

**Geotechnical Exploration and Engineering
Report**

**Proposed Pavement Reconstruction
Capital Area Transportation Authority
4615 Tranter Street
Lansing, Michigan 48911**

Prepared for

**DLZ Michigan, Inc.
1425 Keystone Avenue
Lansing, Michigan 48911**

Prepared by

**Professional Service Industries, Inc.
3120 Sovereign Drive
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January 31, 2014

PSI Project 0408834

January 31, 2014

Mr. Thomas G. Stoffl, P.E., President
DLZ Michigan, Inc.
1425 Keystone Avenue
Lansing, Michigan 48911

Subject: Geotechnical Exploration and Engineering Report
Proposed Pavement Reconstruction
Capital Area Transportation Authority
4615 Tranter Street
Lansing, Michigan 48911
PSI Project No. 0408834

Dear Mr. Stoffl:

In compliance with your instructions, Professional Service Industries, Inc. (PSI) has developed a geotechnical engineering report for the referenced project. The results of this exploration, together with our recommendations, are presented in the accompanying report, a copy of which is being transmitted herewith.

PSI appreciates the opportunity to provide geotechnical engineering and consulting services for your project and looks forward to working with you again. If you have any questions regarding this report, or if we may be of further service, please feel free to contact this office at your convenience.

Respectfully Submitted,
PROFESSIONAL SERVICE INDUSTRIES, INC.



Steve Brenneman
Staff Engineer



Randal H. Pail, P.E.
Principal Consultant



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Chief Engineer / District Manager

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1 PROJECT INFORMATION

1.1 PROJECT AUTHORIZATION

This report presents the results of our geotechnical engineering exploration performed for the proposed pavement reconstruction of the CATA (Capital Area Transportation Authority) Administrative Office bus staging area located at 4615 Tranter Street in Lansing, Michigan. This exploration was undertaken for DLZ Michigan, Inc. PSI's work was authorized by Mr. Thomas G. Stoffl, P.E., President, DLZ Michigan Inc. (DLZ) on January 22, 2014.

1.2 PROJECT DESCRIPTION

Based on the information provided by Mr. Stephen Metzger and Paul Weber with DLZ, PSI understands that the project will consist of the replacement of the existing asphalt pavement located east of the existing CATA Administrative Office facility with maximum dimensions of 300 feet by 125 feet. PSI understands that the existing asphalt pavement is expected to be replaced with concrete pavement.

DLZ anticipates the new pavement will be subject to 100 Gillig Hybrid bus applications per day at 39,600 pounds each. These busses occupy the area of the proposed pavement reconstruction for approximately eight (8) hours per day.

If any of the information noted above is incorrect or has changed, PSI must be informed immediately so that the recommendations may be reviewed and revised as necessary.

1.3 PURPOSE AND SCOPE OF SERVICES

The purpose of this exploration was to evaluate the subsurface conditions at the site and to develop geotechnical design criteria for support of pavements for the planned project. The scope of the exploration and analysis included a reconnaissance of the project site, six (6) soil borings, four (4) pavement cores, field and laboratory testing of recovered samples and an engineering analysis and evaluation of the subsurface materials encountered. The representative area was snow covered upon PSI's arrival on site and existing pavement conditions were not observable.

The geotechnical scope of services did not include an environmental assessment for determining the presence or absence of wetlands, hazardous or toxic materials in the soil, bedrock, surface water, groundwater or air on, below or around this site. Any statement in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes.

2 SITE AND SUBSURFACE CONDITIONS

2.1 SITE LOCATION AND DESCRIPTION

The project site is generally located within the east parking lot of the CATA Administrative Office located at 4615 Tranter Street in Lansing, Michigan. The pavement area to be reconstructed is currently used as a staging area for refueling and maintenance of the CATA bus fleet. The site can be accessed from Tranter Street just south of East Cavanaugh Road. The surface of the project area currently consists of asphalt pavement.

In general, the topography along the staging area slopes downward from west to east. Areas of the pavement that were visible appeared to show indications of distress (i.e., "alligator cracking", longitudinal and transverse cracking) throughout.

2.2 FIELD EXPLORATION AND LABORATORY TESTING

The site subsurface conditions were determined by completion of six (6) soil test borings within the staging area of the CATA Administrative Office, each advanced to a terminal depth of approximately 5 feet below existing grade. Pavement thicknesses were determined at four (4) additional locations by performance of pavement cores. The boring and pavement core locations were established by PSI personnel in the field at the approximate locations depicted on a drawing provided by Mr. Stephen Metzger with DLZ. The approximate test locations are depicted on the Boring and Pavement Core Location Diagrams included in the Appendix.

The borings were completed by means of a CME-55 truck-mounted drilling rig equipped with a rotary head, utilizing 3-1/4 inch, hollow-stem augers to advance the boreholes. Representative samples were recovered employing split-barrel sampling procedures in general accordance with "Penetration Test and Split-Barrel Sampling of Soils" (ASTM D1586). After completion of each test boring, the drill hole was backfilled with the excavated soils and cold-patched at the surface.

Free groundwater level measurements were recorded in each test boring during drilling operations. Groundwater levels encountered are noted on the boring logs which are presented in the Appendix. Seasonal variations may influence the depths to the groundwater, and groundwater quantities and flow volumes will largely depend on the permeability of the soil profile.

In addition to the field exploration, a laboratory-testing program was conducted to evaluate engineering characteristics of the subsurface materials. The laboratory-testing program included visual classification of all samples and moisture content tests on selected samples. Unconfined compressive strengths for selected cohesive samples were estimated using a calibrated spring penetrometer. All phases of the laboratory-testing program were conducted in general accordance with applicable ASTM

specifications. The results of these tests are located on each boring log and are included in the Appendix.

2.3 SUBSURFACE CONDITIONS

The ground surface at the boring and core locations is covered with asphalt pavement ranging in thickness between approximately 5 and 22 inches. Beneath the existing asphalt pavement at locations of Borings B-04 and B-06, fill materials were encountered. Fill at the location of Boring B-04 consists of approximately 5½ inches of brown fine to medium sand with traces of gravel overlying 5 inches of buried topsoil. The topsoil at Boring B-04 is underlain by clayey silt and silty clay fill materials containing traces to some organics to the explored depth of 5 feet. At Boring B-06, PSI encountered approximately 8 inches of apparently pulverized asphalt overlying fine to medium sand fill extended to an approximate depth of 4½ feet.

The pavement materials at Borings B-01 through B-03 and B-05 are underlain by apparent native granular soils which generally consist of fine to medium sand. The apparent native granular soils extended to explored depths of 5 feet at Borings B-01 through B-03 and 2½ feet at Boring B-05. Beneath the granular soils at Borings B-05 and B-06, PSI encountered sandy clay materials ranging in moisture from 17 to 20 percent with unconfined compressive strengths of 1.75 and 1.25 tons per square foot (tsf), respectively.

PSI encountered native granular soils beneath the pavement sections and old fill soils during the field exploration, which generally consist of fine to medium sand with traces of gravel. Standard Penetration Test values (N-values) of the native granular deposits range between 9 and 67 blows per foot (bpf), thereby indicating loose to very dense relative densities. This large range of N-values suggests that shallow samples may have been impacted by frozen soils. Moisture content test results of these native granular soils range between 2 and 10 percent, thereby indicating moist conditions.

Cobbles and boulders are often present in glacial deposits and it is possible that they may be encountered during excavation operations on this site.

The above subsurface descriptions are of a generalized nature, and are provided to highlight the major soil strata encountered. The boring logs (included in the Appendix at the end of this report) should be reviewed for specific information, including blow counts, with regard to individual boring locations. The stratification shown on the boring logs represents the conditions encountered at each specific boring location. Variations may occur and should be expected between boring locations. The stratification represents the approximate boundary between subsurface materials; however, the actual transition may be gradual, abrupt, or not clearly defined. In the absence of foreign substances or debris, it is often difficult to distinguish between native soils and clean fill soil.

A summary of the thicknesses of base materials and/or old fill materials encountered during the field exploration at each boring location can be found in the following Table:

Table 1: Field Exploration Summary

Boring/Core No.	Approximate Thickness of Asphalt Pavement Encountered at Each Boring/Core Location (in.)	Approximate Thickness of Old Fill Soils and Buried Topsoil (in.)
B-01	22½	N/A
B-02	20½	N/A
B-03	10	N/A
B-04	6½	5½ (Sand Base Material) 5 (Topsoil) 25 (Clayey Silt) 18 (Silty Clay)
B-05	19	N/A
B-06	5	13 (Sand Base Material) 8 (Pulverized Asphalt) 28 (Sand Base Material)
C-01	22	N/A
C-02	9	N/A
C-03	22	N/A
C-04	10½	N/A

2.4 GROUNDWATER INFORMATION

Free groundwater was not encountered in any Borings during or upon completion of the drilling operations. Collapse (“dry cave”) of the soils also did not occur at any Borings upon removal of the augers.

Groundwater levels on this site are likely to vary as a result of seasonal conditions, and fluctuations should be anticipated. It is recommended that the contractor determine the actual groundwater levels at the time of the construction to evaluate groundwater impact on construction procedures.

3 EVALUATION AND RECOMMENDATIONS

3.1 SITE PREPARATION AND FILL PLACEMENT

Per DLZ, the existing asphalt pavement located east of the CATA Administrative Office facility is to be replaced with concrete pavement. All pavement structure, including asphalt, curb and gutter, etc., should be removed.

After all pavement structure is removed, total fill or apparent fill removal of the pavement area down to the underlying native subgrade soils across the full width of the pavement is advisable, and offers several advantages. The primary advantage of fill removal to the native soils is that areas of subgrade instability may be addressed and corrected prior to placement of the new pavement section.

Ideally, the apparent old fill (and any organic soils) encountered at Borings B-04 and B-06 should be completely removed from beneath pavements. It should be noted that the fill soils below a depth of about 3½ feet at Boring B-04 appeared to contain appreciable organic content. Boring B-04 terminated within this layer and the total depth of removal is not known. At Boring B-06, fill soil extended to a depth of 4½ feet. It would not be unusual for the thickness, composition and organic contents of the old fill to vary within the site area from that encountered at the individual boring locations. In addition, it is possible that organic native soils, uncontrolled fills or poorly compacted below grade utility trench backfill may be present at other locations within the roadway alignment that were not disclosed by the borings performed. Uncontrolled fill materials (and organic soils, where encountered) generally undergo high and variable volume changes when subjected to loads, resulting in detrimental performance of pavements placed on them. The exact depth of removal of these soils should be determined by PSI during the stripping activities.

Therefore, another advantage of total pavement reconstruction is that existing subgrade soils consisting of uncontrolled fill can be undercut and replaced with clean engineered fill.

The existing fill materials encountered during PSI's field exploration may be suitable for re-use as engineered fill to develop subgrades, provided this material is free of organics, debris, and constituents less than 3 inches in diameter. Any buried topsoil (i.e., organic soils) encountered at the project site should be completely removed from the project site and wasted (or stockpiled in non-settlement sensitive areas of the project sites). Imported fill to develop the subgrade should consist of a granular material, such as MDOT Class II (or similar). Aggregate base fill materials should meet the requirements of MDOT 21AA (or similar). The native granular soils will likely be suitable for re-use as engineered fill.

While we recommend all fill soils be entirely removed from within the planned construction area, some or all of the fill soils could be left in place for support of the

pavements, providing the Owner accepts the risks associated in doing so. These risks include variable support characteristics and the possibility that buried topsoil or other unsuitable soil layer(s) could be present below or within fill deposits, resulting in an increased risk of detrimental support characteristics of the pavement (and/or buried utilities) occurring. If these risks are unacceptable, then all fill soils must be removed as recommended and be replaced with engineered fill. Where organic soils are present below fill soils, both the organic and fill soils should be entirely removed and replaced with engineered fill. The exact depth of removal and the suitability of the old fill material as engineered fill (i.e., as subbase material) should be determined by PSI during the stripping activities.

Unstable areas should be undercut and replaced with engineered fill or stabilized using other suitable methods. Unsuitable areas must be removed and stabilized prior to backfilling the excavation. Undercutting and replacement with engineered fill or discing and recompacting may be suitable remedies. However, more extensive subgrade stabilization measures (such as the use of geofabric, geogrid, and/or 1 to 3-inch stone) can not be ruled out where areas of uncontrolled fill were encountered.

After the subgrade has been stabilized, engineered fill (i.e., subbase and base materials) may then be placed. Proper control of the placement and compaction of new fills should be monitored by PSI. The new materials should be free of organic matter. Fill materials are to be placed in individual lifts not exceeding eight (8) inches in loose thickness. Each lift is to be compacted to a minimum of ninety-five (95) percent of the maximum dry density within three (3) percent of the optimum moisture content as determined in accordance with ASTM standard method D-1557 (Modified Proctor). A sufficient number of in-place density tests should be performed on each lift of the fill. The tests should be performed in accordance with appropriate ASTM procedures.

Considering that construction has occurred on or nearby the site, it is likely that areas of additional fill and/or buried topsoil deposits that were not identified by the boring program could be encountered at this site. Where any organic, soft or otherwise unsuitable soils are identified, they should be completely removed and replaced with engineered fill. Any non-organic fill soils that are encountered should be characterized with respect to the structural application that they will be subjected to before they are utilized as fill or allowed to remain in place. Additional soil borings and/or test pits may be required to evaluate fill soils.

Construction traffic should be restricted from the exposed subgrade to help reduce the potential for loosening of the subgrade soils, particularly where excess moisture is present from groundwater and/or precipitation. PSI recommends that the fill be strategically placed so that the construction equipment remains on newly placed fill soils and not on the exposed subgrade during fill placement.

Each lift of engineered fill should be tested for conformance to the project density requirements by a representative of PSI prior to placement of subsequent lifts. A

minimum of one test per 2,500 square feet of building area and one test per 5,000 square feet of parking area should be performed for each lift, unless otherwise specified by the engineer. The moisture/density relationship (Proctor) of the material to be used as engineered fill should be evaluated by a PSI geotechnical engineer or his representative prior to placement in the field. PSI recommends one Proctor test for every 5,000 cubic yards (cyds) of fill and one test per each change of material.

PSI recommends that imported granular soils conform to the gradation requirements of MDOT Class II granular material. In addition, free-draining, non-plastic granular material such as MDOT Class II granular material is recommended for use as backfill beneath the pavements. PSI recommends that any imported cohesive soils used as engineered fill below at-grade structural elements have a liquid limit less than 40 percent and a plasticity index in the range of 10 to 25. A sheep's foot roller is recommended for compaction if cohesive soils are used. Vibratory compaction equipment should be used for compaction in granular soils. Small, hand operated compaction equipment should be used in confined spaces and against below-grade walls and foundations.

3.2 PAVEMENT DESIGN RECOMMENDATIONS

Based on the scope of service provided by DLZ, California Bearing Ratio (CBR) analysis was not performed in these areas. In lieu of extensive testing for determination of pavement subgrade support characteristics, we have made an estimation based on our laboratory analysis and our experience with similar subgrade soils as follows:

- Estimated Native Granular Subgrade CBR = 6 to 8
- Estimated Clay/Fill Subgrade CBR = 2 to 4
- Estimated Native Granular Subgrade Modulus, $M_R = 6,500$ to $8,000$ psi
- Estimated Clay/Fill Subgrade Modulus, $M_R = 3,000$ to $5,000$ psi

The CBR values should be verified by formal laboratory testing and specific traffic frequencies and axle loading determined prior to pavement design acceptance. In accepting the following pavement designs based on the correlated CBR value, DLZ must then accept a greater risk of over-design or pavement failure and/or higher maintenance costs, compared to an engineered design.

DLZ provided PSI with frequency and axle loading conditions for the proposed pavement which were used to determine the following design inputs:

Table 2. Pavement Design Criteria

Traffic (18-Kip ESAL's per Bus)	Traffic (18-Kip ESAL's Over a 20-Year Design Life)
2.93	2,138,900

The following traffic information has been assumed based on PSI's experience with similar projects:

- Reliability = 95%
- Standard Deviation = 0.49
- Initial Serviceability Index = 4.2
- Terminal Serviceability Index = 2.0

In view of the available soil information, the recommended site preparation activities, and from experience on similar projects, PSI is providing the following pavement section for the pavement area on this site

The following table depicts PSI's recommended pavement design:

Table 3. Recommended Pavement Section

Wearing Course	9" MDOT P1 Concrete
Aggregate Course	8" MDOT 21AA
Subbase Course	12" MDOT Class II

The above recommendations are based on the AASHTO design methods for rigid pavement design and are based on a design life of 20 years. Actual pavement section thicknesses should be provided by the design civil engineers based on actual traffic volumes and axle loads, laboratory determined California Bearing Ratio tests, and the owner's design life requirements. Periodic maintenance should be performed on all pavements during the service life, otherwise reduction of pavement life should be expected. All pavement materials and construction procedures should conform to (Michigan Department of Transportation) MDOT or appropriate local requirements.

Pavements may be placed after the subgrade has been properly prepared as outlined in this report under the supervision of a PSI representative. Unstable areas should be treated as outlined therein. Appropriate drainage, including finger drains around catch basins and perimeter drainage must be incorporated into the pavement design. **Inadequate drainage will result in heaving and significant distress to the pavement due to the freezing of ponded water during cold winter months.**

The aggregate base should comply with the gradation requirements of an MDOT 21AA (or similar) dense-graded aggregate. It should be compacted to ninety-five (95) percent of the maximum dry density as determined by ASTM D1557. The concrete pavement for the entire project should comply with the master composition requirements of MDOT P1 concrete (MDOT 2012 Standard Specifications for Construction and Supplemental Specifications). The placement of the pavement should comply with MDOT construction

specifications. Concrete design parameters include a 28-day mean modulus of rupture of 670 psi and a 28-day mean modulus of elasticity of approximately 4,200,000 psi.

The concrete mix design should consist of a normal weight concrete with a minimum 28-day compressive strength of 3,500 psi when tested in accordance to ASTM C39. The concrete should utilize fibermesh, and contain an air entraining admixture to resist the effects of freezing and thawing. The design of joints, joint spacing, doweling and steel/wire mesh reinforcement was not included in PSI's Scope-of-Services, but should conform to the applicable local or MDOT requirements. Furthermore, the Contractor constructing the pavement should refer to and adhere to CATA specific pavement requirements.

Vehicle traffic or the loading of a partially constructed pavement section will likely cause premature pavement failure. All vehicle traffic or pavement loading should be restricted until the pavement section has been completely constructed or the partial pavement section must be designed for this purpose, particularly if construction traffic will use the partial pavement.

If the materials encountered upon PSI's visual observation of the exposed subgrade after the removal of any fill or pavement materials are not similar to our findings in this report, PSI should be contacted immediately and additional soil borings and/or test pits may be necessary.

It should be recognized that all pavements require regular maintenance and occasional repairs to keep the pavements in a serviceable condition. Of particular value is a timely sealing of joints and cracks, which if left unrepaired, can serve to permit water to enter the pavement section and cause rapid deterioration of the pavement during freeze-thaw cycles. The need for such maintenance and repair is not necessarily indicative of premature pavement failure. However, if appropriate maintenance and repairs are not performed on a timely basis, the serviceable life of the pavement can be reduced significantly.

The pavement surface should be adequately sloped to promote good surface drainage and to reduce water infiltration into the base course. Water should not be allowed to pond behind curbs and saturate the pavement base stone. Where open grade base course is used, an edge drain system will be required to remove water infiltration within the base course. Consideration should also be given to the placement of finger drains radiating outward from the catch basins (if present) at the base course/subgrade interface.

3.2.1 DRAINAGE AND GROUNDWATER CONSIDERATIONS

Significant groundwater infiltration is not anticipated during site grading or in shallow excavations on this site. However, since the subgrade materials encountered in the soil borings on this site generally tend to loosen or become unstable when exposed to free

water, every effort should be made to keep any excavations dry where water is encountered or precipitation or snowmelt occurs during construction.

It is recommended that contractors be responsible for appropriate dewatering procedures based on test pits performed prior to construction. Crushed stone in combination with a geogrid or geofabric may be necessary to stabilize subgrade soils which become wet or unstable during construction.

3.2.2 EXCAVATIONS

Care must be taken so that all excavations made for the subgrade during pavement and fill removal are properly backfilled with suitable material compacted in accordance with the procedures outlined in this report. Before the backfill is placed, all water and loose debris should be removed from these excavations.

Materials removed from the excavation should not be stockpiled immediately adjacent to the excavation, as this load may cause a sudden collapse of the embankment. The contractor should establish a minimum lateral distance from the crest of the slope for all vehicles and spoil piles. Likewise, the contractor should establish protective measures for exposed slope faces and preventative measures for the buildup of moisture in the excavation sidewalls, which can cause slope instability. A slope stability analysis should be performed to determine the factor of safety for cut and fill depths if the depth of the excavations warrant. If temporary shoring of excavation sidewalls is performed, a qualified registered professional engineer must design it.

In Federal Register, Volume 54. No. 209 (October 1989), the United States Department of Labor, Occupational Safety and Health Administration (OSHA) amended its "Construction Standards for Excavations, 29 CFR, part 1926, subpart P". This document was issued to better insure the safety of workmen entering trenches or excavations. It is mandated by this federal regulation that all excavations, whether they be utility trenches or footing excavations, be constructed in accordance with the new OSHA guidelines. It is PSI's understanding that these regulations are being strictly enforced and if they are not closely followed, the owner and the contractor could be liable for substantial penalties.

The contractor is solely responsible for designing and constructing stable, temporary excavations and should shore, slope, or bench the sides of the excavations as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations.

PSI is providing this information solely as a service to DLZ. PSI is not assuming responsibility for construction site safety or the contractor's activities. Such responsibility is not being implied, and should not be inferred.

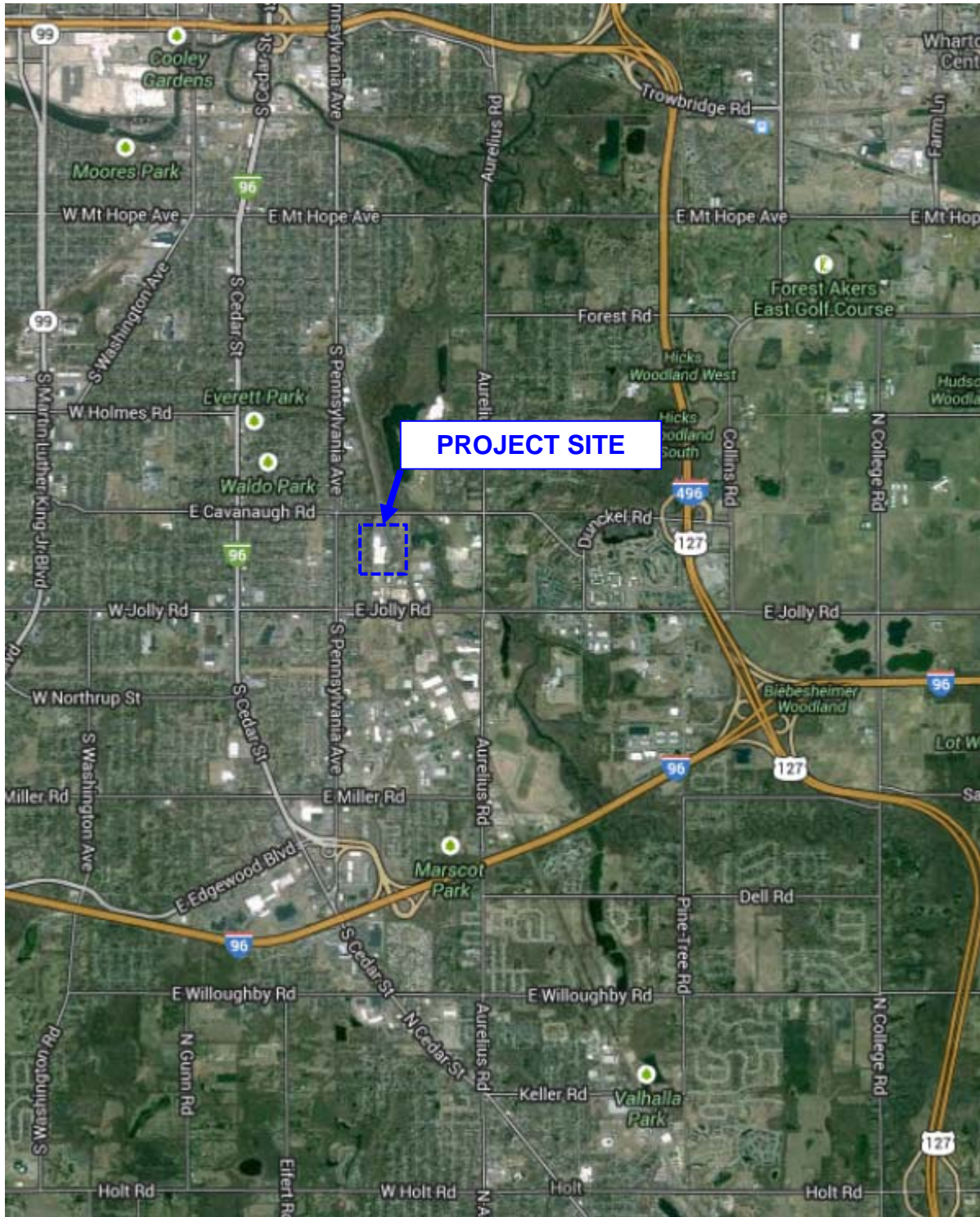
4 REPORT LIMITATIONS

The recommendations submitted for the proposed CATA Pavement Reconstruction project are based on the available soil information and the design details furnished by the DLZ for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, PSI must be notified immediately to determine if changes in the foundation recommendations are required. If PSI is not retained to perform these functions, PSI cannot be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

After the plans and specifications are complete, PSI should be retained to review the final design plans and specifications. This review is required to verify that the engineering recommendations are appropriate for the final configuration, and that they have been properly incorporated into the design documents. This report has been prepared for the exclusive use of DLZ for specific application to the proposed CATA Pavement Reconstruction project to be located in Lansing, Michigan.

APPENDIX

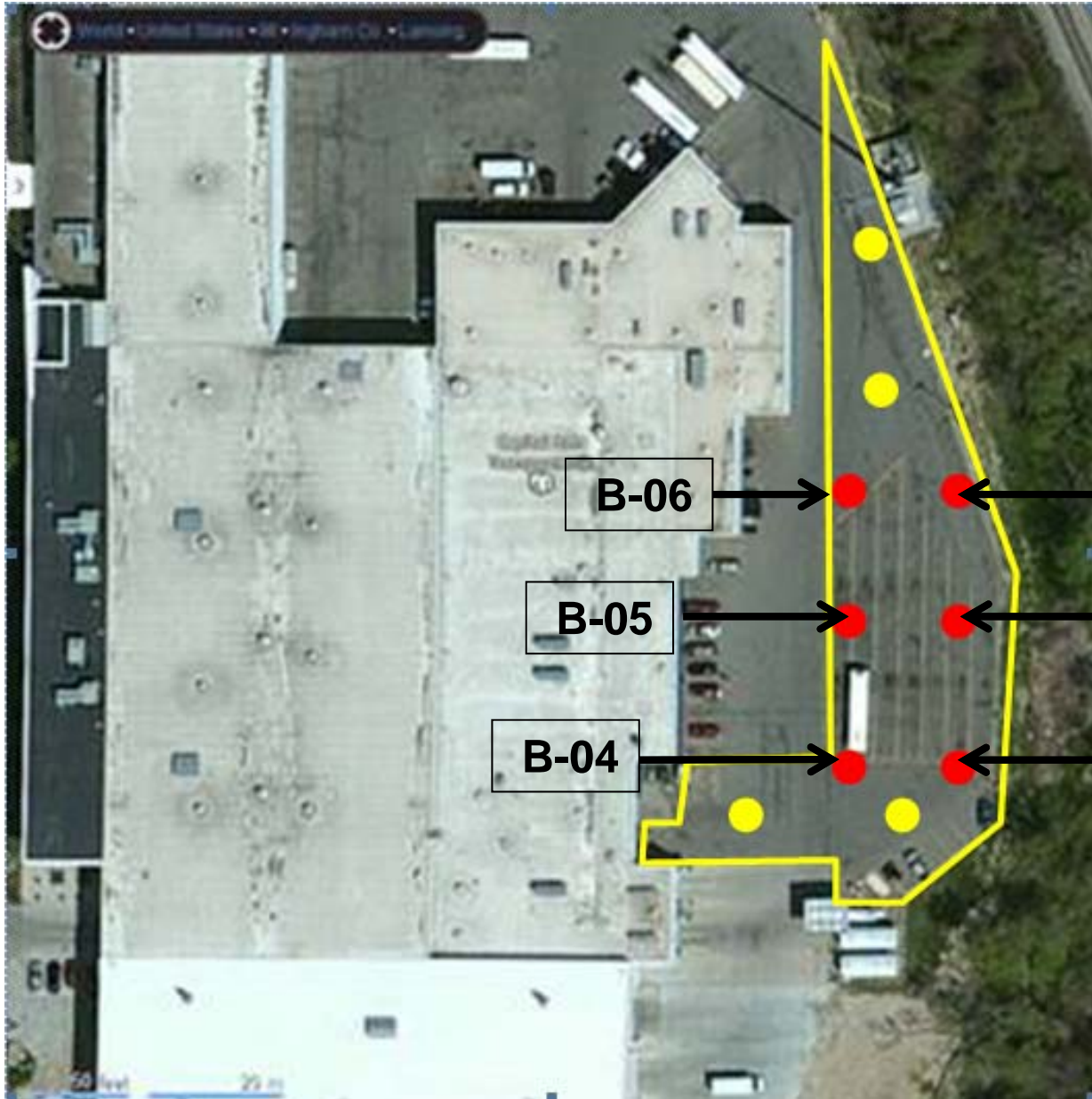


SITE LOCATION DIAGRAM

CATA Pavement Reconstruction
 4615 Tranter Street
 Lansing, MI 48911

FIGURE NO. 1

PSI PROJECT NO. 0408834
 PREPARED BY: STB
 PREPARED ON: 1/31/2014

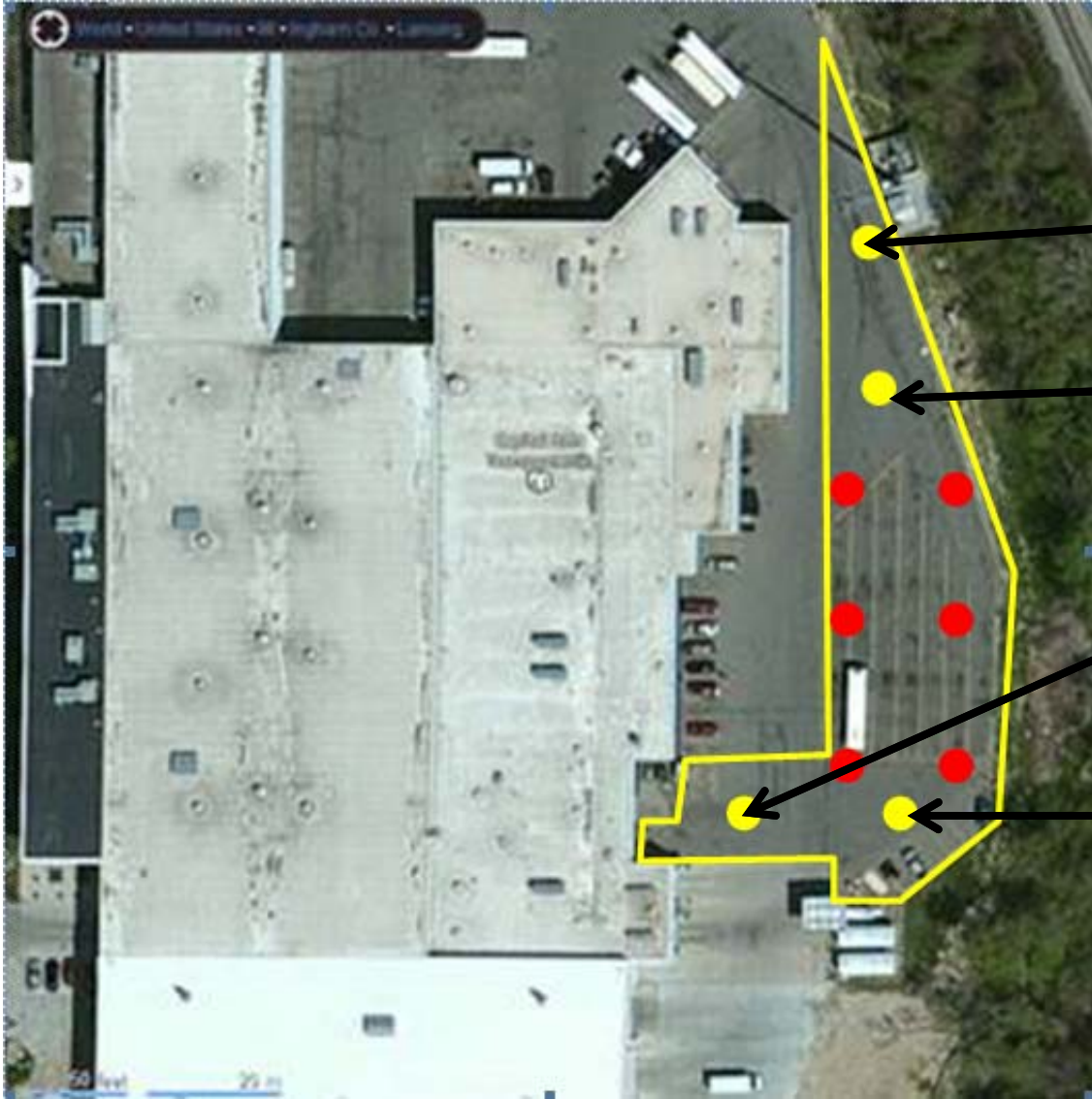


BORING LOCATION DIAGRAM

CATA Pavement Reconstruction
 4615 Tranter Street
 Lansing, MI 48911

FIGURE NO. 1

PSI PROJECT NO. 0408834
 PREPARED BY: STB
 PREPARED ON: 1/31/2014



C-01

C-02

C-03

C-04



PAVEMENT CORE LOCATION DIAGRAM

CATA Pavement Reconstruction
4615 Tranter Street
Lansing, MI 48911

FIGURE NO. 1

PSI PROJECT NO. 0408834
PREPARED BY: STB
PREPARED ON: 1/31/2014

DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-01

Water
 ∇ While Drilling N/A
 ▼ Upon Completion N/A
 ∇ Cave Depth N/A

BORING LOCATION:
 See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0		22.5" ASPHALT									
				1	18	Brown fine to medium SAND, trace Gravel, moist, very dense to medium dense (SP)	SP	12-28-34 N=62	2	×	>>⊙ High N values possibly due to frozen soils
				2	18			7-9-11 N=20	5	×	⊙
5		Boring terminated 5 feet below existing ground surface.									



Professional Service Industries, Inc.
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 Lansing, MI 48911
 Telephone: (517) 394-5700

PROJECT NO.: 0408834
PROJECT: Pavement Reconstruction - CATA
LOCATION: 4615 Tranter Street
 Lansing, Michigan

DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-02

Water	▽	While Drilling	N/A
	▼	Upon Completion	N/A
	▽	Cave Depth	N/A

BORING LOCATION:
See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⊙ × Moisture ▣ PL + LL	STRENGTH, tsf ▲ Qu * Qp	Additional Remarks
0						20.5" ASPHALT						
				1	18	Brown fine to medium SAND, trace Gravel, moist, very dense to medium dense (SP)	SP	26-29-38 N=67	3	×		>>⊙ High N values possibly due to frozen soils
				2	18			7-10-13 N=23	4	×	⊙	
5						Boring terminated 5 feet below existing ground surface.						



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PROJECT: Pavement Reconstruction - CATA
LOCATION: 4615 Tranter Street
 Lansing, Michigan

DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-03

Water	▽	While Drilling	N/A
	▼	Upon Completion	N/A
	▽	Cave Depth	N/A

BORING LOCATION:
See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STANDARD PENETRATION TEST DATA N in blows/ft ⊙ × Moisture ◻ PL + LL STRENGTH, tsf ▲ Qu * Qp	Additional Remarks
0						10" ASPHALT					
				1	18	Brown fine to medium SAND, trace Gravel, moist, very dense to medium dense (SP)	SP	14-29-33 N=62	8	×	>> ⊙ High N values possibly due to frozen soils
				2	18			5-6-6 N=12	10	×	
5						Boring terminated 5 feet below existing ground surface.					



Professional Service Industries, Inc.
 3120 Sovereign Drive, Suite C
 Lansing, MI 48911
 Telephone: (517) 394-5700

PROJECT NO.: 0408834
PROJECT: Pavement Reconstruction - CATA
LOCATION: 4615 Tranter Street
 Lansing, Michigan

DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-04

Water
 ∇ While Drilling N/A
 ▼ Upon Completion N/A
 ∇ Cave Depth N/A

BORING LOCATION:
 See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	STANDARD PENETRATION TEST DATA		Additional Remarks
									N in blows/ft ⊙	Moisture, %	
0						6.5" ASPHALT					
						5.5" Brown fine to medium SAND, trace Gravel, moist (FILL)	SP				
				1	18	5" Buried topsoil, moist (FILL)					
						Mottled brown and gray fine CLAYEY SILT, trace organics, moist (FILL)	CL-ML	5-4-4 N=8	15		
				2	18	Dark gray fine to medium SILTY CLAY, trace Gravel, trace to some organics, moist (FILL)	CL-ML	2-3-4 N=7	24		
5						Boring terminated 5 feet below existing ground surface.					



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 Lansing, Michigan

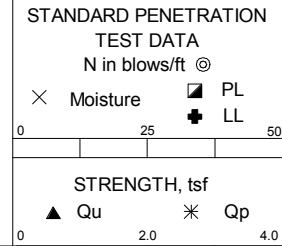
DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-05

Water
 ∇ While Drilling N/A
 ▼ Upon Completion N/A
 ∇ Cave Depth N/A

BORING LOCATION:
 See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0						19" ASPHALT					
				1	18	Brown fine to medium SAND, trace Gravel, moist, loose (SP)	SP	6-5-4 N=9	3		
				2	18	Gray fine to medium SANDY CLAY, trace Gravel, trace organics, moist, stiff, low plastic (CL)	CL	3-2-3 N=5	17		
5						Boring terminated 5 feet below existing ground surface.					



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 Lansing, Michigan

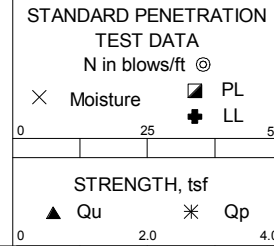
DATE STARTED: 1/23/14 **DRILL COMPANY:** PSI
DATE COMPLETED: 1/23/14 **DRILLER:** E. Motcheck **LOGGED BY:** E. Motcheck
COMPLETION DEPTH: 5.0 ft **DRILL RIG:** CME-55
BENCHMARK: N/A **DRILLING METHOD:** 3 1/4" HSA
ELEVATION: N/A **SAMPLING METHOD:** SS
LATITUDE: **HAMMER TYPE:** Automatic
LONGITUDE: **EFFICIENCY:** N/A
STATION: N/A **OFFSET:** N/A **REVIEWED BY:** J. Walter
REMARKS: None

BORING B-06

Water
 ∇ While Drilling N/A
 ▼ Upon Completion N/A
 ∇ Cave Depth N/A

BORING LOCATION:
 See Boring location Diagram

Elevation (feet)	Depth (feet)	Graphic Log	Sample Type	Sample No.	Recovery (inches)	MATERIAL DESCRIPTION	USCS Classification	SPT Blows per 6-inch (SS)	Moisture, %	STRENGTH, tsf	Additional Remarks
0						5" ASPHALT					
						13" Brown fine to medium SAND, trace Gravel, moist (FILL)	SP				
				1	2	8" ASPHALT (FILL)		50/2"			
						Brown fine to medium SAND, trace Gravel, moist (FILL)	SP				
				2	18	Gray fine to medium SANDY CLAY, trace Gravel, trace organics moist, medium stiff, low plastic (CL)	CL	6-4-3 N=7			
5						Boring terminated 5 feet below existing ground surface.					



Low recovery



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LOCATION: 4615 Tranter Street
 Lansing, Michigan

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS	
			GRAPH	LETTER		
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES	
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES	
	MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
					SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
			SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
					SC	CLAYEY SANDS, SAND - CLAY MIXTURES
	FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
					CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
					OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE		SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
					CH	INORGANIC CLAYS OF HIGH PLASTICITY
					OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	





GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System (USCS), AASHTO 1988 and ASTM designations D2487 and D-2488 are used to identify the encountered materials unless otherwise noted. Coarse-grained soils are defined as having more than 50% of their dry weight retained on a #200 sieve (0.075mm); they are described as: boulders, cobbles, gravel or sand. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve; they are defined as silts or clay depending on their Atterberg Limit attributes. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size.

DRILLING AND SAMPLING SYMBOLS

- SFA: Solid Flight Auger - typically 4" diameter flights, except where noted.
- HSA: Hollow Stem Auger - typically 3¼" or 4¼ I.D. openings, except where noted.
- M.R.: Mud Rotary - Uses a rotary head with Bentonite or Polymer Slurry
- R.C.: Diamond Bit Core Sampler
- H.A.: Hand Auger
- P.A.: Power Auger - Handheld motorized auger
- ☒ SS: Split-Spoon - 1 3/8" I.D., 2" O.D., except where noted.
- ST: Shelby Tube - 3" O.D., except where noted.
- ▮ RC: Rock Core
- ⬇ TC: Texas Cone
- ☞ BS: Bulk Sample
- ☑ PM: Pressuremeter
- CPT-U: Cone Penetrometer Testing with Pore-Pressure Readings

SOIL PROPERTY SYMBOLS

- N: Standard "N" penetration: Blows per foot of a 140 pound hammer falling 30 inches on a 2-inch O.D. Split-Spoon.
- N₆₀: A "N" penetration value corrected to an equivalent 60% hammer energy transfer efficiency (ETR)
- Q_u: Unconfined compressive strength, TSF
- Q_p: Pocket penetrometer value, unconfined compressive strength, TSF
- w%: Moisture/water content, %
- LL: Liquid Limit, %
- PL: Plastic Limit, %
- PI: Plasticity Index = (LL-PL),%
- DD: Dry unit weight, pcf
- ▼, ▽, ▾ Apparent groundwater level at time noted

RELATIVE DENSITY OF COARSE-GRAINED SOILS ANGULARITY OF COARSE-GRAINED PARTICLES

Relative Density	N - Blows/foot
Very Loose	0 - 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	50 - 80
Extremely Dense	80+

Description	Criteria
Angular:	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular:	Particles are similar to angular description, but have rounded edges
Subrounded:	Particles have nearly plane sides, but have well-rounded corners and edges
Rounded:	Particles have smoothly curved sides and no edges

GRAIN-SIZE TERMINOLOGY

Component	Size Range
Boulders:	Over 300 mm (>12 in.)
Cobbles:	75 mm to 300 mm (3 in. to 12 in.)
Coarse-Grained Gravel:	19 mm to 75 mm (¾ in. to 3 in.)
Fine-Grained Gravel:	4.75 mm to 19 mm (No.4 to ¾ in.)
Coarse-Grained Sand:	2 mm to 4.75 mm (No.10 to No.4)
Medium-Grained Sand:	0.42 mm to 2 mm (No.40 to No.10)
Fine-Grained Sand:	0.075 mm to 0.42 mm (No. 200 to No.40)
Silt:	0.005 mm to 0.075 mm
Clay:	<0.005 mm

PARTICLE SHAPE

Description	Criteria
Flat:	Particles with width/thickness ratio > 3
Elongated:	Particles with length/width ratio > 3
Flat & Elongated:	Particles meet criteria for both flat and elongated

RELATIVE PROPORTIONS OF FINES

Descriptive Term	% Dry Weight
Trace:	< 5%
With:	5% to 12%
Modifier:	>12%



GENERAL NOTES

(Continued)

CONSISTENCY OF FINE-GRAINED SOILS

<u>Q_u - TSF</u>	<u>N - Blows/foot</u>	<u>Consistency</u>
0 - 0.25	0 - 2	Very Soft
0.25 - 0.50	2 - 4	Soft
0.50 - 1.00	4 - 8	Firm (Medium Stiff)
1.00 - 2.00	8 - 15	Stiff
2.00 - 4.00	15 - 30	Very Stiff
4.00 - 8.00	30 - 50	Hard
8.00+	50+	Very Hard

MOISTURE CONDITION DESCRIPTION

<u>Description</u>	<u>Criteria</u>
Dry:	Absence of moisture, dusty, dry to the touch
Moist:	Damp but no visible water
Wet:	Visible free water, usually soil is below water table

RELATIVE PROPORTIONS OF SAND AND GRAVEL

<u>Descriptive Term</u>	<u>% Dry Weight</u>
Trace:	< 15%
With:	15% to 30%
Modifier:	>30%

STRUCTURE DESCRIPTION

<u>Description</u>	<u>Criteria</u>	<u>Description</u>	<u>Criteria</u>
Stratified:	Alternating layers of varying material or color with layers at least ¼-inch (6 mm) thick	Blocky:	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Laminated:	Alternating layers of varying material or color with layers less than ¼-inch (6 mm) thick	Lensed:	Inclusion of small pockets of different soils
Fissured:	Breaks along definite planes of fracture with little resistance to fracturing	Layer:	Inclusion greater than 3 inches thick (75 mm)
Slickensided:	Fracture planes appear polished or glossy, sometimes striated	Seam:	Inclusion 1/8-inch to 3 inches (3 to 75 mm) thick extending through the sample
		Parting:	Inclusion less than 1/8-inch (3 mm) thick

SCALE OF RELATIVE ROCK HARDNESS

<u>Q_u - TSF</u>	<u>Consistency</u>
2.5 - 10	Extremely Soft
10 - 50	Very Soft
50 - 250	Soft
250 - 525	Medium Hard
525 - 1,050	Moderately Hard
1,050 - 2,600	Hard
>2,600	Very Hard

ROCK BEDDING THICKNESSES

<u>Description</u>	<u>Criteria</u>
Very Thick Bedded	Greater than 3-foot (>1.0 m)
Thick Bedded	1-foot to 3-foot (0.3 m to 1.0 m)
Medium Bedded	4-inch to 1-foot (0.1 m to 0.3 m)
Thin Bedded	1¼-inch to 4-inch (30 mm to 100 mm)
Very Thin Bedded	½-inch to 1¼-inch (10 mm to 30 mm)
Thickly Laminated	1/8-inch to ½-inch (3 mm to 10 mm)
Thinly Laminated	1/8-inch or less "paper thin" (<3 mm)

ROCK VOIDS

<u>Voids</u>	<u>Void Diameter</u>
Pit	<6 mm (<0.25 in)
Vug	6 mm to 50 mm (0.25 in to 2 in)
Cavity	50 mm to 600 mm (2 in to 24 in)
Cave	>600 mm (>24 in)

GRAIN-SIZED TERMINOLOGY

<u>(Typically Sedimentary Rock)</u>	
<u>Component</u>	<u>Size Range</u>
Very Coarse Grained	>4.76 mm
Coarse Grained	2.0 mm - 4.76 mm
Medium Grained	0.42 mm - 2.0 mm
Fine Grained	0.075 mm - 0.42 mm
Very Fine Grained	<0.075 mm

ROCK QUALITY DESCRIPTION

<u>Rock Mass Description</u>	<u>RQD Value</u>
Excellent	90 -100
Good	75 - 90
Fair	50 - 75
Poor	25 -50
Very Poor	Less than 25

DEGREE OF WEATHERING

Slightly Weathered:	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in), open joints may contain clay, core rings under hammer impact.
Weathered:	Rock mass is decomposed 50% or less, significant portions of the rock show discoloration and weathering effects, cores cannot be broken by hand or scraped by knife.
Highly Weathered:	Rock mass is more than 50% decomposed, complete discoloration of rock fabric, core may be extremely broken and gives clunk sound when struck by hammer, may be shaved with a knife.

Important Information About Your Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you — should apply the report for any purpose or project except the one originally contemplated.*

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,

- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final*, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual

subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that

have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechnical Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.



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