REVISED GEOTECHNICAL ENGINEERING REPORT
7 BREW
1410 NE DOUGLAS STREET
LEE'S SUMMIT, MISSOURI

Prepared For:

EAST SUNSHINE PROPERTY GROUP, L.L.C.
91 Champions Boulevard
Rogers, Arkansas 72758

Prepared By:

KAW VALLEY ENGINEERING, INC.
14700 West 114th Terrace
Lenexa, Kansas 66215

June 16, 2022

Project No. **B21G4397**

KAW VALLEY ENGINEERING, INC.
Office: 913.894.5150
Fax: 913.894.5977
Web: www.kveng.com
Address: 14700 West 114th Terrace
Lenexa, KS 66215

June 16, 2022 **B21G4397**

Mr. Jason Pullman
East Sunshine Property Group, L.L.C.
91 Champions Boulevard
Rogers, Arkansas 72758

**RE: REVISED GEOTECHNICAL ENGINEERING REPORT
7 BREW
1410 NE DOUGLAS STREET
LEE'S SUMMIT, MISSOURI**

Dear Mr. Pullman:

This report presents the results of a subsurface exploration and geotechnical engineering analysis conducted for the referenced project. This exploration was conducted in general accordance with our proposal dated January 12, 2022. Authorization to proceed with the geotechnical services for this site was provided on January 17, 2022. The purpose of this study was to define the subsurface conditions at the site and develop geotechnical parameters related to design and construction of the project.

EXECUTIVE SUMMARY

Information, conclusions, and recommendations, which in our opinion are significant to the design and construction of this project, are provided below. Additional details, the general subsurface profile, other related items, and general information regarding the various phases of our exploration are included in the main body of the report.

The typical subsurface soil profile underlying the site is comprised of 1.0 to 1.5 feet of brown, lean to fat (medium plastic) clays overlying weathered limestone and shale. Shale bedrock was encountered at depths ranging from 2.5 to 3.0 feet below existing ground surface. Based upon the site conditions, KVE recommends the buildings be supported on shallow footings bearing entirely upon the existing shale bedrock. A net allowable bearing pressure of 3,500 pounds per square foot (psf) may be used to design and proportion footings for the buildings.

PROJECT AND SITE DESCRIPTION

The project site is located at 1410 NE Douglas Street in Lee's Summit, Missouri. Presently, the subject property is an existing green space.

The proposed construction is to consist of the construction of a 723 square foot building with a crawl space, remote cooler slab-on-grade building, and associated parking lots and drives. The planned finish floor of the building to be elevation 1028.0 feet. Anticipated maximum structural loads are 30 kips for columns and 2 kips per linear foot for load bearing walls. The site and surrounding area are displayed on Plate 1.

FIELD EXPLORATION

Borings B-1 through B-3 were drilled on February 1, 2022. The boring locations were estimated using measurements from existing surface features. The boring elevations were determined using rod and level surveying. The curb inlet at the northwest corner of the property was used as a benchmark with an elevation of 1025.3 feet. The boring locations and elevation are displayed on Plate 1 and the logs of the boring, respectively.

The boring was drilled using a truck-mounted CME-55 drill rig, with 4-inch O.D. continuous flight augers. Samples were obtained in the borehole utilizing thin-walled steel (Shelby) tubes and a split-barrel sampler (standard penetration test). The samples were obtained at various intervals through the depths of the borings. The borings were drilled to depths ranging from 9.4 to 15.0 feet below the existing ground surface. Detailed logs of the borings are displayed on Plates 2 through 4.

The borings were logged in the field by the driller, based upon visual classifications of materials encountered during drilling, as well as the driller's interpretation of the subsurface conditions between samples. The final boring logs included with this report represent an engineer's interpretation of the field logs and include revisions based upon results of the laboratory testing and an engineer's review of the soil samples.

LABORATORY TESTING PROGRAM

The laboratory testing program was designed to determine the pertinent engineering and index properties of the soil. Moisture content, in-situ density, Atterberg limits, and unconfined compressive strength were determined for select samples. Results of the laboratory tests are displayed upon the borings logs. All tests were performed in general accordance with applicable ASTM standards.

SUBSURFACE CONDITIONS

Stratigraphy. The typical subsurface soil profile underlying the site is comprised of 1.0 to 1.5 feet of brown, lean to fat (medium plastic) clays overlying shale and limestone bedrock. Shale bedrock was encountered at depths ranging from 2.5 to 3.0 feet below existing ground surface.

Moisture contents for the samples ranged from 11.5 to 21.6 percent. The in-situ dry density test for the soils on-site yielded a density of 96.4 pounds per cubic foot. Unconfined compressive strength test on the near-surface soils yielded a strength of 3,275 pounds per square foot (psf). Atterberg limits tests on soils from the borings indicated the upper site soils classify as lean to fat (CL-CH) and lean (CL) clays, in general accordance with the Unified Soil Classification System. These near-surface soils typically have medium to low swell potentials.

Groundwater. Groundwater was not encountered in the depths explored. It should be understood that the level of the groundwater may fluctuate due to rainfall and other climatic factors, and that the groundwater may or may not be present during construction or at other times during the life of the project.

DESIGN CONSIDERATIONS AND RECOMMENDATIONS

Site Preparation. Site preparation should commence with stripping of all vegetation and topsoil from the construction areas. Stripping should extend a minimum of 5 feet beyond the structure footprint. A minimum stripping depth of approximately 12 inches should be anticipated. However, stripping depths will likely vary and should be adjusted to remove all vegetation and root systems. Soils removed during site stripping operations could be used for final site grading outside the proposed building area.

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 thoroughly evaluated by a geotechnical engineer or engineering technician prior to placement of fill. All fill should be placed in accordance with the recommendations presented in the *Structural Fill* section of this report.

Following stripping and cutting to grade, the moisture content of the exposed soils should be evaluated. Depending on the in-situ moisture content of the exposed soils, moisture conditioning of the exposed grade may be required. The moisture content of the exposed grade should be adjusted to within the range recommended for structural fill to allow the exposed material to be compacted to a minimum density of 95 percent of maximum density as determined by the standard Proctor compaction procedure. Extremely wet or unstable areas that hamper compaction of the subgrade may require undercutting and replacement with structural fill or other stabilization techniques. Suitable structural fill should be placed to design grade as soon as practical after reworking the subgrade to avoid moisture changes in the underlying soils.

Following moisture conditioning of the exposed soils, it is recommended that the exposed grade in-place density shall be confirmed to meet or exceed 95% of the maximum dry density as determined by ASTM D 698. Unsuitable areas identified by the density verification should be undercut and replaced with structural fill. Following density verification, suitable structural fill should be placed to design grade as soon as practical to avoid moisture changes in the underlying soils.

After stripping and/or cutting to grade in sidewalk and pavement areas, the exposed materials should also be moisture conditioned and density verified prior to paving. Any soft or unstable areas observed should be undercut and brought up to planned grade with structural fill.

Structural Fill. Soils within 12 inches of the building floor slab base materials and 8 inches beneath pavements should meet the requirements of imported fill (LVC soils). The majority of on-site soils do meet these requirements and are acceptable as structural fill inside the building and project area. All structural fill should consist of approved materials, free of organic matter and debris and in accordance with imported fill parameters. Imported fill material should consist of low swell potential soils with a liquid limit less than 45 and a plasticity index between 10 and 25. This soil is also identified as low volume change (LVC) soil. As an alternative MODOT Type 5 aggregate base may be utilized as imported LVC fill.

All fill should be placed in lifts having a maximum loose lift thickness of 8 inches, and should be compacted to a minimum of 95 percent of the material's maximum dry density as determined by ASTM D 698 (standard Proctor compaction test). The moisture content of the fill at the time of compaction should be within a range of 1 percent below to 3 percent above optimum moisture content as defined by the standard Proctor compaction test. Moisture contents should be maintained within this range until completion of the proposed floor slab and pavements.

The geotechnical engineer should approve all fill material. Approval requires that a moisture-density relationship and Atterberg limits be performed for each proposed material prior to its use in the structural fill.

All utility trenches should be backfilled with either on-site or imported fill material. On-site materials may only be used at depths greater than 12 inches below pavement or building slab base materials. Granular materials such as clean sand or gravel should not be used to bed utilities or backfill trenches unless the bottom of the trench is graded so that water flows away from the structure and pavement areas.

Where fill is being placed on a slope steeper than 5:1 (horizontal:vertical), the existing slope should be benched as fill placement progresses. These benches should be stepped vertically between 12 and 36 inches. This procedure would better key the fill into the original slope and will facilitate compaction of the fill.

Final slopes greater than 3:1 (horizontal:vertical) should not be used for ease of maintenance.

The estimated shrinkage factor for the fill placement is 5 to 7 percent.

Continuous observation by the geotechnical engineer or his representative should be maintained during site preparation and compaction of all fill and backfill material.

Soil Excavation. Soils on the project primarily include Type C classifications as indicated by the OSHA Excavation Standard Handbook. The maximum allowable slope for excavation in Type C soils is 1.5:1 (horizontal to vertical). Any questionable materials should be evaluated by qualified personnel. If the above temporary slopes cannot be achieved, shoring will be required.

To avoid unnecessary collapsing or sliding in trench excavations, no additional length of trench should be excavated than is necessary for the day's placement. All trenches should be backfilled before the end of the day.

Foundations. On the basis of the anticipated maximum loading conditions, structural loads for the buildings may be supported by a combination of isolated shallow spread and strip or trench footings founded entirely upon the underlying shale. A net allowable bearing pressure of 3,500 psf may be used to design and proportion these footings.

The base of exterior footings and interior footings should be placed a minimum of 3 feet below the lowest adjacent exterior grade for frost protection.

Isolated footings should have a minimum width of 24 inches. Strip and trench footings should have minimum widths of 18 and 12 inches, respectively. The base of footing excavations should be free of all water, loose debris, and not allowed to become excessively wet or dry prior to placement of concrete.

All footing excavations should be observed by the geotechnical engineer of record or a representative to verify the suitability of the bearing material prior to placement of reinforcing steel. If soft or unsuitable material is encountered during excavation of the footings, it may be necessary that the existing soil be undercut to suitable material.

Uplift. Uplift forces, if any, may be resisted by the weight of the footings.

Lateral Loads. A coefficient of base friction of 0.25 may be used for the contact between concrete and compacted structural fill or undisturbed foundation soils.

Lateral Pressures. Unrestrained walls below grade should be designed for an equivalent active fluid pressure of 45 psf/ft. Restrained walls below grade should be designed for an "at-rest" equivalent fluid pressure of 65 psf/ft. These pressures assume no hydrostatic loads are allowed to build up behind the walls, and do not include a factor of safety.

Slab-On-Grade (Cooler Structure). The slab-on-grade should be designed such that axial column loads are not transferred through the slab. A 4-inch layer of open graded gravel (ASTM C33 No. 57) should be placed directly below the slab-on-grade. A moisture barrier should be placed between the slab and the open graded gravel. Soils within 12 inches of the building floor slab base materials should be low volume change materials meeting the requirements of imported fill. We recommend that the slab-on-grade be designed for a modulus of subgrade reaction of 125 pounds per cubic inch.

Thickened slab sections can be used to support interior non-load bearing walls provided that:

- Loads do not exceed 900 pounds per linear foot.
- Thickened sections have a minimum thickness and width of 8 inches and 12 inches, respectively.
- Thickness and reinforcement are consistent with structural requirements.

Seismic Soil Classification. According to the 2018 International Building Code, the site soils are best characterized by the "Class C" site classification. This classification can be utilized by the structural engineer as a seismic design parameter.

Settlement. Foundations proportioned and constructed as recommended above should experience total settlement of less than 1 inch with differential settlements of up to 1/2 inch between foundation elements.

Pavement Sections. The CBR value for the soil types encountered on the site are typically estimated to be 2 to 5; therefore, the following pavement sections are recommended for parking areas and drives. The proposed parking lot is assumed to be utilized for light traffic. Recommendations for both flexible and rigid pavements are presented in table 1.

Table 1 – Recommended Pavement Sections for Pavement Life of 20 Years

Loading Type	Concrete	Asphaltic Concrete	Asphaltic Concrete with Aggregate Base
Light Traffic (employee/customer parking, and small delivery truck parking)	5″ Portland Cement Concrete 4″ Well Graded Granular Base 8" Moisture Conditioned and Compacted Onsite Materials	6″ Hot-Mixed Asphalt Concrete 8" Moisture Conditioned and Compacted Onsite Materials	5″ Hot-Mixed Asphalt Concrete 6″ Well Graded Granular Base Course 8" Moisture Conditioned and Compacted Onsite Materials
Heavy Traffic (delivery drives and loading docks)	8″ Portland Cement Concrete 4″ Well Graded Granular Base 8" Moisture Conditioned and Compacted Onsite Materials	8″ Hot-Mixed Asphalt Concrete 8" Moisture Conditioned and Compacted Onsite Materials	7″ Hot-Mixed Asphalt Concrete 6″ Well Graded Granular Base Course 8" Moisture Conditioned and Compacted Onsite Materials

Mixes selected for the Hot-Mix Asphalt Concrete alternate can be MoDOT SP125FEEF or APWA Type 6-01. If a Marshall designed mix is desired, any 50-blow Marshall mix may be selected meeting the aggregate and gradation requirements of APWA Type 2 or 3, MoDOT BP-1 or 2, or other locally produced Marshall mix that is equivalent to KDOT BM-2. Any submitted 50-blow Marshall mix design should also be checked for resistance to stripping during design using AASHTO T 283 to determine if an antistripping agent is needed for the same asphalt concrete chosen for the project. The index of retained strength shall exceed 75%.

Portland cement concrete for pavement, sidewalks, and curbs must meet the current requirements of the Kansas City Metropolitan Materials Board specifications for on-grade concrete.

Pavement in any dumpster area should be the Portland cement concrete section as recommended in the truck access and drives section. Also, preventive maintenance action(s) may be needed for the asphaltic concrete parking and drives in order to maintain the service condition (i.e. crack sealing).

Drainage. The site should be graded so that surface water flows away from the structure and pavement areas and is not allowed to accumulate near or under the slab-on-grade or pavement. Where sidewalks or paving do not immediately adjoin the structure, a grade of at least 5 percent for a minimum of 10 feet from the perimeter walls is recommended.

Landscaping. Consideration should be given to limiting landscaping and irrigation adjacent to the structure and pavement areas. Trees and large bushes can draw moisture from subgrade soils resulting in settlement of foundations and pavements.

OBSERVATION OF CONSTRUCTION

The conclusions and recommendations given in this report are based on interpretation of field boring and laboratory data coupled with our experience. Variations may occur from conditions observed within test borings; therefore, it is imperative to involve the geotechnical engineer in the final design and construction process.

Field observation services are viewed as a continuation of the design process. Unless these services are provided, the geotechnical engineer will not be responsible for improper use of recommendations, or failure by others to recognize conditions which may be detrimental to the successful completion of the project.

LIMITATIONS

The analyses, conclusions, and recommendations contained in this report are based on the site conditions and project layout described herein and further assume that the conditions observed in the exploratory borings are representative of the subsurface conditions throughout the site, i.e., the subsurface conditions elsewhere on the site are the same as those disclosed by the borings. If, during construction, subsurface conditions different from those encountered in the exploratory borings are observed or appear to be present beneath excavations, we should be advised at once so that we can review these conditions and reconsider our recommendations where necessary.

If there is a substantial lapse in time between the submittal of this report and the start of work at the site, or if conditions or the project layout have changed due to natural causes or construction operations at or adjacent to the site, we recommend that this report be reviewed to determine the applicability of conclusions and recommendations considering the changed conditions and time lapse.

We recommend that we be retained to review the project layout and those portions of plans and specifications which pertain to foundations and earthwork to determine if they are consistent with our findings and recommendations. In addition, we are available to observe construction, particularly site grading, earthwork, and foundation construction. We would be available to make other field observations as may be necessary.

This report was prepared for the exclusive use of the owner, architect, and engineer for evaluating the design of the project as it relates to the geotechnical aspects discussed herein. It should be made available to prospective contractors for information on factual data only and not as a warranty of subsurface conditions included in the report. Unanticipated soil conditions may require that additional expense be made to attain a properly constructed project. Therefore, some contingency fund is recommended to accommodate such potential extra costs.

* * * * * *

The following plates are attached to and complete this report:

Plate 1 - Boring Location Plan

Plates 2 through 4 - Logs of Borings

Boring Log Reference Legend

* * * * * *

We appreciate the opportunity to be of service to you on this project. Please contact us if you have any questions or comments.

Respectfully submitted,
Kaw Valley Engineering, Inc.

Robert J. Kabus, P.E.
Geotechnical Engineer

Michael R. Osborn, P.E.
Principal

STATE OF MISSOURI
MICHAEL R. OSBOURN
NUMBER
E-25456
06.16.22
REGISTERED PROFESSIONAL ENGINEER

Site Plan and Boring Locations

Plate 1

7 Brew

1410 Northeast Douglas Street

Lee's Summit, Missouri

Approved By:	Not to Scale	Project No. B21G4397

KAW VALLEY ENGINEERING

LOG OF BORING B-1

Kaw Valley Engineering, Inc.
14700 W 114th Terrace
Lenexa, Kansas 66215
Telephone: (913)894-5150
Fax: (913)894-5977

CLIENT: East Sunshine Property Group, L.L.C.
PROJECT: 7 Brew
NUMBER: B21G4397
LOCATION: 1410 NE Douglas St - Lee's Summit, MO

DATE(S) DRILLED: 2/1/22 - 2/1/22
DRILLING METHOD(S): 4" CFA
DRILL RIG: CME 55
DRILL RIG OPERATOR: Les Scott
LOGGED BY: Scott Bishop

GROUNDWATER INFORMATION:
Water level while boring - Dry
Water level after boring - Dry

SURFACE ELEVATION: 1027.6'

Depth (ft)	N: Blows/ft, P: Tons/sq ft, T: Blows/six inches, REC: %, RQD: %	Recovery (in)	Moisture Content (%)	LL	PL	PI	Dry Density (pounds/cubic ft)	Compressive Strength (pounds/sq ft)	Confining Pressure (pounds/sq in)	Minus No. 200 Sieve (%)	Description of Stratum
0–1.5		6	18.2	46	21	25	96.4	3,275			TOPSOIL (18") — 1026.1'
1.5–3											GRAVELY CLAY: Brown; very stiff; slightly moist (Gravel is highly weathered Limestone fragments) — 1024.6'
3–11	T = 6/8/13 (3.5–5)		19.7								SHALE: Light brown mottled brown and light gray; moderately weathered; with iron staining — 1016.6'
	T = 7/11/16 (8.5–10)		15.9								
11–15	T = 12/18/26 (13.5–15)		21.3								SHALE: Gray; moderately weathered — 1012.6'

BORING TERMINATED AT 15.0'

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - BLOWS PER SIX INCHES
REC - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Surficial condition - Grass

LOG OF BORING B-2

Kaw Valley Engineering, Inc.
14700 W 114th Terrace
Lenexa, Kansas 66215
Telephone: (913)894-5150
Fax: (913)894-5977

CLIENT: East Sunshine Property Group, L.L.C.
PROJECT: 7 Brew
NUMBER: B21G4397
LOCATION: 1410 NE Douglas St - Lee's Summit, MO

DATE(S) DRILLED: 2/1/22 - 2/1/22
DRILLING METHOD(S): 4" CFA
DRILL RIG: CME 55
DRILL RIG OPERATOR: Les Scott
LOGGED BY: Scott Bishop

GROUNDWATER INFORMATION:
Water level while boring - Dry
Water level after boring - Dry

SURFACE ELEVATION: 1026.9'

DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS/SIX INCHES REC: % RQD: %	RECOVERY (IN)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CUBIC FT	COMPRESSIVE STRENGTH (POUNDS/SQ FT)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–1												TOPSOIL (12") 1025.9'
1–2.5												GRAVELY CLAY: Brown; very stiff; slightly moist (Gravel is highly weathered Limestone fragments) 1024.4'
2.5–8												SHALE: Light brown mottled gray; moderately weatherd; with iron staining 1018.9'
4	Sample	T = 11/12/22		20.4	45	23	22					
8–14.7												SHALE: Gray; moderately to slightly weathered 1012.2'
9	Sample	T = 8/34/50=3"		14.8								
14	Sample	T = 14/27/50=3"		14.0								

BORING TERMINATED AT 14.8'

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - BLOWS PER SIX INCHES
REC - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Surficial condition - Grass

LOG OF BORING B-3

Kaw Valley Engineering, Inc.
14700 W 114th Terrace
Lenexa, Kansas 66215
Telephone: (913)894-5150
Fax: (913)894-5977

CLIENT: East Sunshine Property Group, L.L.C.
PROJECT: 7 Brew
NUMBER: B21G4397
LOCATION: 1410 NE Douglas St - Lee's Summit, MO

DATE(S) DRILLED: 2/1/22 - 2/1/22
DRILLING METHOD(S): 4" CFA
DRILL RIG: CME 55
DRILL RIG OPERATOR: Les Scott
LOGGED BY: Scott Bishop

GROUNDWATER INFORMATION:
Water level while boring - Dry
Water level after boring - Dry

SURFACE ELEVATION: 1026.8'

DEPTH (FT)	N: BLOWS/FT P: TONS/SQ FT T: BLOWS/SIX INCHES REC: % RQD: %	RECOVERY (IN)	MOISTURE CONTENT (%)	LIQUID LIMIT (LL)	PLASTIC LIMIT (PL)	PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CUBIC FT	COMPRESSIVE STRENGTH (POUNDS/SQ FT)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
0–1											TOPSOIL (12") 1025.8'
1–2.5	T = 13/14/12		11.5	27	22	5					GRAVELY CLAY: Brown; very stiff; slightly moist (Gravel is highly weathered Limestone fragments) 1024.3'
2.5–6	T = 4/10/11		21.6								SHALE: Light brown mottled brown and gray; moderately weathered; with iron staining 1020.8'
6–9.4	T = 20/50=5"		15.4								SHALE: Gray; moderately to slightly weathered 1017.4'

BORING TERMINATED AT 9.4'

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - BLOWS PER SIX INCHES
REC - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
Surficial condition - Grass

BORING LOG REFERENCE LEGEND

DESCRIPTIVE SOIL CLASSIFICATION

Soil description is based on the Unified Soil Classification System as outlined in ASTM Designation D-2487. The Unified Soil Classification group symbol for soil descriptions shown on the boring logs corresponds with the group names listed below. The description includes soil constituents, consistency, relative density, color and any other appropriate descriptive terms. Geologic description of bedrock, when encountered, is also shown in the description column. Refer to the appropriate notes for bedrock classification.

Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name	Group Symbol	Group Name
GW	Well graded gravel	SW	Well graded sand	CL	Lean clay	CH	Fat clay
GP	Poorly graded gravel	SP	Poorly graded sand	ML	Silt	MH	Elastic silt
GM	Silty gravel	SM	Silty sand	OL	Organic clay Organic silt	OH	Organic clay Organic silt
GC	Clayey gravel	SC	Clayey sand			PT	Peat

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf

< 500	Very Soft
500 – 1,000	Soft
1,001 – 2,000	Firm
2,001 – 4,000	Stiff
4,001 – 8,000	Very Stiff
8,001 – 16,000	Hard
> 16,000	Very Hard

RELATIVE PROPORTIONS

Descriptive Term(s) (Components also Percent in Sample)	Sand & Gravel Percent of Dry Wt.	Fines Percent of Dry Wt.
Trace	< 15	<5
Some	15 – 29	5 - 12
Modifier	> 30	> 12

RELATIVE DENSITY OF COARSE-GRAINED SOILS

N - (blows/ft)	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50+	Very Dense

GRAIN SIZE TERMINOLOGY

Major Component	Size Range
Cobbles	12 in to 3 in
Gravel	3 in to #4 sieve
Sand	#4 to #200 sieve
Silt or Clay	Passing #200 sieve

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. In pervious soil the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels is not possible with only short-term observation.

DEFINITIONS OF ABBREVIATIONS

CR – Core recovery, length of core recovered in each run compared to the length drilled expressed as percent
LL – Liquid limit of specimen
N – Number of blows to penetrate last 12 inches with 140-pound hammer in standard penetration test
Blow count reported for each 6-inch interval on logs
PL – Plastic limit of specimen
RQD – Rock quality designation, aggregate length of core pieces greater than 4 inches long, expressed as percent of length drilled
TW – Thin walled tube
SS – Standard penetration test
NQ2 – 2 inches diameter core
CFA – Continuous flight augers
HSA – Hollow stem augers
EOB – End of boring

KAW VALLEY ENGINEERING