Thiele Geotech Inc

Geotechnical Exploration Report

Ashland Townhome Development

North 24th Street and Euclid Street
Ashland, Nebraska

Prepared for:
Ashland Affordable Housing Partners, LLC
1886 South 126th Street
Omaha, NE 68144

June 14, 2018
TG Project No. 18245.00

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GEOTECHNICAL ▪ MATERIAL ▪ ENVIRONMENTAL ▪ ENGINEERING

Geotechnical Exploration Report

Ashland Townhome Development

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INTRODUCTION

Thiele Geotech, Inc. has completed a geotechnical exploration study for the proposed Ashland Townhome Development to be located near North 24th Street and Euclid Street in Ashland, Nebraska. The purpose of this study was to identify the general soil and ground water conditions underlying the site; to evaluate engineering properties of the existing soils; to provide earthwork and site preparation recommendations; and to recommend design criteria and parameters for foundations, pavements, and other earth supported improvements.

This study included soil borings, laboratory testing, and engineering analysis. A series of three test borings was spaced across the project site at strategic locations. The field and laboratory data are presented in the Appendix, along with a description of investigative methods.

The drilling and testing performed for this study were conducted solely for geotechnical analysis. No analytical testing or environmental assessment has been conducted. Any statements or observations in this report regarding odors, discoloration, or suspicious conditions are strictly for the information of our client. If an evaluation of environmental conditions is desired, a separate environmental assessment should be conducted. This study did not include biological assessment (e.g. mold, fungi, bacteria) or evaluation of measures for their control.

It should also be noted that this report was prepared for design purposes only, and may not be sufficient for a contractor in bid preparation. Prospective contractors should evaluate potential construction problems on the basis of their own knowledge and experience in the local area and on similar projects, taking into account their own intended construction methods and procedures.

This report is an instrument of service prepared for use by our client on this specific project. The report may be duplicated as necessary and distributed to those directly associated with this project, including members of the design team and prospective contractors. However, the technical approach and report format shall be considered proprietary and confidential, and this report may not be distributed in whole or in part to any third party not directly associated with this project. By using and relying on this report, all other parties agree to the same terms, conditions, and limitations to which the client has agreed.

PROJECT DESCRIPTION

Our understanding of the project is based upon information provided by Foundations Development, LLC.

The project consists of constructing a new townhome development in the approximate 1.6-acre site located on the northwest corner of North 24th Street and Euclid Street in Ashland, Nebraska. It is anticipated that a total of three two-story, slab-on-grade, rowhouse type townhomes will be constructed, consisting of approximately 12 living units. The proposed townhomes are assumed to be wood-framed with a combination of brick/stone veneer. No structural loading information was provided. For purposes of this report, maximum column loads of 30 kips and maximum wall loads of 2 kips per lineal foot have been assumed.

Grading plans were unavailable at the time of this report. It is assumed that minor grading will be required to establish finished grades, with cuts and fills of 2 feet or less anticipated.

SURFACE AND SUBSURFACE CONDITIONS

SITE CONDITIONS

The site is located on the northwest corner of North 24th and Euclid Streets in Ashland, Nebraska. It is generally bound on the north by Furnas Street, on the east by North 24th Street, on the south by Euclid Street, and on the west by residential lots. The site generally slopes down to the northeast and was surfaced with grass and numerous large established trees at the time of exploration. Overhead power lines run east and west along the northern portion of the site.

LOCAL GEOLOGY

The surface geology of eastern Nebraska is Pleistocene in age and consists of eolian (wind-blown) deposits of Peoria and Loveland loess. The loess formed in dune-shaped hills along the Missouri River and various tributaries. The Peoria loess typically consists of silty lean clays that are stiff when dry but become softer with increasing moisture content. The Peoria sometimes exhibits low unit weight and is collapse susceptible. The Loveland loess is an older deposit, and typically consists of lean clays. The Loveland generally exhibits higher unit weights and shear strengths than the Peoria. Perched moisture conditions sometimes occur above the Peoria/Loveland interface.

The loess overlies Pleistocene glacial deposits of Kansan and Nebraskan till. The till consists of lean to fat clays mixed with sand, gravel, and occasional cobbles. The glacial deposits are generally fairly deep, but are sometimes near the surface at lower elevations on steep slopes. Cretaceous sandstone or Pennsylvanian limestone and shale form the bedrock unit below the glacial deposits. The depth to bedrock is normally great, and rock is rarely encountered in construction.

Along drainageways, alluvial and colluvial deposits are typically present. These soils were formed by erosion of the adjoining loess-mantled hills. Alluvial deposits are generally present along creeks and in major drainageways. The upper several feet of alluvium are usually stiffer due to the effects of desiccation. Colluvial soils are usually located at the base of steep slopes and in upland draws, and are formed by local creep and sloughing.

SOIL CONDITIONS

The soils encountered in the test borings generally consisted of man-placed fill, altered Peoria loess, Peoria loess, and Todd Valley alluvium.

Man-placed fill was encountered at the surface of all three borings. The fill layer thickness ranged from 3 feet in boring B-2 to 8 feet in boring B-3. The fill was generally described as brown to dark brown, moist to very moist, hard, lean clay. Based on an assumed Standard Proctor (ASTM D698), the fill appears to have been placed in a relatively structural manner and compacted between 92 to over 100 percent of the maximum dry density.

An approximate 3-feet thick layer of altered Peoria loess was encountered below the man-placed fill in boring B-2. This is a weathered layer of Peoria loess that has been altered physically and chemically due to the effects of freeze-thaw, exposure, and has become slightly organic from years of vegetative growth. It was described as a dark brown, very moist, firm, lean clay.

Peoria loess was encountered below the altered Peoria loess in boring B-2 and below the man-placed fill in borings B-1 and B-3. It was described as a light gray, very moist, soft to firm, lean clay.

Todd Valley alluvium was encountered below the Peoria loess in all three borings, extending to termination depths. It was described as a light brown, dry, medium dense, poorly-graded sand.

Ranges of engineering properties from laboratory tests on selected samples are presented in Table 1.

Table 1 – Laboratory Results

Soil Layer	Moisture Content (%)	Dry Unit Weight (pcf)	Unconfined Compressive Strength (tsf)	Standard Penetration Values (N)*	Classification *(LL/PI)*
Man-placed fill	12 to 25	96 to 120	1.6 to 2.3	--	CL (38/22)
Altered Peoria loess	26	92	1.3	--	CL (visual)
Peoria loess	24 to 31	87 to 96	1.1 to 1.4	--	CL (visual)
Todd Valley alluvium	1 to 4	--	--	20 to 27	SP (P200: 2.9%, 3.0%)

** Standard Penetration Values are actual field recorded values and have not been corrected for hammer energy.*

GROUND WATER OBSERVATIONS

Ground water was not encountered in any of the test borings during or at the end of the drilling operation. However, it must be noted that ground water levels may fluctuate due to seasonal variations and other factors. The materials encountered in the test borings have relatively low permeabilities and observations over an extended period of time through use of piezometers or cased borings would be required to better define current ground water conditions.

ANALYSIS AND RECOMMENDATIONS

GENERAL

With the encountered soil conditions, this site appears suitable to support the proposed structures. The soil encountered in the borings was generally firm and stable near the assumed footing subgrade elevation and should provide adequate load carrying capabilities with conventional spread footings following the recommendations and procedures provided in the Shallow Foundation section.

Ground water was not encountered in any of the soil borings and is not anticipated to be encountered during construction of the structures. However, it should be noted that ground water does have a tendency to rise and fall with changes in season.

EARTHWORK AND EXCAVATIONS

Rubble and waste materials from site clearing should be removed from the site and lawfully disposed or recycled. Waste materials should not be buried on-site. Where trees are cleared, the stumps should be excavated and removed.

Relocation of any existing utility lines within the zone of influence of proposed construction areas should also be completed as part of the site preparation. The lines should be relocated to areas outside of the proposed construction. Excavations created by removal of the existing lines should be cut wide enough to allow for use of heavy construction equipment to recompact the fill. In addition, the base of the excavations should be evaluated by a geotechnical engineering representative prior to placement of fill.

Topsoil and vegetation should be stripped to a depth of 4 to 6 inches in areas to be disturbed during grading, including borrow and fill areas. Stripping depths will likely vary and should be adjusted to remove all vegetation and root systems. A representative of the geotechnical engineer should monitor the stripping operations to observe that all unsuitable materials have been removed. Care should be exercised to separate these materials to avoid incorporation of the organic matter in structural fill sections.

Surfaces to receive fill should be broken up and recompacted to allow new fill to bond to the existing soil. Slopes steeper than 5H:1V should be benched before placing fill.

The excavated site soils will generally be suitable for reuse as structural fill, although significant moisture conditioning may be required. Any off-site borrow should be a clean, inorganic silt or lean clay with a liquid limit less than 45 and a plasticity index less than 20. Borrow material should not contain an appreciable amount of roots, rock, or debris, and should not contain any foreign material with a dimension greater than 3 inches.

All fills should be placed and compacted as structural fill. Fill should be placed in thin lifts not to exceed 8 inches loose thickness. Structural fill should be compacted with a sheepsfoot type roller to a minimum of 95 percent of the maximum dry density (ASTM D698, Standard Proctor). Moisture content should be controlled to between -3 and +4 percent of optimum.

Backfill soils in utility trenches should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum. Lift thicknesses should be appropriately matched to the type of compaction equipment used. Backfill soils around foundations, basement walls, and retaining walls should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum. Granular backfill should not be used in exterior trenches or around foundation elements.

Quality control testing is an important part of any earthwork operation. It is recommended that a representative of the geotechnical engineer periodically monitor earthwork operations to verify proper compliance with these recommendations, including compaction levels.

OSHA's Construction Standards for Excavations require that the contractor's excavation activities follow certain worker safety procedures. These include a requirement that excavations over 4 feet deep be sloped back, shored, or shielded. The soils encountered in the test borings generally classify as type B and C soils according to the OSHA standard. The maximum allowable slope for an unbraced excavation in these soils is 1H:1V and 1.5H:1V, respectively, although other provisions and restrictions apply. Excavations over 20 feet deep require specific design by a licensed Professional Engineer. The contractor is solely responsible for site/excavation safety and compliance with OSHA regulations. The geotechnical engineer assumes no responsibility for site safety, and the above information is provided only for consideration by the designers.

SHALLOW FOUNDATIONS

The site conditions identified are favorable for the use of conventional spread foundations to support structural loads. Based on our bearing capacity and settlement analysis, a net allowable bearing pressure of 1,500 pounds per square foot was determined. This allowable bearing pressure may be used to size wall footings and column pads. The bearing pressure was calculated based on a safety factor of 3 against bearing failure. Foundation settlements are estimated at less than 1 inch total and ½ inch differential over a span of 20 feet. If maximum design loads significantly exceed 3 kips per foot for walls, these bearing pressures may not be applicable and should be reevaluated.

It is recommended that column footings be at least 3 feet square and that load bearing wall footings be at least 16 inches wide. Exterior footings and footings in unheated areas should be founded a minimum of 3.5 feet below adjacent grade to provide reasonable frost protection. It is recommended that all footings be steel reinforced.

The condition of the bearing soils can vary and should be observed by the geotechnical engineer at the time of excavation. If unsuitable bearing soils are identified, they should be improved by compaction or replaced by structural fill. As an alternative, the footing bottom could be extended through unsuitable materials if suitable material is present below.

SEISMIC SITE CLASS

Seismic structural design requirements are dictated by a site classification based on average soil properties within the top 100 feet. Based on our local experience, the soil profile was estimated below the maximum boring depth. The average undrained shear strength was then estimated based on the actual laboratory testing and on assumed soil properties for the deeper soil profile.

The site classifies as Site Class D (stiff soil profile) according to Table 1613.5.2 of the 2009 International Building Code.

FLOOR SLABS

To avoid localized slab failures, it is important that interior backfill around foundation elements and in plumbing trenches be properly compacted. Interior backfill should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor).

To provide uniform support for floor slabs, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor). Care should be taken to maintain the condition of the subgrade. Areas that become saturated, frozen, or disturbed should be reworked prior to slab placement. Any unstable areas should be excavated and replaced with structural fill. A granular cushion beneath the floor slab is considered a construction convenience and may be used, but is not considered critical to proper slab performance.

A 10 mil thick vapor retarder is recommended beneath the concrete to inhibit upward migration of moisture through the slab. Care should be taken when finishing concrete placed directly on a vapor retarder to minimize potential problems with curling and blistering.

Interior partition walls weighing up to 1,000 pounds per lineal foot may be supported directly on the floor slab. It is recommended that control joints be provided between partition walls that bear on the floor slab and walls supported on footings. Entrance slabs should be designed as structural stoops with a cavity beneath the slab to accommodate frost heave.

Contraction joints are important to control the location of cracks in the floor slab that result from stresses caused by normal drying shrinkage. Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Contraction joints should be cut to a minimum of ¼ of the slab thickness (1/5 of the thickness for early entry saw method).

Joints should be spaced no more than 30 times the thickness of the slab or 15 feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints where slabs are subjected to heavy loads. Joints should be carefully planned and laid out to match column lines and to meet reentrant corners. Joints should be perpendicular to edges and should not form angles less than 45 degrees or over 225 degrees. To accommodate the relative movement that commonly occurs between floors and foundations, isolation joints should be provided against walls, and diamond or circular isolation joints should be constructed around columns.

PAVEMENTS

Pavement performance is directly affected by the degree of compaction, uniformity, and stability of the subgrade. This is particularly important where traffic from heavy trucks is anticipated. The final subgrade should be reworked and compacted immediately prior to pavement construction. The subgrade should then be proof rolled, and any unstable areas should be excavated and replaced to create a uniform and stable subgrade.

For concrete pavements, it is recommended that the upper 12 inches of the subgrade be compacted to a minimum of 90 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D1557, Modified Proctor). Subgrade preparation should extend a minimum of 2 feet laterally beyond the edge of the pavement.

Under sidewalks, the upper 6 inches of the subgrade should be compacted to a minimum of 95 percent of the maximum dry density at a moisture content between -3 and +4 percent of optimum (ASTM D698, Standard Proctor). Subgrade preparation should extend laterally 6 inches beyond the edge of the sidewalk.

Based on the forgoing subgrade preparation procedures, recommended minimum pavement thicknesses are provided in Table 2. These minimum thicknesses are prescriptive values based on traffic classification, and not on a detailed analysis using traffic counts. Note that we do not recommend using an aggregate base as part of the pavement section due to concerns over drainage and freeze/thaw deterioration of the base material.

Table 2 – Minimum Pavement Thicknesses

Pavement Category	Pavement Type/Thickness (inches)
	Concrete
Sidewalks	4
Driveways	5
Subgrade Support Values: CBR = 3, k=120 pci *Materials: (reference City of Omaha Standard Specifications for Public Works Construction, 2014 Edition)* *concrete - mix type L65 (f'_c = 4,000 psi) (Section 500)*	

Contraction joints are important to control the location of cracks in concrete pavement that result from stresses caused by normal drying shrinkage and thermal effects. A proper jointing system will enhance structural capacity and prolong the life span of a concrete pavement as well as improve ride quality. Contraction joints should be cut to a minimum of ¼ of the slab thickness (1/5 of the thickness for early entry saw method). Joints should be cut as soon as practical after the concrete has set sufficiently to support foot traffic, and must be cut before any shrinkage cracks form. Joints should be spaced no more than 24 times the thickness of the slab or 12½ feet maximum. Panels should be kept as square as possible, with the length to width ratio limited to 125 percent. Dowel bars should be used for load transfer across construction joints, and should be considered for contraction joints subjected to heavy truck traffic. Joints should be carefully planned and laid out to meet inlets, drainage structures, reentrant corners, and radiuses. Joints should be perpendicular to edges and radiuses, and should not form angles less than 45 degrees or over 225 degrees. Isolation joints should be provided around any structures.

We recommend that joints be sealed to reduce moisture infiltration and to reduce the accumulation of non-compressible materials. Joint sealing should be considered as a two part process, sealing of the exposed sawcut face of the concrete and sealing of the joint itself. Following sawcutting and cleaning the joints with compressed air, a penetrating concrete sealer (Silane, Silicate, or Siliconate based) should be spray applied to the joint extending outwards a minimum of 8 inches either side of the sawcut. This penetrating sealer will help to limit moisture infiltration along the sawcut face, helping to mitigate premature joint damage from freeze-thaw cycles. Following the spray applied sealer, a hot pour joint sealer can be used to fill the sawcut. Use of backer rods is not recommended.

Backfill behind curbs and within islands/medians should consist of relatively impervious cohesive soils. Backfill should be compacted to a minimum of 95 percent of the maximum dry density (ASTM D698) to minimize subsidence and to reduce moisture infiltration around the edges of the pavement. Granular soils should not be used for fill in islands as this can increase infiltration into the subgrade. Porous fills, including granular material and loosely placed clay soils, also act as a reservoir that can allow moisture to seep through cracks and joints onto the pavement surface, sometimes long after the water is trapped.

This condition is especially pronounced when loose backfill consolidates and allows surface water to pond.

SURFACE DRAINAGE AND LANDSCAPING

The long-term performance of any project is contingent upon keeping the subgrade soils at more or less constant moisture content, and by not allowing surface drainage a path to the subsurface. Positive surface drainage away from structures must be maintained at all times. Landscaped areas should be designed and built such that irrigation and other surface water will be collected and carried away from the structure.

Construction staging and grading should provide for removal of surface water from the site. If prolonged ponding of surface water occurs, removal and replacement of wet or disturbed soils may be necessary. Temporary grades should be established to prevent runoff from entering excavations or footing trenches. Backfill should be placed as soon as structural strength requirements are met, and should be graded to drain away from the building.

The final grade of the foundation backfill and any overlying pavements should have a positive slope away from foundation walls on all sides. For grass or landscape covered areas, a minimum slope of 2 inch per foot for 5 to 10 feet away from the building is recommended. A minimum slope of 3 percent is recommended for grassed or landscaped areas of the site away from the building. For paved areas, a minimum slope of 1 percent for concrete pavement is recommended. Pavements and exterior slabs that abut the structure should be carefully sealed against moisture intrusion at the joint.

OTHER RECOMMENDATIONS

During detailed design, additional issues may arise and possible conflicts may occur with our recommendations. Such issues and conflicts should be resolved through dialogue between the geotechnical engineer and designers. It is recommended that the geotechnical engineer review the final design, including the plans and specifications, to verify that our recommendations are properly interpreted and incorporated into the design.

If any changes are made in the design of the project, including the nature or location of proposed facilities on the site or significant elevation changes, the analysis and recommendations of this report shall not be considered valid unless the changes are reviewed. The analysis and recommendations of this report should not be applied to different projects on the same site or to similar projects on different sites.

The analysis and recommendations in this report are based upon borings at specific locations. The nature and extent of variation between boring locations is impossible to predict. Because of this, geotechnical recommendations are preliminary until they have been confirmed through observation of site excavation and earthwork preparation. If variations appear during subsequent exploration or during construction,

we may reevaluate our recommendations and modify them, if appropriate. The geotechnical engineer should be retained during construction to observe compliance with the recommendations of this report and to provide quality control testing of earthwork construction. If these services are provided by others, including the contractor, the entity that provides construction phase observation and testing shares responsibility as the geotechnical engineer of record for implementing or modifying these recommendations.

Respectfully submitted,
Thiele Geotech, Inc.

Reviewed by,

Andrew J. Miller, P.E.
Nebraska License E-16419

Prepared by,

Heath E. Cutler

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APPENDIX

Subsurface Exploration Methods

Legend of Terms

Boring Location Plan

Boring Logs

Soil Test Summary

SUBSURFACE EXPLORATION METHODS

The fieldwork for this study was conducted on May 22, 2018. The exploratory program consisted of three test borings drilled at the approximate locations shown on the Boring Location Plan. Boring locations were selected to provide the desired site coverage and were adjusted to accommodate access conditions. The boring locations were laid out in the field using a handheld GPS and coordinates interpreted from Google Earth. Elevations were interpolated from Google Earth. The boring locations and elevations should only be considered accurate to the degree implied by the methods used to define them.

Test borings were advanced using flight augers powered by a truck-mounted drill rig. Soil samples were obtained at selected depths as indicated on the boring logs. A 3-inch nominal diameter thin-walled sampler was hydraulically pushed to obtain undisturbed samples. Disturbed samples were obtained by driving a 2-inch nominal diameter split barrel sampler while conducting standard penetration tests (SPT). The SPT values presented on the boring logs are actual field recorded numbers and have not been corrected for hammer energy or overburden.

The boring logs were prepared based on visual classification of the samples and drill cuttings, and by observation of the drilling characteristics of the subsurface formations. The logs have been supplemented and modified based on the laboratory test results and further examination of the recovered samples. The stratification lines on the boring logs represent the approximate boundary between soil types, but the insitu transition may be gradual.

Water level observations were made at the times stated on the boring logs. The borings were backfilled with drill cuttings at the completion of the fieldwork.

The field boring logs were reviewed to outline the depths, thicknesses, and extent of the soil strata. A laboratory testing program was then developed to further classify the basic soils and to evaluate the engineering properties for use in our analysis.

Laboratory tests to further classify the soils included visual classification, moisture content, dry unit weight, Atterberg limits, and fraction passing the #200 sieve. The shear strengths of cohesive samples were evaluated using the unconfined compression test.

The boring logs and related information in this report are indicators of subsurface conditions only at the specific locations and times noted. Subsurface conditions, including ground water levels, at other locations of the site may differ significantly from conditions that exist at the sampling locations. Also note that the passage of time may affect conditions at the sampling locations.

Thiele Geotech Inc

LEGEND OF TERMS

Soil Description Terms

Consistency - Fine Grained	Consistency - Coarse Grained	Moisture Conditions
Very Soft, Soft, Firm, Hard, Very Hard	Very Loose, Loose, Medium Dense, Dense, Very Dense	Dry, Slightly Moist, Moist Very Moist, Wet (Saturated)

Sample Identification

Sample Type	Sample Data	Laboratory Data
U -- Undisturbed (Shelby Tube)	No. -- Number	MC -- Moisture content
S -- Split barrel (disturbed)	SPT -- Standard penetration test	γ_d -- Dry unit weight
C -- Continuous sample	bpf -- blows per foot	q_u -- Unconfined compression
A -- Auger cuttings (disturbed)	Rec -- Recovery	LL/PI -- Liquid limit & plasticity index

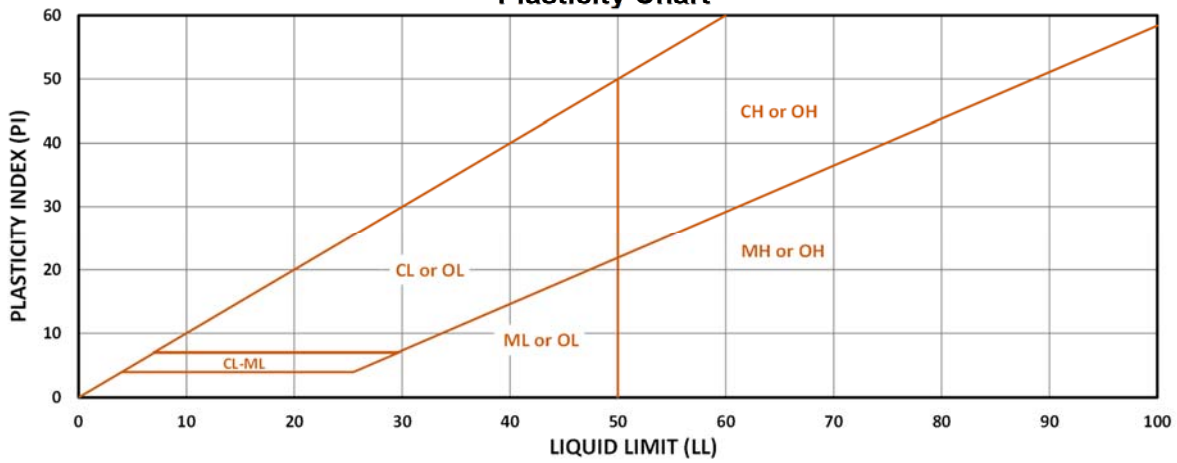
Unified Soil Classification System

Peat	Pt	Highly organic soils	50% or more smaller than No. 200 sieve
Fat Clay	CH	Clay - Liquid Limit > 50 *	
Elastic Silt	MH	Silt - Liquid Limit > 50 *	
Lean Clay	CL	Clay - Liquid Limit < 50 *	
Silt	ML	Silt - Liquid Limit < 50 *	
Silty Clay	CL-ML	Silty Clay *	
Clayey Sand	SC	Sands with 12 to 50 percent smaller than No. 200 sieve *	More than 50% larger than No. 200 sieve and % sand > % Gravel
Silty Sand	SM		
Poorly-Graded Sand with Clay	SP-SC	Sands with 5 to 12 percent smaller than No. 200 Sieve *	
Poorly-Graded Sand with Silt	SP-SM		
Well-Graded Sand with Clay **	SW-SC		
Well-Graded Sand with Silt **	SW-SM		
Poorly-Graded Sand	SP	Sands with less than 5 percent smaller than No. 200 sieve *	
Well-Graded Sand **	SW		
Clayey Gravel	GC	Gravels with 12 to 50 percent smaller than No. 200 Sieve *	More than 50% larger than No. 200 sieve and % gravel > % sand
Silty Gravel	GM		
Poorly-Graded Gravel with Clay	GP-GC	Gravels with 5 to 12 percent smaller than No. 200 sieve *	
Poorly-Graded Gravel with Silt	GP-GM		
Well-Graded Gravel with Clay **	GW-GC		
Well-Graded Gravel with Silt **	GW-GM		
Poorly-Graded Gravel	GP	Gravels with less than 5 percent smaller than No. 200 sieve *	
Well-Graded Gravel **	GW		

* *See Plasticity Chart for definition of silts and clays*

** *See Criteria for Sands and Gravels for definition of well-graded*

Plasticity Chart

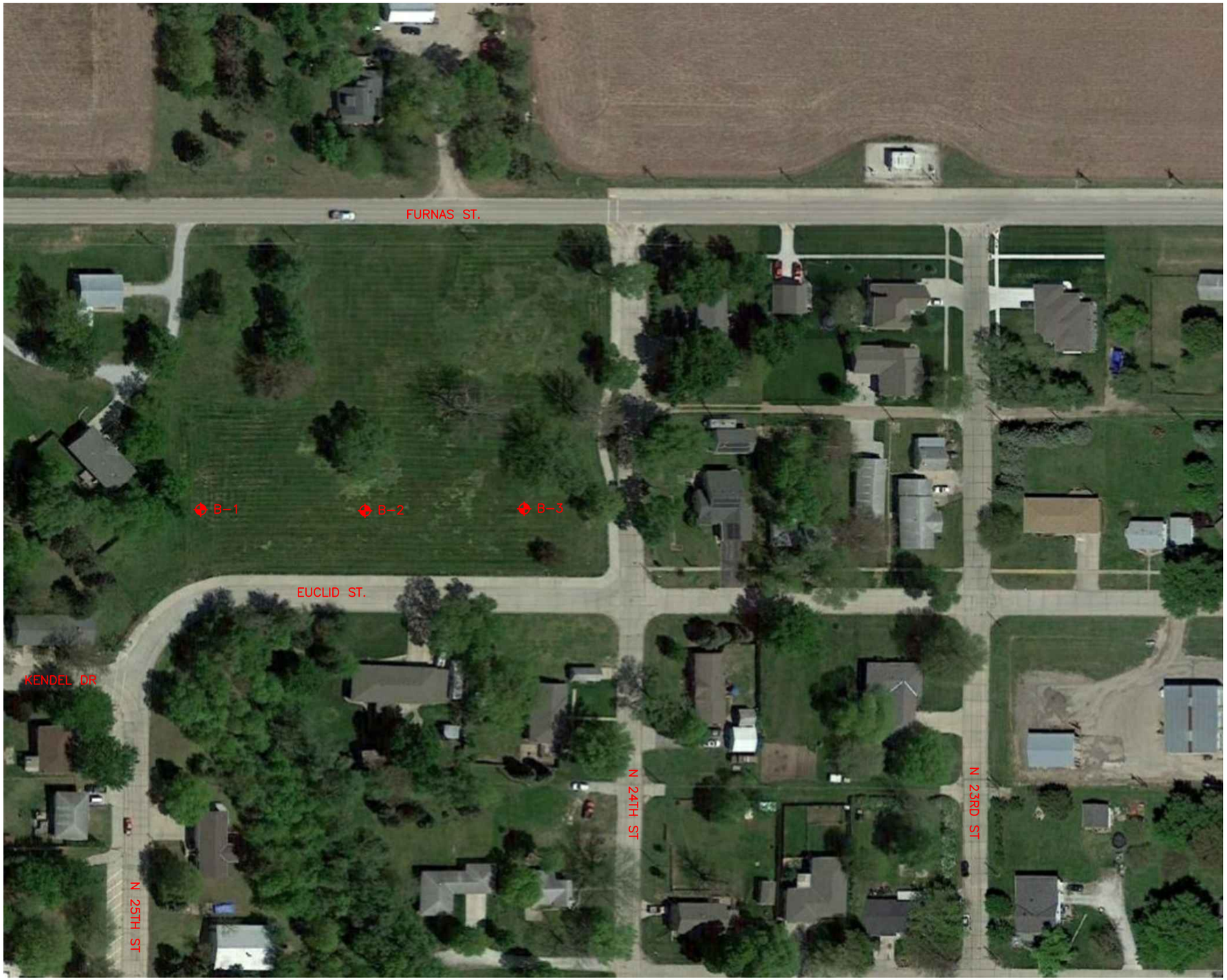


Criteria for Sands and Gravels

Boulders	Cobbles	Coarse Gravel	Fine Gravel	Coarse Sand	Medium Sand	Fine Sand	FINES (silt or clay)
Sieve size 12"		3"	¾"	#4	#10	#40	#200

Well-graded sands (SW) $C_u=D_{60}/D_{10}\geq 6$ and $C_c=(D_{30})^2/(D_{10} \times D_{60}) \leq 3$ and ≥ 1

Well-graded gravels (GW) $C_u=D_{60}/D_{10}\geq 4$ and $C_c=(D_{30})^2/(D_{10} \times D_{60}) \leq 3$ and ≥ 1



N

0 50 100
SCALE: 1"= 100'

LEGEND:

BORING LOCATION

Thiele Geotech Inc

PROJECT

ASHLAND TOWNHOME DEVELOPMENT
N 24TH ST. AND EUCLID ST.
ASHLAND, NE

JOB # 18245.00 | DATE: 06/01/18

BORING LOCATION PLAN

Thiele Geotech Inc

Thiele Geotech, Inc.
13478 Chandler Rd
Omaha, NE 68138
Telephone: 402-556-2171

BORING NUMBER B-1

CLIENT Ashland Affordable Housing Partners, LLC
PROJECT NAME Ashland Townhome Development
PROJECT NUMBER 18245.00
PROJECT LOCATION N. 24th St. and Euclid St., Ashland, NE
DRILLING DATE 5/22/18
SURFACE Grass
GROUND ELEVATION 1098 ft
BORING DEPTH 25 feet
DRILLING METHOD Flight
HOLE SIZE 6 inches
GROUND WATER LEVELS:
DRILLER Seth Yakel
DRILL RIG CME 45B #145
DURING DRILLING None encountered
LOGGED BY Tyler Wegner
CHECKED BY Heath Cutler
END OF DRILLING None encountered
NOTES Boring backfilled with cuttings
AFTER DRILLING Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		very moist	brown	hard	lean clay	fill												
								U-1	11			25.4	95.7	1.56				
		moist																
								U-2	8			23.5	99.4	2.28				
5																		
		very moist	light brown	firm	lean clay	Peoria loess												
								U-3	8			24.1	96.3	1.36				
10																		
				soft														
								U-4	12			30.6	86.9					
15																		
		dry	light brown	medium dense	poorly graded sand	Todd Valley alluvium												
								S-5		27		2.1						2.9
20							fine sand											
								S-6		20		1.1						
25																		

Bottom of borehole
at 25.0 feet.

Thiele Geotech Inc

Thiele Geotech, Inc.
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Omaha, NE 68138
Telephone: 402-556-2171

BORING NUMBER B-2

CLIENT Ashland Affordable Housing Partners, LLC
PROJECT NAME Ashland Townhome Development
PROJECT NUMBER 18245.00
PROJECT LOCATION N. 24th St. and Euclid St., Ashland, NE
DRILLING DATE 5/22/18
SURFACE Grass
GROUND ELEVATION 1093 ft
BORING DEPTH 25 feet
DRILLING METHOD Flight
HOLE SIZE 6 inches
GROUND WATER LEVELS:
DRILLER Seth Yakel
DRILL RIG CME 45B #145
DURING DRILLING None encountered
LOGGED BY Tyler Wegner
CHECKED BY Heath Cutler
END OF DRILLING None encountered
NOTES Boring backfilled with cuttings
AFTER DRILLING Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		slightly moist	dark brown	hard	lean clay	fill	appreciable gravel	U-1	7			11.9	120.3		38	16	22	
		very moist	dark brown	firm	lean clay	altered Peoria loess		U-2	12			25.5	91.6	1.28				
5																		
		very moist	light brown	soft	lean clay	Peoria loess		U-3	12			26.4	86.6					
10																		
								U-4	12			28.0	91.0					
15																		
							fine sand	U-5	12			31.1	89.7					
20																		
		dry	light brown	medium dense	poorly graded sand	Todd Valley alluvium		S-6		23		2.8						
25																		

Bottom of borehole at 25.0 feet.

Thiele Geotech Inc

Thiele Geotech, Inc.
13478 Chandler Rd
Omaha, NE 68138
Telephone: 402-556-2171

BORING NUMBER B-3

CLIENT Ashland Affordable Housing Partners, LLC
PROJECT NAME Ashland Townhome Development
PROJECT NUMBER 18245.00
PROJECT LOCATION N. 24th St. and Euclid St., Ashland, NE
DRILLING DATE 5/22/18
SURFACE Grass
GROUND ELEVATION 1091 ft
BORING DEPTH 25 feet
DRILLING METHOD Flight
HOLE SIZE 6 inches
GROUND WATER LEVELS:
DRILLER Seth Yakel
DRILL RIG CME 45B #145
DURING DRILLING None encountered
LOGGED BY Tyler Wegner
CHECKED BY Heath Cutler
END OF DRILLING None encountered
NOTES Boring backfilled with cuttings
AFTER DRILLING Not measured

DEPTH (ft)	GRAPHIC LOG	VISUAL/MANUAL DESCRIPTION: MOISTURE	COLOR	CONSIST.	SOIL TYPE	GEOLOGIC ORIGIN	REMARKS	SAMPLE TYPE NUMBER	RECOVERY (IN)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	q_u (tsf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	FINES CONTENT (%)
0		moist	dark brown	hard	lean clay	fill												
								U-1	9			22.5	97.0	2.27				
5								U-2	10			23.6	99.2	2.18				
10		very moist	light brown	firm	lean clay	Peoria loess	iron stains	U-3	12			26.3	95.5	1.06				
				soft														
15								U-4	12			30.9	89.7					
20		dry	light brown	medium dense	poorly graded sand	Todd Valley alluvium	fine sand	S-5		25		3.7						3.0
25								S-6		20		2.5						

Bottom of borehole at 25.0 feet.

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SUMMARY OF LABORATORY RESULTS

CLIENT Ashland Affordable Housing Partners, LLC **PROJECT NAME** Ashland Townhome Development

PROJECT NUMBER 18245.00 **PROJECT LOCATION** N. 24th St. and Euclid St., Ashland, NE

Boring Number	Sample Number	Depth	Water Content (%)	Unit Weight		Void Ratio	Sat. (%)	Unconfined Compression		Atterberg Limits		%<#200 Sieve	Class.	Other Tests
				Wet Density (pcf)	Dry Density (pcf)			q_u (tsf)	Strain (%)	LL	PI			
B-1	U-1	0.5-2.0'	25.4	120.1	95.7	0.760	90	1.56	6.2					
	U-2	3.5-5.0'	23.5	122.7	99.4	0.696	91	2.28	9.0					
	U-3	8.5-10.0'	24.1	119.4	96.3	0.750	87	1.36	6.6					
	U-4	13.5-15.0'	30.6	113.5	86.9	0.939	88							
	S-5	18.5-20.0'	2.1									2.9	SP	
	S-6	23.5-25.0'	1.1											
B-2	U-1	0.5-2.0'	11.9	134.6	120.3	0.401	80			38	22		CL	
	U-2	3.5-5.0'	25.5	115.0	91.6	0.839	82	1.28	3.8					
	U-3	8.5-10.0'	26.4	109.5	86.6	0.945	75							
	U-4	13.5-15.0'	28.0	116.5	91.0	0.851	89							
	U-5	18.5-20.0'	31.1	117.6	89.7	0.879	96							
	S-6	23.5-25.0'	2.8											
B-3	U-1	0.5-2.0'	22.5	118.8	97.0	0.738	83	2.27	9.3					
	U-2	3.5-5.0'	23.6	122.5	99.2	0.699	91	2.18	7.8					
	U-3	8.5-10.0'	26.3	120.6	95.5	0.765	93	1.06	4.4					
	U-4	13.5-15.0'	30.9	117.4	89.7	0.879	95							
	S-5	18.5-20.0'	3.7									3.0	SP	
	S-6	23.5-25.0'	2.5											


PROFESSIONAL CIVIL ENGINEER
HEATH E
CUTLER
E-16142
STATE OF NEBRASKA
6-14-18