GEOTECHNICAL INVESTIGATION REPORT
PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE
7699 MCLAUGHLIN ROAD
PEYTON, COLORADO 80831

PREPARED FOR:

Christian Brothers Automotive Corporation
17725 Katy Freeway, Suite 200
Houston, Texas 77094

PREPARED BY:

EARTH SCIENCE LLC

5319 University Drive, Suite 20
Irvine, California 92612

Report Date: May 2, 2017
Project Number: 17-1194

EARTH SCIENCE LLC

5319 University Drive, Suite 20
Irvine, California 92612
(949) 278-0897

May 2, 2017

Christian Brothers Automotive Corporation
17725 Katy Freeway, Suite 200
Houston, Texas 77094

RE: Geotechnical Investigation Report
Proposed Christian Brothers Automotive
7699 McLaughlin Road
Peyton, Colorado 80831
Earth Science Project Number: 17-1194

Earth Science LLC (Earth Science), in conjunction with Western Technologies Inc. (Geotechnical Testing Engineer), is pleased to provide the results of the Geotechnical Investigation Report (Report) for the above-mentioned address (Subject Property) to Christian Brothers Automotive Corporation (CBAC).

The objective of the attached Report was to explore the subsurface conditions at the Subject Property to obtain information on the physical and engineering properties of the soil and to develop geotechnical engineering recommendations for the design and construction of an approximately 6,000 square foot automotive service facility at the Subject Property, as well as other improvements such as paved driveways and parking areas.

The investigation included the advancement of nine Standard Penetration Test (SPT) borings (identified as B-1 through B-9) to varying terminal depths between 10.0 and 16.5 feet below ground surface (bgs) using a truck-mounted drill rig. The attached Report provides the results of the field investigation and the corresponding conclusions and recommendations.

Earth Science appreciates the opportunity to be of service to CBAC. If you have any questions concerning the attached Report, or if we can assist you with any other matter, please contact the undersigned at (949) 278-0897.

Respectfully,

Sean Rakhshani
Principal

GEOTECHNICAL SUMMARY

CAUTION:
This summary is prepared only for the convenience of the report user, and is NOT a substitute for the content and limitations of the report, which must be read and understood in their entirety prior to use for any purpose.

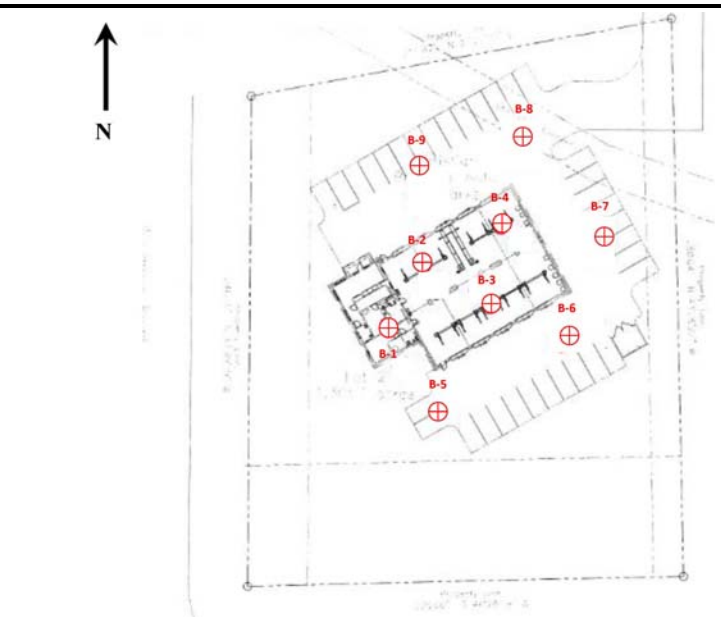
SOILS:
The subsurface soils consisted of medium dense to very dense sand with variable clay content to depths of about 8' to 11' bgs, underlain by very stiff to hard fat clay with variable sand content and medium dense to very dense clayey sand down to the maximum investigation depth of 16.5' bgs.

GROUNDWATER:
Groundwater was encountered in all nine boring locations at varying depths ranging from 7' to 9' bgs.

SITE PREPARATION:
Strip and remove any debris, vegetation, and other deleterious materials. Scarify the sub-grade to a minimum depth of 8" and re-compact in accordance with the attached report. The pavement sub-grade should be cut as required to the design finish sub-grade elevation.

FILL AND COMPACTION REQUIREMENTS:
Onsite soil can be used as fill in the building and pavement areas. Imported non-expansive fill soil should conform to the specifications outlined in the attached report. Un-compacted fill lifts should not exceed 10" and should be compacted to 95% (ASTM D698). Fill should be compacted within a water content range of –3 to +3 % of the optimum water content.

FOUNDATIONS:
The proposed building can be supported by spread footings bearing into the existing sand. The footings can be designed for a maximum net allowable bearing capacity of 3,000 psf. The allowable bearing capacity applies to dead load plus design live load conditions. An ultimate passive earth pressure resistance of 280 psf/ft is recommended for design. A coefficient of sliding resistance of 0.35 is recommended for design. The lateral load resistance should incorporate a factor of safety of at least 1.5. The foundations should bear a minimum of 36" below the final adjacent site grade for frost considerations. Strip footings should have a minimum width of 16" and isolated column pad foundations should have a minimum dimension of 24". The estimated total post-construction foundation settlement is 1" or less with differential settlement of half the total foundation settlement.



KEY

⊕ Approximate Borings Locations

PAVEMENT DESIGN RECOMMENDATIONS

RIGID PAVING SECTION:

Pavement Type	Pavement Thickness (Inches)
Light Duty (Vehicle Parking Areas)	5.0
Medium Duty (Passenger Vehicle Driveways)	6.0
Heavy Duty (Entrance, Dumpster Pads, and Truck Traffic Areas)	7.0

SUB-GRADE:
Base course is not required from a geotechnical point of view; however, a thin layer of base course, up to 4" in thickness, may be desired for construction purposes.

CONCRETE:
The concrete should have a minimum 28-day compressive strength of 4,000 psi. Concrete quality will be important to produce the desired flexural strength and long-term durability. Assuming a nominal maximum aggregate size of 1" to 1"-3/8", the concrete is recommended to have entrained air of 5% (+/- 1%) and a maximum water cement ratio of 0.45. The pavement should be reinforced with No. 3 bars placed on chairs on 24" on-center in each direction.

JOINTS:
Proper joint placement and design is critical to pavement performance. Contraction joints should be placed at 15' on-center. The contraction joints should be saw cut as soon as possible after placement of the concrete but before shrinkage cracks occur. The concrete should be saw cut at least 3/8" wide and 2" deep.

Western Technologies Inc.

GEOTECHNICAL EVALUATION REPORT

PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE
Woodmen Road and US Highway 24
Peyton, Colorado
WT Reference No. 3127JS025

PREPARED FOR:
Earth Science LLC
5319 University Drive, Suite 20
Irvine, California 92612

May 2, 2017

Roger K. Southworth, P.E.
Managing Director

Jeff M. Boyd, P.E.
Senior Geotechnical Engineer

Western Technologies Inc.
The Quality People
Since 1955

278 Sawyer Drive, No. 2
Durango, Colorado 81303-7904
(970) 375-9033 • fax 375-9034

May 2, 2017

Earth Science LLC
5319 University Drive, Suite 20
Irvine, California 92612

Re: Geotechnical Evaluation — Job No. 3127JS025
Proposed Christian Brothers Automotive
Woodmen Road at US Highway 24
Peyton, Colorado

Western Technologies Inc. (WT) has completed the geotechnical evaluation for the above-referenced project. This study was performed in general accordance with our proposal number 3127PS025 dated April 13, 2017. The results of our study, including the boring location diagram, boring logs, laboratory test results, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. Please do not hesitate to contact us if the design conditions change or if you have any questions concerning this report. We look forward to working with you on future projects.

Sincerely,
WESTERN TECHNOLOGIES INC.

Roger K. Southworth, P.E.
Managing Director

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

APPENDIX A

APPENDIX B

GEOTECHNICAL EVALUATION
PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE
WOODMEN ROAD AT US HIGHWAY 24
PEYTON, COLORADO

JOB NO. 3127JS025

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed Christian Brothers Automotive. The purpose of these services is to provide information and recommendations regarding:

- Foundation Design
- Floor Slab Support
- Pavement Design
- Seismic Design Parameters
- Drainage
- Earthwork

The results of the field exploration and laboratory tests are presented in the Appendix.

2.0 PROJECT DESCRIPTION

The project will consist of constructing an automotive facility in Peyton, Colorado. The site location is shown on the attached Site Location Diagram (Plate 1). The building will be a single-story structure with a footprint of less than 6,000 square feet. It was assumed that the structure would have maximum wall loads of less than 4 kips per linear foot and maximum column loads of less than 200 kips. The development will also include the construction of a concrete parking lot and associated improvements. It was assumed that grade changes of less than 2 feet would be required to develop the finish site grades. We should be notified immediately if any of our assumptions are incorrect since a revision of the recommendations presented herein could then be necessary.

Has the 9-foot high retaining wall design been addressed?

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Four borings were drilled in the planned building area to depths of 16½ feet and five borings were drilled in the planned parking area to depths of 10 feet. The borings were drilled at the approximate locations indicated on the attached Boring Location Diagram (Plate 2).

A WT geotechnical engineer monitored the drilling operations and prepared a field log for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples.

The final boring logs, included in Appendix A, represent our interpretation of the field logs and may include modifications based on laboratory observations of the recovered samples. The final logs describe the materials encountered, their thicknesses, and the depths at which samples were obtained.

The Unified Soil Classification System was used to classify the soil. The soil classification symbols appear on the boring logs and are briefly described in Appendix A.

3.2 Laboratory Testing

Laboratory tests were performed on representative samples to aid in material classification and to estimate the pertinent engineering properties of the soil. Testing was performed in general accordance with applicable ASTM methodologies. The following tests were performed and the results are presented in Appendix B.

- Water Content
- Percent Passing the No. 200 Sieve

The laboratory test results were used in the development of the recommendations contained in this report.

3.3 Analyses and Report

Analyses were performed and this report was prepared for the exclusive purpose of providing geotechnical engineering information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

This geotechnical engineering report includes a description of the project, a discussion of the field exploration and laboratory testing programs, a discussion of the subsurface

conditions, and design recommendations as required to satisfy the purpose previously described.

4.0 SITE CONDITIONS

4.1 Surface

The project site is a vacant and vegetated with grass and weeds. The site is relatively flat and level.

4.2 Subsurface

The borings typically encountered medium dense to very dense sand with variable clay content to depths of about 8 to 11 feet, underlain by very stiff to hard fat clay with variable sand content and medium dense to very dense clayey sand.

4.3 Groundwater

Groundwater was encountered in the borings at depths of about 7 to 9 feet during drilling. The level of the groundwater table will fluctuate seasonally with variations in the amount of precipitation, evaporation, and surface water runoff. The observations made during this investigation must be interpreted carefully because they are short-term and do not constitute a groundwater study.

5.0 RECOMMENDATIONS

5.1 General

The recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0, **Project Description**, and the assumption that the subsurface conditions are those disclosed by the test borings. Others may change the plans, final elevations, number and type of structures, foundation loads, and floor levels during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

5.2 Foundations

The proposed building can be supported by spread footings bearing into the existing sand. The footings can be designed for a maximum net allowable bearing capacity of 3,000 pounds per square foot (psf). The allowable bearing capacity applies to dead load plus design live load conditions.

Resistance to lateral loads will be provided by the passive earth pressure acting against the footings and the frictional resistance acting along the base of the footings. An ultimate passive earth pressure resistance of 280 pounds per square foot per foot (psf/ft) is recommended for design. A coefficient of sliding resistance of 0.35 is recommended for design. The lateral load resistance should incorporate a factor of safety of at least 1.5.

The foundations should bear a minimum of 36 inches below the final adjacent site grade for frost considerations. Strip footings should have a minimum width of 16 inches and isolated column pad foundations should have a minimum dimension of 24 inches.

We estimate that the total post-construction settlement of foundations supported as recommended herein will be on the order of 1 inch or less. We estimate that the differential settlement between comparably sized and loaded foundations could be on the order of one-half the total foundation settlement. Additional foundation settlement can occur if water from any source infiltrates the foundation subgrade. Therefore, proper drainage should be provided in the final design and during construction.

All footings, stem walls, and masonry walls should be reinforced to reduce the potential for distress caused by differential foundation settlement. The use of joints at openings and other discontinuities in masonry walls is recommended. Joints should also be closely spaced along the length of masonry site retaining walls and screen walls to accommodate minor differential foundation settlement.

We recommend that the geotechnical engineer or a representative of the engineer observe the footing excavations prior to placing the foundation reinforcement and concrete. This observation is to assess whether the exposed bearing stratum is similar to that anticipated for support of the footings. Any loose, soft, or disturbed material should be undercut to a suitable bearing subgrade.

5.3 Slab-on-Grade Support

The floor slab can be designed as a slab-on-grade. The floor slab subgrade should be prepared in accordance with the procedures outlined in the **Earthwork** section of this report.

A minimum four-inch-thick layer of drainage aggregate should be provided beneath at-grade floor slabs to prevent the capillary rise of water beneath the slab and a damp slab. The drainage aggregate should consist of sand, sand-gravel, crushed stone, or a combination of these materials. The granular fill should have a maximum particle diameter of no more than one-half the granular fill thickness and should contain no more than 5 percent passing the No. 200 sieve. In addition, the granular fill should have a maximum plasticity index of 6.

The use of vapor retarders is desirable for any slab-on-grade where the floor will be covered by products using water-based adhesives, wood, vinyl-backed carpet, impermeable floor coatings (urethane, epoxy, acrylic terrazzo, etc.). When used, the design and installation should be in accordance with the recommendations presented in ACI 302.1R and 302.2R. Final determination on the use of a vapor retarder should be left to the slab designer.

All concrete placement and curing operations should follow the American Concrete Institute manual recommendations. Improper curing techniques and/or high slump (high water-cement ratio) could cause excessive shrinkage, cracking, or curling of the floor slab. Concrete slabs should be allowed to cure adequately before placing vinyl or other moisture-sensitive floor covering.

5.4 Seismic Considerations

Structural design criteria based upon the 2012/2015 International Building Code is provided below.

- Site Soil Classification: Site Class D
- Risk Category: I/II/III

S_s = 0.168 g	S_{MS} = 0.269 g	S_{DS} = 0.179 g
S_1 = 0.058 g	S_{M1} = 0.139 g	S_{D1} = 0.093 g

5.5 Drainage

Properly functioning foundations and floor slabs require appropriately constructed and maintained site drainage conditions. Therefore, it is extremely important that positive

drainage be provided during construction and maintained throughout the life of the structure. It is also important that proper planning and control of landscape and irrigation be performed.

5.6 Pavement

It was assumed that the pavement would be subject to passenger vehicles and small- to large-size delivery trucks. On this basis, a daily traffic value of 10 Equivalent 18-kip Single Axle Loads (ESAL) was assumed for the pavement design. It was assumed that this traffic volume is an average for the life of the pavement and that it includes any anticipated traffic growth.

A revision of the recommended pavement sections may be necessary if the expected traffic loading conditions are different than assumed. An evaluation of the type and volume of traffic that each portion of the parking lot will experience should be conducted to determine if the pavement sections presented herein are appropriate.

Recommended Portland cement concrete pavement sections for the pavement are presented in the following table

Traffic Area	Portland Cement Concrete Pavement (inches)
Light Duty	5.0
Access Drives	6.0

A minimum 7-inch thick Portland cement concrete is recommended for the dumpster pad and the area in front of the dumpster pad.

Base course is not required from a geotechnical point of view. However a thin layer of base course, up to 4 inches in thickness, may be desired for construction purposes.

The concrete should have a minimum 28-day compressive strength of 4,000 psi. Concrete quality will be important to produce the desired flexural strength and long-term durability. Assuming a nominal maximum aggregate size of 1 to 1-3/8 inches, the concrete is recommended to have entrained air of 5 percent (+/- 1 percent) and a maximum water cement ratio of 0.45.

Proper joint placement and design is critical to pavement performance. Contraction joints should be placed at 15 feet on-center. The contraction joints should be saw cut as soon as

possible after placement of the concrete but before shrinkage cracks occur. The concrete should be saw cut at least 3/8-inch wide and 2 inches deep.

Isolation joints should be placed where the pavement will abut the building, drainage inlets, manholes, T- and unsymmetrical intersections, and anywhere differential settlement between the pavement and a structure may take place. The isolation joints should be 0.5 inch wide.

All joints should be properly cleaned and sealed as soon as possible to avoid infiltration of water, small gravel, and other debris. Either cold-pour or hot-poured sealing material may be used. Backing should be provided to hold the isolation joint sealant in place. Manufacturers' instructions for mixing and installing the joint materials hold be followed.

The pavement should be reinforced with No. 3 bars placed on chairs on approximately 24-inches on-center in each direction. Curbs should extend around the pavement perimeter to reduce the potential for distress due to heavy wheel loads near the edge of the pavement and to provide channelized drainage.

The site soils are expansive and differential heave may occur. The pavement service life may be reduced due to water infiltration into the subgrade soils heave induced cracks in the pavement. This will result in a softening and loss of strength of the subgrade soils. A regular maintenance program to seal pavement cracks will help prolong the life of the pavement.

Material and compaction requirements should conform to recommendations presented in the **Earthwork** section of this report. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections.

6.0 EARTHWORK

6.1 General

The conclusions contained in this report are contingent upon compliance with recommendations presented in this section. Any excavating, trenching, or disturbance that occurs after completion of the earthwork must be backfilled, compacted, and tested in accordance with the recommendations contained herein. It is not reasonable to rely upon our conclusions and recommendations if any future unobserved and untested trenching, earthwork activities, or backfilling occurs.

6.2 Site Clearing

Strip and remove any debris, vegetation, and other deleterious materials from the building and pavement areas. The building area is defined as the area within the building footprint plus five feet beyond the perimeter of the footprint. All exposed surfaces should be free of mounds and depressions that could prevent uniform compaction.

6.3 Building Pad and Pavement Preparation

The building pad and pavement subgrades should be cut as required to develop to proposed site grade. The subgrade should then be scarified to a minimum depth of 8 inches and recompacted in accordance with the recommendations presented in Section 6.5. The site can then be raised to the design finish grade with engineered fill.

6.4 Materials

The on-site soil can be used as fill in the building and pavement areas. Imported non-expansive fill soil should conform to the following:

- Gradation (ASTM C136):

	percent finer by weight
6"	100
4"	85-100
¾"	70-100
No. 4 Sieve	50-100
No. 200 Sieve	30 (max)

- Maximum expansive potential (%)* 1.5
- Maximum soluble sulfates (%) 0.10

* Measured on a sample compacted to approximately 95 percent of the ASTM D698 maximum dry density at about three percent below the optimum water content. The sample is confined under a 100 psf surcharge and submerged.

Imported fill should be approved by WT prior to placement.

The backfill for the portions of the foundation excavations outside of the building and above the base of the foundations should consist of on-site clay. This is recommended to promote

drainage away from the structure and to reduce the potential for water ponding in the non-expansive soil backfill beneath the foundations.

6.5 Placement and Compaction

a. Place and compact fill in horizontal lifts, using equipment and procedures that will produce recommended water contents and densities throughout the lift.

b. Uncompacted fill lifts should not exceed 10 inches.

c. No fill should be placed over frozen ground nor should frozen fill or backfill be used.

d. Materials should be compacted to the following:

Material	Minimum Percent Compaction (ASTM D698)
• Fill in the building and pavement areas	95
• Nonstructural fill	90

Fill should be compacted within a water content range of –3 to +3 percent of the optimum water content.

6.6 Compliance

Recommendations for foundation, slab-on-grade, and pavement elements supported on compacted fill or prepared subgrade depend upon compliance with the **Earthwork** recommendations. To assess compliance, observation and testing should be performed under the direction of the project geotechnical engineer. Please contact us to provide these testing and observation services.

7.0 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that a sufficient schedule of tests and observations will be performed during construction to verify compliance. At a minimum, these tests and observations should be comprised of the following:

- Observations and testing during site preparation and earthwork;
- Observation of foundation excavations; and
- Consultation as may be required during construction.

Retaining the geotechnical engineer who developed your report to provide construction observation is the best way to verify compliance, and to help you manage the risks associated with unanticipated conditions.

8.0 LIMITATIONS

This report has been prepared assuming the project criteria described in Section 2.0. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, contact WT to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced borings. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between borings, however variations can and often do exist. Whenever any deviation, difference or change is encountered or becomes known, WT should be contacted.

This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid until the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall have any right to rely on this report without the express written authorization of WT.

9.0 CLOSURE

We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the boring locations. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.

Geotechnical
Environmental
Inspections
Materials

Western Technologies Inc.
The Quality People
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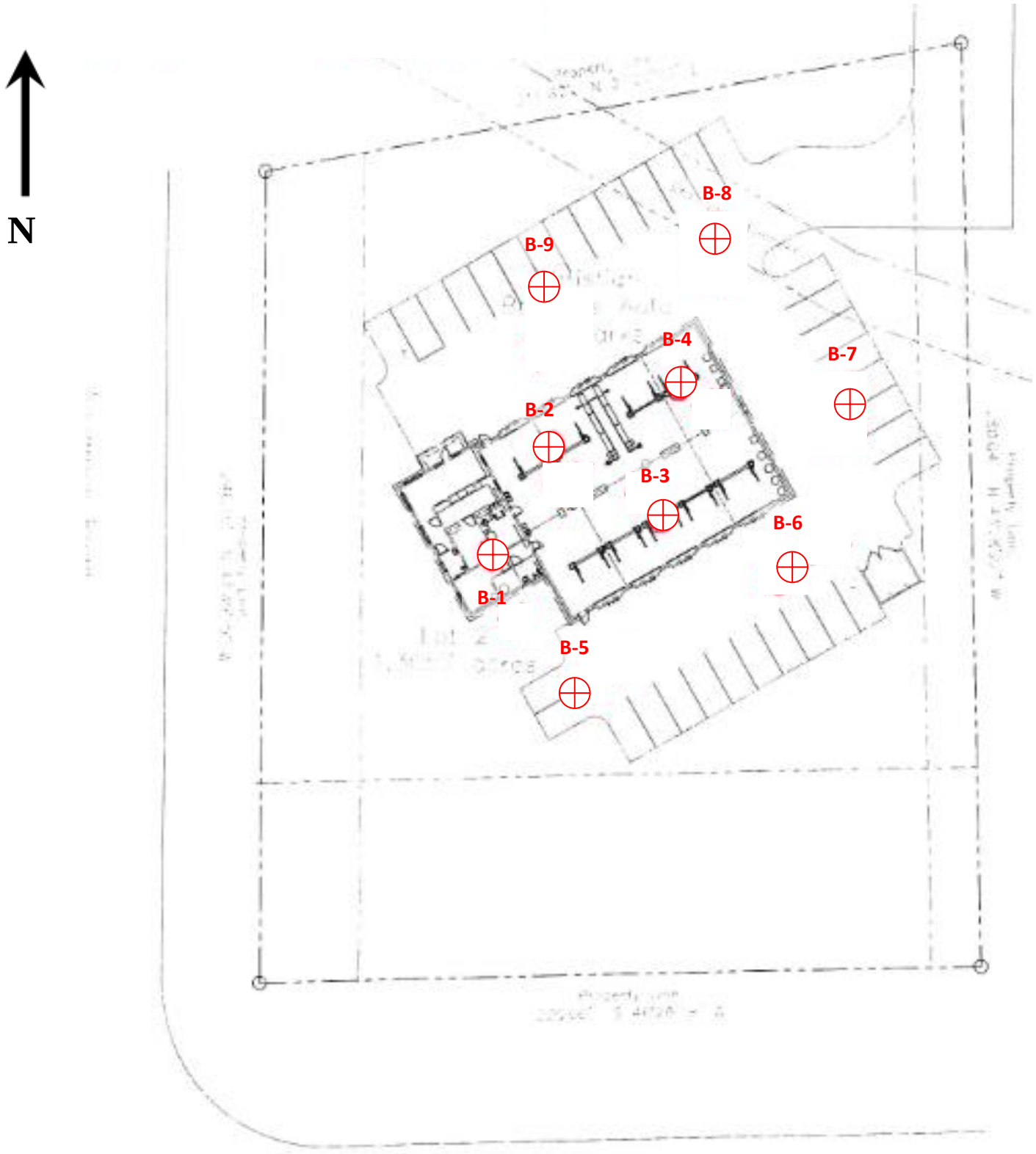
PROJECT: PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE

JOB NO.: 3127JS025

PLATE: 1

SITE LOCATION DIAGRAM



⊕ **Approximate Boring Location**

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PROJECT: PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE
JOB NO.: 3127JS025

BORING LOCATION DIAGRAM

PLATE: 2

Allowable Soil Bearing Capacity	The recommended maximum contact stress developed at the interface of the foundation element and the supporting material.
Backfill	A specified material placed and compacted in a confined area.
Base Course	A layer of specified aggregate material placed on a subgrade or subbase.
Base Course Grade	Top of base course.
Bench	A horizontal surface in a sloped deposit.
Caisson/Drilled Shaft	A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson).
Concrete Slabs-On-Grade	A concrete surface layer cast directly upon base course, subbase or subgrade.
Crushed Rock Base Course	A base course composed of crushed rock of a specified gradation.
Differential Settlement	Unequal settlement between or within foundation elements of a structure.
Engineered Fill	Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer.
Existing Fill	Materials deposited through the action of man prior to exploration of the site.
Existing Grade	The ground surface at the time of field exploration.
Expansive Potential	The potential of a soil to expand (increase in volume) due to absorption of moisture.
Fill	Materials deposited by the actions of man.
Finished Grade	The final grade created as a part of the project.
Gravel Base Course	A base course composed of naturally occurring gravel with a specified gradation.
Heave	Upward movement.
Native Grade	The naturally occurring ground surface.
Native Soil	Naturally occurring on-site soil.
Rock	A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation.
Sand and Gravel Base Course	A base course of sand and gravel of a specified gradation.
Sand Base Course	A base course composed primarily of sand of a specified gradation.
Scarify	To mechanically loosen soil or break down existing soil structure.
Settlement	Downward movement.
Soil	Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water.
Strip	To remove from present location.
Subbase	A layer of specified material placed to form a layer between the subgrade and base course.
Subbase Grade	Top of subbase.
Subgrade	Prepared native soil surface.

COARSE-GRAINED SOILS

LESS THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE
GP	POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES	
GM	SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES	
GC	CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES	
SW	WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE
SP	POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES	
SM	SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES	
SC	CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES	

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS

MORE THAN 50% FINES

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50
CL	LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY	
OL	ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY	
MH	ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT	SILTS AND CLAYS LIQUID LIMIT MORE THAN 50
CH	FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY	
OH	ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY	
PT	PEAT AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	Above 12 in.
COBBLES	3 in. – 12 in.
GRAVEL	No. 4 – 3 in.
Coarse	¾ in. – 3 in.
Fine	No. 4 – ¾ in.
SAND	No. 200 – No. 4
Coarse	No. 10 – No. 4
Medium	No. 40 – No. 10
Fine	No. 200 – No. 40
Fines (Silt or Clay)	Below No. 200

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

CLAYS & SILTS	BLOWS PER FOOT
VERY SOFT	0 – 2
SOFT	3 – 4
FIRM	5 – 8
STIFF	9 – 15
VERY STIFF	16 – 30
HARD	OVER 30

RELATIVE DENSITY

SANDS & GRAVELS	BLOWS PER FOOT
VERY LOOSE	0 – 4
LOOSE	5 – 10
MEDIUM DENSE	11 – 30
DENSE	31 – 50
VERY DENSE	OVER 50

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1⅜-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

PLASTICITY INDEX	TERM
0	NON-PLASTIC
1 – 7	LOW
8 – 20	MEDIUM
Over 20	HIGH

DEFINITION OF WATER CONTENT

DRY
SLIGHTLY DAMP
DAMP
MOIST
WET
SATURATED

The number shown in **"BORING NO."** refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features, or through the use of Global Positioning System (GPS) devices. The accuracy of GPS devices is somewhat variable.

"DRILLING TYPE" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"N" in "BLOW COUNTS" refers to a 2-inch outside diameter split-barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows, or "blow count", of the hammer is recorded for each of three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the Standard Penetration Test (SPT) "**N**"-Value. Refusal to penetration is considered more than 50 blows per 6 inches. (Ref. ASTM D1586).

"R" in "BLOW COUNTS" refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inch is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. (Ref. ASTM D3550).

"CS" in "BLOWS/FT." refers to a 2½-in. outside diameter California style split-barrel sampler, lined with brass sleeves, driven into the ground with a 140-pound hammer dropped 30 inches repeatedly until a penetration of 18 inches is achieved or until refusal. The number of blows of the hammer is recorded for each of the three 6-inch increments totaling 18 inches. The number of blows required for advancing the sampler for the last 12 inches (2nd and 3rd increments) is defined as the "CS" blow count. The "CS" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows for a 6-inch increment. (Ref. ASTM D 3550)

"SAMPLE TYPE" refers to the form of sample recovery, in which **N** = Split-barrel sample, **R** = Ring-lined sample, **"CS"** = California style split-barrel sample, **G** = Grab sample, **B** = Bucket sample, **C** = Core sample (ex. diamond bit rock coring).

"DRY DENSITY (LBS/CU FT)" refers to the laboratory-determined dry density in pounds per cubic foot. The symbol **"NR"** indicates that no sample was recovered.

"WATER (MOISTURE) CONTENT" (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

"USCS" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-1

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
8.1		G				SC		CLAYEY SAND; brown to dark brown, damp to moist
5.1		N		32		SP-SC		POORLY GRADED SAND; with clay, brown, dense, damp
		N		30	5			
						SP		POORLY GRADED SAND; light brown, medium dense, wet
18.5		N		23				▽
						CH		SANDY FAT CLAY; brown-gray, very stiff, moist
		N		31	10			
						SC		CLAYEY SAND; green-gray, very dense, wet
		N		50/8"	15			
								Boring terminated at 16 feet

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater at 8 feet encountered during drilling**

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-4**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-2

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp to moist
		N		57		SP-SC		POORLY GRADED SAND; with clay, brown, very dense, damp
						SP		POORLY GRADED SAND; light brown, medium dense, wet
		N		27	5			
3.9		N		22				▽
						CH		SANDY FAT CLAY; green-gray, very stiff, moist
		N		19	10			
						SC		CLAYEY SAND; green-gray, very dense, wet
		N		50/9"	15			
								Boring terminated at 16 feet

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 7 feet encountered during drilling**

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-5**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-3

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
7.8		G				SC		CLAYEY SAND; brown to dark brown, damp to moist
		N		34		SP-SC		POORLY GRADED SAND; with clay, brown, dense, damp
						SP		POORLY GRADED SAND; light brown, dense, damp
		N		46	5			
		N		27				changing to medium dense, wet ▽
		N		27	10			
						CH		SANDY FAT CLAY; brown, hard, moist
						CH		FAT CLAY; dark green-gray, hard, moist
		N		47	15			
								Boring terminated at 16.5 feet

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 7 feet encountered during drilling**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-6**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-4

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp to moist
4.9		N		50/11"		SP-SC		POORLY GRADED SAND; with clay, light brown, very dense, damp
						SC		CLAYEY SAND; brown to dark brown, very dense, damp
7.6		N		50/11"	5			
						SP		POORLY GRADED SAND; light brown, medium dense, wet
		N		40				
						SC		CLAYEY SAND; light brown to brown, medium dense, wet
		N		28	10			
								changing to very dense
		N		50/10"	15			
								Boring terminated at 16 feet

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 9 feet encountered during drilling**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-7**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-5

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp
		G				SP-SC		POORLY GRADED SAND; with clay, brown, damp
		G			5			
						SP		POORLY GRADED SAND; light brown, moist changing to wet ▽
					10			**Boring terminated at 10 feet**
					15			

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 7 feet encountered during drilling**

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-8**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-6

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
8.8		G				SC		CLAYEY SAND; brown to dark brown, damp
		G				SP-SC		POORLY GRADED SAND; with clay, brown, damp
		G			5			
						SP		POORLY GRADED SAND; light brown, moist changing to wet ▽
					10			**Boring terminated at 10 feet**
					15			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 8 feet encountered during drilling**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-9**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-7

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp
		G				SP-SC		POORLY GRADED SAND; with clay, brown, damp
		G			5			
						SP		POORLY GRADED SAND; light brown, moist changing to wet ▽
					10			**Boring terminated at 10 feet**
					15			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 8 feet encountered during drilling**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-10**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-8

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp
		G				SP-SC		POORLY GRADED SAND; with clay, brown, damp
		G			5			
						SP		POORLY GRADED SAND; light brown, moist changing to wet ▽
					10			**Boring terminated at 10 feet**
					15			

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 7 feet encountered during drilling**

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-11**

BORING LOG

DATE DRILLED: **4-26-17**
LOCATION: **See Boring Location Diagram**
ELEVATION: **Not determined**

BORING NO. B-9

EQUIPMENT TYPE: **Mobile B-47**
DRILLING TYPE: **4" Auger**
FIELD ENGINEER: **R. Southworth**

WATER CONTENT (%)	POCKET PENETROMETER (tsf)	SAMPLE TYPE	SAMPLE	BLOWS/FT.	DEPTH (FEET)	USCS	GRAPHIC	SOIL DESCRIPTION
		G				SC		CLAYEY SAND; brown to dark brown, damp
		G				SP-SC		POORLY GRADED SAND; with clay, brown, damp
		G			5			
						SP		POORLY GRADED SAND; light brown, moist
								changing to wet ▽
					10			**Boring terminated at 10 feet**
					15			

N- STANDARD PENETRATION TEST
R- RING SAMPLE
NR- NO SAMPLE RECOVERY
G- GRAB SAMPLE
B- BUCKET SAMPLE
BN- BLUNT NOSE PENETROMETER

NOTES: **Groundwater 9 feet encountered during drilling**

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

WESTERN TECHNOLOGIES INC.

PROJECT: **PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE**
REF. NO.: **3127JS025**

PLATE **A-12**

BORING LOG

Boring No.	Depth (ft)	USCS Class.	Water Content (%)	Particle Size Distribution (%) Passing by Weight						Atterberg Limits		Pocket Penetrometer (tsf)	Remarks
				3"	¾"	#4	#10	#40	#200	LL	PI		
B-1	0 - 2	SC	8.1						22.9				
	2 - 3½	SP-SC	5.1						6.2				
	7 - 8½	SP	18.5						4.5				
B-2	7 - 8½	SP-SC	3.9						7.0				
B-3	0 - 2	SC	7.8						21.1				
B-4	2 - 3½	SP-SC	4.9						10.3				
	5 - 6½	SC	7.6						15.3				
B-6	0 - 2	SC	8.8						22.3				

NOTE: NP = Non-plastic

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PROJECT: PROPOSED CHRISTIAN BROTHERS AUTOMOTIVE

JOB NO.: 3127JS025

PLATE

B-1

LABORATORY TEST RESULTS

Markup Summary

Locked (1)

Subject: Callout
Page Label: 8
Lock: Locked
Status:
Checkmark: Unchecked
Author: dsdrice
Date: 4/10/2018 10:53:41 AM
Color:

Has the 9-foot high retaining wall design been addressed?