Department of Natural Resources
Office of Land and Facilities
Design, Construction and Customer Systems Section

BALD MOUNTAIN RECREATION AREA

REMODEL SHOOTING RANGE CONCESSIONAIRE'S BUILDING AND CONSTRUCT POLE BUILDING

DNR PROJECT No. 41-7769

ADDENDUM No. 1

BID OPENING DATE: Wednesday, Dec. 9, 2009 at 2:00 p.m., Local Time
DATE ADDENDUM ISSUED: Thursday, Dec. 3, 2009
STATE UNIT: Office of Communications
DMB File No. 751/10042.AGY
Index No.: 14410

TO: ALL BIDDERS

SUBJECT: This Addendum No. 1 is issued to clarify and revise the Contract Documents of the above referenced project.

ITEM #1: The Owner will **NOT** be providing propane for temporary heating. It is the Contractor's responsible for temporary heating.

ITEM #2: The Contractor must field verify the distance of the electrical run from the Concessionaire's Building to the New Pole Barn. Bid Electrical work as shown on drawings and specifications.

ITEM #3: Builder's Risk Insurance is **NOT** required for this project.

ITEM #4: The Contractor must include in his/her bid for winter conditions. No change orders will not be issued for frost conditions.

ITEM #5: Anticipated Award Date is Wednesday, December 18th, 2009

ITEM #6: Attachment: The Soil Boring Report is being issued as part of this Addendum #1.

ITEM #7: Correction: Appendix II – DNR or US Army Corps of Engineer Permits have not been issued for this project.

ITEM #7: Hardware Set 1 -Pole barn entrance doors:

3	ea.	Butt Hinge CB199 NRP 4 ½ x 4 ½		32D	Stanley
1	ea.	Lockset 45H 7 AB 15H	26D	BEST	
1	ea.	Closer D4550 CS		AL	Stanley
1	ea.	Kickplate K0050 B4E 10" x 1 ½" ldw		32D	Trimco
1	ea.	Threshold S205A		AL	Reese
1	ea.	Sweep 353A –Mount pull side		AL	Reese
1	ea.	Weatherstrip 854A		AL	Reese

Acknowledgment: Two copies of this Addendum No. 1, properly signed in the space provided below, shall be submitted with your duplicate Proposal and Contract Forms.

Paul Stoddard, R.A.
Design, Construction and Customer Systems
Office of Land and Facilities
(517) 373-9906

_____
(Firm Name)

_____
(Bidder's Signature and Title)

_____
(Date)

GEOTECHNICAL EXPLORATION

PROPOSED STORAGE BUILDING
MICHIGAN DEPARTMENT OF NATURAL RESOURCES
BALD MOUNTAIN SHOOTING RANGE
14520 SHARON VALLEY ROAD
LAKE ORION, MICHIGAN

PSI PROJECT NO. 525158

PSI Information To Build On
Engineering • Consulting • Testing

November 24, 2009

Mr. R. Paul Stoddard, LEED AP
The Michigan Department of Natural Resources
Stevens T. Mason Building; 8th Floor
530 West Allegan Street
Lansing, Michigan 48933

RE: Geotechnical Exploration
Proposed Storage Building
MDNR Bald Mountain Shooting Range
2500 Kern Road
Lake Orion, Michigan
PSI Project No. **525158**

Dear Mr. Stoddard:

In compliance with your instructions, Professional Service Industries, Inc. (PSI) has conducted a geotechnical exploration for the referenced project. The results of this exploration, together with our recommendations, are to be found in the accompanying report, two (2) copies of which are being transmitted herewith.

PSI appreciates the opportunity to provide geotechnical engineering and consulting services for your project and looks forward to working with you. PSI provides additional consulting services, which include construction materials testing and observation services, environmental services, roof consulting and observation services, pavement and asphalt testing services and specialty engineering and testing. 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.

Daniel J. Wisinski
Project Manager

Mark Carlson (LO)
Mark J. Carlson, P.E.
Principal Consultant/Chief Engineer

GEOTECHNICAL EXPLORATION

FOR THE:

PROPOSED STORAGE BUILDING
MDNR BALD MOUNTAIN SHOOTING RANGE
2500 KERN ROAD
LAKE ORION, MICHIGAN

PREPARED FOR:

THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES
STEVENS T. MASON BUILDING; 8TH FLOOR
530 WEST ALLEGAN STREET
LANSING, MICHIGAN 48933

BY:

PROFESSIONAL SERVICE INDUSTRIES, INC.
3120 SOVEREIGN DRIVE, SUITE C
LANSING, MICHIGAN 48911

PSI REPORT NO. 525158

NOVEMBER 24, 2009

PSI

TABLE OF CONTENTS

PROJECT INFORMATION

Project Authorization

This report presents the results of a geotechnical exploration performed relative to the proposed construction of a storage building to be located at the Bald Mountain Shooting Range in Lake Orion, Michigan. This exploration was performed for The Michigan Department of Natural Resources (MDNR).

The services for this project were performed in accordance with PSI Proposal No. 52511134, dated November 9, 2009. The Proposal included a proposed scope of services, estimated cost, unit rates, time schedule and PSI's General Conditions. Authorization to perform this exploration and analysis was in the form of an acceptance of PSI's proposal, by Mr. R. Paul Stoddard of the MDNR.

Project Description

PSI understands that the new storage building will be a single-story, wood-frame structure bearing on conventional shallow foundations and a concrete slab-on-grade. The building will encompass approximately 2,400 square feet in plan area and be located in the eastern portion of the project site. Structural loads were not provided to PSI; however, based on past experience, we anticipate the storage building will require foundations to support individual column loads of up to 25 kips. We anticipate the finished floor elevation will be within approximately 1 foot of the existing site grades.

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.

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 foundations for the planned project.

The scope of the exploration and analysis included a reconnaissance of the project site, completion of two (2) soil borings, field and laboratory testing of recovered samples and an engineering analysis and evaluation of the subsurface materials encountered. Design recommendations addressing uplift forces were not included in our scope of services and are assumed to be provided by others.

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

conditions are strictly for the information of the MDNR. Prior to development of this site, an environmental assessment is advisable.

As directed by the scope of work provided by the MDNR, PSI did not provide any service to investigate or detect the presence of moisture, mold or other biological contaminates in or around any structure, or any service that was designed or intended to prevent or lower the risk of the occurrence or the amplification of the same. The MDNR acknowledges that mold is ubiquitous to the environment with mold amplification occurring when building materials are impacted by moisture. The MDNR further acknowledges that site conditions are outside of PSI's control, and that mold amplification will likely occur, or continue to occur, in the presence of moisture. As such, PSI cannot and shall not be held responsible for the occurrence or recurrence of mold amplification.

PSI also provides an array of complementary environmental and industrial hygiene services to assist our clients in successfully assessing and developing properties such as the one referenced in this report. PSI's environmental consultants apply their experience, local geologic knowledge and thorough understanding of ASTM standards, environmental risk, and regulatory knowledge to conduct due diligence assessments of a wide range of property types and proposed developments.

If requested by you, we would be pleased to provide your team with a proposal for this and other services regularly provided by PSI. Our familiarity with the site from the Geotechnical scope of work will enable our environmental professionals to proceed quickly in preparing a cost effective and pragmatic Phase I ESA.

SITE AND SUBSURFACE CONDITIONS

Site Location and Description

The Bald Mountain Shooting Range is located within the Bald Mountain State Recreation Area at 2500 Kern Road (immediately north of its intersection with Greenshield Road) in Lake Orion, Michigan. The Bald Lake Recreation incorporates almost 1 square mile of wooded, rolling terrain, however, the shooting range consists of a cleared, approximately 10-acre area located in the southwest portion of the facility. The existing shooting range consists of several open air target ranges (which are located in the north portion of the site), a wood frame clubhouse (located in the central portion of the site) and an asphalt paved parking area (located in the south portion of the site). The storage building will be located in the "greenbelt area" located on the east side of the existing 5-stand range in northeast portion of the site. At the time of field exploration, the surface of the site in the area of the proposed storage building was relatively level and apparently stripped of surface vegetation. The surface runoff was generally directed toward an isolated low-lying wetland area located in the east portion of the site. The surface of the site was soft at the time of field operations and the truck-mounted drilling equipment experienced some difficulty in moving between boring locations.

Field Exploration and Laboratory Testing

The site subsurface conditions were determined by completion of two (2) soil test borings, extending to a depth of 15 feet below the existing ground surface. The boring locations and depths were established by the MDNR and provided to PSI on an untitled and undated site drawing. The test borings were located in the field by PSI using conventional measuring procedures referencing existing site features. The approximate boring positions are overlain on the previously referenced print included in the Appendix.

Determination of the ground surface elevations at the test boring positions was not within the scope of PSI's services, nor were the elevations provided to PSI. Therefore, all indicated depths for the various materials encountered are referenced to existing grades at the time of drilling. Prior to design and construction, it is recommended that a State of Michigan registered surveyor determine the exact location and elevation of the borings and provide the information to PSI for review relative to our recommendations provided herein.

The borings were completed by means of a truck-mounted drilling rig equipped with a rotary head, utilizing 3¼ 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 the test borings, the drill holes were backfilled with the excavated soils.

Free groundwater level measurements were recorded in each test boring during and after completion of drilling operations and removal of the augers. Groundwater levels are noted on the boring logs that 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 to be found on the boring logs that are included in the Appendix.

Subsurface Conditions

At the time of field exploration, the ground surface at both boring locations was covered with about 6 inches of topsoil fill underlain by 2 to 3½ feet of apparent clayey sand fill.

It should be expected that the thickness of these unsuitable soil materials will vary across the site.

Beneath the aforementioned near-surface old fill soils, fine to medium sand and clays sands were encountered extending to the explored depth of the borings. The standard penetration values (N-values) recorded during the sampling of the native granular materials ranged from 12 to 23 blows per foot (indicating a medium dense relative density).

Cobbles and boulders are often noted in glacial deposits. Though apparently none were encountered during soil boring operations, it is possible that they may be encountered during excavation operations.

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 should be reviewed for specific information as to individual boring locations. The stratification shown on the boring logs represent the conditions only at the actual boring locations. 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, it is difficult to distinguish between native soils and clean fill soil.

Groundwater Information

During drilling operations, free groundwater was encountered at the location of Boring 1 at a depth of approximately 10 feet below the existing ground surface. Collapse of the test borings at depths of 8½ and 9 feet upon the removal of the augers precluded the measurement of the groundwater level upon the completion of drilling operations at the location of Borings 1 and 2, respectively. The collapsed depth will sometimes provide an approximation of the level of the groundwater in sandy soils.

The groundwater observations presented in this report represent conditions at the time of the field activities. 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.

EVALUATION AND RECOMMENDATIONS

Site Preparation

Topsoil fill and uncontrolled old fill will generally undergo high and variable volume changes when subjected to loads, resulting in detrimental performance of floor slabs,

structural fills and shallow foundations placed on them. Therefore, it is recommended that all topsoil fill and uncontrolled old fill be stripped from the construction areas and wasted or stockpiled for later use. Based on the soil borings, approximately 2 to 3½ feet of these materials are present at the site. The thickness of the topsoil fill and old fill is likely to vary throughout the site and other, possibly more extensive, deposits could be encountered during the sitework activities. The exact depth of removal of these soils should be determined by PSI during the stripping activities.

After the topsoil fill and any existing old fill materials have been removed from the areas of construction and any cut sections are performed the upper 12 inches of the exposed subgrade should be compacted to 95 percent of the maximum dry density as determined in accordance with ASTM standard method D1557. Any unsuitable areas must be removed and replaced with engineered fill or stabilized using other suitable methods prior to backfilling the excavation.

After the subgrade has been compacted and stabilized, any engineered fill required may then be placed. The engineered fill should consist of an environmentally clean, well-graded material such as MDOT Class II. Proper control of the placement and compaction of engineered fills should be monitored by PSI. The new materials should be free of organic matter and placed in individual lifts not exceeding 8 inches in loose thickness. Each lift is to be compacted to 95 percent of the maximum dry density within three (3) percent of the optimum moisture content as determined in accordance with ASTM standard method D1557. 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.

Foundation Recommendations (Borings 1 and 2)

Considering the site subsurface conditions and the proposed construction, it appears that the proposed conventional shallow foundations will be suitable for the support of the proposed storage building providing the following design and construction details are incorporated. Estimated total settlements should be approximately 1 inch with differential settlement of ½ of the total settlement

Footings are to be extended to bear on the native sand soils at a depth of at least 3.5 feet below the existing site grades. The foundations should have a diameter that proportions the foundation for a net allowable soil bearing pressure of up to **3,000 pounds per square foot** where they bear directly on the **native soils**.

In order to protect against frost action, all perimeter footings, exterior footings and footings located in unheated areas must bear at a depth of 3½ feet below final surface grades. Shallow footing excavations must be protected from the effects of frost action if construction is carried out during the winter months.

Footings supporting individual columns should have dimensions of no less than 24 inches. The purpose of limiting the footing size is to prevent "punching" shear deformation and to provide for vertical stability. **PSI recommends that uplift forces due to wind forces be considered in the design of the proposed structure.** Uplift forces may be resisted by the mass of the structure, through buried concrete dead man anchors and by the effective or buoyant weight of the soil backfill placed above the structure foundation.

Floor Slab

The upper 12 inches of the exposed subgrade soils should be compacted to 95 percent of the maximum dry density as determined in accordance with ASTM standard method D1557. It appears the treated existing soils and newly placed engineered fill will be adequate to support the floor slabs. If loose or unsuitable fill soils are encountered at the subgrade level, we recommend that these materials be undercut to an adequate depth and replaced with properly compacted granular fill soil.

A granular mat should be provided between the floor slab and the subgrade soil. It should be 4 inches or greater in thickness and be properly compacted as recommended in this report. The granular mat materials should comply with the current version of ACI 302.1.

The floor slab should be suitably reinforced to make it as rigid as necessary. Proper joints should be provided at the junctions of the slab and the foundation system so that a small amount of independent movement can occur without causing damage. The floor areas should be provided with joints at frequent intervals to compensate for concrete volume changes during curing. If a vapor retarder/barrier will be utilized, placement should be in compliance with the current version of ACI 302.1, local building codes and the recommendations of the flooring manufacturer. A modulus of subgrade reaction for the imported fill and native soils specified and conditioned as described in this report of **125 psi/in** may be used for the floor slab design. This value may be confirmed in the field by performing a 1 foot by 1 foot plate load test. However, depending on how the slab load is applied, the value will have to be geometrically modified.

Drainage and Groundwater Considerations

Since the foundation materials generally tend to loosen or become unstable when exposed to free water, every effort should be made to keep the excavations dry where water is encountered or precipitation or snowmelt occurs during construction. A gravity drainage system, sump pumps, or other conventional minor dewatering procedures should be sufficient for this purpose, providing excavations extend only a foot or less below any groundwater level.

Excavation Safety Considerations

Care must be taken so that all excavations made for the foundations 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, inasmuch 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 current 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 and safe, 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.

All earthwork and foundation placement operations should be conducted in accordance with the project specifications and under the observation of a representative of the geotechnical engineer. We are providing this information solely as a service to the MDNR. PSI does not assume responsibility for construction site safety or the contractor's or other parties' compliance with local, state and federal safety or other regulations. Such responsibility is not being implied and should not be inferred.

REPORT LIMITATIONS

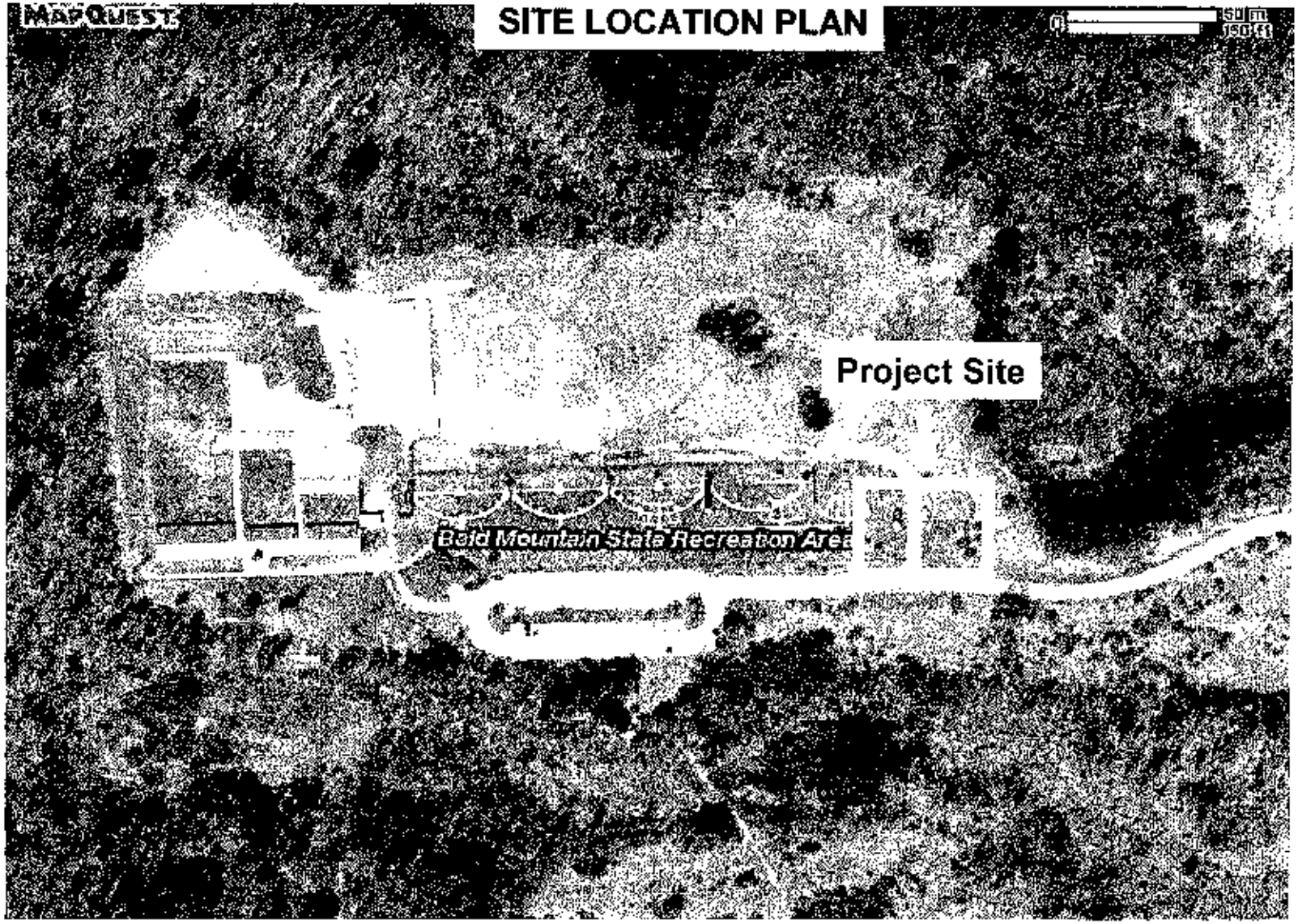
The recommendations submitted for the proposed storage building are based on the available soil information and the design details furnished by The Michigan Department of Natural Resources for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface 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 can not 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 The Michigan Department of Natural Resources for specific application to the proposed storage building planned for the Bald Mountain Shooting Range in Lake Orion, Michigan.

APPENDIX

SITE LOCATION PLAN



PSI Information To Build On
Engineering • Consulting • Testing

Proposed Storage Building
Bald Mountain Shooting Range
2500 Kern Road
Lake Orion, Michigan

PSI Project
No. 525158

BORING LOG

PSI No.: **0525-158**

Client: **Michigan Department of Natural Resources**

Project: **Proposed Storage Building, Bald Mountain Shooting Range, Lake Orion, Michigan**

Boring No.: **1** **(1 of 1)** | Total Depth **15.0'** | Elev: **N/A±** | Location: **See boring location plan**

Type of Boring: **3 1/4" HSA** | Started: **11/13/09** | Completed: **11/13/09** | Driller: **PSI**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows / REC/ROD	Sample Depth (Feet)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	N	Qp (tsf)
	0.5	TOPSOIL FILL (6")		1.0			
		Brown fine to medium SAND FILL, trace gravel & topsoil, moist	6-4-6	2.5		10	---
	3.5			3.5			
		Brown fine to medium SAND with occasional clay seams, trace gravel, moist, medium dense (SP)	4-6-8	5.0		14	---
	5.5			6.0			
		Brown fine to medium CLAYEY SAND, trace gravel, moist, medium dense (SC)	3-5-7	7.5		12	---
	8.5			8.5			
	10.0	Brown fine to medium SAND, trace gravel, moist, medium dense (SP)	4-5-7	10.0		12	---
		Brown fine to medium SAND & GRAVEL, wet (SP-GP)					
	12.0						
		Brown fine to medium CLAYEY SAND, wet, medium dense (SC)		13.5			
	15.0		4-6-10	15.0		16	–
		Boring was terminated at 15 feet below the existing ground surface.					
		Groundwater was encountered at 10 feet during drilling operations. The collapse of the borehole at a depth of 8.5 feet below the existing ground surface upon the removal of the augers precluded the measurement of groundwater.					

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches.In three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

BORING LOG

PSI No.: **0525-158**

Client: **Michigan Department of Natural Resources**

Project: **Proposed Storage Building, Bald Mountain Shooting Range, Lake Orion, Michigan**

Boring No.: **2** **(1 of 1)** | Total Depth **15.0'** | Elev: **N/A±** | Location: **See boring location plan**

Type of Boring: **3 1/4" HSA** | Started: **11/13/09** | Completed: **11/13/09** | Driller: **PSI**

Elevation	Depth	DESCRIPTION OF MATERIALS (Classification)	* Sample Blows REC/RQD	Sample Depth (Feet)	N VALUE (bpf) PL %MC LL 10 20 30 40 50 60 70 80 90	N	Qp (tsf)
	0.4	TOPSOIL FILL (5")		1.0			
	2.0	Brown fine to medium CLAYEY SAND FILL, trace gravel, moist	6-5-5	2.5		10	--
		Brown fine to medium SAND with occasional clay seams, trace gravel, moist, medium dense (SP)		3.5			
			6-6-6	5.0		12	--
				6.0			
			3-5-8	7.5		13	--
	8.5			8.5			
		Brown fine to coarse SAND & GRAVEL, moist, medium dense (SP-GP)	6-10-12	10.0		22	--
	13.0			13.5			
		Brown fine to medium CLAYEY SAND, trace gravel, moist, medium dense (SC)	8-11-12			23	--
	15.0	Boring was terminated at 15 feet below the existing ground surface.		15.0			

Groundwater was not encountered during drilling operations or observed upon the completion of the boring. The borehole collapsed at a depth of 9 feet below the existing ground surface upon the removal of the augers.

*Number of blows required for a 140 lb hammer dropping 30" to drive 2" O.D., 1.375" I.D. sampler a total of 18 inches in three 6" increments. The sum of the last two increments of penetration is termed the standard penetration resistance, N.

GENERAL NOTES

SAMPLE IDENTIFICATION

The Unified Soil Classification System and ASTM D2487 and ASTM D2488 are used to identify the soil unless otherwise noted.

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.
Q_u:	Unconfined compressive strength, tsf.
Q_p:	Penetrometer value, index value of unconfined compressive strength, tsf.
W_c:	Water content, %.
PL:	Plastic Limit, %.
LL:	Liquid Limit, %.
PI:	Plasticity Index.
γ_d:	Natural dry density, pcf.
▼	Groundwater level observed at time noted after completion of boring.

DRILLING AND SAMPLING SYMBOLS

SS:	Split-Spoon – 1 3/8" ID., 2" O.D., except where noted.
ST:	Shelby Tube – 3" O.D., except where noted
AU:	Auger Sample.
RC:	Rock Core (approx. 2" diameter)
WS:	Washed Sample

RELATIVE DENSITY AND CONSISTENCY CLASSIFICATION (Terzaghi & Peck, 1948)

TERM (COHESIONLESS SOILS)	STANDARD PENETRATION RESISTANCE
Very Loose	0 – 4
Loose	5 – 10
Medium	11 – 30
Dense	31 – 50
Very Dense	51 and over

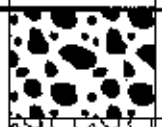
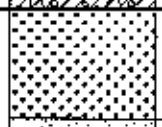
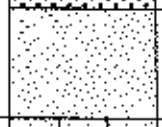
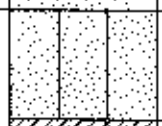
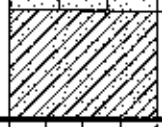
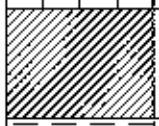
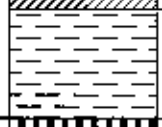
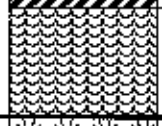
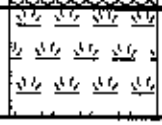
TERM (COHESIVE SOILS)	Qu – (TSF)
Very Soft	0 – 0.24
Soft	0.25 – 0.49
Medium	0.50 – 0.99
Stiff	1.00 – 1.99
Very Stiff	2.00 – 4.00
Hard	4.00+

PARTICLE SIZE (ASTM D2487 AND D422)

Boulders	≥ 12 in. (300mm)	Medium Sand	<2mm (#10 sieve) to 425μm (#40 sieve)
Cobbles	< 12in. (300mm) to 3 in. (75 mm)	Fine Sand	<425μm (#40 sieve) to 75μm (#200 sieve)
Gravel	< 3in. (75mm) to 4.75mm (#4 sieve)	Silt	<75μm (#200 sieve) to 5μm
Coarse Sand	< 4.75mm (#4 sieve) to 2mm (#10 sieve)	Clay	<5μm

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		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	SAND AND SANDY SOILS	CLEAN SANDS		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		(LITTLE OR NO FINES)		SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES		SM	SILTY SANDS, SAND - SILT MIXTURES
		(APPRECIABLE AMOUNT OF FINES)		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

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