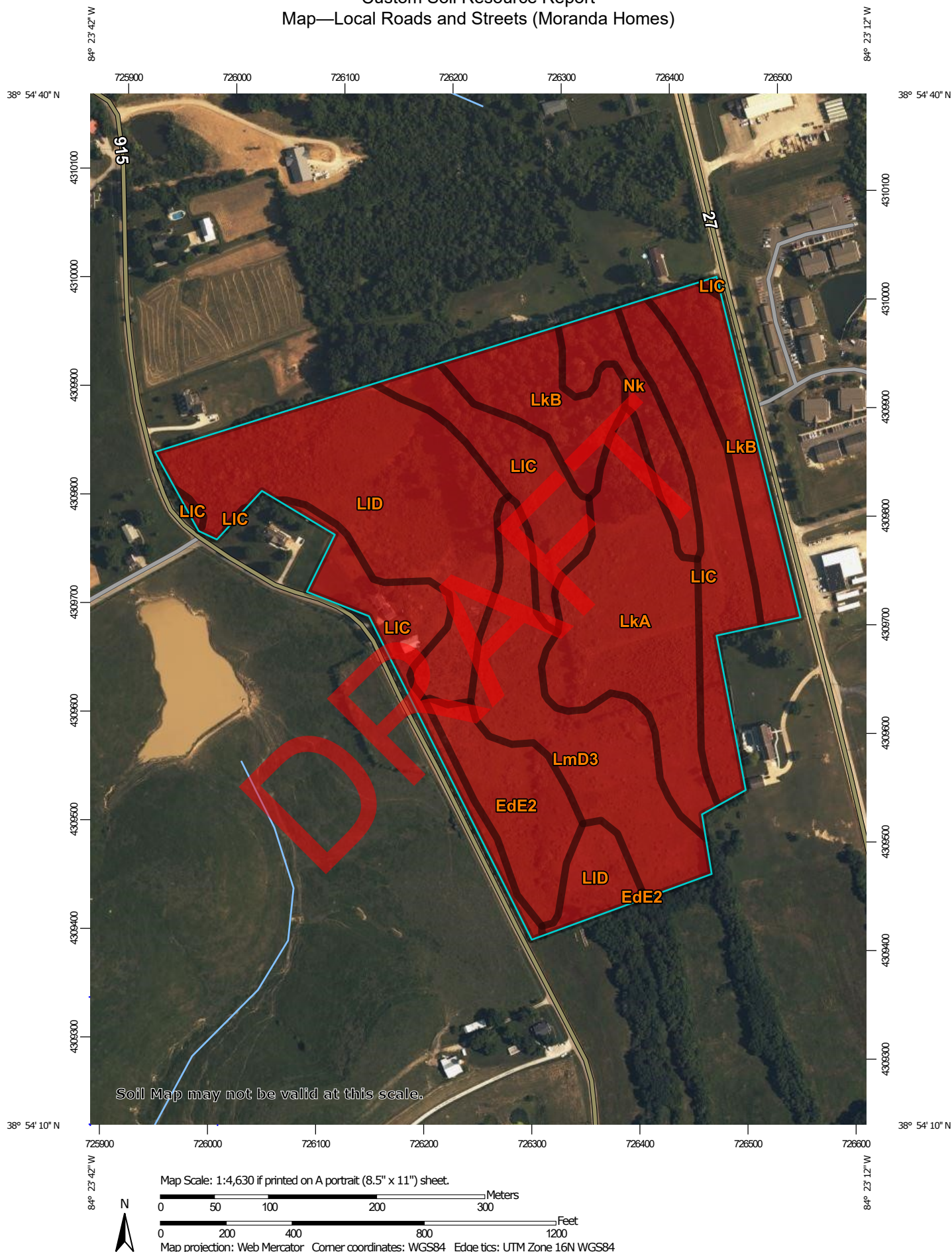
of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

DRAFT

Custom Soil Resource Report

Map—Local Roads and Streets (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Tables—Local Roads and Streets (Moranda Homes)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Very limited	Eden, eroded (85%)	Slope (1.00)	3.2	6.9%
				Low strength (1.00)		
				Frost action (0.50)		
				Shrink-swell (0.19)		
			Faywood, eroded (6%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Depth to hard bedrock (0.54)		
				Frost action (0.50)		
			Lowell, eroded (6%)	Slope (1.00)		
				Shrink-swell (1.00)		
				Low strength (1.00)		
				Frost action (0.50)		
				Soluble bedrock (0.15)		
			Fairmount, eroded (3%)	Depth to hard bedrock (1.00)		
				Slope (1.00)		
				Low strength (1.00)		
				Large stones (0.74)		
				Frost action (0.50)		
LkA	Licking silt loam, 0 to 2 percent slopes	Very limited	Licking (90%)	Shrink-swell (1.00)	7.4	15.9%
				Low strength (1.00)		
				Depth to saturated zone (0.56)		
LkB	Licking silt loam, 2 to 6 percent slopes	Very limited	Licking (90%)	Shrink-swell (1.00)	5.8	12.6%

Custom Soil Resource Report

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Low strength (1.00)		
				Depth to saturated zone (0.56)		
LIC	Licking silty clay loam, 6 to 12 percent slopes	Very limited	Licking (85%)	Shrink-swell (1.00)	10.4	22.3%
				Low strength (1.00)		
				Depth to saturated zone (0.56)		
				Slope (0.04)		
LID	Licking silty clay loam, 12 to 20 percent slopes	Very limited	Licking (80%)	Shrink-swell (1.00)	11.1	23.9%
				Low strength (1.00)		
				Slope (1.00)		
				Depth to saturated zone (0.56)		
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Very limited	Markland, severely eroded (80%)	Shrink-swell (1.00)	6.4	13.7%
				Low strength (1.00)		
				Slope (1.00)		
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Very limited	Newark, occasionally flooded (90%)	Flooding (1.00)	2.2	4.7%
				Depth to saturated zone (1.00)		
				Low strength (0.11)		
Totals for Area of Interest					46.5	100.0%

Rating	Acres in AOI	Percent of AOI
Very limited	46.4	100.0%
Totals for Area of Interest	46.5	100.0%

Rating Options—Local Roads and Streets (Moranda Homes)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Sanitary Facilities

Sanitary Facilities interpretations are tools designed to guide the user in site selection for the safe disposal of sewage and solid waste. Example interpretations include septic tank absorption fields, sewage lagoons, and sanitary landfills.

Septic Tank Absorption Fields (Moranda Homes)

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 60 inches is evaluated. The ratings are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in downslope areas.

Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect the specified use. "Not limited" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance can be expected. "Somewhat limited" indicates that the soil has features that are moderately favorable for the specified use. The limitations can be overcome or minimized by special planning, design, or installation. Fair performance and moderate maintenance can be expected. "Very limited" indicates that the soil has one or more features that are unfavorable for the specified use. The limitations generally cannot be overcome without major soil reclamation, special design, or expensive installation procedures. Poor performance and high maintenance can be expected.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.00. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.00) and the point at which the soil feature is not a limitation (0.00).

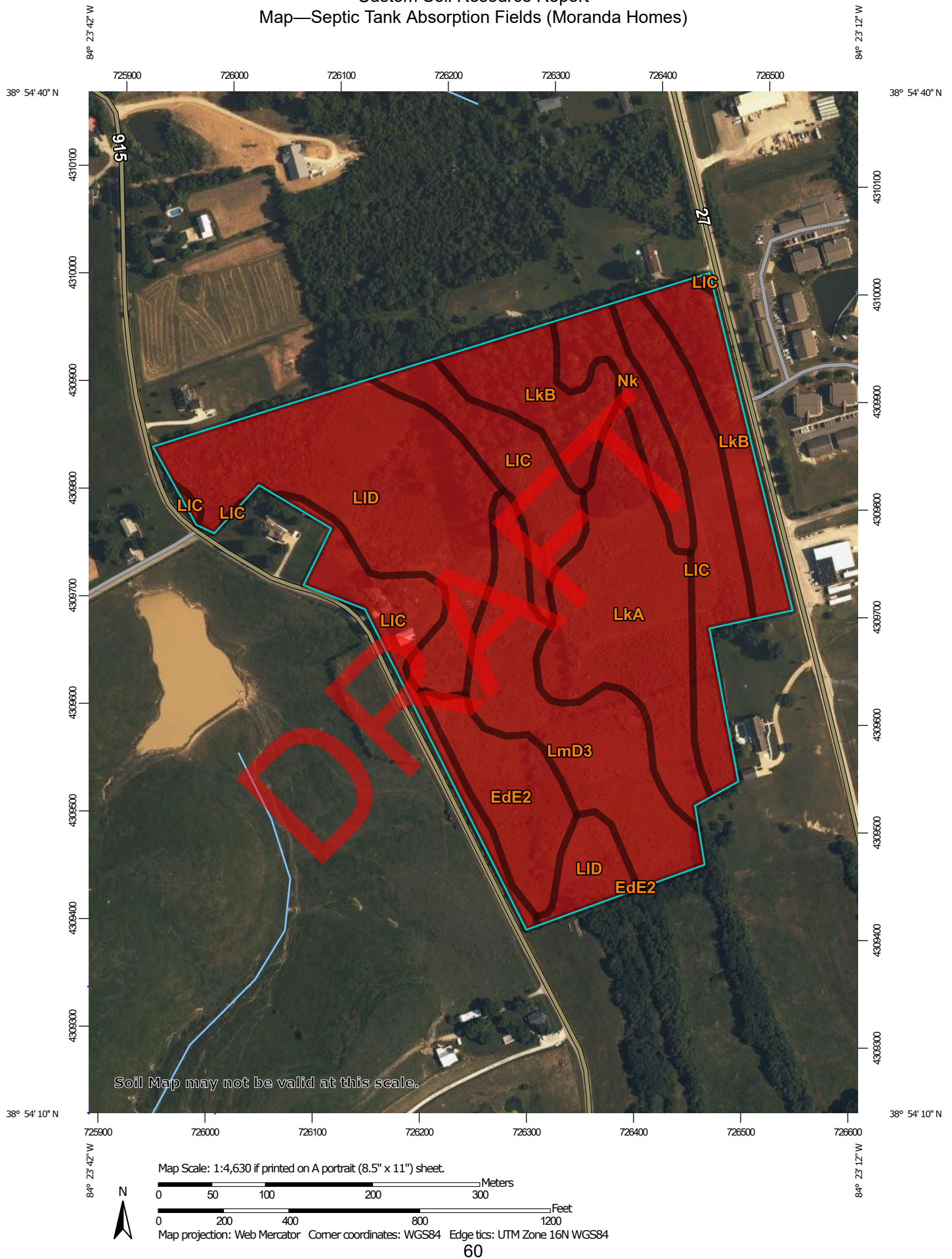
The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Custom Soil Resource Report

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

DRAFT

Custom Soil Resource Report
Map—Septic Tank Absorption Fields (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Lines

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Soil Rating Points

-  Very limited
-  Somewhat limited
-  Not limited
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone, Campbell, and Kenton Counties, Kentucky
Survey Area Data: Version 20, Sep 8, 2021

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Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

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Tables—Septic Tank Absorption Fields (Moranda Homes)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	Very limited	Eden, eroded (85%)	Slow water movement (1.00)	3.2	6.9%
				Slope (1.00)		
				Depth to bedrock (1.00)		
			Faywood, eroded (6%)	Slow water movement (1.00)		
				Slope (1.00)		
				Depth to bedrock (1.00)		
			Lowell, eroded (6%)	Slow water movement (1.00)		
				Slope (1.00)		
				Depth to bedrock (0.62)		
			Fairmount, eroded (3%)	Depth to bedrock (1.00)		
				Slope (1.00)		
				Large stones (0.74)		
LkA	Licking silt loam, 0 to 2 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	7.4	15.9%
				Slow water movement (1.00)		
LkB	Licking silt loam, 2 to 6 percent slopes	Very limited	Licking (90%)	Depth to saturated zone (1.00)	5.8	12.6%
				Slow water movement (1.00)		
LIC	Licking silty clay loam, 6 to 12 percent slopes	Very limited	Licking (85%)	Depth to saturated zone (1.00)	10.4	22.3%
				Slow water movement (1.00)		
				Slope (0.04)		
LID	Licking silty clay loam, 12 to 20 percent slopes	Very limited	Licking (80%)	Depth to saturated zone (1.00)	11.1	23.9%

Custom Soil Resource Report

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
				Slow water movement (1.00)		
				Slope (1.00)		
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Very limited	Markland, severely eroded (80%)	Slow water movement (1.00)	6.4	13.7%
				Slope (1.00)		
				Depth to saturated zone (0.84)		
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	Very limited	Newark, occasionally flooded (90%)	Flooding (1.00)	2.2	4.7%
				Depth to saturated zone (1.00)		
				Slow water movement (0.50)		
Totals for Area of Interest					46.5	100.0%

Rating	Acres in AOI	Percent of AOI
Very limited	46.4	100.0%
Totals for Area of Interest	46.5	100.0%

Rating Options—Septic Tank Absorption Fields (Moranda Homes)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

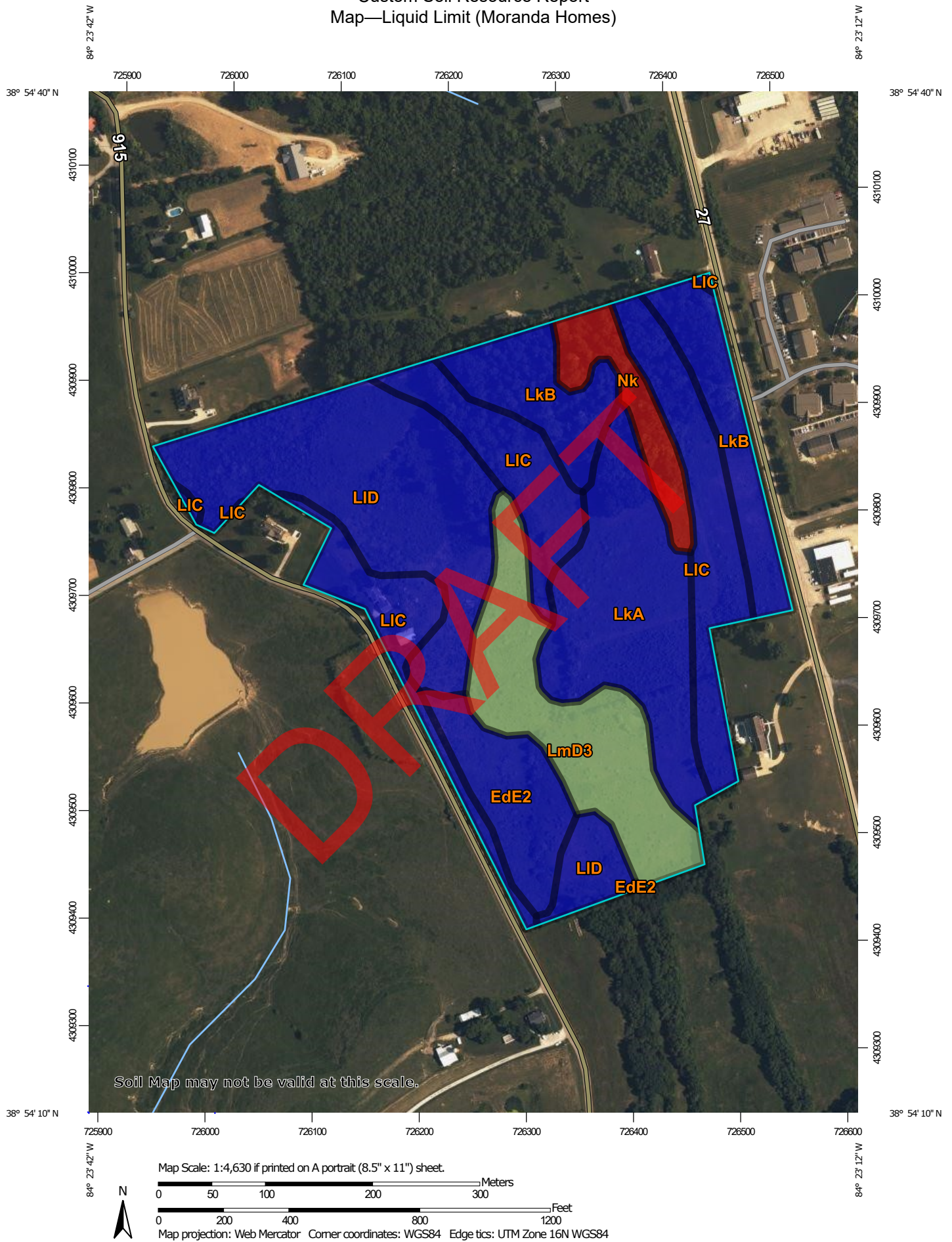
Liquid Limit (Moranda Homes)

Liquid limit (LL) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state. Generally, the amount of clay- and silt-size particles, the organic matter content, and the type of minerals determine the liquid limit. Soils that have a high liquid limit have the capacity to hold a lot of water while maintaining a plastic or semisolid state.

Liquid limit is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Custom Soil Resource Report
Map—Liquid Limit (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Background

 Aerial Photography

Soils

Soil Rating Polygons

-  ≤ 30.7
-  > 30.7 and ≤ 48.5
-  > 48.5 and ≤ 51.3
-  Not rated or not available

Soil Rating Lines

-  ≤ 30.7
-  > 30.7 and ≤ 48.5
-  > 48.5 and ≤ 51.3
-  Not rated or not available

Soil Rating Points

-  ≤ 30.7
-  > 30.7 and ≤ 48.5
-  > 48.5 and ≤ 51.3
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

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Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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Table—Liquid Limit (Moranda Homes)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	51.3	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	51.3	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	51.3	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	51.3	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	51.3	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	48.5	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	30.7	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Liquid Limit (Moranda Homes)*Units of Measure:* percent*Aggregation Method:* Dominant Component*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Interpret Nulls as Zero:* No*Layer Options (Horizon Aggregation Method):* All Layers (Weighted Average)**Plasticity Index (Moranda Homes)**

Plasticity index (PI) is one of the standard Atterberg limits used to indicate the plasticity characteristics of a soil. It is defined as the numerical difference between the liquid limit and plastic limit of the soil. It is the range of water content in which a soil exhibits the characteristics of a plastic solid.

The plastic limit is the water content that corresponds to an arbitrary limit between the plastic and semisolid states of a soil. The liquid limit is the water content, on a percent by weight basis, of the soil (passing #40 sieve) at which the soil changes from a plastic to a liquid state.

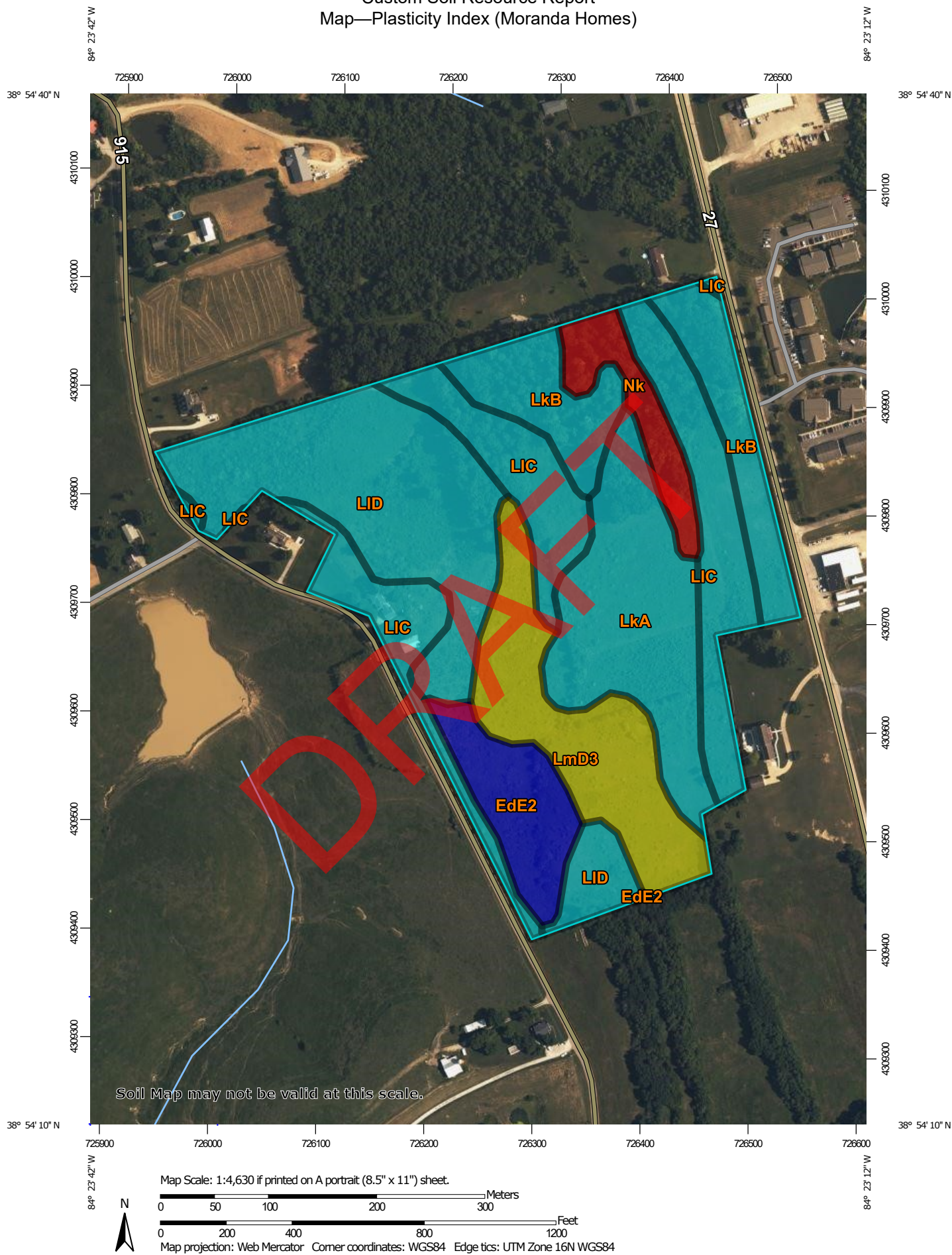
Custom Soil Resource Report

Soils that have a high plasticity index have a wide range of moisture content in which the soil performs as a plastic material. Highly and moderately plastic clays have large PI values. Plasticity index is used in classifying soils in the Unified and AASHTO classification systems.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

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Custom Soil Resource Report
Map—Plasticity Index (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 ≤ 10.5
 > 10.5 and ≤ 22.7
 > 22.7 and ≤ 27.3
 > 27.3 and ≤ 29.5
 Not rated or not available

Soil Rating Lines

 ≤ 10.5
 > 10.5 and ≤ 22.7
 > 22.7 and ≤ 27.3
 > 27.3 and ≤ 29.5
 Not rated or not available

Soil Rating Points

 ≤ 10.5
 > 10.5 and ≤ 22.7
 > 22.7 and ≤ 27.3
 > 27.3 and ≤ 29.5
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways

 US Routes
 Major Roads
 Local Roads
Background
 Aerial Photography

MAP INFORMATION

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 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—Plasticity Index (Moranda Homes)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	29.5	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	27.3	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	27.3	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	27.3	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	27.3	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	22.7	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	10.5	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Plasticity Index (Moranda Homes)*Units of Measure:* percent*Aggregation Method:* Dominant Component*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Interpret Nulls as Zero:* No*Layer Options (Horizon Aggregation Method):* All Layers (Weighted Average)**Percent Clay (Moranda Homes)**

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. The estimated clay content of each soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay affect the fertility and physical condition of the soil and the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

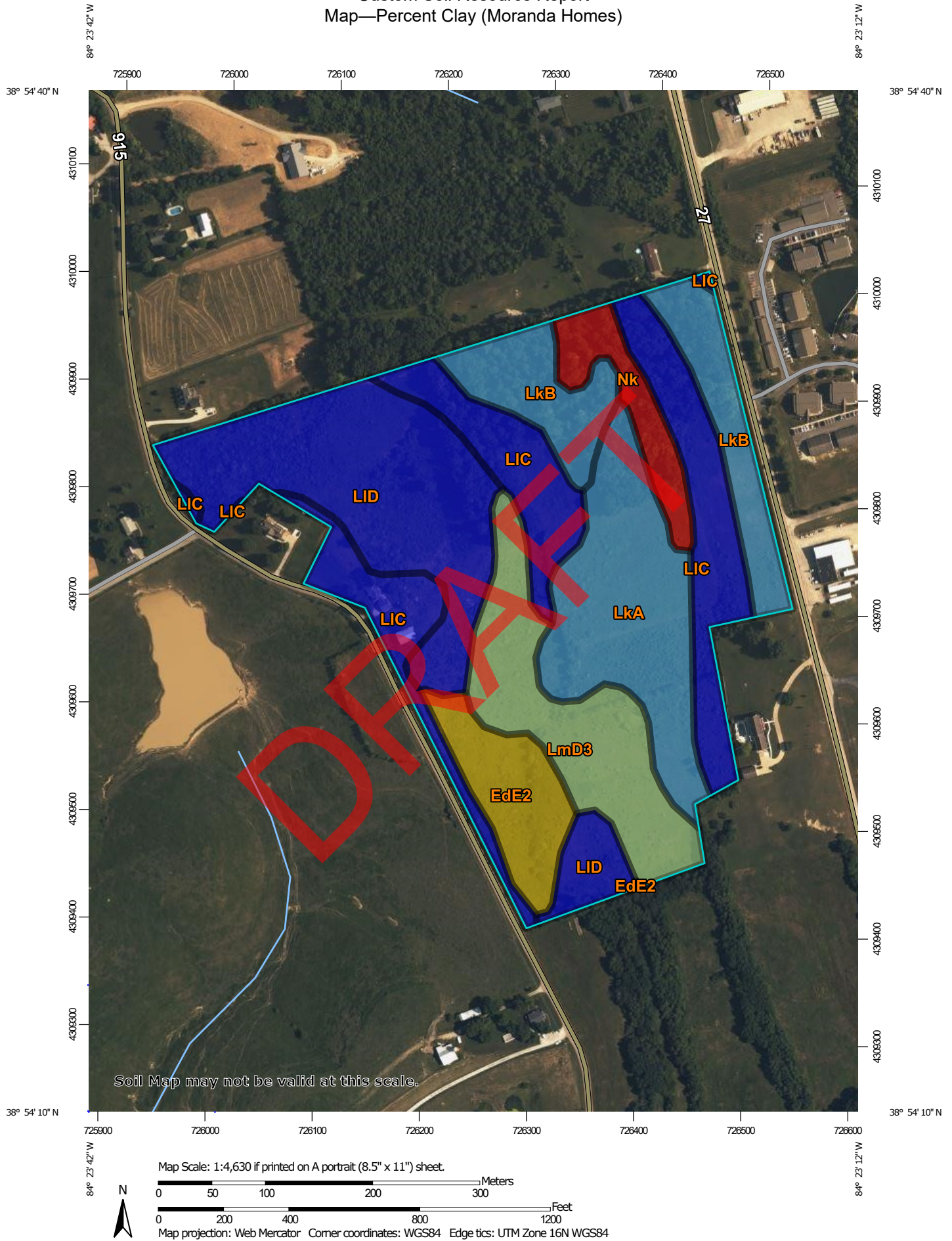
Custom Soil Resource Report

Most of the material is in one of three groups of clay minerals or a mixture of these clay minerals. The groups are kaolinite, smectite, and hydrous mica, the best known member of which is illite.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

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Custom Soil Resource Report
Map—Percent Clay (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

-  ≤ 24.6
-  > 24.6 and ≤ 41.0
-  > 41.0 and ≤ 41.1
-  > 41.1 and ≤ 42.7
-  > 42.7 and ≤ 43.6
-  Not rated or not available

Soil Rating Lines

-  ≤ 24.6
-  > 24.6 and ≤ 41.0
-  > 41.0 and ≤ 41.1
-  > 41.1 and ≤ 42.7
-  > 42.7 and ≤ 43.6
-  Not rated or not available

Soil Rating Points

-  ≤ 24.6
-  > 24.6 and ≤ 41.0
-  > 41.0 and ≤ 41.1
-  > 41.1 and ≤ 42.7
-  > 42.7 and ≤ 43.6
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

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Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—Percent Clay (Moranda Homes)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	41.0	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	42.7	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	42.7	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	43.6	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	43.6	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	41.1	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	24.6	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Percent Clay (Moranda Homes)*Units of Measure:* percent*Aggregation Method:* Dominant Component*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Interpret Nulls as Zero:* No*Layer Options (Horizon Aggregation Method):* All Layers (Weighted Average)**Soil Qualities and Features**

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Representative Slope (Moranda Homes)

Slope gradient is the difference in elevation between two points, expressed as a percentage of the distance between those points.

The slope gradient is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

DRAFT

Custom Soil Resource Report
Map—Representative Slope (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 0 - 5
 5 - 15
 15 - 45
 45 - 60
 60 - 100
 Not rated or not available

Soil Rating Lines

 0 - 5
 5 - 15
 15 - 45
 45 - 60
 60 - 100
 Not rated or not available

Soil Rating Points

 0 - 5
 5 - 15
 15 - 45
 45 - 60
 60 - 100
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—Representative Slope (Moranda Homes)

Map unit symbol	Map unit name	Rating (percent)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	25.0	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	1.0	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	4.0	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	9.0	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	16.0	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	16.0	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	1.0	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Representative Slope (Moranda Homes)*Units of Measure:* percent*Aggregation Method:* Dominant Component*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Interpret Nulls as Zero:* No**Soil Slippage Potential (Moranda Homes)**

Soil slippage potential is the hazard that a mass of soil will slip when vegetation is removed, soil water is at or near saturation, and other normal practices are applied. Conditions that increase the hazard of slippage but are not considered in this rating are undercutting lower portions or loading the upper parts of a slope or altering the drainage or offsite water contribution to the site, such as through irrigation.

Slippage is an important consideration for engineering practices, such as constructing roads and buildings, and for forestry practices.

Custom Soil Resource Report

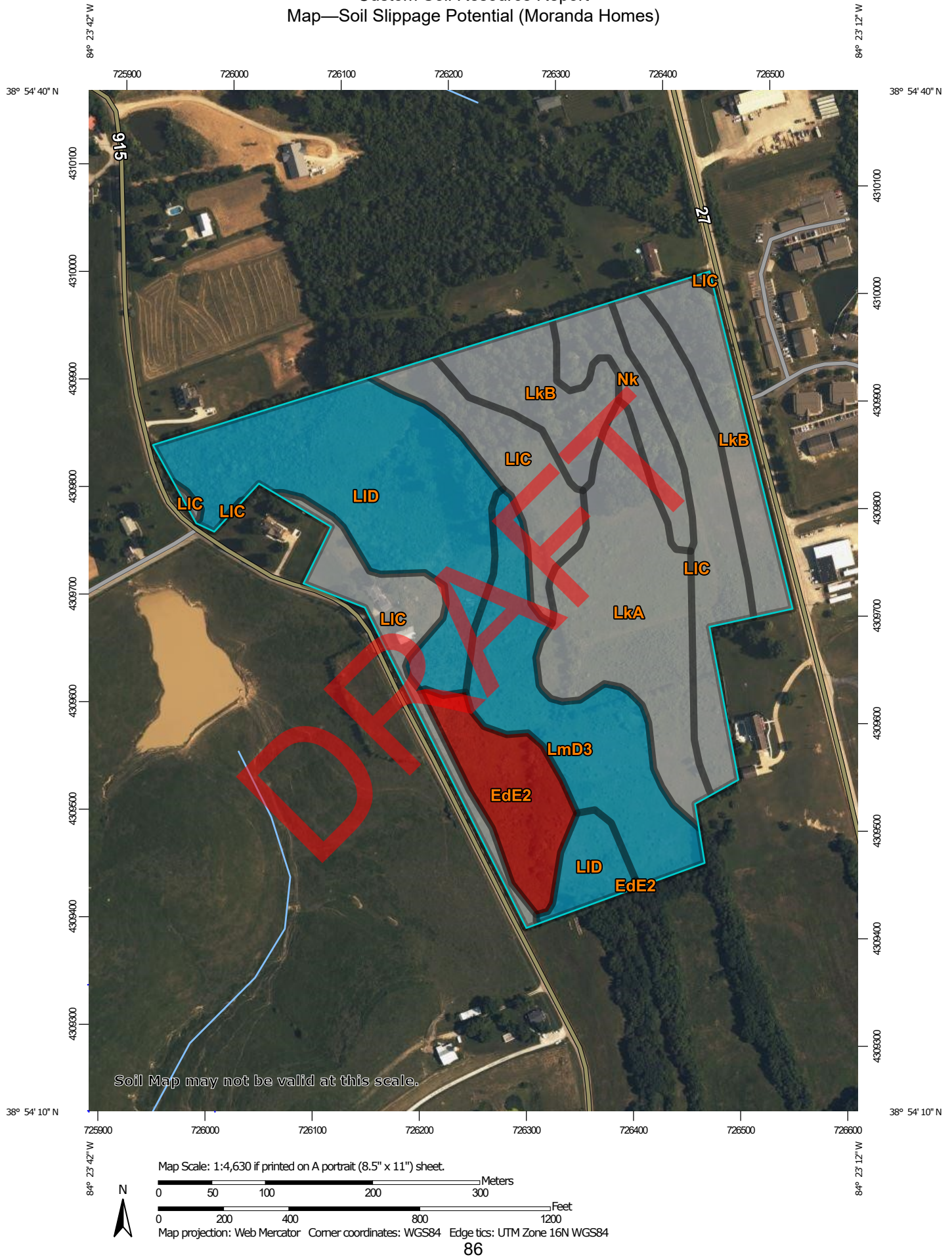
Soil slippage potential classes are estimated by observing slope; lithology, including contrasting lithologies; strike and dip; surface drainage patterns; and occurrences of such features as slip scars and slumps.

The map unit components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as listed for the map unit. The percent composition of each component in a particular map unit is presented to help the user better understand the percentage of each map unit that has the rating presented.

Other components with different ratings may be present in each map unit. The ratings for all components, regardless of the map unit aggregated rating, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

DRAFT

Custom Soil Resource Report
Map—Soil Slippage Potential (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 Low
 Moderately low
 Medium
 Moderately high
 High
 Not rated or not available

Soil Rating Lines

 Low
 Moderately low
 Medium
 Moderately high
 High
 Not rated or not available

Soil Rating Points

 Low
 Moderately low
 Medium
 Moderately high
 High
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails
 Interstate Highways
 US Routes
 Major Roads
 Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL:
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Boone, Campbell, and Kenton Counties, Kentucky
 Survey Area Data: Version 20, Sep 8, 2021

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Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—Soil Slippage Potential (Moranda Homes)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	High	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes		7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes		5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes		10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	Low	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	Low	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)		2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Soil Slippage Potential (Moranda Homes)*Aggregation Method: Dominant Condition**Component Percent Cutoff: None Specified**Tie-break Rule: Higher***AASHTO Group Classification (Surface) (Moranda Homes)**

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

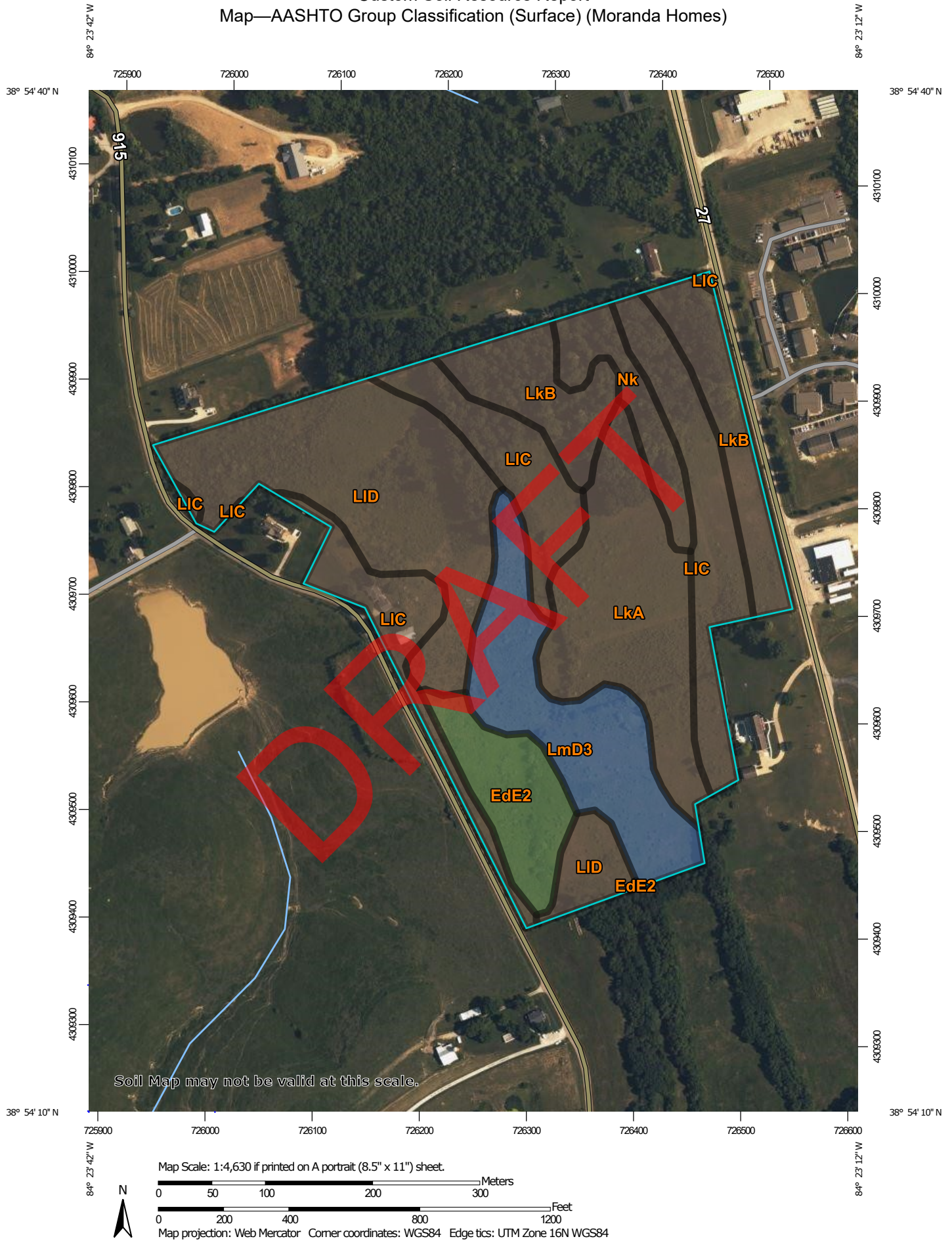
The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

Custom Soil Resource Report

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

DRAFT

Custom Soil Resource Report
Map—AASHTO Group Classification (Surface) (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	A-1
	A-1-a
	A-1-b
	A-2
	A-2-4
	A-2-5
	A-2-6
	A-2-7
	A-3
	A-4
	A-5
	A-6
	A-7
	A-7-5
	A-7-6
	A-8
	Not rated or not available

Soil Rating Lines

	A-1
	A-1-a
	A-1-b
	A-2

	A-2-4
	A-2-5
	A-2-6
	A-2-7
	A-3
	A-4
	A-5
	A-6
	A-7
	A-7-5
	A-7-6
	A-8
	Not rated or not available

Soil Rating Points

	A-1
	A-1-a
	A-1-b
	A-2
	A-2-4
	A-2-5
	A-2-6
	A-2-7
	A-3
	A-4
	A-5
	A-6

	A-7
	A-7-5
	A-7-6
	A-8
	Not rated or not available

Water Features

 Streams and Canals

Transportation

	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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Survey Area Data: Version 20, Sep 8, 2021

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Date(s) aerial images were photographed: Jun 27, 2019—Sep 22, 2019

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MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

DRAFT

Table—AASHTO Group Classification (Surface) (Moranda Homes)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	A-7-6	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	A-4	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	A-4	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	A-4	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	A-4	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	A-6	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	A-4	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—AASHTO Group Classification (Surface) (Moranda Homes)*Aggregation Method:* Dominant Condition*Component Percent Cutoff:* None Specified*Tie-break Rule:* Lower*Layer Options (Horizon Aggregation Method):* Surface Layer (Not applicable)**Unified Soil Classification (Surface) (Moranda Homes)**

The Unified soil classification system classifies mineral and organic mineral soils for engineering purposes on the basis of particle-size characteristics, liquid limit, and plasticity index. It identifies three major soil divisions: (i) coarse-grained soils having less than 50 percent, by weight, particles smaller than 0.074 mm in diameter; (ii) fine-grained soils having 50 percent or more, by weight, particles smaller than 0.074 mm in diameter; and (iii) highly organic soils that demonstrate certain organic characteristics. These divisions are further subdivided into a total of 15 basic soil groups. The major soil divisions and basic soil groups are determined on the basis of estimated or measured values for grain-size distribution and Atterberg limits. ASTM D 2487 shows the criteria chart used for classifying soil in the Unified system

and the 15 basic soil groups of the system and the plasticity chart for the Unified system.

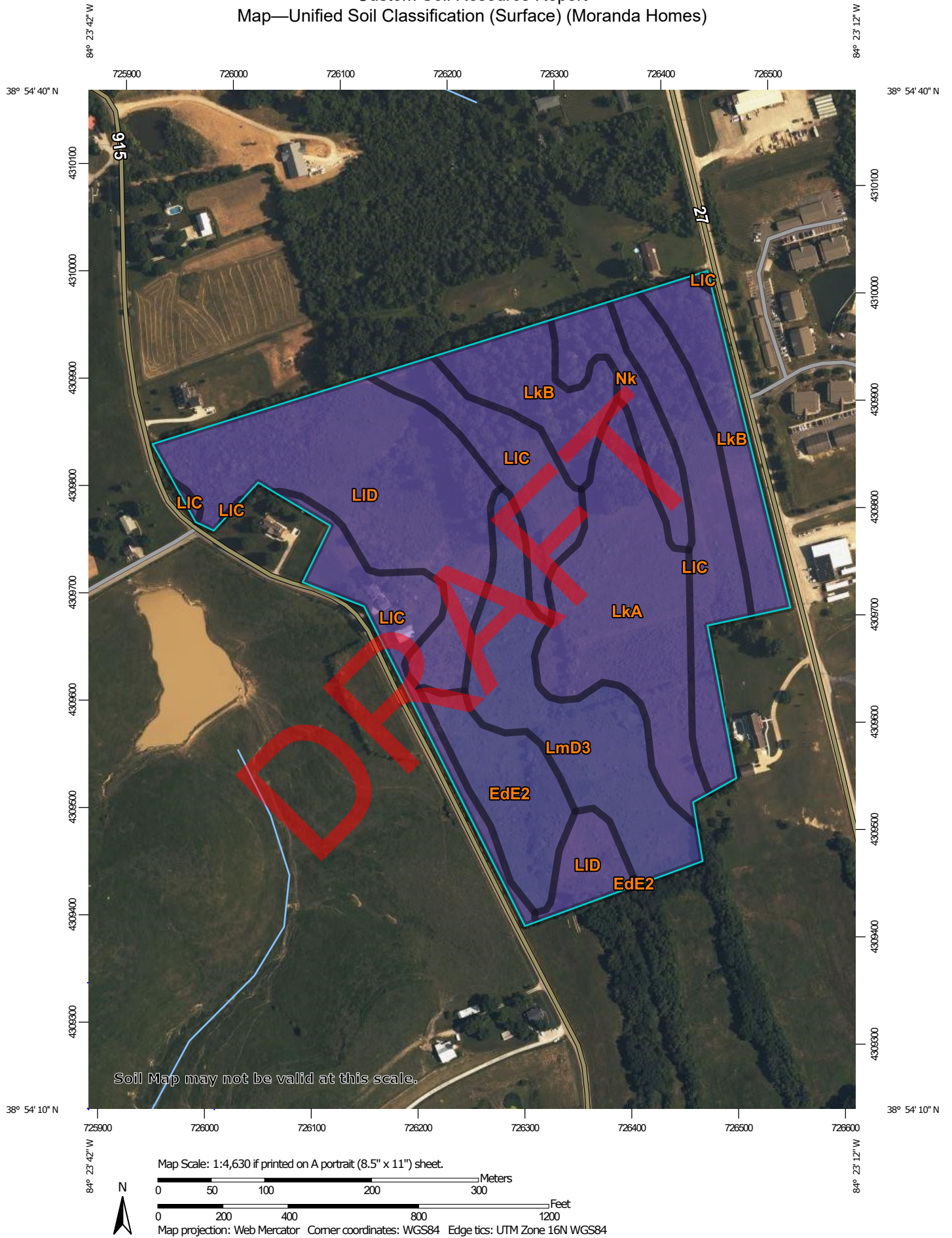
The various groupings of this classification correlate in a general way with the engineering behavior of soils. This correlation provides a useful first step in any field or laboratory investigation for engineering purposes. It can serve to make some general interpretations relating to probable performance of the soil for engineering uses.

For each soil horizon in the database one or more Unified soil classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

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Custom Soil Resource Report

Map—Unified Soil Classification (Surface) (Moranda Homes)



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 CH
 CL
 CL-A (proposed)
 CL-K (proposed)
 CL-ML
 CL-O (proposed)
 CL-T (proposed)
 GC
 GC-GM
 GM
 GP
 GP-GC
 GP-GM
 GW
 GW-GC
 GW-GM
 MH
 MH-A (proposed)
 MH-K (proposed)
 MH-O (proposed)
 MH-T (proposed)
 ML

 ML-A (proposed)
 ML-K (proposed)
 ML-O (proposed)
 ML-T (proposed)
 OH
 OH-T (proposed)
 OL
 PT
 SC
 SC-SM
 SM
 SP
 SP-SC
 SP-SM
 SW
 SW-SC
 SW-SM
 Not rated or not available

Soil Rating Lines

 CH
 CL
 CL-A (proposed)
 CL-K (proposed)
 CL-ML
 CL-O (proposed)
 CL-T (proposed)
 GC
 GC-GM
 GM
 GP
 GP-GC
 GP-GM
 GW
 GW-GC
 GW-GM
 MH
 MH-A (proposed)
 MH-K (proposed)
 MH-O (proposed)
 MH-T (proposed)
 ML
 ML-A (proposed)
 ML-K (proposed)
 ML-O (proposed)
 ML-T (proposed)
 OH
 OH-T (proposed)
 OL
 PT
 SC
 SC-SM
 SM

 SP
 SP-SC
 SP-SM
 SW
 SW-SC
 SW-SM
 Not rated or not available

Soil Rating Points

 CH
 CL
 CL-A (proposed)
 CL-K (proposed)
 CL-ML
 CL-O (proposed)
 CL-T (proposed)
 GC
 GC-GM
 GM
 GP
 GP-GC
 GP-GM
 GW
 GW-GC
 GW-GM
 MH
 MH-A (proposed)
 MH-K (proposed)
 MH-O (proposed)
 MH-T (proposed)
 ML
 ML-A (proposed)
 ML-K (proposed)
 ML-O (proposed)
 ML-T (proposed)
 OH
 OH-T (proposed)
 OL
 PT
 SC
 SC-SM
 SM
 SP
 SP-SC
 SP-SM
 SW
 SW-SC
 SW-SM
 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails

MAP INFORMATION

-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads
- Background**
 -  Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:15,800.

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MAP INFORMATION

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Table—Unified Soil Classification (Surface) (Moranda Homes)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	CL	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	CL-ML	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	CL-ML	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	CL-ML	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	CL-ML	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	CL	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	CL-ML	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Unified Soil Classification (Surface) (Moranda Homes)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

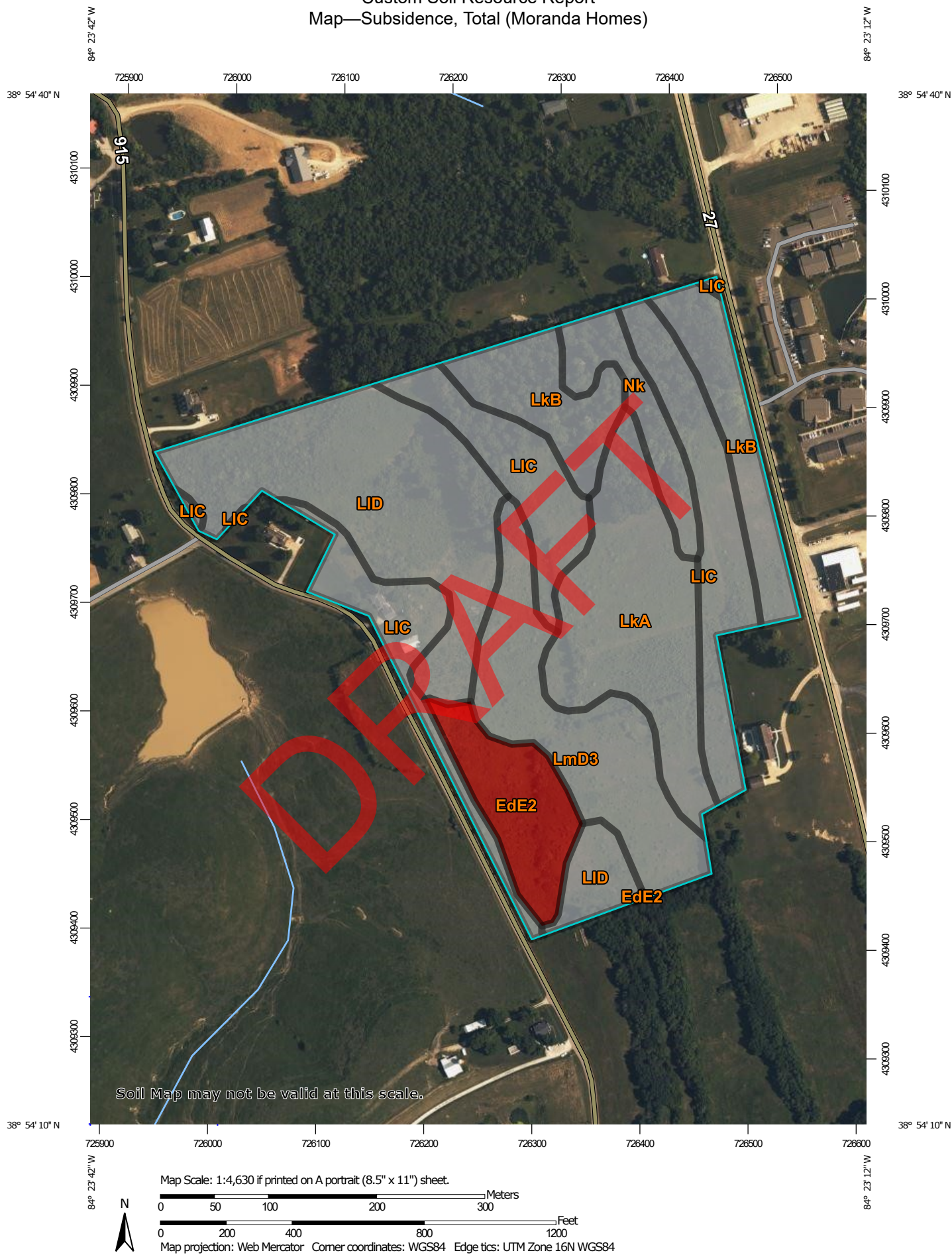
Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Subsidence, Total (Moranda Homes)

Subsidence is the decrease in surface elevation as a result of the drainage of wet soils that have organic layers or semifluid, mineral layers. Total subsidence is the potential decrease of surface elevation as a result of the drainage of these wet soils.

The susceptibility of soils to subsidence is an important consideration for organic soils that are drained. If these soils are drained for community development, special foundations are needed for buildings. Utility lines, sidewalks, and roads that lack special foundations may settle at different rates, thus causing breakage, high maintenance costs, and inconvenience.

Custom Soil Resource Report
Map—Subsidence, Total (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 = 0

 Not rated or not available

Soil Rating Lines

 = 0

 Not rated or not available

Soil Rating Points

 = 0

 Not rated or not available

Water Features

 Streams and Canals

Transportation

 Rails

 Interstate Highways

 US Routes

 Major Roads

 Local Roads

Background

 Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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DRAFT

Table—Subsidence, Total (Moranda Homes)

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	0	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes		7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes		5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes		10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes		11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)		6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)		2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Subsidence, Total (Moranda Homes)*Units of Measure:* centimeters*Aggregation Method:* Dominant Condition*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Interpret Nulls as Zero:* Yes**Parent Material Name (Moranda Homes)**

Parent material name is a term for the general physical, chemical, and mineralogical composition of the unconsolidated material, mineral or organic, in which the soil forms. Mode of deposition and/or weathering may be implied by the name.

The soil surveyor uses parent material to develop a model used for soil mapping. Soil scientists and specialists in other disciplines use parent material to help interpret soil boundaries and project performance of the material below the soil. Many soil properties relate to parent material. Among these properties are proportions of sand, silt, and clay; chemical content; bulk density; structure; and the kinds and amounts of rock fragments. These properties affect interpretations and may be criteria used to separate soil series. Soil properties and landscape information may imply the kind of parent material.

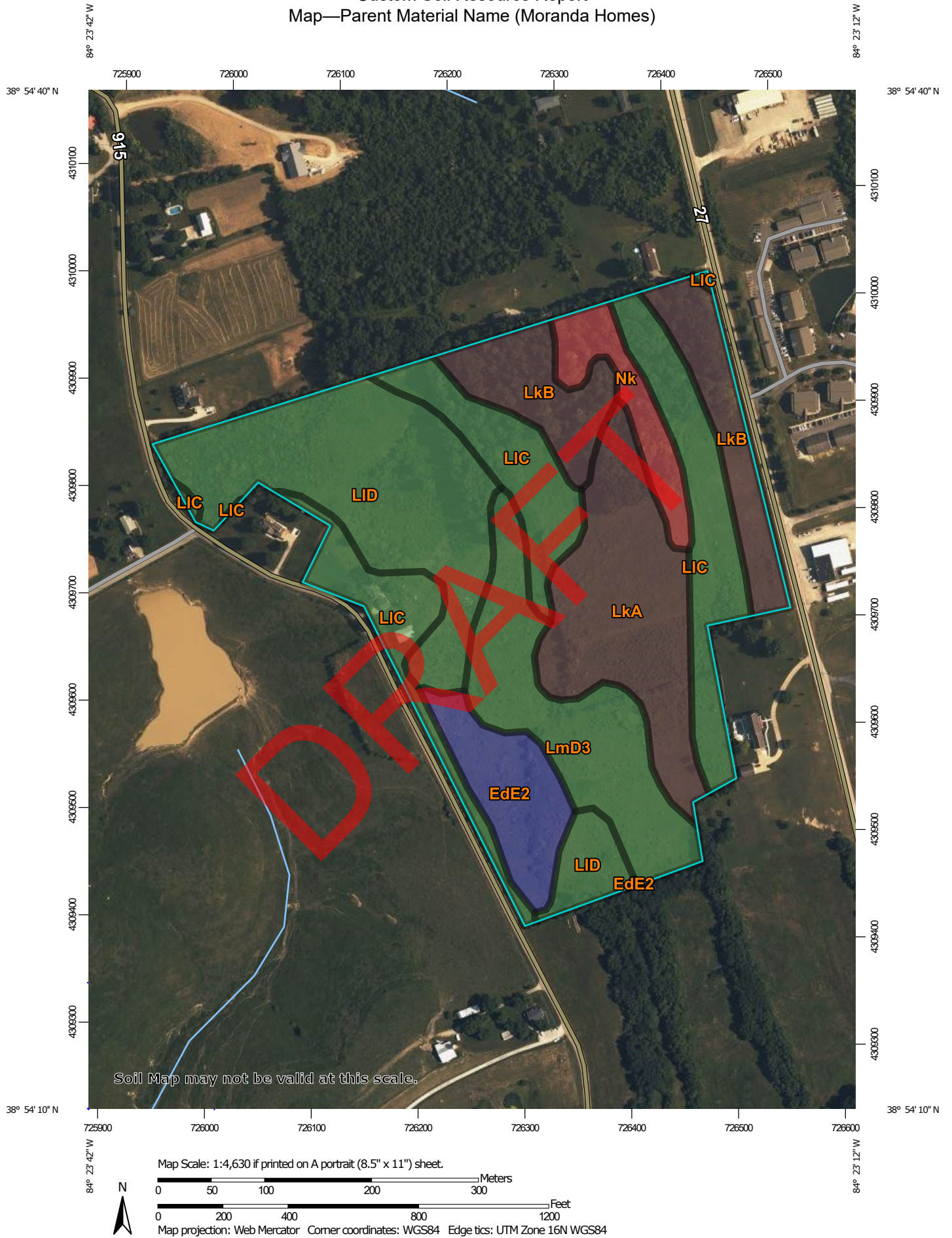
Custom Soil Resource Report

For each soil in the database, one or more parent materials may be identified. One is marked as the representative or most commonly occurring. The representative parent material name is presented here.

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Custom Soil Resource Report

Map—Parent Material Name (Moranda Homes)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

-  clayey residuum weathered from calcareous siltstone and/or clayey residuum weathered from limestone and shale
-  clayey, calcareous lacustrine deposits
-  mixed fine-silty alluvium
-  silty alluvium over clayey, calcareous lacustrine deposits
-  Not rated or not available

Soil Rating Lines

-  clayey residuum weathered from calcareous siltstone and/or clayey residuum weathered from limestone and shale
-  clayey, calcareous lacustrine deposits
-  mixed fine-silty alluvium

 silty alluvium over clayey, calcareous lacustrine deposits

 Not rated or not available

Soil Rating Points

-  clayey residuum weathered from calcareous siltstone and/or clayey residuum weathered from limestone and shale
-  clayey, calcareous lacustrine deposits
-  mixed fine-silty alluvium
-  silty alluvium over clayey, calcareous lacustrine deposits
-  Not rated or not available

Water Features

 Streams and Canals

Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background

 Aerial Photography

MAP INFORMATION

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Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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MAP LEGEND

MAP INFORMATION

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DRAFT

Table—Parent Material Name (Moranda Homes)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EdE2	Eden silty clay loam, 20 to 35 percent slopes, eroded	clayey residuum weathered from calcareous siltstone and/or clayey residuum weathered from limestone and shale	3.2	6.9%
LkA	Licking silt loam, 0 to 2 percent slopes	clayey, calcareous lacustrine deposits	7.4	15.9%
LkB	Licking silt loam, 2 to 6 percent slopes	clayey, calcareous lacustrine deposits	5.8	12.6%
LIC	Licking silty clay loam, 6 to 12 percent slopes	silty alluvium over clayey, calcareous lacustrine deposits	10.4	22.3%
LID	Licking silty clay loam, 12 to 20 percent slopes	silty alluvium over clayey, calcareous lacustrine deposits	11.1	23.9%
LmD3	Licking silty clay, 12 to 20 percent slopes, severely eroded (markland)	silty alluvium over clayey, calcareous lacustrine deposits	6.4	13.7%
Nk	Newark silt loam (0 to 2 percent slopes, occasionally flooded)	mixed fine-silty alluvium	2.2	4.7%
Totals for Area of Interest			46.5	100.0%

Rating Options—Parent Material Name (Moranda Homes)*Aggregation Method: Dominant Condition**Component Percent Cutoff: None Specified**Tie-break Rule: Lower*

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GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
R.C.: Diamond Bit Core Sampler
H.A.: Hand Auger
P.A.: Power Auger - Handheld motorized auger

☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
■ ST: Shelby Tube - 3" O.D., except where noted.
▮ RC: Rock Core
↓ TC: Texas Cone
☞ BS: Bulk Sample
☒ PM: Pressuremeter

CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
N₆₀: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
Q_u: Unconfined compressive strength, TSF
Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
w%: Moisture/water content, %
LL: Liquid Limit, %
PL: Plastic Limit, %
PI: Plasticity Index = (LL-PL), %
DD: Dry unit weight, pcf
▽, ▽, ▼ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

ANGULARITY OF COARSE-GRAINED PARTICLES

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%

GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

<u>Q_u - TSF</u>	<u>N - Blows/foot</u>	<u>Consistency</u>
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

<u>Description</u>	<u>Criteria</u>
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

<u>Description</u>	<u>Criteria</u>	<u>Description</u>	<u>Criteria</u>
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick	Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick	Lensed:	Inclusion of small pockets of different soils
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing	Layer:	Inclusion greater than 3 inches thick (75 mm)
Slickensided:	Fracture planes appear polished or glossy, sometimes striated	Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
		Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

<u>Q_u - TSF</u>	<u>Consistency</u>
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

<u>Description</u>	<u>Criteria</u>
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

<u>Voids</u>	<u>Void Diameter</u>
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

<u>(Typically Sedimentary Rock)</u>	
<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

<u>Rock Mass Description</u>	<u>RQD Value</u>
Excellent	90 - 100
Good	75 - 90
Fair	50 - 75
Poor	25 - 50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		CLEAN SANDS (LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SC	CLAYEY SANDS, SAND - CLAY MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
		SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

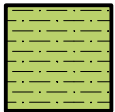
Graphic Symbols for Materials and Rock Deposits



CONCRETE
Portland Cement Concrete



BITUMINOUS CONCRETE



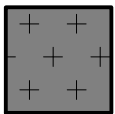
CLAYSTONE



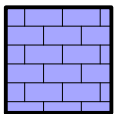
COAL
Coal, Anthracite Coal



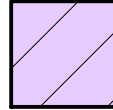
CONGLOMERATE/BRECCIA
Conglomerate, Breccia



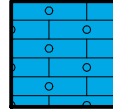
IGNEOUS ROCK
Anorthosite, Basalt, Metabasalt, Diabase
(Gabbro), Gabbro,
Granite/Granodiorite, Hornfels,
Pegmatite, Rhyolite/Metarhyolite



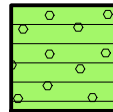
LIMESTONE
Limestone, Dolomite



METAMORPHIC ROCK
Amphibolite, Gneiss, Marble, Phyllite,
Quartzite, Schist, Serpentine, Slate



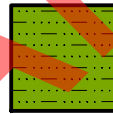
CHERT



SANDSTONE
Sandstone, Orthoquartzite
(Sandstone)



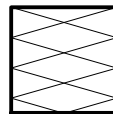
SHALE



SILTSTONE



NO RECOVERY

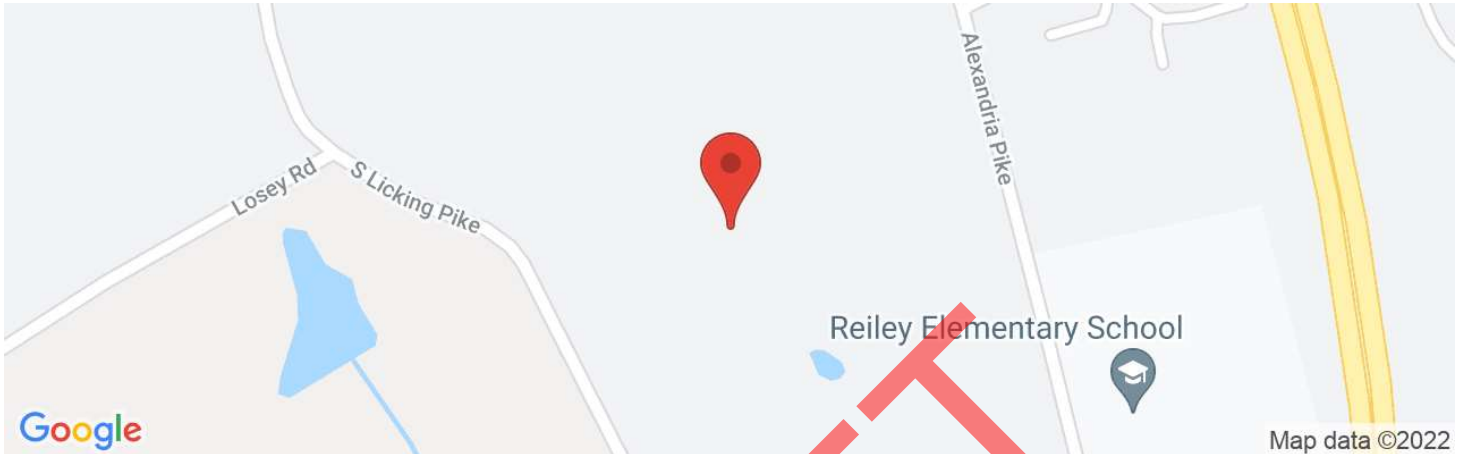


VOID



Alexandria Residential Development

Latitude, Longitude: 38.9071, -84.3901



Date	1/18/2022, 2:15:45 PM
Design Code Reference Document	IBC-2015
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	0.153	MCE_R ground motion. (for 0.2 second period)
S_1	0.08	MCE_R ground motion. (for 1.0s period)
S_{MS}	0.244	Site-modified spectral acceleration value
S_{M1}	0.192	Site-modified spectral acceleration value
S_{DS}	0.163	Numeric seismic design value at 0.2 second SA
S_{D1}	0.128	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2 second
F_v	2.4	Site amplification factor at 1.0 second
PGA	0.071	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.114	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
$SsRT$	0.153	Probabilistic risk-targeted ground motion. (0.2 second)
$SsUH$	0.165	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
$S1RT$	0.08	Probabilistic risk-targeted ground motion. (1.0 second)
$S1UH$	0.09	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
$S1D$	0.6	Factored deterministic acceleration value. (1.0 second)
$PGAd$	0.6	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.924	Mapped value of the risk coefficient at short periods
C_{R1}	0.883	Mapped value of the risk coefficient at a period of 1 s

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APPENDIX B

GEOTECHNICAL EXPLORATION AND EARTHWORK CONSTRUCTION REQUIREMENTS

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SECTION B.1: GEOTECHNICAL EXPLORATIONS

B.1-1 Purpose

This section fulfills the infrastructure requirements of Kentucky Revised Statutes (KRS) 100.273 through 100.292 by determining that: (1) important in situ Subdivision soils and geologic features that will impact the functional use of public and private improvements have been identified; and (2) that soils and geologic aspects of the design and construction of public and private improvements within the Public Street Right of way or Private Street easements meet the support requirements of their intended use.

- (A) All earthwork and geotechnical exploration requirements within Appendix B shall apply to areas within the Public Street Right-of-way and Private Street easements, and areas structurally supporting the Public Street Right-of-way and Private Street easements;
- (B) All Geotechnical Engineering and Geotechnical Technician work and reporting required under Appendix B shall be provided by the Applicant of the proposed Subdivision. The Geotechnical Technician must be under the direction and control of the Geotechnical Engineer who has been employed by the Applicant for the proposed Subdivision. The proposed Subdivision's Geotechnical Engineer shall have substantial professional engineering discretion to determine when the Geotechnical Engineering intent of the requirements of this Appendix is being met.
- (C) The Applicant shall submit all Geotechnical Engineering and Geotechnical Technician reports and testing results to staff at the appropriate submittal time, as noted in Appendix B.

B.1-2 Geotechnical Explorations Outside of Right-of-Way

- (A) Prior to the approval of the preliminary plat, a geotechnical engineer shall complete a preliminary report that addresses the soil and bedrock types and any existing slope stability issues that are expected in the proposed Subdivision.
 - (1) The Geotechnical Engineer's preliminary report will render a preliminary engineering opinion about the suitability of those soil and bedrock types and existing slopes to provide the necessary support for the intended private property use of the Subdivision.
 - (2) The opinion of expected soil and bedrock types and opinion of soil support suitability can be based on the Geotechnical Engineer's local soil and bedrock knowledge, USGS maps, and a visual field reconnaissance.
- (B) The requirement for preliminary and final geotechnical explorations outside of the Public Right-of-way may be further regulated by the applicable legislative body's zoning ordinance.

B.1-3 Geotechnical Explorations Within Right-of-Way

- (A) Preliminary Geotechnical Exploration

- (1) Prior to the approval of the preliminary plat a geotechnical engineer shall complete a preliminary geotechnical exploration report. The report will address the soil and bedrock types that are expected on the project site, and present an engineering opinion about the suitability of the soil and bedrock types (when properly prepared and constructed) to provide adequate proposed Public Street Right-of-way structural support, including the minimum required CBR (subgrade support) values for asphalt and/or concrete pavements described herein.
 - (2) The opinion of expected soil and bedrock types and opinion of Subgrade support suitability can be based on the Geotechnical Engineer's local soil and bedrock knowledge, USGS maps, and a visual field reconnaissance.
 - (3) Campbell County soil types that may require replacement or other form of remediation during Subgrade construction in order to provide the minimum required CBR values for Concrete and Asphalt pavement designs shown in Table A-1 are non-plastic silts (soils that classify ML according to the Unified Soil Classification System (USCS)) and highly plastic silts and clays (MH and CH soils) with standard Proctor maximum dry densities less than 100 pounds per cubic foot and plasticity indices greater than 30 percent.
- (B) Final Geotechnical Exploration
- Prior to approval of the Improvement Plans or Grading Plans a Geotechnical Engineer shall complete a final geotechnical exploration report that identifies the soil and bedrock types present on the project site covered by the Improvement Plans or Grading Plans and presents a written engineering opinion about the suitability of the soils and bedrock to provide stable Right-of-way earthwork construction, and to provide the minimum CBR values for Asphalt and Concrete pavement.
- (1) This written report shall be submitted to staff and be based on the results of soil borings, test pits, field and laboratory soil testing, etc. that are sufficient for the Geotechnical Engineer to render his/her engineering opinion.
 - (2) If the soils are not suitable to provide the minimum CBR values, the Geotechnical Engineer shall include recommendations in the written report for subgrade improvement or alternate pavement designs.

SECTION B.2: EARTHWORK SPECIFICATIONS

B.2-1 Purpose

The purpose of this section is to establish the appropriate earthwork specifications and material testing requirements so that the Public Street Right-of-way and Private Street easements have adequate earthwork structural support and the required pavement subgrade support.

B.2-2 Earthwork Excavations

The following shall apply to earthwork excavations other than trenches or temporary excavations:

- (A) All topsoil shall be stripped from proposed cut, fill and pavement areas.

- (B) Excavations shall be made to approximate grade or Subgrade elevations consistent with approved plans.
- (C) Final cut slopes shall not be steeper than a slope of 3.0 horizontal to 1.0 vertical unless otherwise designed by a Geotechnical Engineer, but in no case shall be steeper than 2.0 horizontal to 1.0 vertical.
- (D) Any spongy, unstable, or organic material that is exposed at the finished Subgrade level must be removed to expose stiff, non-yielding, non-organic soils and the excavated material replaced with soils capable of producing the required Subgrade CBR for the pavement design being used for the project (see Section A.1: Pavement Design Method and Required Thicknesses of these regulations).
- (E) When excavating at the cut/fill transition during earthwork, remove spongy or unstable material, organic matter, or other unsuitable materials that are exposed. The Contractor shall remove same to expose stiff, non-yielding, non-organic soils and shall replace with approved materials, placed and compacted in accordance with these regulations and the recommendations of the geotechnical engineer.
- (F) Excavations can be backfilled with the same soils that were removed, provided they meet the requirements of Subsection B.2-3: Controlled Fill, Subsection B.2-4: Trench Backfill, Subsection B.2-5: Shallow Trench Backfill, and Subsection B.2-6: Deep Trench Backfill.

B.2-3 Controlled Fill Other than Trench Backfill

- (A) Construction of controlled fills shall be observed and tested by a Geotechnical Technician. Density testing and reporting is required at a minimum frequency of one density test per 500 cubic yards.
- (B) Organic or vegetative soils shall not be used in the construction of the controlled fill.
- (C) Controlled fills shall be constructed of natural soils or bedrock to approximate Subgrade elevation in level lift thicknesses that are approved by the Geotechnical Engineer. All shale used in controlled fills shall be pulverized to a soil-like consistency and moisture-conditioned the same as a soil. Limestone shall be laid flat and shall be broken up and dispersed in the fill so that it does not nest or impede compaction. The incorporation of limestone floaters in the fill shall be in accordance with the recommendations of the Geotechnical Engineer.
- (D) Except for the top one foot of earthwork finished grades, which is the pavement subgrade, controlled fills shall be constructed with soils that are within two percent below to three percent above their optimum moisture content and compacted to a firm, non-yielding condition and to dry densities at least 95 percent of the maximum dry density, as determined by the standard Proctor moisture-density test (ASTM D698, latest edition), or 87 percent of maximum dry density as determined by the modified Proctor moisture-density test (ASTM D1557, latest edition).

- (E) Clean granular soils that do not exhibit a well-defined moisture-density curve shall be compacted to a firm, non-yielding condition and to at least 75 percent relative density as determined by the testing methods contained in ASTM D4253 and D4254, latest edition.
- (F) Controlled fill slopes shall not be steeper than 3.0 horizontal to 1.0 vertical unless otherwise designed by a Geotechnical Engineer. In no case shall unreinforced fill slopes be steeper than 2.5 horizontal to 1.0 vertical.
- (G) Lime stabilization in controlled fills is prohibited unless designed and approved by a Geotechnical Engineer.
 - (1) Prior to using lime stabilization, staff shall approve the recommended lime stabilization specifications from a Geotechnical Engineer.
 - (2) The Geotechnical Engineer shall be required to monitor the lime stabilization process in the field to determine that it is consistent with their recommended specifications.
 - (3) A letter from the Geotechnical Engineer shall be submitted to staff confirming that the lime stabilization process used in the field was consistent with their written recommendations.
- (H) Heavy equipment used for compaction shall be capable of producing the required controlled fill densities without lamination.
 - (1) Cohesive soils shall be compacted with kneading type compaction equipment.
 - (2) Cohesionless soils shall be compacted with smooth face vibratory equipment.

B.2-4 Trench Backfill

The following general information shall apply to all trench backfill:

- (A) Trench backfill is defined as the backfill material used to refill the trench excavation above the initial utility conduit bedding and cover that is a part of underground utility installation.
- (B) Natural non-organic soils, bedrock, approved aggregates, and Controlled Low Strength Material shall be used to backfill utility trenches as defined herein.
- (C) Backfill shall not be flushed with water to obtain compaction.
- (D) A Geotechnical Technician shall observe, test and report on the trench backfill compaction at least once per day when said trench backfill operations are occurring.

B.2-5 Shallow Trench Backfill

The following shall apply to shallow trench backfill:

- (A) Shallow trenches are defined as the utility trenches where the backfill material (the material above the granular utility conduit bedding and cover material) is less than three feet deep to finish earthwork grade.
- (B) Shallow trench backfill under the pavement and within a 1 horizontal to 1 vertical projection downward from the bottom edge of curb shall be dense graded aggregate (DGA), No. 57 crushed limestone (only when connected to a Drainage structure) or controlled low strength material (CLSM) as set out in Appendix C: Details C.2 and C.3. Aggregates shall be compacted as shown in the above noted details.
- (C) Shallow trench backfill within the Right of Way but outside of the pavement and beyond a 1.0 horizontal to 1.0 vertical projection downward from the bottom edge of curb shall be natural, nonorganic soil or bedrock (no pieces of limestone thicker than six inches or more than 12 inches long/wide or specified aggregates as set in Appendix C: Details C.2 and C.3.
 - (1) All shale shall be pulverized to a soil-like consistency and moisture-conditioned as a soil.
 - (2) All limestone shall be laid flat, broken up, and dispersed so it does not nest or impede compaction.
 - (3) All backfill shall be moisture-conditioned to within two percent below to three percent above the optimum moisture content for compaction, shall be placed in layers of 8 to 10 inches in thickness, and each lift shall be thoroughly compacted to densities not less than 90 percent of the standard Proctor maximum dry density, or 82 percent of the modified Proctor maximum dry density for that soil.
 - (4) Backfill method shall be either a sheepfoot roller attachment on a track mounted excavator or a self-propelled kneading-type compactor operating longitudinally in the trench excavation.

B.2-6 Deep Trench Backfill

The following shall apply to deep trench backfill:

- (A) Deep trench backfill is defined as any trench with backfill deeper than shallow trench backfill.
- (B) Deep trench backfill shall consist of natural non-organic soil or bedrock (no pieces of limestone thicker than six inches or more than 12 inches long/wide) or specified aggregates as set out in Appendix C: Details C.2 and C.3.
 - (1) All shale shall be pulverized to a soil-like consistency and moisture-conditioned as a soil.
 - (2) All limestone shall be laid flat, broken up and dispersed so that it does not nest or impede compaction.

- (3) All backfill shall be moisture-conditioned to within two percent below to three percent above the optimum moisture content for compaction.
 - (4) Backfill lifts shall be 10 inches thick or less (unless otherwise specified by the Geotechnical Engineer), and compacted to not less than 95 percent of the standard Proctor maximum dry density for that soil.
 - (5) Backfill method shall be either a sheepsfoot roller attachment on a track mounted excavator or a self-propelled kneading-type compactor operating longitudinally in the trench excavation.
- (C) Where depths of trenches are more than four feet and worker safety is at risk, the technician shall observe the compaction process in layers with an appropriate type of compaction equipment and document observations until worker safety is assured when compaction testing, as required, is resumed.

B.2-7 Street Pavement Subgrade

- (A) Subgrade Preparation During Excavation
Subgrade is defined as the top one foot of the soils under the pavement. The pavement Subgrade must provide adequate support for the pavement structure as defined in these regulations.
- (1) During earthwork and initial pavement subgrade preparation, the Geotechnical Engineer or Geotechnical Technician shall evaluate in situ pavement subgrade materials on the site and develop an opinion about their suitability to provide the minimum CBR values when compacted to the required densities at the specified moisture contents.
 - (2) Any soils identified as unsuitable to prove the minimum CBR values will be removed from the subgrade and replaced with suitable soils, or otherwise improved as recommended by the Geotechnical Engineer.
- (B) Final Subgrade Preparations and Testing
- (1) At the time of final Subgrade preparation, density testing and proofrolling before paving, the Subgrade shall be within two percent of its optimum moisture content and compacted to a firm, non-yielding condition and to dry densities at least 98 percent of the maximum dry density, determined by the standard Proctor moisture-density test (ASTM D698, latest edition) or 89 percent of the maximum dry density as determined by the modified Proctor moisture-density test (ASTM D1557, latest edition). Cohesive Subgrade material shall be properly knit together and free of loose, dry, crumbly, baked or crusted soil material.
 - (2) The Subgrade shall consist of cohesive soils, clean #57 crushed limestone, crushed stone base, or Controlled Low Strength Material (CLSM). Any aggregate material used to replace part of the cohesive Subgrade soil must be drained, so that no standing water can collect and be held in the aggregate Subgrade.

- (3) Clean granular soils that do not exhibit a well-defined moisture-density curve shall be compacted to a firm, non-yielding condition and to at least 80 percent relative density as determined by the testing methods contained in ASTM D4253 and D4254, latest edition.
- (4) The Subgrade shall be shaped to plan elevation and cross-section and checked by the Staff inspector for conformity with the cross section shown on the approved Improvement Drawings immediately prior to placing the pavement. Pavement shall not be placed on any part of the Subgrade which does not conform to the cross section shown on the approved Improvement Drawings.

(C) Final Subgrade Proofrolling

- (1) Subgrade Proofrolling is the final test to be performed immediately prior to beginning the paving operations.
- (2) Prior to the placement of pavement materials and after confirming proper density and moisture content of the Subgrade soils, all Street Subgrades shall be proofrolled to test the stability and uniformity of Subgrade materials.
- (3) Subgrade Proofrolling shall be performed with a dual axle dump truck fully loaded with clayey soils or aggregate.
- (4) Subgrade Proofrolling shall be performed at walking speed with at least two passes made in each drive lane direction with the outside wheel generally traveling along the inside line of the future Curb during one pass, and the wheel-paths offset one-half of the truck width during the second pass to maximize subgrade coverage. Extra proofroll passes shall be made at the discretion of the Staff inspector.
 - a) Where proofrolling indicates areas of soft or unsuitable Subgrade soils or areas of non-uniform Subgrade stability, the area shall be delineated and repaired.
 - b) Areas of soft or unsuitable Subgrade soils or areas of non-uniform Subgrade stability shall be identified by observing Pumping and/or Rutting. Pumping is defined as movement or deflection of the Subgrade soil that extends beyond the limits of the direct wheel load. Unless accompanied by Rutting (which is common), the pumping Subgrade soil may rebound back to its original position after the wheel load passes. Pumping failures are typically caused by Subgrade soils with higher than optimum moisture content located within a zone up to several feet below the Subgrade surface. Rutting is defined as imprints or depressions in the Subgrade caused by direct wheel loads. Rutting failures are typically caused by inadequate compaction of near surface soils.
 - c) Rutting in excess of one inch in depth shall be deemed a Subgrade failure requiring Subgrade repair.
 - d) Pumping or deflection of less than one inch is acceptable so long as the Subgrade soil rebounds back to its original position after the wheel load

passes. Pumping or deflection greater than one inch or areas of permanent deflections shall be deemed a Subgrade failure requiring Subgrade repair.

e) For larger areas of subgrade proofroll failure, the alternative pavement design procedures in Subsection A.1-2(B) can be implemented by the Applicant.

- (5) Subgrade repairs shall be performed by scarifying, aerating and recompacting the Subgrade soils. As an alternative, the failed Subgrade soils can be removed and replaced with properly compacted soils capable of producing the required CBR value.
- (6) In all cases, repaired areas shall be retested for compaction and proofrolled again before proceeding with the placement of pavement materials. Rutting can typically be repaired by scarifying, aerating, and recompacting, while areas of pumping will more likely require a more significant repair with depth often including the removal and replacement of unsuitable Subgrade materials.

(D) Final Subgrade Inspection Testing and Reporting Requirements

- (1) Both the Staff inspector and the Geotechnical Technician have final Subgrade review, testing, and reporting responsibilities.
- (2) The Geotechnical Engineer shall provide soil testing to develop an opinion of adequate bearing characteristics of the final Subgrade soils. Those tests will include, but are not limited to, moisture content testing, density testing, and verification of soil types being adequate to produce the required CBR values for the pavement. Moisture content testing, density testing, and verification of soil types being adequate to produce the required CBR values for the pavement shall be performed by the Geotechnical Engineer at intervals no less than one test per 100 lineal feet of Street for Streets of 500 lineal feet or less, or one test per 200 lineal feet for Streets over 500 lineal feet.
- (3) The Geotechnical Technician and the Staff Inspector shall review the proofrolling described in Subsection B.2-7(C): Final Subgrade Proofrolling and determine whether the Subgrade passes the proofroll.
- (4) Paving operations shall only be permitted to begin after passing inspection results are achieved from Subsection B.2-7: Street Pavement Subgrade, Subsection B.2-7(C): Final Subgrade Proofrolling, and Clause B.2-7(D)(2). Inspection reports referenced in Clause B.2-7(D)(1) and Clause B.2-7(D)(2) shall be placed in the Staff project file and Staff shall make their inspection records available to the Developer.
- (5) Street paving shall occur within 30 hours after passing inspection results are achieved from Clause B.2-7(D)(1) and Clause B.2-7(D)(2). A ¼ inch rain event or sub-freezing temperature occurrence between a passing proofroll and Street paving shall void the proofroll and geotechnical testing and shall require re-evaluation.
- (6) For concrete pavements, small pours of up to one hundred square yards to complete intersections, cul-de-sacs, etc. do not require subgrade re-proofrolling

after initially passing a proofroll as part of a large subgrade preparations and testing. Moisture conditioning and rerolling may be required.

B.2-8 Controlled Low Strength Material

- (A) CLSM may be used in place of compacted clayey soils to uniformly backfill utility trenches, manholes, etc.
- (B) CLSM shall not be used in place of clean, free-draining #57 crushed limestone specified for and intended as Drainage backfill around catch basins and manholes or in trench drains, such as between catch basin pairs.
- (C) CLSM shall be transported by mixing truck to ensure proper suspension when placed. Constant agitation is required.
- (D) Flotation of pipes should be avoided by backfilling in 8 to 12 inch lifts until fluid head subsides.
- (E) Adequate separation from aluminum pipe, such as a bituminous coating, is required.
- (F) CLSM shall extend from the top of compacted bedding or other backfill to bottom of pavement structure.
 - (1) CLSM placement shall begin no greater than six inches above the top of the pipe.
- (G) CLSM shall have a minimum excavatable strength of 20 pounds per square inch at three days and 30 pounds per square inch at 28 days. CLSM shall have a maximum excavatable strength of 100 pounds per square inch at 28 days for potential future excavatability.

B.2-9 Construction Equipment on Paved Surfaces

Only rubber tired or rubber tracked equipment shall be used on paved surfaces.

B.2-10 Work Adjacent to Plastic Concrete

Grading operations adjacent to Concrete Curb are prohibited for a minimum of 24 hours after Concrete placement has been completed.

B.2-11 Final Geotechnical Reporting

After the completion of all earthwork covered under this Appendix, for each Subdivision section that is constructed and is to be recorded, the Geotechnical Engineer shall complete a final written report for that Subdivision section. The report will include the following:

- (1) All relevant construction inspection results; and
- (2) A statement from the project Geotechnical Engineer that, to the best of his/her knowledge and belief, all earthwork operations within the Public Street Right-of-

way, Private Street easements and areas structurally supporting the Public Street Right-of-way and Private Street easements were performed in general conformance with the requirements of this Appendix and the recommendations for the areas within the Public Street Right-of-way, Private Street easements and areas structurally supporting the Public Street Right-of-way and Private Street easements contained in the associated geotechnical exploration report.

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