Applied GeoTech

GEOTECHNICAL INVESTIGATION

PROPOSED MULTI-FAMILY RESIDENCES

2823 SOUTH 9150 WEST

MAGNA, UTAH

PREPARED FOR:

AXESS HOME BUYERS
PO BOX 57746
SALT LAKE CITY, UTAH 84157

ATTENTION: MIKE KESSLER

PROJECT NO. 1220959 **JULY 12, 2023**

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EXECUTIVE SUMMARY

1. Approximately 1½ and 5 feet of fill was encountered in Borings B-1 and B-2, respectively. Sand was encountered below the fill in Boring B-1 and clay in Boring B-2. Sand was encountered below the clay in Boring B-2 at a depth of approximately 9 feet and extends the full depth of the boring, approximately 15½ feet. The sand in Boring B-1 has a gravel layer between approximately 19 to 23½ feet and extends to a depth of approximately 34 feet where interlayered silt and silty sand was encountered. Interlayered lean clay and silt was encountered below the silt and sand at a depth of approximately 39½ feet and extends the full depth of the boring, approximately 46 feet.

2. No subsurface water was encountered in the borings. Fluctuations in water levels should be expected over time.

3. The buildings may be supported on spread footings bearing on the undisturbed natural soil or on structural fill extending down to the undisturbed natural soil and may be designed for a net allowable bearing pressure of 1,500 pounds per square foot. Footings bearing on at least 2 and 4 feet of structural fill may be designed for net allowable bearing pressures of 2,500 and 3,500 pounds per square foot, respectively.

4. Geotechnical information relating to foundations, subgrade preparation, materials and pavement is included in the report.

SCOPE

This report presents the results of a geotechnical study for the proposed multi-family residences planned for 2823 South 9150 West in Magna, Utah. The report presents the subsurface conditions encountered, laboratory test results and recommendations for foundations and pavement. The study was conducted in general accordance with our proposal dated November 16, 2022.

Field exploration was conducted to obtain information on the subsurface conditions at the site. Samples obtained from the study were tested in the laboratory to determine physical and engineering characteristics of the on-site soil. Information obtained from the field and laboratory investigations was used to define conditions at the site and to develop recommendations for the proposed foundations and pavement.

This report has been prepared to summarize the data obtained during the study and to present our conclusions and recommendations based on the proposed construction and the subsurface conditions encountered. Design parameters and a discussion of geotechnical engineering considerations relating to construction are included in the report.

SITE CONDITIONS

At the time of our field study, there was a single-story garage in the southeast corner of the property. Review of aerial photographs of the site indicate there was a house on the south side of the property.

The ground surface at the site is relatively flat and slopes gently down to the north.

Vegetation at the site consists of grass, weeds and a few trees.

There are houses on the surrounding properties. The west side of the property is bordered by 9150 West Street and the north side by 2820 South Street.

FIELD STUDY

Two borings were drilled on June 23 and 28, 2023 at the approximate locations indicated on Figure 1 using 8-inch-diameter hollow-stem auger powered by a truck-mounted drill rig. The borings were logged and soil samples obtained by a geologist from AGEC. Logs of the subsurface conditions encountered in the borings are graphically shown on Figure 2 with legend and notes on Figure 3.

SUBSURFACE CONDITIONS

Approximately 1½ and 5 feet of fill was encountered in Borings B-1 and B-2, respectively. Sand was encountered below the fill in Boring B-1 and clay in Boring B-2. Sand was encountered below the clay in Boring B-2 at a depth of approximately 9 feet and extends the full depth of the boring, approximately 15½ feet. The sand in Boring B-1 has a gravel layer between approximately 19 to 23½ feet and extends to a depth of approximately 34 feet where interlayered silt and silty sand was encountered. Interlayered lean clay and silt was encountered below the silt and sand at a depth of approximately 39½ feet and extends the full depth of the boring, approximately 46 feet.

A description of the soils encountered in the borings follows:

Fill - The fill in Boring B-1 consists of silty sand. It is slightly moist, brown and contains organics. The fill in Boring B-2 consists of sandy silt. It is slightly moist, brown to dark brown and contains wood and roots.

Laboratory tests performed on a sample of the fill indicate it has a moisture content of 11 percent and a dry density of 95 pounds per cubic foot (pcf).

Sandy Lean Clay - The clay is medium stiff, moist and brown.

Laboratory tests performed on a sample of the clay indicate it has a natural moisture content of 14 percent and a natural dry density of 95 pcf. Results of a consolidation test on the clay indicate it will compress a small to moderate amount with the addition of light to moderate loads. Results of the test are presented on Figure 4.

Interlayered Lean Clay and Silt - The interlayered soil contains a small to large amount of sand. It is medium stiff to stiff, very moist and gray.

Laboratory tests performed on samples of the interlayered soil indicate that it has natural moisture contents ranging from 20 to 29 percent and natural dry densities ranging from 98 to 109 pcf.

Interlayered Silt and Silty Sand - The interlayered soil is medium dense, moist and brown.

Laboratory tests performed on a sample of the interlayered soil indicate that it has a natural moisture content of 7 percent and a natural dry density of 99 pcf.

Silty Sand - The sand contains occasional silt and clay layers. It is loose to dense, slightly moist and brown.

Laboratory tests performed on a sample of the sand indicate that it has a natural moisture content of 13 percent and a natural dry density of 95 pcf.

Silty Gravel with Sand - The gravel is very dense, slightly moist and brown.

Results of the laboratory tests are summarized on Table I and are included on the logs of the borings.

SUBSURFACE WATER

No subsurface water was encountered in the borings. Fluctuations in water levels should be expected over time.

PROPOSED CONSTRUCTION

We understand that the buildings will be two-story structures with slab-on-grade floors. We assume maximum column loads of 50 kips and maximum wall loads of 3 kips per foot.

We have assumed traffic for pavement areas to consist of passenger vehicles with five delivery trucks per day and two garbage trucks per week.

If the proposed construction, building loads or traffic is significantly different from what is described above, we should be notified so that we can reevaluate the recommendations given.

RECOMMENDATIONS

Based on the subsurface conditions encountered, laboratory test results and our understanding of the proposed construction, the following recommendations are given:

A. Site Grading

1. Subgrade Preparation

   Approximately 1½ to 5 feet of fill was encountered in the borings. There was a house with a basement on the south end of the property. The fill should be removed from below proposed buildings, slabs, pavement and other areas sensitive to differential settlement.

   The high silt content of the upper soil and the clay below the fill in Boring B-2 may result in some access concerns for construction equipment when the upper soil is very moist to wet. Placement of 1 to 2 feet of granular fill with less than 15 percent passing the No. 200 sieve could be used to improve construction equipment access when the upper soil is very moist to wet.

2. Excavation

   We anticipate that excavation at the site can be accomplished with typical excavation equipment. Excavation equipment with a flat cutting edge should be used when excavating for building foundations to minimize disturbance of the bearing soil.

   Temporary unretained excavation slopes may be constructed at 1½ horizontal to 1 vertical or flatter. Permanent unretained cut and fill slopes may be constructed at 2 horizontal to 1 vertical or flatter. Permanent unretained slopes should be protected from erosion by revegetation or other methods.

3. Materials

Listed below are recommendations for imported structural fill.

Fill to Support	Recommendations
Footings	Non-expansive granular soil Passing No. 200 Sieve < 35% Liquid Limit < 30% Maximum size 4 inches
Floor Slab (Upper 4 inches)	Sand and/or Gravel Passing No. 200 Sieve < 5% Maximum size 2 inches
Slab Support	Non-expansive granular soil Passing No. 200 Sieve < 50% Liquid Limit < 30% Maximum size 6 inches

Materials placed as fill to support structures should be non-expansive granular soil. The onsite sand meeting the imported structural fill criteria given above may be used as fill for the project. The silt and clay are not recommended for use as fill below the proposed buildings but may be used as site grading fill, utility trench and wall backfill outside the proposed building areas. The topsoil, organics, debris and other deleterious materials should be removed from the soil to be used as fill for the project.

The natural soil and fill will likely require moisture conditioning prior to use as fill. Drying of the soil may not be practical during cold or wet periods of the year.

4. Compaction

Compaction of materials placed at the site should equal or exceed the minimum densities as indicated below when compared to the maximum dry density as determined by ASTM D 1557.

Fill To Support	Compaction Criteria
Foundations	≥ 95%
Concrete Slabs	≥ 90%
Pavement	
Base Course	≥ 95%
Fill placed below Base Course	≥ 90%
Landscaping	≥ 85%
Retaining Wall Backfill	85 - 90%

To facilitate the compaction process, fill should be compacted at a moisture content within 2 percent of the optimum moisture content.

The fill should be placed and compacted in thin enough lifts to allow for proper compaction. Fill placed for the project should be frequently tested for compaction.

5. Drainage

The ground surface surrounding the proposed buildings should be sloped away from the buildings in all directions. Roof downspouts and drains should discharge beyond the limits of backfill.

The collection and diversion of drainage away from the pavement surface is important to the satisfactory performance of the pavement section. Proper drainage should be provided.

B. Foundations

1. Bearing Material

With the proposed construction and the subsurface conditions encountered, the buildings may be supported on spread footings bearing on the undisturbed natural soil or on compacted structural fill. Structural fill should extend down to the undisturbed natural soil and out away from the edge of the footings at least a distance equal to the depth of fill beneath footings.

Topsoil, unsuitable fill, organics, debris and other deleterious materials should be removed from below footing areas.

2. Bearing Pressure

Spread footings bearing on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil may be designed for a net allowable bearing pressure of 1,500 pounds per square foot. Footings bearing on at least 2 and 4 feet of structural fill may be designed for net allowable bearing pressures of 2,500 and 3,500 pounds per square foot, respectively.

3. Settlement

We estimate that total and differential settlements will be less than 1 inch and ½ of an inch, respectively, for footings designed as indicated above.

4. Temporary Loading Conditions

The allowable bearing pressure may be increased by one-half for temporary loading conditions such as wind or seismic loads.

5. Frost Depth

Exterior footings and footings beneath unheated areas should be placed at least 30 inches below grade for frost protection.

6. Foundation Base

The base of foundation excavations should be cleared of loose or deleterious material prior to fill or concrete placement.

7. Construction Observation

A representative of the geotechnical engineer should observe footing excavations prior to structural fill or concrete placement.

C. Concrete Slab-on-Grade

1. Slab Support

Concrete slabs may be supported on the undisturbed natural soil or on compacted structural fill extending down to the undisturbed natural soil.

Topsoil, organics, unsuitable fill, debris and other deleterious materials should be removed from below proposed slab areas.

2. Underslab Sand and/or Gravel

A 4-inch layer of free-draining sand and/or gravel (less than 5 percent passing the No. 200 sieve) should be placed below floor slabs for ease of construction and to promote even curing of the slab concrete.

3. Vapor Barrier

A vapor barrier should be placed under the concrete floor if the floor will receive an impermeable floor covering. The barrier will reduce the amount of water vapor passing from below the slab to the floor covering.

D. Lateral Earth Pressure

1. Lateral Resistance for Footings

Lateral resistance for footings placed on the natural soil or on compacted structural fill is controlled by sliding resistance between the footing and the foundation soils. A friction value of 0.35 may be used in design for ultimate lateral resistance. The passive resistance may be added to the friction resistance where appropriate.

2. Subgrade Walls and Retaining Structures

The following equivalent fluid weights are given for the design of subgrade walls and retaining structures. The active condition is where the wall moves away from the soil. The passive condition is where the wall moves into the soil and the at-rest condition is where the wall does not move. The values listed below assume a horizontal surface adjacent the wall.

Soil Type	Active	At-Rest	Passive
Clay & Silt	50 pcf	65 pcf	250 pcf
Sand & Gravel	40 pcf	55 pcf	300 pcf

3. Seismic Conditions

Under seismic conditions, the equivalent fluid weight should be increased by 29 pcf for the active condition and 14 pcf for the at-rest condition. A decrease of 29 pcf is recommended for the passive condition. This assumes a peak ground acceleration of 0.49g which represents a 2 percent probability of exceedance in a 50-year period.

4. Safety Factors

The values recommended above assume mobilization of the soil to achieve the soil strength under active and passive conditions. Conventional safety factors used for structural analysis for such items as overturning and sliding resistance should be used in design.

E. Seismicity, Faulting and Liquefaction

1. Seismicity

Listed below is a summary of the site parameters that may be used with the 2018 and 2021 International Building Codes:

Description	Value[1]
Site Class	D[2]
S_s - MCE_R ground motion (period=0.2s)	0.95g
S_1 - MCE_R ground motion (period=1.0s)	0.34g
F_a - Site amplification factor at 0.2s	1.12
PGA - MCE_G peak ground acceleration	0.41g
PGA_M - Site modified peak ground acceleration	0.49g

[1]Values obtained from information provided by the Applied Technology Council at https://hazards.atcouncil.org.

[2]Site Class D is selected based on the subsurface conditions encountered and our understanding of the geology of the area.

2. Faulting

There are no mapped active faults extending through the project site. The closest mapped fault, which is considered active, is the Granger Fault located approximately 6 miles east-northeast of the site (Utah Geological Survey, 2023).

3. Liquefaction

The site is located in an area mapped as having a "moderate" liquefaction potential (Salt Lake County, 2002). Based on the subsurface conditions encountered, liquefaction is not considered to be a significant hazard at the site.

F. Water Soluble Sulfates

Based on our experience in the area, the soil is not expected to have significant water soluble sulfates. No special cement type is needed for concrete placed in contact with the soil. Other conditions may dictate the type of cement to be used in concrete for the project.

G. Pavement

Based on the subsurface conditions encountered, laboratory test results and the assumed traffic, the following pavement support recommendations are given:

1. Subgrade Support

The near surface soil consists of silty sand and sandy silt with clay below the fill in Boring B-2. A California Bearing Ratio (CBR) value of 3 percent was used in the analysis which assumes a clay subgrade.

2. Pavement Thickness

Based on the subsoil conditions encountered at the site, assumed traffic as described in the Proposed Construction section of the report, a design life of 20 years for flexible pavement and 30 years for rigid pavement and methods presented by the AASHTO, a pavement section consisting of 3 inches of asphaltic concrete overlying 8 inches of base course is recommended. A rigid pavement section consisting of 5 inches of Portland cement concrete could be used as an alternative.

A pavement section consisting of 6½ inches of Portland cement concrete over 4 inches of base course is recommended for the trash dumpster approach slab.

3. Pavement Materials and Construction

a. Flexible Pavement (Asphaltic Concrete)

The pavement materials should meet the specifications for the applicable jurisdiction.

b. Rigid Pavement (Portland Cement Concrete)

The rigid pavement thickness given above assumes that the pavement will have aggregate interlock joints and that a concrete shoulder or curb will be provided.

The pavement materials should meet the specifications for the applicable jurisdiction. The pavement thickness indicated above assumes that the concrete will have a 28-day compressive strength of 5,000 pounds per square inch. Concrete should be air entrained with approximately 6 percent air. Maximum allowable slump will depend on the method of placement but should not exceed 4 inches.

4. Jointing

Joints for concrete pavement should be laid out in a square or rectangular pattern. Joint spacings should not exceed 30 times the thickness of the slab or 15 feet, whichever is smallest. The joint spacings indicated should accommodate the contraction of the concrete and under these conditions steel reinforcing will not be required. The depth of joints should be approximately one-fourth of the slab thickness.

H. Preconstruction Meeting

A preconstruction meeting should be held with representatives of the owner, project architect, geotechnical engineer, general contractor, earthwork contractor and other members of the design team to review construction plans, specifications, methods and schedule.

LIMITATIONS

This report has been prepared in accordance with generally accepted soil and foundation engineering practices in the area for the use of the client for design purposes. The conclusions and recommendations included within the report are based on the information obtained from the borings drilled at the approximate locations indicated on Figure 1, the results of laboratory tests and our experience in the area. Variations in the subsurface conditions may not become evident until additional exploration or excavation is conducted. If the subsurface conditions, proposed construction or groundwater level is found to be significantly different from what is described above, we should be notified to reevaluate the recommendations given.

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

PROFESSIONAL ENGINEER
7/12/2023
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DOUGLAS R.
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STATE OF UTAH

Douglas R. Hawkes, P.E., P.G.

Reviewed by Jay R. McQuivey, P.E.

DRH/rs

REFERENCES

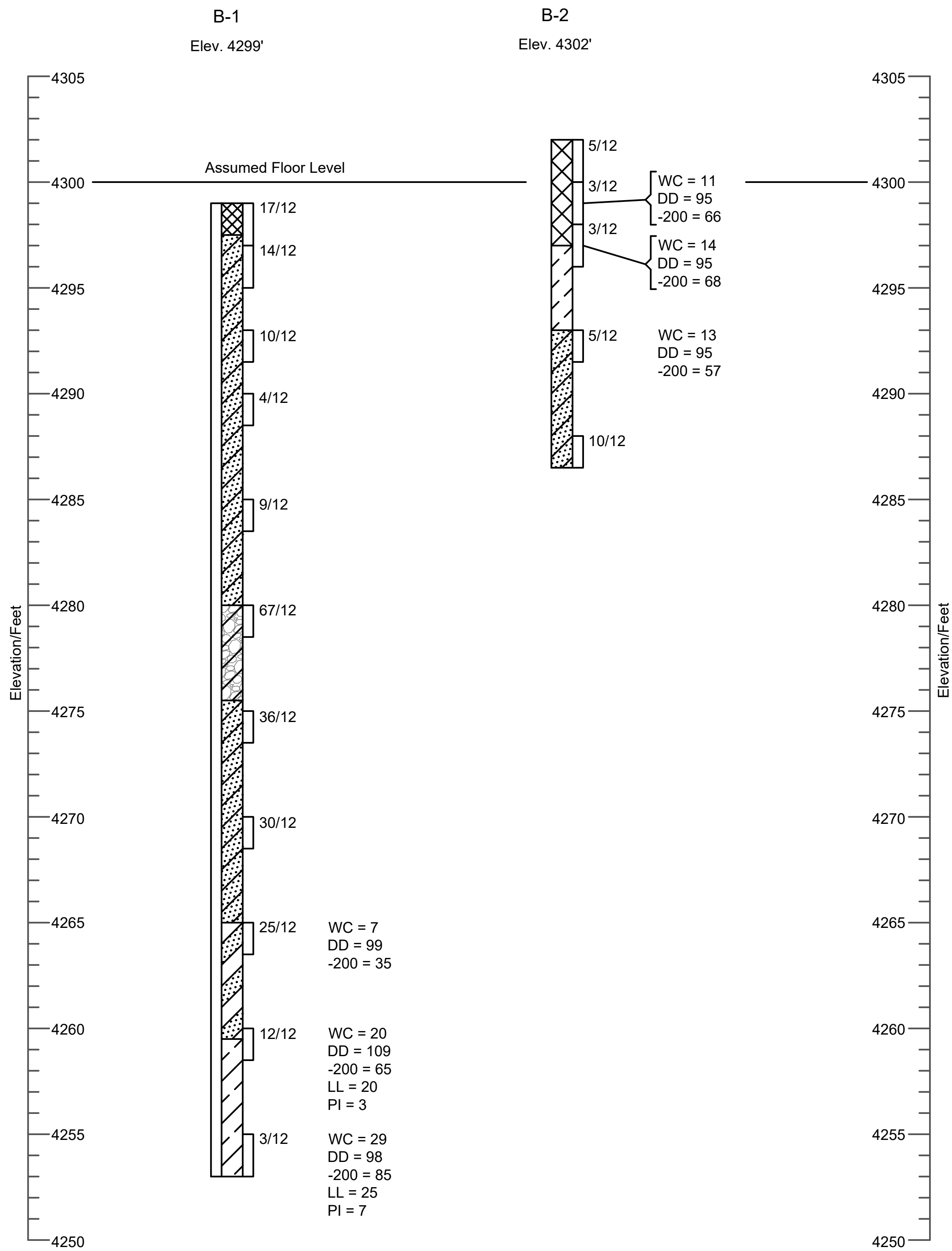
International Code Council, 2020; 2021 International Building Code, Falls Church, Virginia.

International Code Council, 2017; 2018 International Building Code, Falls Church, Virginia.

Salt Lake County, 2002; Surface Rupture and Liquefaction Potential Special Study Areas Map, Salt Lake County, Utah, adopted March 31, 1989, updated March 2002, Salt Lake County Public Works - Planning Division, 2001 South State Street, Salt Lake City, Utah.

Utah Geological Survey, 2023; Utah Geologic Hazards Portal accessed on July 12, 2023 at https://geology.utah.gov/apps/hazards/.

1220959	AGEC	Exploratory Boring Locations	Figure 1



Approximate Vertical Scale 1" = 8'

See Figure 3 for Legend and Notes

1220959	AGEC	Exploratory Boring Logs	Figure 2

LEGEND:

Fill; silty sand, slightly moist, brown, organics.

Fill; sandy silt, slightly moist, brown to dark brown, wood, roots.

Sandy Lean Clay (CL); medium stiff, moist, brown.

Interlayered Lean Clay and Silt (CL/ML); small to large amounts of sand, medium stiff to stiff, very moist, gray.

Interlayered Silt and Silty Sand (ML/SM); medium dense, moist, brown.

Silty Sand (SM); occasional silt and clay layers, loose to dense, slightly moist, brown.

Silty Gravel with Sand (GM); very dense, slightly moist, brown.

10/12 California Drive sample taken. The symbol 10/12 indicates that 10 blows from a 140-pound automatic hammer falling 30 inches were required to drive the sampler 12 inches.

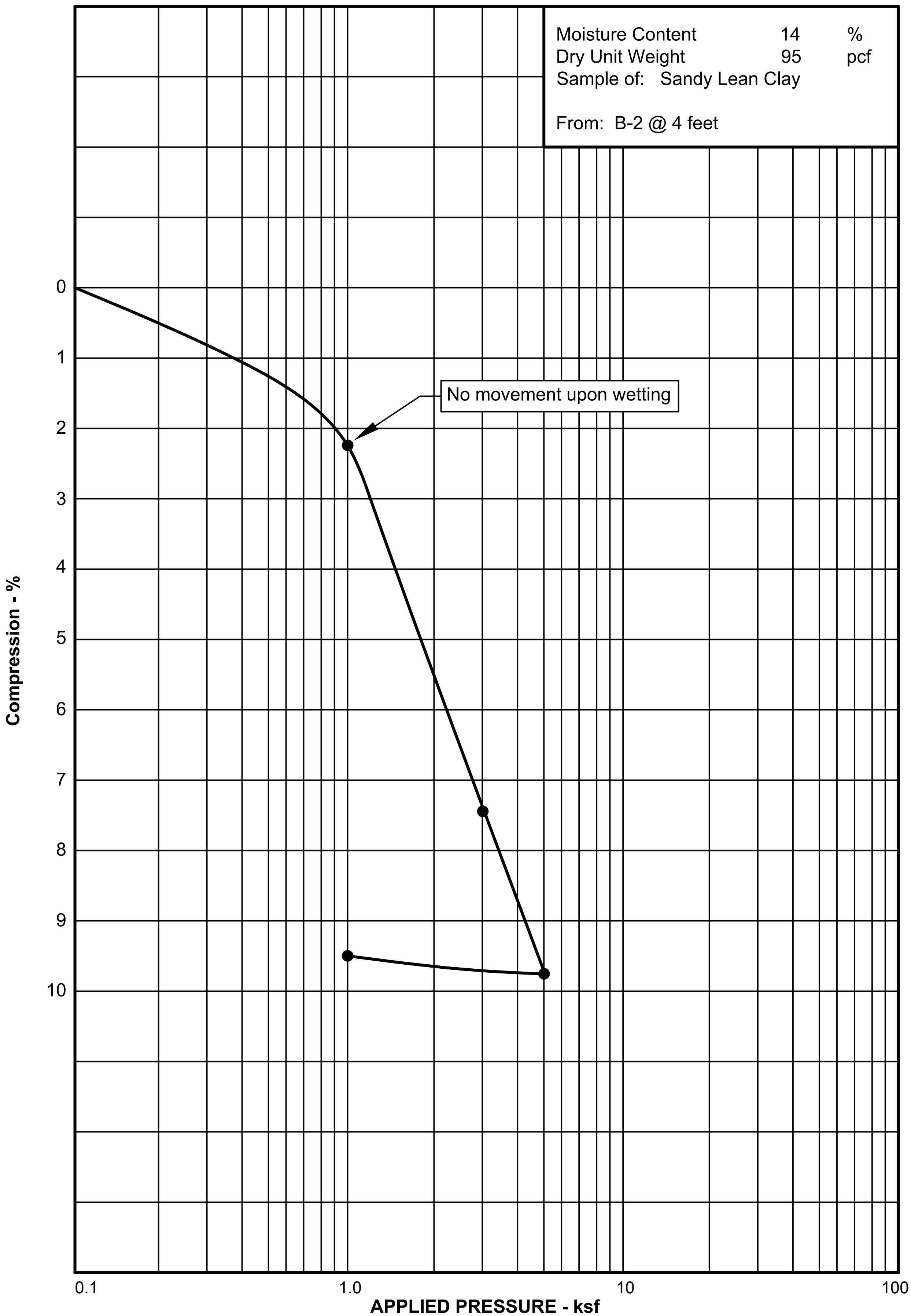
Indicates slotted 1½-inch PVC pipe installed in the boring to the depth shown.

NOTES:

1. The borings were drilled on June 23 and 28, 2023 with 8-inch-diameter hollow-stem auger.
2. Locations of the borings were measured approximately by pacing from features shown on Figure 1.
3. Elevations of the borings were determined by interpolating between contours shown on the site plan provided.
4. The boring locations and elevations should be considered accurate only to the degree implied by the method used.
5. The lines between materials shown on the boring logs represent the approximate boundaries between material types and the transitions may be gradual.
6. No free water was encountered in the borings at the time of drilling.
7. WC = Water Content (%);
   DD = Dry Density (pcf);
   -200 = Percent Passing the No. 200 Sieve;
   LL = Liquid Limit (%);
   PI = Plasticity Index (%);
   WSS = Water Soluble Sulfates (%).

1220959	AGEC	Exploratory Boring Legend and Notes	Figure 3

Applied Geotechnical Engineering Consultants, Inc.



Project No. 1220959 **CONSOLIDATION TEST RESULTS** **Figure 4**

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER: 1220959

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (%)	SAMPLE CLASSIFICATION
BORING	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX			
B-1	34	7	99			35					Interlayered Silt and Silty Sand
	39	20	109			65	20	3			Interlayered Sandy Silt and Lean Clay
	44	29	98			85	25	7			Interlayered Silt with Silt and Lean Clay
B-2	2	11	95			66					Fill; Sandy Silt
	4	14	95			68					Sandy Lean Clay
	9	13	95			57					Sandy Silt