GEOTECHNICAL EXPLORATION
PROPOSED TACO BELL
7520 WEST LOWER BUCKEYE ROAD
PHOENIX, ARIZONA
FOR
HITCHENS ASSOCIATES ARCHITECTS

***TEC* 21C018RPT.01**
APRIL 12, 2021

TERRANE ENGINEERING CORPORATION

TERRANE ENGINEERING CORPORATION
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April 12, 2021

Mr. Greg Hitchens
Hitchens Associates Architects
3126 N. Los Alamos
Mesa, AZ 85213

Re: Geotechnical Exploration for Proposed Taco Bell
7520 West Lower Buckeye Road, Phoenix, Arizona
TEC 21C018RPT.01

Dear Mr. Hitchens:

Terrane Engineering Corporation *(TEC)* is pleased to provide this geotechnical exploration report for the referenced project. Our services were performed for you in general accordance with your request and *TEC* Proposal 21012PR.FC, March 15, 2021.

The report summarizes project and site data, describes services performed, and provides information and recommendations regarding foundations, lateral earth pressures, slabs-on-grade, pavement, earthwork, and surface drainage. The appendix presents supporting information such as figures, logs, and laboratory data. The geotechnical engineer or his qualified representative should verify conditions and recommendations presented in this report during construction.

The opportunity to provide services for your project is appreciated. If you have any questions concerning this report or if I may be of service, please contact me.

Sincerely,

TERRANE ENGINEERING CORPORATION

Registered Professional Engineer (Civil) CERTIFICATE NO 19397 FRANK COSTELLO Date Signed 4/12/21 ARIZONA U.S.A.

Frank Costello, P.E

Copies to: Addressee, greg@hitcharch.com (pdf only)

TABLE OF CONTENTS

APPENDIX

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1. INTRODUCTION

This report presents the results of our geotechnical exploration for the proposed restaurant 7520 West Lower Buckeye Road in Phoenix, Arizona. The location of the site is shown on the Vicinity Map in the Appendix. This geotechnical exploration was performed by *TEC* to provide information and recommendations regarding:

- Near-surface soil and groundwater conditions on site,
- Index and engineering characteristics of site soils,
- Foundations, slabs-on-grade, pavement, earthwork, and surface drainage.

2. PROJECT DESCRIPTION

With respect to this geotechnical exploration, the project consists of a restaurant and related parking and drives as shown on the Site Map in the Appendix. The building is expected to be a one-story, masonry or frame structure supported by spread-footing foundations with a slab-on-grade floor. Wall and column loads are estimated to be on the order of 1 to 4 kips per lineal foot and 10 to 40 kips, respectively. Asphalt and portland cement concrete with an aggregate base course will be used for paved areas. Finished grades are expected to be near existing grades.

3. SCOPE OF SERVICES

Field, laboratory, and engineering services were performed for this geotechnical exploration by *TEC* in general accordance with current, local standards of practice for engineering and testing.

3.1 Field

Fieldwork consisted of contacting Bluestake for public utility clearances, site reconnaissance by a field engineer, and drilling and sampling with a truck-mounted, auger drill rig. Two borings were advanced to 16½ feet and a pavement subgrade sample was obtained at the locations shown on

the Site Map. The field engineer logged the borings and obtained ring, split-spoon, and bulk samples at selected depths. Upon completion, the borings were backfilled with auger cuttings.

3.2 Laboratory

A program was developed by the geotechnical engineer to obtain data used in development of foundation, slab-on-grade, pavement, and earthwork recommendations. It consisted of gradation, plasticity index, standard proctor, remolded swell potential, and collapse potential tests.

3.3 Engineering

Field and laboratory data were evaluated by *TEC* to formulate recommendations for foundations, slabs-on-grade, pavement, and earthwork.

4. SITE CHARACTERIZATION

Information regarding surface features, subsurface soil and groundwater conditions, and laboratory test results is presented in this section. This information was gathered by *TEC* for geotechnical engineering purposes only. This site characterization does not and was not intended to address the existence or likelihood of contamination on or around the site. Specialized methods and procedures, which were not part of this scope of services, are required for an adequate environmental site assessment.

4.1 Surface

The site was relatively flat, practically cleared, vacant lot with some gravel on the surface. There was about a foot of relief with the center being higher and drainage across the surface to the east and west. Bluestake had marked a buried gas line in the part of the site. Historical, aerial photographs indicated the site was farmland until five years ago when grading for the commercial center started.

4.2 Subsurface

As shown on the logs in the Appendix, fill and interbedded, alluvial soils were encountered in the borings. Silty sand (SM) fill was encountered to a foot in Boring 2. The native soils included sandy silty clays (CL-ML) and sandy lean clays (CL), which were predominant. Prior farming likely affected soils to depths of 2 to 3 feet. Generally, calcareous cementation was minimal to light, but a zone of moderate cementation was encountered in Boring 2 at 5 feet. Groundwater was not encountered during exploration.

4.3 Laboratory

Index tests indicated the subgrade sample was sandy lean clay (CL) with a standard proctor maximum dry density of 115.2 pounds per cubic foot (pcf) and optimum moisture content of 14.8 percent. A remolded swell test indicated it had moderate expansion potential; after immersion,

2.8 percent swell occurred under a 100-psf surcharge. Laboratory tests on ring samples indicated dry density and moisture content of soils range from 98 to 113 pcf and 6.4 to 13.5 percent.

Collapse potential tests on soils from depths between 2 and 3 feet indicated they have moderate settlement potential at existing conditions; 2.3 to 2.8 percent consolidation occurred under a surcharge of 1,500 pounds per square foot (psf). When immersed in water, the samples exhibited low collapse potential by settling an additional 0.7 percent. Total consolidation under a 3,000-psf surcharge ranged from 3.9 to 5.1 percent.

5. DISCUSSION

The recommendations presented herein are based on our understanding of the project as presented in the Project Description and the assumption that subsurface conditions encountered in the borings adequately represent conditions on the site. Because project criteria regarding grading, number and type of structures, foundation loads, etc. can change and because subsurface conditions near and between the borings are not always similar to those encountered during exploration, the geotechnical engineer must be contacted for review and possible revision of the recommendations presented herein when related project criteria are altered during design or construction or when subsurface conditions substantially different from those expected based on available information are encountered during additional exploration or construction.

6. RECOMMENDATIONS

This section presents recommendations regarding foundations, lateral earth pressure, slabs-on-grade, pavement, earthwork, and surface drainage. They are design-level recommendations that must be confirmed by adequate observation and testing during construction. The firm that provides construction observation and testing services must assume the role of geotechnical engineer for this project.

6.1 Foundations

Based on the variable bearing characteristics and prior farming of near-surface soils, spread-footing foundations planned for support of the building should bear on recompacted, site soils or imported, engineered fill. An allowable bearing capacity of up to 2,500 pounds per square foot (psf) may be used for design of footings founded at least 18 inches below finished grade. Total and differential settlements are estimated to be less than an inch provided recommendations herein are followed.

All footing excavations should be reviewed by the geotechnical engineer prior to concrete placement and preferably prior to steel placement. Finished grade is finished floor for interior

footings and lowest adjacent finished grade for exterior footings. The recommended minimum lateral dimensions for wall and column footings are 16 and 24 inches, respectively. The allowable bearing capacity may be increased by one-third for wind and seismic loads.

Lightly loaded interior walls may be supported on thickened slab sections provided that: (1) loads do not exceed 900 pounds per lineal foot, (2) thickened sections are a minimum of 12 inches wide, and (3) section thickness and reinforcement are consistent with structural requirements.

Reinforcement of footings, stem walls, and masonry walls to reduce the potential for distress caused by differential foundation movements should be evaluated during design. The size, quantity, and location of reinforcement should be determined by a qualified structural engineer.

6.2 Lateral Earth Pressures

Lateral earth pressures for design of foundations and small, simple retaining walls with near-level, adjacent grades and without hydrostatic pressures or surcharges can be calculated using the equivalent fluid pressures presented below:

- Active:

Undisturbed subsoil	35 psf/ft
Compacted granular soils	30 psf/ft

- Passive:

Continuous footings	250 psf/ft
Column footings	300 psf/ft

If retaining wall heights will exceed 8 feet or if hydrostatic pressures or surcharges are likely, the geotechnical engineer should be consulted for additional analysis and recommendations. Retaining wall backfill should be free-draining, granular material with less than 5 percent fines, and a drainage system should be installed to prevent water accumulation in the retaining wall backfill. A coefficient of friction of 0.4 between footings and bearing soils may be used to resist lateral foundation loads. If passive earth pressures are used in conjunction with base friction to resist lateral loads, reduce the coefficient of friction to 0.3.

6.3 Slabs-On-Grade

Slabs-on-grade supported by prepared subgrade may be designed using a modulus of subgrade reaction of 150 pounds per cubic inch (pci). However, this condition should be limited to areas where differential movements are allowable. To reduce movements related to clayey soils, over compaction by equipment and drying of subgrade should be prevented. Also, turndowns extending below base course should be included to reduce migration of water under slabs.

Slabs should bear on a suitable aggregate base course that meets gradation and compaction recommendations included in this report. The use of dowels and keyways should be evaluated

for use at control and construction joints where load transfer capability is required. All concrete, especially slabs-on-grade, should be placed at minimum water-cement ratios and slumps on moistened surfaces and properly cured to minimize warping and curling. A vapor barrier should be included where moisture-sensitive floor coverings are planned.

6.4 Pavements

Recommendations for asphalt and portland cement concrete pavement sections are presented in the following subsections. The pavement sections are considered appropriate for a traffic loading of five daily equivalent, 18-kip, single-axle loads (ESALs) provided the recommendations in this report are followed. If a heavier traffic loading is anticipated, the geotechnical engineer should be contacted for review of recommended pavement sections.

Pavement sections should be designed and constructed with sufficient gradient to ensure positive drainage off and away from the pavement and supporting soil. Water should not be permitted to pond in areas immediately adjoining paved sections. Turndowns or curbs should extend below base course to prevent easy migration of water into the base course. Aggregate base, asphalt concrete, and portland cement concrete should conform to Maricopa Association of Governments (MAG) Specifications. Subgrade and aggregate base course preparation, placement, and compaction recommendations are presented in Earthwork.

- **6.4.1 Flexible Pavement:** A flexible pavement section consisting of 2½ inches of asphalt concrete on a 4-inch aggregate base course may be used for paved areas. Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. A ¾-inch mix is recommended.

- **6.4.2 Rigid Pavement:** A rigid pavement section consisting of 5 inches of portland cement concrete on prepared subgrade may be used for paved areas. The minimum compressive strength should be 3,500 pounds per square inch (psi) after 28 days. Longitudinal and transverse joints in the pavement should be provided as needed for expansion/contraction and isolation. All joints should be sealed to prevent entry of foreign material and dowelled to permit load transfer across the joints. If dowels cannot be used at joints accessible to wheel loads, pavement thickness should be increased by 25 percent at the joint and tapered to its design thickness in a longitudinal distance of 5 feet.

6.5 Earthwork

The foundation, pavement, and slab-on-grade recommendations presented in this report are predicated on fulfillment of the following earthwork recommendations:

- **6.5.1 Site Clearing:** Existing fill, vegetation, debris, and other deleterious materials must be removed from building, slab-on-grade, pavement, and other areas requiring prepared

subgrade prior to construction. After site clearing, the exposed surfaces should be relatively flat to allow for proper subgrade preparation.

- **6.5.2 Excavation:** Generally, conventional equipment is expected to be suitable for the proposed foundation and shallow utility excavations, and temporary excavations can probably be cut with vertical or near-vertical side slopes. Where moderately cemented soils are encountered, reduced excavation rates and the use of heavier equipment should be anticipated. In all cases, Occupational Safety and Health Administration (OSHA) Standards must be followed.

- **6.5.3 Workability:** At elevated moisture contents, the site soils may "pump" and become unworkable. This may require changes or additions in equipment and procedures such as grading the site to prevent ponding after site clearing, scarification and drying, over-excavation and replacement, or use of lightweight equipment.

- **6.5.4 Building Area Preparation:** In the building area, which includes the building footprint and five feet beyond the perimeter, existing soils should be over-excavated and recompacted. Over-excavation should extend 2 feet below foundation bearing level. After over-excavation, the exposed subgrade should be scarified and recompacted to a depth of 8 inches. Clayey site soils may be used as fill below foundation bearing level; however, imported materials should be used as fill above foundation bearing level. Subgrade preparation and fill placement should be accomplished in a manner that results in uniform moisture contents and densities in accordance with Placement and Compaction. Soils disturbed subsequently should be recompacted.

- **6.5.5 Slab-On-Grade and Pavement Preparation:** After Site Clearing, the exposed subgrade should be scarified and compacted to a depth of 10 inches. Subgrade preparation and fill placement should be accomplished in accordance with Placement and Compaction. Soils disturbed subsequently should be recompacted.

- **6.5.6 Materials:** Clean, silty (non-plastic to low-plasticity), site soils or similar imported soils approved by the geotechnical engineer may be used for fill or backfill in foundation, slab-on-grade, and pavement areas. Clayey site soils are not recommended for use as fill or backfill beneath interior slabs-on-grade above foundation level or below exterior slabs-on-grade where differential movements are not tolerable. Aggregate base, asphalt concrete, and portland cement concrete should conform to MAG Standards or a qualified professional's specifications.

  Imported soils should have a maximum expansion potential of 1½ percent as determined on a sample compacted to 95 percent of standard proctor density about 3 percent below optimum moisture content and saturated under a surcharge of 100 psf. Imported soils

should conform to the gradation presented in Table 6.1, have no more than 0.10 percent soluble sulfates, and be approved by the geotechnical engineer prior to use.

Table 6.1 Gradation Requirements for Imported Soil

U.S Standard Sieve Size	Percent Passing by Weight
6-inch	100
4-inch	70-100
No. 4	50-100
No. 200	60 (maximum)

- **6.5.7 Placement and Compaction:** All fill and backfill materials should be uniformly moisture conditioned, placed in relatively horizontal loose lifts not exceeding the effective depth of compaction equipment (commonly 8 to 10 inches), and uniformly compacted to at least 95 percent of standard proctor maximum dry density. Aggregate base beneath asphalt pavement should be compacted to at least 100 percent of maximum dry density. Clayey site soils should be compacted at a moisture content between optimum and 4 percent above optimum. Silty site soils and imported soils and materials should be compacted at a moisture content within 3 percent of optimum.

6.6 Construction Observation and Testing

The recommendations presented herein are predicated on adequate observation and testing during construction, which, at a minimum, should include:

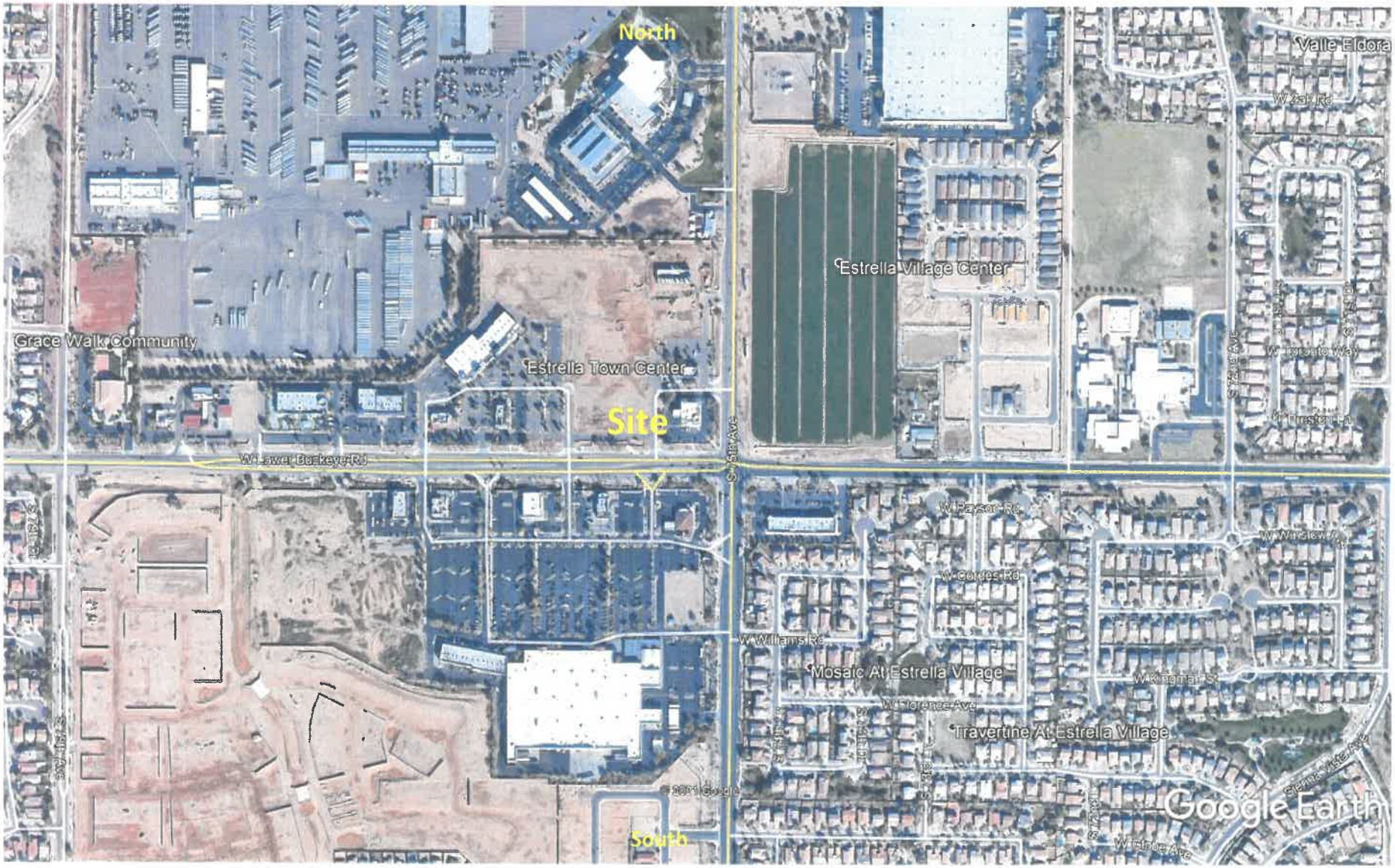
- Review of site clearing and all foundation excavations to evaluate whether actual conditions are consistent with those encountered during exploration.
- Observation and testing of placement and compaction of all fill and backfill materials to evaluate compliance with specifications.
- Field and laboratory sampling and testing of portland cement concrete to evaluate compliance with specifications regarding slump, temperature, entrained air, and strength.
- Field and laboratory sampling and testing of asphalt concrete to evaluate compliance with specifications regarding bitumen content, gradation, and compacted density.

Adequate observation and testing during the construction phase are critical to the performance of constructed improvements and confirmation of the design-level recommendations presented herein. Accordingly, the firm that performs construction observation and testing must assume the role of geotechnical engineer for this project.

6.7 Surface Drainage

Construction and final site grades should be designed to prevent water from ponding in areas on or adjacent to foundations and slabs-on-grade. Infiltration of water into foundation and utility excavations must be prevented during construction and throughout the life of the project. Planters and other water-retaining features are not recommended along building perimeters. If planters are planned, they should be designed to prevent over watering and moisture increases under the adjacent building slab. Where pavement or slabs do not immediately abut a structure, slopes and drainage should be provided to prevent ponding within 5 feet of the building.

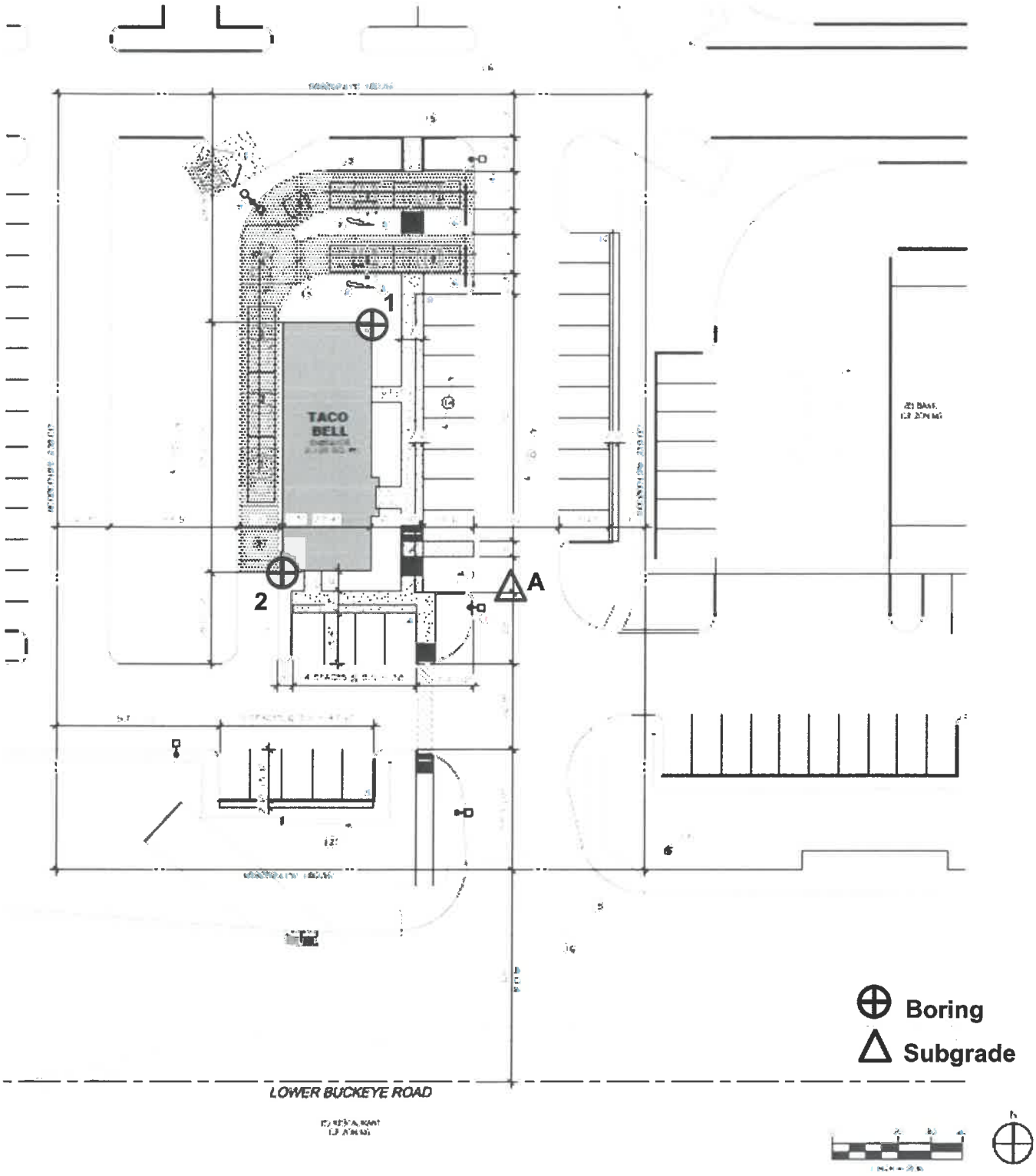
APPENDIX



Vicinity Map

Taco Bell, 7520 West Lower Buckeye Road, Phoenix, Arizona

TEC Project 21C018



Site Map (ref. Hitchens Associates Architects)
Taco Bell, 7520 West Lower Buckeye Road, Phoenix, Arizona
TEC 21C018

GLOSSARY OF TERMS

ALLOWABLE BEARING CAPACITY: The allowable pressure at the base of the footing in excess of that at the same level due to the surrounding surcharge.

ASTM: American Society for Testing and Materials.

BACKFILL: Material replaced in a confined space, usually a man-made excavation.

BASE COURSE: A layer of specified material, usually granular, of planned thickness constructed on the subgrade for the purpose of serving one or more functions such as distributing load, providing drainage, minimizing frost action, etc.

BENCH: A horizontal surface in a sloped deposit.

CALICHE: A desert soil formed by the near surface crystallization of calcite and/or other soluble minerals by upward-moving solutions.

COLLAPSE POTENTIAL: Ability of a soil to undergo significant decrease in volume upon an increase in moisture content.

COMPRESSIBILITY: The property of a soil or rock pertaining to its susceptibility to decrease in volume when subjected to load.

DIFFERENTIAL SETTLEMENT: The difference in downward movement between two adjacent foundation elements.

ENGINEERED FILL: Specified material placed and compacted under full-time observation of the geotechnical engineer or his qualified representative in accordance with project specifications.

EQUIVALENT FLUID PRESSURE: Horizontal pressure of soil, or soil and water, in combination which increases linearly with depth and are equivalent to those that would be produced by a fluid of a selected unit weight.

EXISTING GRADE: Elevation of ground surface at time of exploration.

EXPANSION POTENTIAL: The ability of a soil to increase its volume upon contact with water.

FILL: Material placed by man to raise the surface of the land.

GLOSSARY Continued

FINISHED GRADE: The final grade of ground surface, floor slab, pavement, etc.

HEAVE: Upward movement of ground or structural element.

MAG: Maricopa Association of Governments.

MAXIMUM DRY DENSITY: The maximum dry density obtainable in the laboratory for a given compactive effort.

MOISTURE CONTENT: The ratio of the mass of water contained in the pore spaces of soil or rock material, to the solid mass of particles in that material, expressed as a percentage.

OPTIMUM MOISTURE CONTENT: The moisture content at which a soil can be compacted to a maximum dry unit weight by a given compactive effort.

PLASTICITY: The property of a soil that allows it to be deformed beyond the point of recovery without cracking or appreciable volume change.

ROCK: Natural solid mineral matter occurring in large masses or fragments.

SCARIFY: To mechanically loosen or break the existing soil structure.

SETTLEMENT: Downward movement of ground or structural element.

SOIL: Sediments or other unconsolidated accumulations of solid particles produced by the physical and chemical disintegration of rocks, and which may or may not contain organic matter.

STRIP: Remove from present location.

SUBBASE: A layer used in pavement or slab-on-grade system between the subgrade and base course, or between the subgrade and portland cement concrete pavement.

SUBGRADE: The soil prepared and compacted to support a structure or a pavement system.

TERRANE: 1. A geologic formation or group of formations. 2. The area of surface over which a particular rock or group of rocks is prevalent. 3. An area or region considered in relation to its fitness or suitability for some specific purpose.

BORING LOG NOTES

These notes and boring logs are intended for use with this geotechnical report for the purposes described therein. The logs indicate our interpretation of subsurface conditions at the described locations on the date noted. Subsurface conditions may vary, and groundwater levels may change because of seasonal or other factors. Accordingly, the boring logs should not be made a part of the construction plans or be used to define construction conditions.

The borings were positioned by measuring from and visually referencing existing site features. The approximate positions are shown on the Site Plan.

"Boring Size/Type" refers to the diameter and type of boring. "HSA" denotes hollow-stem auger; "HA" denotes hand auger, and "SSA" denotes solid stem auger.

"Sample Type" refers to the sampling method and equipment used during exploration where:

- N indicates a 2.00-inch-outside-diameter, split-spoon sampler driven by a 140-pound hammer dropped 30 inches,

- R indicates a 2.42-inch-inside-diameter ring sampler driven by a 140-pound hammer dropped 30 inches, and

- G indicates a grab sample from auger cuttings.

"Blows/Foot" refers to the number of blows required to drive the sampler one foot or a specified distance. Refusal is 50 blows per foot for R samples and 100 blows per foot, 50 blows for six inches, or 25 blows without advancing for N samples.

"Dry Density" refers to unit weight of the soil in pounds per cubic foot as determined in the laboratory. "NR" indicates that no sample was recovered, and "*" indicates that the sample was too disturbed for density testing.

"Moisture Content" refers to the moisture content of the soil in percent by weight as determined in the laboratory.

"Description and Classification" refer to the materials encountered in the boring. Generally, the descriptions and classifications are based on visual examination in the field. Further examination and testing were performed on selected samples in the laboratory. The terms and symbols used in the boring logs are in general accordance with the Unified Soil Classification System and the American Society for Testing and Materials.

Log of Boring 1

Project: Taco Bell
Location: Phoenix, AZ
***TEC* Job No:** 21C018
Date: March 23, 2021

Drill Rig: CME 45
Boring Size/Type: 6"/SSA
Elevation (ft): Not determined
Logged by: F. Costello

Drilled by: J&R Drilling
Groundwater: Not encountered
Other:

Depth (feet)	Sample Type	Blows/ Foot	Dry Density (pcf)	Water Content (%)	Description and Classification
					Sandy Silty Clay (CL-ML); light brown
	R	18	113	10.0	Sandy Lean Clay (CL); light brown
5	R	23	98	9.3	light cementation
10	N	34			Sandy Silty Clay (CL-ML); tan, light cementation
15	N	22			Sandy Lean Clay (CL); light brown, light cementation trace gravel
					Stopped @ 16½ feet
20					
25					
30					
35					
40					

Log of Boring 2

Project: Taco Bell
Location: Phoenix, AZ
***TEC* Job No:** 21C018
Date: March 23, 2021

Drill Rig: CME 45
Boring Size/Type: 6"/SSA
Elevation (ft): Not determined
Logged by: F. Costello

Drilled by: J&R Drilling
Groundwater: Not encountered
Other:

Depth (feet)	Sample Type	Blows/ Foot	Dry Density (pcf)	Water Content (%)	Description and Classification
					Silty Sand (SM); tan, fill
	R	18	101	6.4	Sandy Lean Clay (CL); light brown
5	R	47	*	13.5	mottled, brown & tan, moderate cementation
10	N	28			light brown, light cementation
15	N	28			Sandy Silt (ML); tan, light cementation
					Stopped @ 16½ feet
20					
25					
30					
35					
40					

SUMMARY OF INDEX PROPERTY TESTS - *TEC* 21C018RPT.01

BORING OR PIT NO.	DEPTH (ft)	USCS SOIL TYPE	PARTICLE SIZE ANALYSIS – ASTM D422 (percent passing by weight)								ATTERBERG LIMITS ASTM D4318			MOISTURE-DENSITY RELATIONSHIP			NOTES
			3"	2"	1"	½"	#4	#8	#40	#200	LL	PL	PI	MAXIMUM DENSITY (pcf)	OPTIMUM MOISTURE (%)	ASTM METHOD	
A	0-3	CL			100	99	98	97	90	70	31	13	18	115.2	14.8	D698-A	

SUMMARY OF ENGINEERING PROPERTY TESTS - *TEC* 21C018RPT.01

BORING OR PIT NO.	DEPTH (ft)	USCS SOIL TYPE	INITIAL CONDITIONS		CONSOLIDATION / EXPANSION					STRENGTH				R-VALUE ASTM D1844	NOTES
			DRY DENSITY (pcf)	WATER CONTENT (%)	ASTM TEST	LOAD (ksf)	Δ H (%)	EXP. INDEX	SWELL PRES. (ksf)	ASTM TEST	c (ksf)	Ø (deg)	q (psi)		
A	0-3	CL	110	11.4	D4546	0.1	+2.8								1, 2
1	2-3	CL	115	10.0	D5333	1.5	-2.3								
						1.5	-3.0								1
						3.0	-3.9								
2	2-3	CL	99	6.4	D5333	1.5	-2.8								
						1.5	-3.5								1
						3.0	-5.1								

1) Sample immersed in water.
2) Remolded to approximately 95 percent of maximum dry density about 3 percent below optimum moisture content.