Exploration of Subsurface Conditions
and
Foundation Recommendations

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI

July 2019

Family Partners
Owner

Zwick & Gandt Architecture, Inc.
Architect

VonArx Engineering, Inc.
Civil Engineer/Surveyor

JGE No. 19119.1

JACOBI GEOTECHNICAL ENGINEERING, INC.
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JACOBI GEOTECHNICAL ENGINEERING, INC.

July 17, 2019

Mr. Barth Holohan
Family Partners
12882 Manchester Rd Ste 201
Saint Louis MO 63131-1858

RE: Geotechnical Report
Family Partnership Manchester
Manchester, Missouri
JGE No. 19119.1

Dear Mr. Holohan:

Enclosed is our report, **Exploration of Subsurface Conditions and Foundation Recommendations – Family Partnership Manchester – Manchester, Missouri**, dated July 2019.

We appreciate the opportunity to be of service to you on this project. If you have any questions or comments concerning this report, please call.

Sincerely,

Jacobi Geotechnical Engineering, Inc.

Christine E. Dayton, E.I.
Staff Engineer

Carl L. Jacobi, P.E.
Principal

CED/CLJ/cm

Distribution: Barth Holohan, Family Partners, via email: barth@familypartners.com
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STATE OF MISSOURI
CARL L. JACOBI
NUMBER PE-020950
PROFESSIONAL ENGINEER

Exploration of Subsurface Conditions
and
Foundation Recommendations

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI

1.0 INTRODUCTION

At the request of Mr. Barth Holohan of Family Partners, Jacobi Geotechnical Engineering, Inc. (JGE) conducted a subsurface exploration for a new residential development in Manchester, Missouri. The purpose of our exploration was to characterize and observe the subsurface conditions, provide recommendations for foundations, and to address other geotechnical aspects. Our services were provided in general accordance with our proposal dated June 5, 2019, which was authorized by Mr. Barth Holohan on June 14, 2019.

2.0 PROJECT AND SITE DESCRIPTION

Three senior living homes are planned for a flag-shaped area located north of Forest Parkway Drive in Manchester, Missouri. The Location Plan, Figure 1, shows the site relative to the surrounding roads and topography.

The buildings are planned to each be 7,215 square feet in footprint, one-story, and supported by shallow foundations with a slab-on-grade. The wood-framed structures will each be backed by a patio and retaining walls to achieve proposed finished floor elevations. A driveway is planned along the east edge of the site with parking generally provided along the driveway. A stormwater detention basin is planned at the northwest corner and south end of the site with a bioretention basin proposed below a turn-around area in the driveway. Up to 18 feet of cut and 10 feet of fill are anticipated to accommodate planned improvements. Phase One will consist of developing the southern portion of the site and construction of Sabrina House. Phase Two is conceptual at this time, and consists of Amelia House and Isabella House. The proposed site improvements are illustrated on the Site Plan, Figure 2.

The site is currently grass covered but appears to have been previously developed. Two structures occupied the site prior to 2008 when the project area was cleared. The site was not redeveloped after 2008. Surface topography ranges from about elevation (El.) 588 feet along the eastern edge to El. 514 feet at the northwest corner.

3.0 FIELD EXPLORATION

The field exploration consisted of excavating 13 test pits, designated as TP-A through TP-M, at the approximate locations shown on the Site Plan. JGE personnel staked the test pit locations estimating from existing site features. Test pit elevations were estimated from the Site Plan with 2-foot contours. The project surveyor should be retained if more accurate elevation and location data are necessary.

A Komatsu PC170LC trackhoe was used to excavate the test pits on July 1, 2019. The test pits were terminated at bucket refusal, at depths between 6 inches and 9 feet below the ground surface. A JGE representative prepared logs of the test pits and collected disturbed samples. Pocket penetrometer tests were performed at select locations. The test pits were backfilled with the excavation spoils at completion.

4.0 LABORATORY TESTING

In our laboratory, the samples were characterized using manual-visual methods. Moisture contents were determined for each sample. One Atterberg limits test was performed on a select sample.

The nature and thickness of the soils encountered, and the results of the field sampling and laboratory testing are shown on the Test Pit Logs in the Appendix. Our Test Pit Log Legend and Nomenclature sheet, included at the front of the Appendix, can be used to interpret the logs.

5.0 SUBSURFACE CONDITIONS

Presented herein is the general description of the soils encountered. Detailed information regarding the soil types and interpretive soil stratigraphy is presented in the Test Pit Logs.

Existing fill was encountered in TP-C to a depth of about 4 feet and in TP-D and TP-E to depths of 1 foot. Fill materials within TP-C consisted of medium stiff, high plastic clay (CH) containing trace amounts of gravel and silty clay (CL). Fill observed within TP-D and TP-E consisted of high plastic, gravelly clay (CH) containing brick fragments and limestone cobbles. Topsoil was observed in TP-B, TP-F, TP-J, and TP-M to depths between 2 and 12 inches. Crushed limestone aggregate was observed in TP-G to a depth of 8 inches.

The natural soil profile is generally comprised of stiff, high plastic clay (CH) containing varying quantities of gravel, cobbles, and boulders. Weathered sandstone was observed in TP-I and TP-L, starting at the ground surface to depths of about six inches. Moisture contents of the soils were typically between 20 and 30 percent but ranged from 17 to 41 percent.

Bucket refusal was encountered within each of the test pits, at depths between six inches and 9 feet. Refusal is a designation applied to any material that cannot be further penetrated by the excavation equipment without extensive effort and is usually indicative of a very hard or very dense material, such as boulders or bedrock.

Groundwater was not encountered at the time of exploration. Groundwater levels may not stabilize in an excavation even after several days. Groundwater is subject to seasonal and climatic variations and may be present at different depths at a future date.

The observed existing fill and bucket refusal depths are summarized in Table 1, on the next page.

Table 1. Test Pit Data Summary

Test Pit	General Location	Approximate Elevation (feet)	Observed Depth of Existing Fill (feet)	Depth to Cobbles/ Boulders (feet)	Depth to Refusal (feet)
TP-A	Sabrina House	575	Not Observed	At Surface	1.5
TP-B	Sabrina House	574	Not Observed	Not Observed	2.5
TP-C	Sabrina House	562	4	4	7.5
TP-D	Sabrina House	570	1	At Surface	5
TP-E	Driveway-North	576	1	At Surface	4
TP-F	Driveway-Middle	576	Not Observed	At Surface	1
TP-G	Driveway-South	566	Not Observed	1	9
TP-H	East Slope/Wall	583	Not Observed	At Surface	8
TP-I	Amelia House	568	Not Observed	At Surface[1]	0.5
TP-J	Amelia House	554	Not Observed	1	7
TP-K	Overflow Parking	566	Not Observed	At Surface	1.5
TP-L	Isabella House	569	Not Observed	At Surface[1]	0.5
TP-M	Isabella House	560	Not Observed	Not Observed	1
[1]Material consisted of weathered sandstone					

6.0 GEOTECHNICAL CONCERNS AND RECOMMENDATIONS

Geotechnical concerns were encountered during our exploration. These issues are not unusual or insurmountable but will add to the construction cost of the project.

6.1 Expansive Soil Remediation

Potentially expansive soil (high plastic clay) was encountered within the test pits at depths which may impact the proposed buildings. High plastic clay soils have the potential for volume change with changes in the soil moisture content. The volume change can lead to slab-on-grade movement and cracking, and in severe cases, movement and cracking of foundations and walls.

To reduce heave or settlement related problems associated with expansive soils, we recommend that high plastic clay be removed and replaced within 3 feet of the floor slab subgrade and 2 feet of the foundation subgrades. The overexcavation should extend 2 feet beyond the edges of foundations and floor slabs if non-expansive soil is to be used as the replacement material. A representative of JGE should observe the foundation excavations to determine if remedial measures due to high plastic, potentially expansive clay are necessary. The base of the excavations must not be allowed to desiccate during the remediation and construction process.

The overexcavation should be backfilled with properly compacted, non-expansive fill materials such as low plastic soil, lime stabilized clay, or 1-inch minus gradation crushed limestone. Lean concrete (3-sack mix) may also be used as the replacement material beneath foundations, and if used, the excavation for the concrete can be the same width as the planned footings. Extending the footings 2 feet below the normal bearing elevation and casting taller foundation walls is also an acceptable alternative.

The suggested method of treatment for high plastic clay is based on generally accepted standards in the local engineering community. Swell pressures and volume change potential greater than can be remediated by the suggested method may exist. Consequently, the owner should recognize that there is an inherent risk that floor slab and foundation damage may occur, even after remedial treatment of the subgrade soil.

6.2 Shallow Refusal

Bucket refusal was encountered in each of the test pits at depths between 6 inches and 9 feet below the ground surface. Excavation with backhoes or trackhoes in narrow trenches may be difficult if refusal material is encountered. Dense boulders or rock may be encountered within some excavations. Rock excavation below the refusal depths may require chipping or blasting. A contingency fund should be established for rock excavation.

6.3 Existing Fill Remediation

Existing fill was observed in three of the test pits (TP-C, TP-D, and TP-E) to depths of 1 to 4 feet below the ground surface. Fill may also be present in other areas of the site, between or away from the test pit locations.

Based on our field observations and laboratory testing, the fill may not have been placed with compaction effort. The overall quality of an unknown/undocumented fill is suspect since pockets or layers of poorly or uncompacted soil, or deleterious material may be present. These materials may cause excessive settlement.

We recommend the existing fill be removed in its entirety from the planned structural areas and replaced with acceptable structural fill. Material placed and compacted should be in accordance with the recommendations presented later in this report. The overexcavation should extend laterally beyond the perimeter of the building to a distance equivalent to the depth of the overexcavation, but not less than 4 feet.

6.4 High Moisture Content

Presently, some of the onsite soils may be too wet to achieve proper compaction. Moisture conditioning of the soils may be necessary during general grading to achieve proper compaction. Aeration or a drying agent, such as Code L, may be necessary to lower the soil moisture to allow for proper compaction.

7.0 DESIGN RECOMMENDATIONS

The following sections detail recommendations for the building and site design. These recommendations assume the grading has been performed in general accordance with the recommendations provided above and in the "Construction Considerations" section that follows.

7.1 Shallow Foundations

Shallow foundations bearing in firm, low plastic, natural soil or compacted, non-expansive structural fill are appropriate for support of the proposed structure. The potentially expansive soil and existing fill should be remediated as previously described. Shallow foundations can be designed for net allowable bearing pressure of 2,000 pounds per square foot (psf). Continuous footings should have a minimum width of 18 inches. Isolated column footings should have a minimum dimension of 30 inches. Exterior footings and foundations in unheated portions of the building should be provided with at least 30 inches of soil cover for frost protection. Interior footings in heated parts of the building can be located at nominal depths below the finish floor.

Rock and cohesive soil are anticipated to be encountered during foundation excavation. Foundations should bear on materials of similar compression characteristics to reduce the potential for differential settlement. When foundations will be supported on both soil and rock, the foundations must be extended to bear on very stiff soils or rock. Overdeepened footing excavations may be backfilled with lean concrete (3-sack mix) or flowable fill up to the design base of the footing elevations.

Following the recommendations given in this report, settlement should be less than 1 inch and differential settlement should be less than ¾ inch.

7.2 Seismic Design Considerations

In our professional opinion, based on the field data, laboratory data, and assumed depth to rock, the site fits the International Building Code for Site Class C. The proposed building can be designed for this or more stringent soil types. We recommend the structural engineer determine the Seismic Design Category.

7.3 Floor Slabs

The floor slabs may be designed using a modulus of subgrade reaction of 125 pounds per cubic inch (pci) for a properly compacted subgrade. The following recommendations are not intended to supersede the structural engineer's design for the floor slabs.

The floor slabs should be supported on a layer of crushed stone. This will help distribute concentrated loads and equalize moisture conditions beneath the slabs. If a polyethylene moisture barrier is placed atop the crushed stone and beneath the floor, careful attention to curing of the concrete slab should be followed or excessive shrinkage cracking and "curling" can occur. We suggest the applicable recommendations provided in the American Concrete Institute (ACI) Standards be followed for curing the concrete floor slabs.

The floor slabs should not be structurally connected to the foundation walls and column pads. Isolation joints should be used where the slabs meet a wall or column. We also suggest that joints be placed in the floor slabs on no more than 15-foot intervals for 4-inch thick floors. The joints should be located in such a manner that each floor slab section is rectangular. Such joints permit slight movements of the independent elements and help prevent random cracking that might otherwise be caused by restraint of shrinkage, slight rotations, heave, or settlement.

7.4 Retaining and Below Grade Walls

Retaining walls and building walls retaining soil should be designed to withstand lateral earth pressures caused by the weight of the backfill and surcharge loads. The equivalent fluid unit weights tabulated on the following page are recommended for design of the walls. Values for granular material should only be used if the granular backfill extends from the wall a lateral distance of at least one-half the wall height. High plastic clays should not be used as wall backfill, since the clays may swell upon wetting, which could result in excessive lateral pressures. The walls should be designed to resist an additional uniform lateral load of one-half of surface loads above the walls. This table assumes that positive foundation and backfill drainage is provided to prevent buildup of hydrostatic pressure.

Table 2. Recommended Lateral Earth Pressures

Backfill Type	Equivalent Fluid Unit Weights	
	Fixed-Headed Walls (pcf)	Free-Headed Walls (pcf)
Cohesive Soil	60	50
Granular Material (1-inch minus)	48	30

A fixed headed wall is a wall connected to floor joists or beams that prevent deflection of the top after backfilling. A free headed wall is designed to deflect at the top and remain fixed at the base, such as a retaining wall. A wing wall attached to a fixed headed wall should be considered fixed headed unless the structural design permits independent rotation.

Wall footings can be designed for net allowable bearing pressure of 2,000 pounds per square foot (psf). The walls can be designed with a coefficient of friction between the base of the concrete footing and the subgrade soil of 0.3. A passive soil resistance modeled by an equivalent fluid unit weight of 200 pounds per cubic foot may be used for soil against the face of the exterior base or a key below the base of the walls. The upper 30 inches of soil should not be included in passive pressure calculations in frost susceptible areas.

To prevent the building of hydrostatic pressures behind the wall, a drainage system should be installed. Drains should consist of 4-inch diameter, perforated plastic pipe laid with the holes down and surrounded with a select filter material consisting of 0.5 to 1-inch clean crushed stone. This stone should be isolated from the surrounding soil with a layer of synthetic filter material such as Mirafi 140N or similar. Where practical, drains should drain by gravity to daylight or storm sewers (if allowed by the utility company).

If modular block retaining walls are used, they typically utilize mechanically stabilized earth (MSE) as the backfill. Foundations and configurations of MSE walls will be designed by others. The geosynthetic reinforcement type and placement should be designed for internal and global stability. Soil parameters, backfill materials, and required compaction should be assumed or specified by the designer.

We recommend a global stability analysis of any planned retaining walls be performed for this project if the walls will support structures, are greater than 6 feet in height, if a slope is planned above or below the wall, or if the wall will be subject to direct contact with water on a routine basis (such as within a detention basin).

7.5 Proposed Cut Slopes

Reportedly, a rock cut is being considered along the eastern edge of the site. Elevation change from the top to bottom of the slope is up to 18 feet. We anticipate the rock encountered in at least a portion of this slope, if not all of the slope, will not be competent enough to remain stable at the proposed inclination. A modular block retaining wall should be considered. A global stability analysis of cut or fill slopes with an inclination greater than 3H:1V is recommended for this project.

7.6 Site Drainage and Final Grading

Adequate site drainage should be provided to reduce infiltration of surface water around the perimeter of the structures and beneath the slabs. All grades should be sloped away from the structures, and roof and surface drainage should be collected and discharged such that water is not permitted to infiltrate the foundation backfill.

8.0 CONSTRUCTION CONSIDERATIONS

The following sections present recommendations for the construction phase of the project.

8.1 Siltation Control

Some of the soils at this site are susceptible to erosion. Appropriate erosion control measures, such as proper site contouring during general grading and the installation of siltation fences or the placement of staked straw bales, should be used during construction to keep eroded materials on site.

8.2 Site Preparation

Cut and fill areas must be stripped of surface vegetation, topsoil, and existing fill prior to fill placement. Topsoil and soft surface materials could be stockpiled for later use in green areas or common ground or be removed from the site. The subgrade in all areas to receive fill should then be scarified, proofrolled and compacted as specified later in this report, and under the observation of JGE. Soft spots and areas where the recommended compaction cannot be achieved should be undercut and replaced with compacted, non-expansive cohesive soil fill or crushed stone.

8.3 Structural Fill Considerations

Low plastic, silty clay soil with a liquid limit less than 45 and a plastic index less than 20 is suitable for structural fill. Crushed limestone or limestone screenings may also be used as structural fill at the site. Boulders or rock ledges over 12 inches in maximum dimension should not be placed under or within 15 feet of structures. The onsite soils consisting of high plastic clay are not suitable for use as structural fill within 2 feet of foundations and 3 feet of floor slabs.

Cohesive fill and aggregate should be placed in 8-inch loose lifts. Cohesive fill should be compacted to a minimum dry density of 90 percent of the modified Proctor maximum dry density for the material (ASTM D 1557). Well-graded granular fill should be compacted to a minimum dry density of 95 percent of the maximum dry density as determined by the modified Proctor test. Field density tests should be performed on each lift of fill to check that proper compaction is being achieved.

Rock cut and/or blasted from cut areas may be used as structural fill. If elected, the shot rock fill should be free of deleterious material and individual pieces should be less than 12 inches in dimension in any direction. Boulders larger than 12 inches will need to be crushed to a smaller dimension. A well-graded mixture of particle sizes should be provided, or the fill placement should be controlled so the particle size gradually decreases as finished grade is approached. The fill should be placed in no more than 12-inch thick lifts.

Fill containing gravel, cobbles, and/or boulders is not conducive to density testing. In areas of rubble fill, compaction should be performed by tracking over the fill material with a Caterpillar D8 dozer (or equivalent) until negligible subgrade deflection is observed by a JGE representative.

Slopes to receive fill which are steeper than 5 horizontal to 1 vertical (5H:1V) should be benched prior to the placement of fill. Horizontal benching will provide a level surface for compaction and reduce the potential for development of inclined planes of weakness between the existing surface and the newly compacted structural fill. Benched slopes should not be steeper than 1H:1V and the individual benches should not exceed 4 feet in height.

8.4 Foundation Excavations

A JGE representative should observe the foundation excavations to check that the foundations will bear on competent materials. The base of all excavations should be clean, relatively dry, and free of loose soil or uncompacted fill. The excavations should be protected from extreme temperatures, precipitation, and construction disturbances. To reduce the possibility of desiccation or saturation of the foundation soils, we recommend the concrete be placed as soon as possible after the excavation is made.

Disturbance of the soils in footing and floor slab excavations should be avoided. The potential for such disturbance will increase during wetter portions of the year. Footing subgrade materials that have been excessively disturbed should be overdeepened to firm, undisturbed soil and replaced with properly compacted, non-expansive fill. Excessively disturbed soils beneath the floor slabs should be removed and replaced with additional granular material.

8.5 Excavation Bracing Requirements

The United States Department of Labor, Occupational Safety and Health Administration (OSHA) issued "Construction Standards for Excavations, 29 CFR, Part 1926, Subpart P" to provide for the safety of workers entering trenches or excavations. This document should be consulted for safe and legal excavations.

9.0 CONSTRUCTION MONITORING PROGRAM

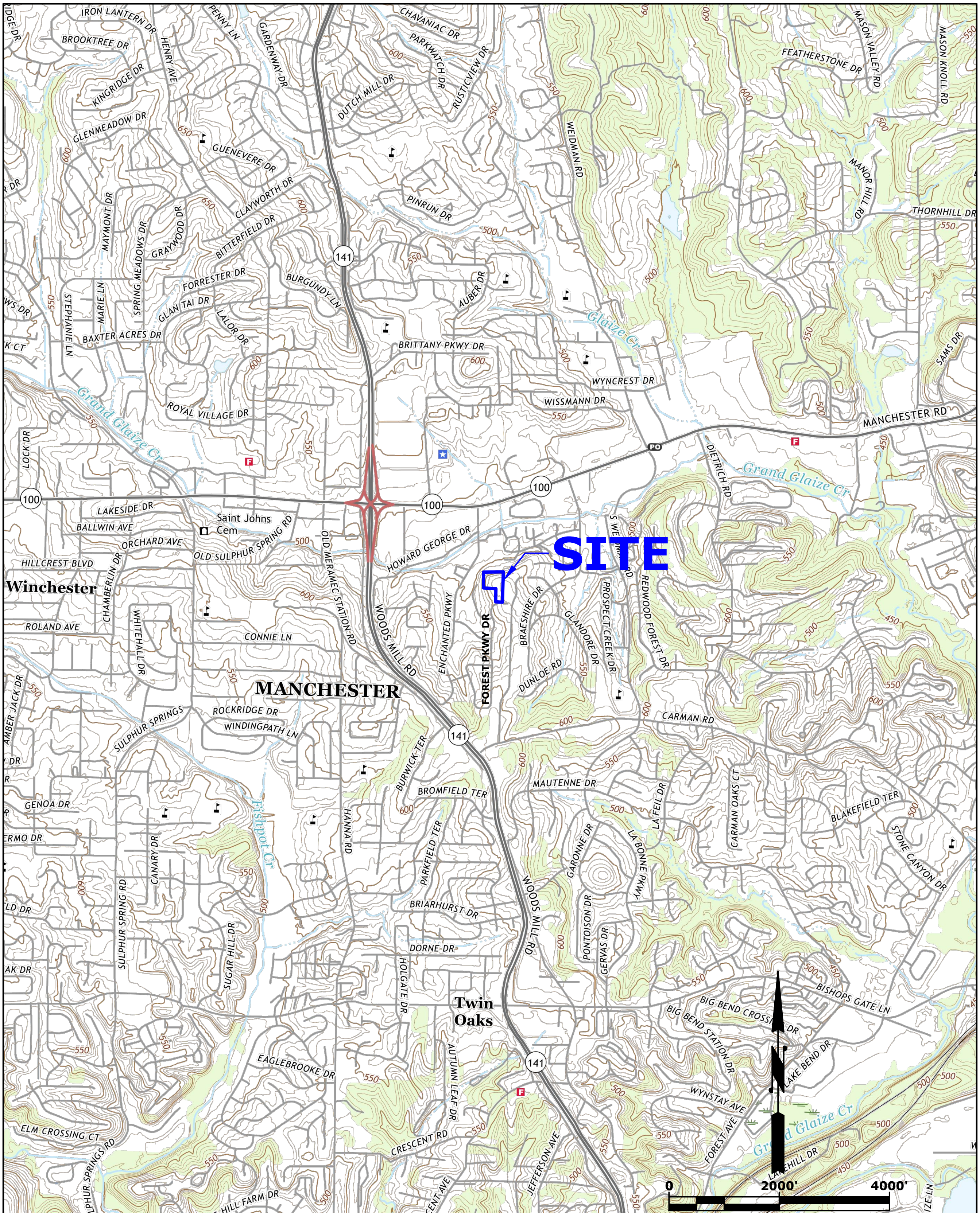
The following are highlights of a construction monitoring program. These services are intended to assess our design assumptions and to provide construction quality assurance by comparing and documenting procedures and test results with plans, specifications, and good engineering practice. In this endeavor, JGE should:

- Review project plans and construction specifications to assess the interpretation of this report
- Observe site preparation
- Observe remediation of potentially expansive soil and existing fill
- Verify the suitability of potential fill materials
- Monitor placement and proper density of structural fill and backfill
- Observe footing and floor slab excavations and verify that suitable bearing materials are present
- Test concrete during building construction

10.0 LIMITATIONS

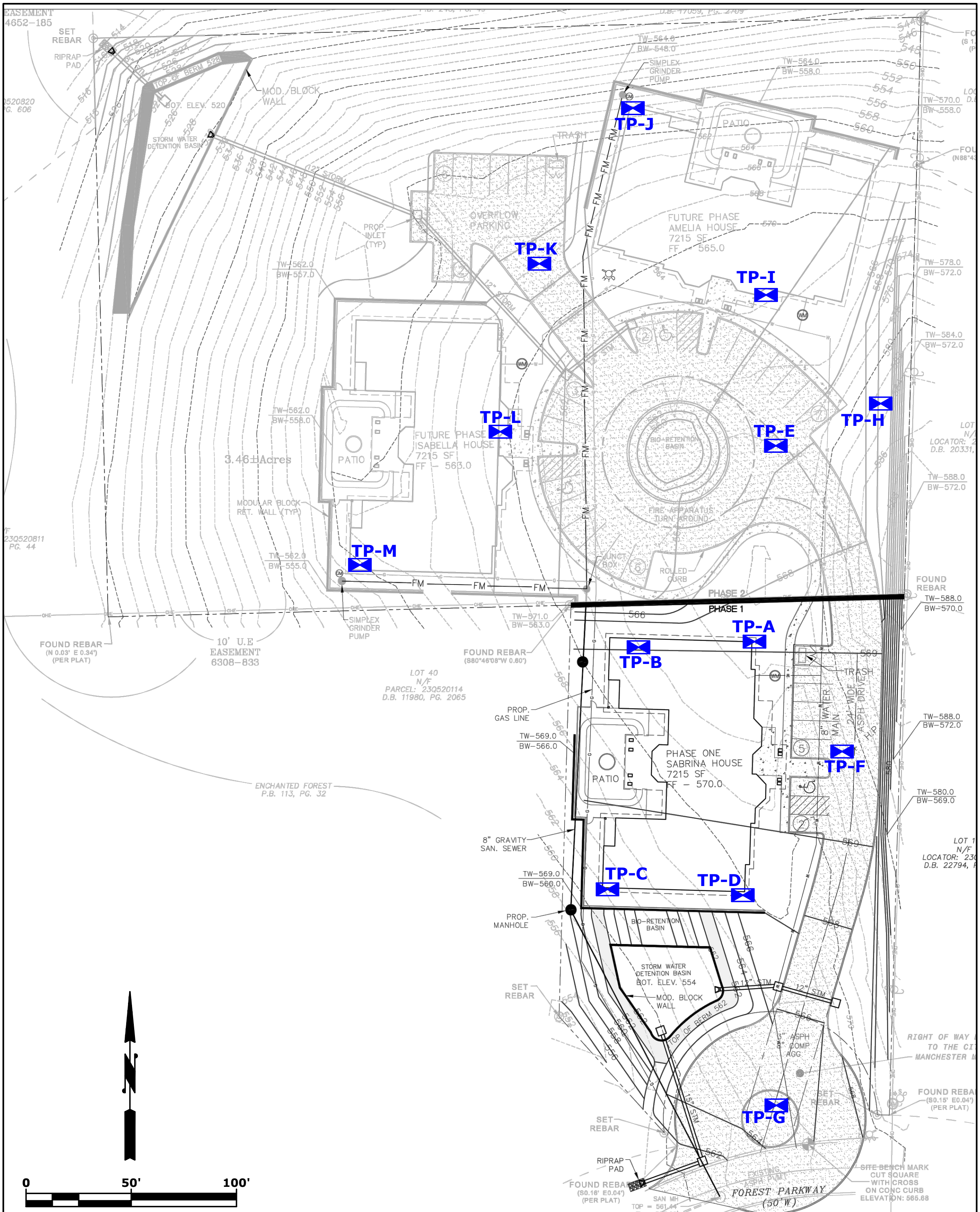
The recommendations provided herein are based on the information obtained at 13 specific locations within the project area and regionally accepted practice. JGE should be contacted if conditions encountered are not consistent with those described.

In addition, we should be provided with a set of final development plans, as soon as they are available for review, to determine the applicability of our recommendations. Construction specifications also merit our review to assess the interpretation of this report. Failure to provide these documents for review may nullify some or all of the recommendations provided herein.



Location Plan based on USGS MANCHESTER and KIRKWOOD, MISSOURI QUADRANGLES 7.5-MINUTE SERIES, dated 2017 Contour Interval: 10 feet	**JACOBI GEOTECHNICAL ENGINEERING, INC.**
	LOCATION PLAN
	Family Partnership Manchester
	Manchester, Missouri
	19119.1 **July 2019**

Figure 1



Site Plan based on drawing by VonArx Engineering, received 5/30/2019

Approximate Test Pit Location

JACOBI GEOTECHNICAL ENGINEERING, INC.	
SITE PLAN	
Family Partnership Manchester	
Manchester, Missouri	
19119.1	July 2019

Figure 2

APPENDIX

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT LOG
LEGEND AND NOMENCLATURE

Depth - Depth below ground surface, in feet.

Elevation - Referenced to msl, city, or site datum, in feet.

Type No. - Sample type and number designated by the following:

DT – Drive tube sampler; relatively undisturbed, obtained by driving 2-inch-diameter, thin walled tube sampler

BS - Bag samples; disturbed, obtained from cuttings

USCS - Unified Soil Classification System; designates letter symbols for soil types (ASTM D 2487 & D 2488)

Soil Description - Describes soil according to the Unified Soil Classification System (ASTM D 2488 & D 2488), indicates constituents and characteristics. Solid lines between descriptions indicate approximate change between soil types and the transition may be gradual.

▼ **Water level –** Ground water detected at the time of excavating

Shear Strength Test Results

Shear Strength - Results reported from either field or laboratory tests in kips per square foot (ksf), determined by Pocket Penetrometer Test unless preceded by CP or TV

PP – Pocket Penetrometer - Approximates shear strength of unconfined compressive test

CP – Static Cone Penetrometer - Approximates shear strength of unconfined compressive test

TV - Torvane – Miniature vane used in determining approximate shear strength

Laboratory Test Results

Moisture % - Moisture content expressed as a percentage of the dry unit weight (ASTM D 2216)

Liquid Limit and Plastic Limit - Index tests performed for classifying fine-grained components of soils (ASTM D 4318)

Dry Density - Obtained from Shelby tube or continuous samplers, reported in pounds per cubic foot (pcf)

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-A

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 575.0
TOTAL DEPTH (ft) 1.5

DEPTH (ft)	FIELD TESTING				MATERIAL DESCRIPTION	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING							DEPTH (ft)
	SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	DEPTH (ft) / ELEVATION (ft)				SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0					Reddish-brown, fat, CLAY with limestone cobbles			CH								0.0
	GS 1	6/6			1.5 / 573.5					28						

Refusal at 1.5 feet. Test pit terminated at 1.5 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-B

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 574.0
TOTAL DEPTH (ft) 2.5

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					TOPSOIL: 4 inches											0.0
					0.4 — 573.6											
					Reddish-brown, fat, CLAY, trace gravel			CH								
2.5	GS 1	6/6		2	2.5 — 571.5					25						2.5

Refusal at 2.5 feet. Test pit terminated at 2.5 feet.

NOTES:

TEST PIT NUMBER TP-C

JACOBI GEOTECHNICAL ENGINEERING, INC.

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019 **LOGGED BY** M. Schultz **ELEVATION (ft)** 562.0

COMPLETION DATE 7/1/2019 **CHECKED BY** M. Schultz **TOTAL DEPTH (ft)** 7.5

CONTRACTOR Joerling Excavating **GROUND WATER LEVELS:**

EQUIPMENT Komatsu PC170LC / Test Pits **AT TIME OF EXCAVATION** ---

SAMPLING Grab sample / **AT END OF EXCAVATION** ---

BACKFILL Excavation Spoils **AFTER EXCAVATION** ---

DEPTH (ft)	SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION	WATER LEVEL	GRAPHIC LOG	USCS	SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					FILL: Reddish-brown, fat, CLAY, trace silty clay and gravel											0.0
2.5																2.5
	GS 1	6/6		0.75					Grab	26			50	19	31	
4.0					Depth 4.0 / Elevation 558.0: Reddish-brown, fat, CLAY with gravel and limestone cobbles and boulders			CH								
5.0																5.0
	GS 2	6/6		1.75					Grab	40						
7.5					Depth 7.5 / Elevation 554.5											7.5

Refusal at 7.5 feet. Test pit terminated at 7.5 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-D

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 570.0
TOTAL DEPTH (ft) 5.0

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION	DEPTH (ft)	ELEVATION (ft)	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					FILL: Brown, fat, GRAVELLY CLAY with brick fragments and limestone cobbles	1.0	569.0			CH								0.0
					Brown, fat, GRAVELLY CLAY with limestone cobbles and boulders	5.0	565.0			CH								
2.5	GS 1	6/6										41						2.5
5.0																		5.0

Refusal at 5.0 feet. Test pit terminated at 5.0 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-E

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 576.0
TOTAL DEPTH (ft) 4.0

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					0.1 TOPSOIL: 1 inch 575.9											0.0
					FILL: Reddish-brown, fat, GRAVELLY CLAY with brick fragments, limestone cobbles, and boulders			CH								
					1.0 575.0											
					Reddish-brown, fat, GRAVELLY CLAY with limestone cobbles and boulders			CH								
2.5	GS 1	6/6								17						2.5
					4.0 572.0											

Refusal at 4.0 feet. Test pit terminated at 4.0 feet.

NOTES:

TEST PIT NUMBER TP-F

JACOBI GEOTECHNICAL ENGINEERING, INC.

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019 **LOGGED BY** M. Schultz **ELEVATION (ft)** 576.0

COMPLETION DATE 7/1/2019 **CHECKED BY** M. Schultz **TOTAL DEPTH (ft)** 1.0

CONTRACTOR Joerling Excavating **GROUND WATER LEVELS:**

EQUIPMENT Komatsu PC170LC / Test Pits **AT TIME OF EXCAVATION** ---

SAMPLING Grab sample / **AT END OF EXCAVATION** ---

BACKFILL Excavation Spoils **AFTER EXCAVATION** ---

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	FIELD TESTING: RECOVERY, in/in (RQD, %)	FIELD TESTING: BLOW COUNTS (N VALUE)	FIELD TESTING: PENETROMETER (ksf)	MATERIAL DESCRIPTION: DEPTH (ft)	MATERIAL DESCRIPTION	MATERIAL DESCRIPTION: ELEVATION (ft)	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	LABORATORY TESTING: MOISTURE CONTENT (%)	LABORATORY TESTING: DRY UNIT WT. (pcf)	LABORATORY TESTING: SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	DEPTH (ft)
0.0					0.2	TOPSOIL: 2 inches	575.8											0.0
					1.0	Red, fat, CLAY with limestone cobbles	575.0			CH								

Refusal at 1.0 feet. Test pit terminated at 1.0 feet.

NOTES:

TEST PIT NUMBER TP-G

JACOBI GEOTECHNICAL ENGINEERING, INC.

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019 **LOGGED BY** M. Schultz **ELEVATION (ft)** 566.0

COMPLETION DATE 7/1/2019 **CHECKED BY** M. Schultz **TOTAL DEPTH (ft)** 9.0

CONTRACTOR Joerling Excavating **GROUND WATER LEVELS:**

EQUIPMENT Komatsu PC170LC / Test Pits **AT TIME OF EXCAVATION** ---

SAMPLING Grab sample / **AT END OF EXCAVATION** ---

BACKFILL Excavation Spoils **AFTER EXCAVATION** ---

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					CRUSHED LIMESTONE: 8 inches											0.0
					0.7 — 565.3											
					Red, fat, CLAY with limestone cobbles and boulders			CH								
2.5																2.5
	GS 1	6/6		1.75						23						
5.0																5.0
7.5																7.5
					9.0 — 557.0											

Refusal at 9.0 feet. Test pit terminated at 9.0 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-H

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019 **LOGGED BY** M. Schultz **ELEVATION (ft)** 583.0

COMPLETION DATE 7/1/2019 **CHECKED BY** M. Schultz **TOTAL DEPTH (ft)** 8.0

CONTRACTOR Joerling Excavating **GROUND WATER LEVELS:**

EQUIPMENT Komatsu PC170LC / Test Pits **AT TIME OF EXCAVATION** ---

SAMPLING Grab sample / **AT END OF EXCAVATION** ---

BACKFILL Excavation Spoils **AFTER EXCAVATION** ---

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					Gray, weathered, LIMESTONE COBBLES with brown, fat, clay											0.0
2.5																2.5
5.0																5.0
7.5																7.5
					8.0 575.0											

Refusal at 8.0 feet. Test pit terminated at 8.0 feet.

NOTES: Samples not obtained per client request.

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-I

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 568.0
TOTAL DEPTH (ft) 0.5

DEPTH (ft)	FIELD TESTING				MATERIAL DESCRIPTION	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING				ATTERBERG LIMITS			DEPTH (ft)
	SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	DEPTH (ft) / ELEVATION (ft)				SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0																0.0
					Tan, SANDSTONE 0.5 / 567.5											

Refusal at 0.5 feet. Test pit terminated at 0.5 feet.

NOTES:

TEST PIT NUMBER TP-J

JACOBI GEOTECHNICAL ENGINEERING, INC.

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019 **LOGGED BY** M. Schultz **ELEVATION (ft)** 554.0
COMPLETION DATE 7/1/2019 **CHECKED BY** M. Schultz **TOTAL DEPTH (ft)** 7.0
CONTRACTOR Joerling Excavating **GROUND WATER LEVELS:**
EQUIPMENT Komatsu PC170LC / Test Pits **AT TIME OF EXCAVATION** ---
SAMPLING Grab sample / **AT END OF EXCAVATION** ---
BACKFILL Excavation Spoils **AFTER EXCAVATION** ---

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION	DEPTH (ft) / ELEVATION (ft)	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					TOPSOIL: 12 inches	1.0 / 553.0											0.0
					Brown, fat, CLAY with limestone cobbles	6.5 / 547.5			CH								
2.5																	2.5
	GS 1	6/6		2						◣	26						
5.0																	5.0
					Gray, weathered, LIMESTONE	7.0 / 547.0											

Refusal at 7.0 feet. Test pit terminated at 7.0 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-K

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 566.0
TOTAL DEPTH (ft) 1.5

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					Brown, fat, CLAY with limestone cobbles 1.5 / 564.5			CH								0.0

Refusal at 1.5 feet. Test pit terminated at 1.5 feet.

NOTES:

TEST PIT NUMBER TP-L

JACOBI GEOTECHNICAL ENGINEERING, INC.

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 569.0
TOTAL DEPTH (ft) 0.5

DEPTH (ft)	FIELD TESTING				MATERIAL DESCRIPTION	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING				ATTERBERG LIMITS			DEPTH (ft)
	SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	DEPTH (ft) / ELEVATION (ft)				SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0.0					Tan, SANDSTONE 0.5 / 568.5											0.0

Refusal at 0.5 feet. Test pit terminated at 0.5 feet.

NOTES:

JACOBI GEOTECHNICAL ENGINEERING, INC.

TEST PIT NUMBER TP-M

FAMILY PARTNERSHIP MANCHESTER
MANCHESTER, MISSOURI
JGE No. 19119.1

START DATE 7/1/2019
COMPLETION DATE 7/1/2019
CONTRACTOR Joerling Excavating
EQUIPMENT Komatsu PC170LC / Test Pits
SAMPLING Grab sample /
BACKFILL Excavation Spoils

LOGGED BY M. Schultz
CHECKED BY M. Schultz
GROUND WATER LEVELS:
AT TIME OF EXCAVATION ---
AT END OF EXCAVATION ---
AFTER EXCAVATION ---

ELEVATION (ft) 560.0
TOTAL DEPTH (ft) 1.0

DEPTH (ft)	FIELD TESTING: SAMPLE NUMBER	RECOVERY, in/in (RQD, %)	BLOW COUNTS (N VALUE)	PENETROMETER (ksf)	MATERIAL DESCRIPTION (DEPTH (ft) / ELEVATION (ft))	WATER LEVEL	GRAPHIC LOG	USCS	LABORATORY TESTING: SAMPLE TYPE	MOISTURE CONTENT (%)	DRY UNIT WT. (pcf)	SHEAR STRENGTH (ksf)	ATTERBERG LIMITS: LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	DEPTH (ft)
0.0					TOPSOIL: 12 inches 1.0 — 559.0											0.0

Refusal at 1.0 feet. Test pit terminated at 1.0 feet.

NOTES: