Geotechnical Pavement Section Design

Curtis Road and Davis Road

3050 Curtis Road
Peyton, Colorado
ProTeX Job No.: 8619
PCD File No. MS-19-006

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Curtis Road and Davis Road
3050 Curtis Road
Peyton, Colorado
ProTeX Job No.: 8619

January 13, 2019
(Revision 1, August 16, 2021 – Additional Roadway Surface Option)
(Revision 2, September 23, 2021 – Additional edits per Client/County request)

Home Run Restorations, Inc.

Re: **Geotechnical – Pavement Section Design**

Project: Curtis Road and Davis Road
3050 Curtis Road
Peyton, Colorado

ProTeX Job No.: 8619

Attention: Mr. Shawn Shaffer

At your request, ProTeX has completed a soil investigation for the subject project. The accompanying report includes field observations and laboratory testing supporting our conclusions and recommendations for the proposed development.

Respectfully submitted,
ProTeX - the PT Xperts, LLC

Date Expires: 10/31/2021
Thomas M. Perkins, P.E.

Curtis Road and Davis Road
3050 Curtis Road
Peyton, Colorado
ProTeX Job No.: 8619

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APPENDICES

1.0 INTRODUCTION

1.1 Scope

ProTeX was retained by Home Restorations, Inc. to evaluate the subsurface soil conditions with respect to a proposed low volume rural roadway pavement section design for the project known as 3050 Curtis Road. The contents of this report include the findings from the field exploration and laboratory testing, with supporting recommendations for the proposed development.

1.2 Proposed Site Development

It is this firm's understanding that the proposed development will consist of:

- Four (4) individual residential home sites
- Paved section of road that provides access to the lots
- Rural gravel access to the lots

It is anticipated the proposed roadway(s) will have low volume traffic and light to moderate vehicle loads.

1.3 Terms and Conditions

This report was prepared for Home Restorations, Inc. The contents of this report may not be relied upon by any other party without the expressed written permission of ProTeX - the PT Xperts, LLC and the written permission of Home Restorations, Inc. The report presents site conditions at the time of the investigation and for the aforementioned proposed development. The report should be updated prior to construction if a maximum of one year has elapsed from the issued date.

2.0 FIELD AND LABORATORY TESTING

2.1 Geotechnical Site Reconnaissance

The site consists of approximately 36 acres of located at 3050 Curtis Road in Peyton, Colorado. At the time of the field site visit on December 17, 2018 the following site conditions were observed:

- Grading of the custom residential homes were in progress as well as rough grading of proposed rural access

2.2 Field Investigation

A total of 2 test holes (test holes TP1 and TP2) were completed within the proposed roadways alignment for the purpose of pavement section design**.** The soils were sampled at the anticipated depth of the proposed roadway. At each test hole location, the soils encountered were visually observed, classified, logged and representative samples were obtained where applicable. Refer to the site plan in Appendix B for approximate test hole locations.

2.3 Laboratory Testing

Subsequent to the field investigation, soil samples were submitted for laboratory testing. Tests were performed to determine the following:

- **Sieve Analysis and Atterberg Limits**- Used for formal classification of soils in general accordance with the Unified Soil Classification System (USCS) per ASTM Test Method D2487 and AASHTO Soil Classification System. Sieve analysis is performed in general accordance with AASHTO Test Methods T11 and T27. The Atterberg Limits were determined in general accordance with AASHTO Test Method T11 and T27.
- **Resistance Value (R-Value)** – The R-Value test procedure expresses a material's resistance to deformation as a function of the ratio of the transmitted lateral pressure to applied vertical pressure in general accordance to ASTM D2844. Subgrade materials tested are assigned an R-Value for the purpose of pavement section design analysis.
- **Moisture Content** – The moisture content of the soil was tested in general accordance to AASHTO T 265.

Laboratory Test Summary

Location	Depth (ft)	Plasticity Index	%Passing #200	Moisture Content (%)	USCS Soil Classification	AASHTO Soil Classification	Tested R-Value
TP1	1-3	NP	26	4.2	SM	A-2-5	76
TP1	8-10	6	30	5.1	SC-SM	A-2-5	-
TP2	1-3	NP	17	3.6	SM	A-2-5	-
TP2	3-5	NP	20	3.5	SM	A-2-5	-

See Appendix A for a detailed compilation of the laboratory test results.

2.4 Potential for Soil Expansion (One-Dimensional Expansion Potential)

The expansion potential (Swell) of the subgrade soils, sampled from the rural roadway, was not tested due to soil properties (Plasticity Index and Percent Passing the #200 Sieve) which are designated in the Section D.2.4. in the El Paso County Engineering Appendix D – Pavement Design Criteria and Report. **The plasticity index of soils evaluated as a part of this design did not exceed 10; therefore, mitigation measures such as stabilization or treatment of subgrade soils is not required.**

3.0 RECOMMENDATIONS

The recommendations contained herein are based on the findings of the field investigation, laboratory test results and local experience.

3.1 Pavement Section Recommendations

The pavement recommendations have been prepared in accordance with most current edition of El Paso County Engineering Appendix D – Pavement Design Criteria and Report (Revised 12/13/2016) Sections D.1 to D.5.

3.1.1 Projected Traffic

The projected traffic volumes/loads for pavement section design analysis, accounts for the year of the intended completion of the proposed development including construction traffic through build-out. The following anticipate Design ESAL for pavement section design and was anticipated based on the size and location of development and surrounding roadways. The design ESAL value for Local Roadways is designated in the Engineering Criteria Manual (ECM) Table D-2. Minimum Pavement Sections for El Paso County MuniCode (see below).

Roadway Classifications	Design ESAL
Paved Access Roadway for Custom Lots	36, 500

3.1.2 Pavement Design Analysis

The design for the project were determined from surface soils properties within the proposed roadways, design parameters and structural coefficients provided in the El Paso County Engineering Design Criteria:

Low Volume Rural Custom Home Access Roadway:

Analysis Period	20 years
Change in Serviceability Factor	2.0
Seasonal Variation Factor (SVF)	3.2
*Design R-value	76
Resilient Modulus	27,185 psi
Reliability	75%
Combined Standard Error	0.45
Structural Coefficients	
Gravel	0.18
Hot Mix Asphalt	0.44
**Aggregate Base Course/Recycled Concrete	0.11
W_{18} - Equivalent Single Axle Load (ESAL)	36,500
Calculated SN (Structural Number)	**1.09**

Design R-value is based on actual tested R-values according to ASTM D2844
****Materials must meet the requirements in Section D.5.5.I of El Paso County, Colorado - Engineering Criteria Manual.***

Low Volume Rural Asphaltic Concrete Roadway:

Asphaltic Concrete Roadway for the Custom Home Lots	
Required Structural Number	1.09
Hot Mix Asphalt	3 inches*
Aggregate Base Course/Recycled Concrete	4 inches*
Actual Structural Number	1.76

Minimum allowable thickness per Table D-2 of El Paso County, Colorado - Engineering Criteria Manual.

Low Volume Rural Gravel Roadway:

Gravel Access Roadway for the Custom Home Lots	
Gravel for Gravel Roadway	6 inches*
Processed/Compacted Native Subgrade	6 inches

Gravel for Roadway must meet Requirements in Table D-7 of the El Paso County Engineering Criteria Manual

El Paseo County Engineering Criteria Manual Table D-7. Gravel for Gravel Roads

Sieve Designation	*Percent Passing by Weight*
¾"	100
#4	50-78
#8	37-67
#40	13-35
#200	0-15 4-15
Plastic Index (PI)	*4—12*

Pavement materials and placement should conform to the County of El Paso, Colorado specifications. In no case, should pavement surfacing be placed on unstable wet subgrade. Care should be taken with regard to parkway grading, placement of landscape vegetation and irrigation systems to minimize moisture infiltration in subgrade soils below pavement sections.

4.0 CLOSURE

4.1 Limitations

The recommendations contained in this report are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed by the test holes. Should unusual material or conditions be encountered during construction, the ProTeX geotechnical engineer should be notified to make supplemental recommendations as deemed necessary. This report is issued with the understanding that it is the responsibility of the owner to see that its provisions are carried out or brought to the attention of those concerned. The scope of services for this project does not include any environmental assessment of the site or identification of contaminated or hazardous materials or conditions.

The findings of this report are considered valid as of the present date. However, changes in the conditions of the site can occur with the passage of time, whether due to natural events or to human activities on this or adjacent sites. In addition, changes in applicable or appropriate codes and standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, this report may become invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and revision as changed conditions are identified.

4.2 Recommended Additional Services

The recommendations provided in this report are based on the assumption that a testing plan will be implemented with an adequate schedule of testing to ensure that the construction process meets the recommendations/specifications presented in this report. The testing and observation should be performed under the direction of the ProTeX Geotechnical Engineer/representative and should include, but not necessarily be limited to the following:

1. Approve and document that fill material used as engineered fill in pavement areas meets the specifications.

2. Monitor and test placement of fill soils in pavement locations to verify and document conformance with project specifications.

Appendix A

LABORATORY SERVICES REPORT

Report Number: 65151173.0043
Service Date: 01/04/19
Report Date: 01/09/19
Task:

Terracon
4685 S Ash Ave, Ste H-4
Tempe, AZ 85282-6767
480-897-8200

Client

ProTeX
Attn: Jeff Ritter
1102 W. Southern Ave, Ste. 4
Tempe, AZ 85282

Project

ProTeX Protex Job # 3050 Curtis Rd.
In House - Terracon Tempe Lab
Tempe, AZ

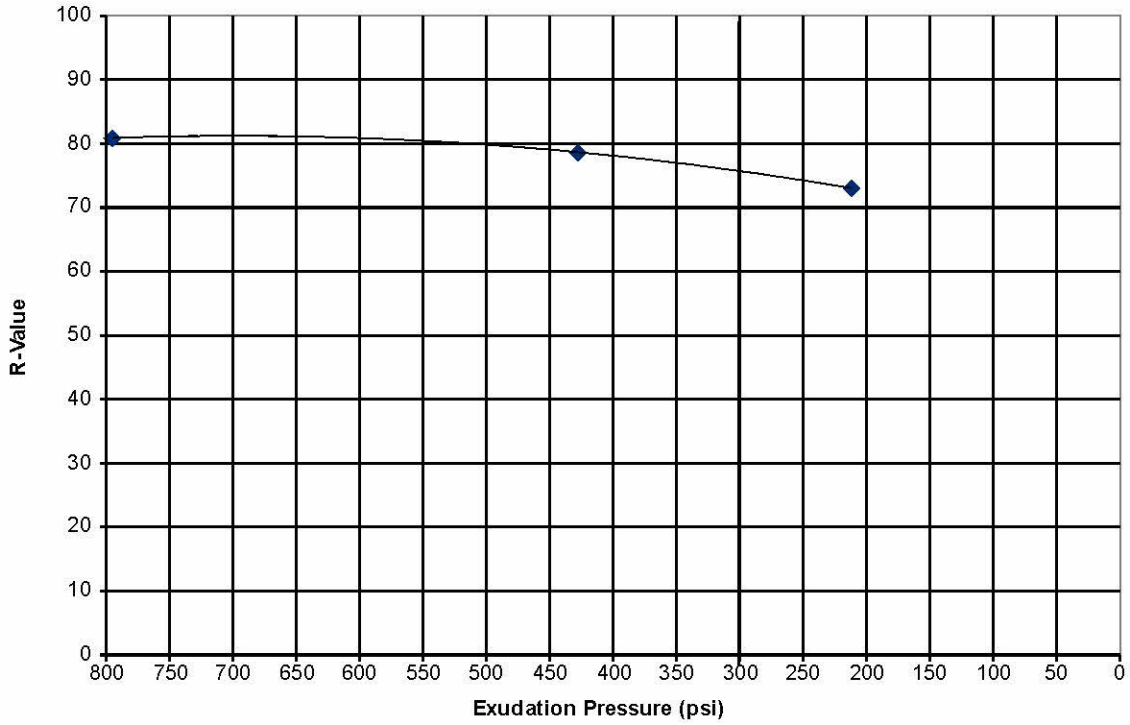
Project No. 65151173

Material Description: Silty Sand
Sample Location: TP-1 @ 0'-3'
Lab Number: 2362 Sample Source: Job #3050 Curtis Rd

RESISTANCE R-VALUE AND EXPANSION PRESSURE OF COMPACTED SOILS (ASTM D2844)

SPECIMEN I. D.	A	B	C
Moisture Content	11.4%	10.5%	9.7%
Compaction Pressure (psi)	350	350	350
Specimen Height (inches)	2.51	2.50	2.52
Dry Density (pcf)	118.5	119.5	119.8
Horiz. Pres. @ 1000lbs (psi)	16.0	13.0	12.0
Horiz. Pres. @ 2000lbs (psi)	28.0	22.0	20.0
Displacement	4.35	4.25	4.13
Expansion Pressure (psi)	0.0	0.0	0.0
Exudation Pressure (psi)	212	428	796
R Value	73	79	81

R-Value: 76



Services:
Terracon Rep: Joseph Menezes
Reported To:
Contractor:

Report Distribution

(1) ProTeX, Emailed
(1) ProTeX, Engineering Department

Reviewed By: Clifford, Metz
Laboratory Manager

ProTeX the PT Xperts LLC
1102 W. Southern Ave., Ste. 4
Tempe, AZ 85282
Office: (602)-272-7891
Fax: (602) 272-7892

Soils Summary

Client:	Home Run Restorations, Inc.	ProTeX Job No:	8619
Project Name:	Curtis Rd and Davis Rd	ProTeX Lab No:	190007 - Phoenix
Job Name:	3050 Curtis Rd	Date Received:	1/2/2019
Material:	Geo samples - Native (On-site)	Sampled By:	Tim C Pachak
Material Supplier:		Date Sampled:	12/17/2018
Sample Location:	TP1 (1-3')	Submitted By:	Spencer Drenth

AASHTO T89/T90

Plasticity Index

Liquid Limit	**NV**
Plastic Limit	**NP**
Plasticity Index	**NP**

Expansion Index, (EI)	Potential Expansion
0 - 20	Very Low
21 - 51	Low
52 - 90	Medium
91 - 130	High
> 130	Very High

Expansion Index

EI = **NA**

Percent Swell of Soil

% Swell	**NV**

Notes:

pH and Resistivity

pH Reading:	**NA**
Resistivity (ohms-cm)	**NA**

Class: Silty sand

Symbol: SM

Moisture Density (Proctor)

Max. Dry Density	**NV**
Opt. Moisture %	**NV**
Corr. Max. Dry Density	**NV**
Corr. Opt. Moisture %	**NV**
% Rock	**0**

* = out of specification

AASHTO T11/T27

Sieve	% Pass	Specs	*
1"	100		
1/2"	100		
#4	100		
#10	98		
#40	75		
#100	41		
#200	26		

Remarks:

Reviewed By:

Jerald W Grossarth

ProTeX the PT Xperts LLC
1102 W. Southern Ave., Ste. 4
Tempe, AZ 85282
Office: (602)-272-7891
Fax: (602) 272-7892

Soils Summary

Client:	Home Run Restorations, Inc.	ProTeX Job No:	8619
Project Name:	Curtis Rd and Davis Rd	ProTeX Lab No:	190008 - Phoenix
Job Name:	3050 Curtis Rd	Date Received:	1/2/2019
Material:	Geo samples - Native (On-site)	Sampled By:	Tim C Pachak
Material Supplier:		Date Sampled:	12/17/2018
Sample Location:	TP1 (10')	Submitted By:	

AASHTO T89/T90

Plasticity Index

Liquid Limit	**25**
Plastic Limit	**19**
Plasticity Index	**6**

Expansion Index, (EI)	Potential Expansion
0 - 20	Very Low
21 - 51	Low
52 - 90	Medium
91 - 130	High
> 130	Very High

Expansion Index

EI = **NA**

Percent Swell of Soil

% Swell	**NV**

Notes:

pH and Resistivity

pH Reading:	**NA**
Resistivity (ohms-cm)	**NA**

Class: Silty, clayey sand

Symbol: SC-SM

Moisture Density (Proctor)

Max. Dry Density	**NV**
Opt. Moisture %	**NV**
Corr. Max. Dry Density	**NV**
Corr. Opt. Moisture %	**NV**
% Rock	**1**

* = out of specification

AASHTO T11/T27

Sieve	% Pass	Specs	*
1"	100		
1/2"	100		
#4	99		
#10	97		
#40	73		
#100	43		
#200	30		

Remarks:

Reviewed By:

Jerald W Grossarth

ProTeX the PT Xperts LLC
1102 W. Southern Ave., Ste. 4
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Soils Summary

Client:	Home Run Restorations, Inc.	ProTeX Job No:	8619
Project Name:	Curtis Rd and Davis Rd	ProTeX Lab No:	190009 - Phoenix
Job Name:	3050 Curtis Rd	Date Received:	1/2/2019
Material:	Geo samples - Native (On-site)	Sampled By:	Tim C Pachak
Material Supplier:		Date Sampled:	12/17/2018
Sample Location:	TP2 (1-3')	Submitted By:	

AASHTO T89/T90

Plasticity Index

Liquid Limit	**NV**
Plastic Limit	**NP**
Plasticity Index	**NP**

Expansion Index, (EI)	Potential Expansion
0 - 20	Very Low
21 - 51	Low
52 - 90	Medium
91 - 130	High
> 130	Very High

Expansion Index

EI = **NA**

Percent Swell of Soil

% Swell	**NV**

Notes:

pH and Resistivity

pH Reading:	**NA**
Resistivity (ohms-cm)	**NA**

Class: Silty gravel

Symbol: GM

Moisture Density (Proctor)

Max. Dry Density	**NV**
Opt. Moisture %	**NV**
Corr. Max. Dry Density	**NV**
Corr. Opt. Moisture %	**NV**
% Rock	**1**

* = out of specification

AASHTO T11/T27

Sieve	% Pass	Specs	*
1"	100		
1/2"	100		
#4	99		
#10	96		
#40	76		
#100	32		
#200	17		

Remarks:

Reviewed By:

Jerald W Grossarth

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Office: (602)-272-7891
Fax: (602) 272-7892

Soils Summary

Client:	Home Run Restorations, Inc.	ProTeX Job No:	8619
Project Name:	Curtis Rd and Davis Rd	ProTeX Lab No:	190010 - Phoenix
Job Name:	3050 Curtis Rd	Date Received:	1/2/2019
Material:	Geo samples - Native (On-site)	Sampled By:	Tim C Pachak
Material Supplier:		Date Sampled:	12/17/2018
Sample Location:	TP2 (5')	Submitted By:	

AASHTO T89/T90

Plasticity Index

Liquid Limit	**NV**
Plastic Limit	**NP**
Plasticity Index	**NP**

Expansion Index, (EI)	Potential Expansion
0 - 20	Very Low
21 - 51	Low
52 - 90	Medium
91 - 130	High
> 130	Very High

Expansion Index

EI = **NA**

Percent Swell of Soil

% Swell	**NV**

Notes:

pH and Resistivity

pH Reading:	**NA**
Resistivity (ohms-cm)	**NA**

Class: Silty sand

Symbol: SM

Moisture Density (Proctor)

Max. Dry Density	**NV**
Opt. Moisture %	**NV**
Corr. Max. Dry Density	**NV**
Corr. Opt. Moisture %	**NV**
% Rock	**1**

* = out of specification

AASHTO T11/T27

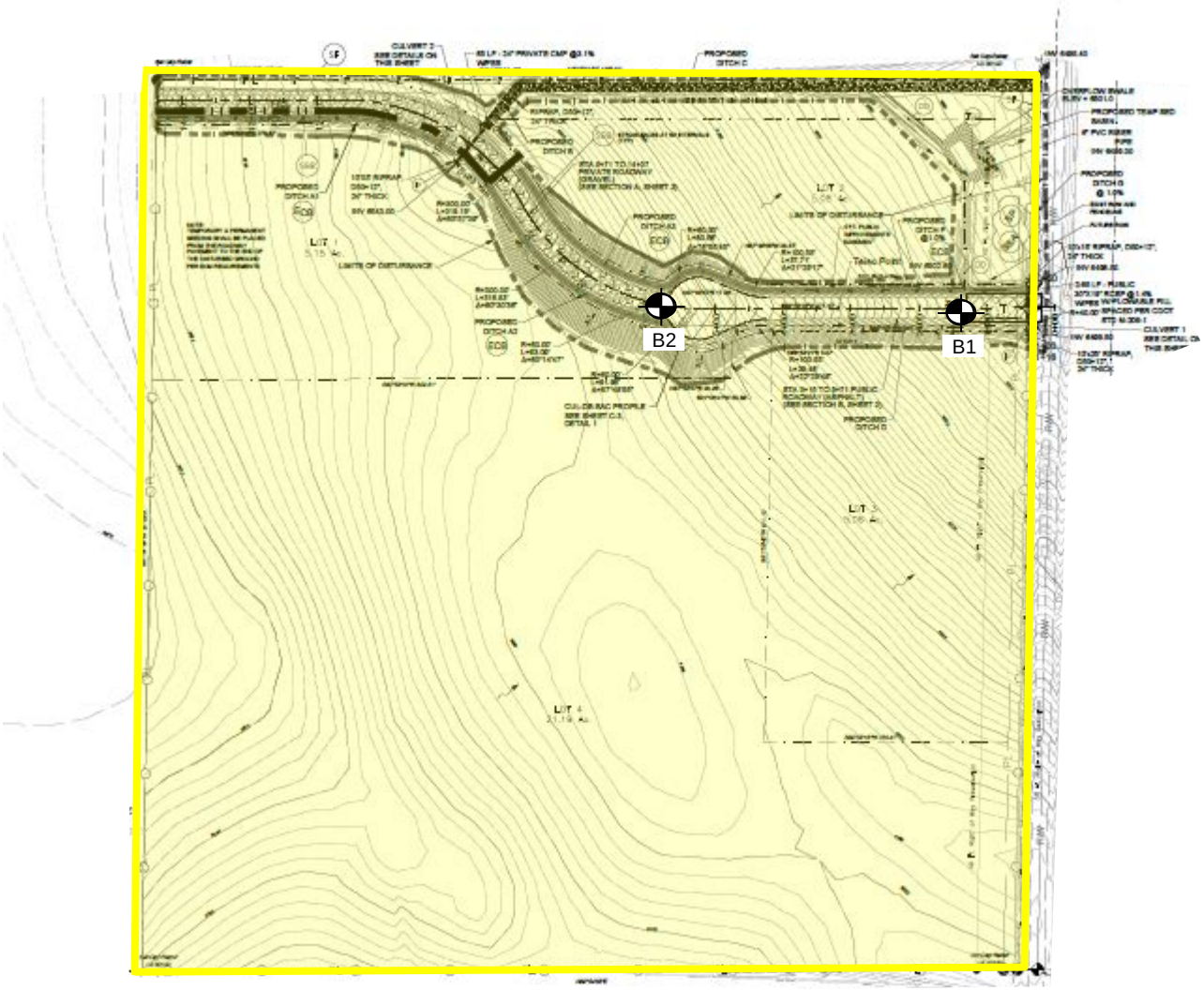
Sieve	% Pass	Specs	*
1"	100		
1/2"	100		
#4	99		
#10	96		
#40	77		
#100	35		
#200	20		

Remarks:

Reviewed By:

Jerald W Grossarth

Appendix B



GRAPHIC SCALE

(IN FEET)

Legend:

Approximate Boring Location

Site Plan

Scale: N.T.S.	Drawn by: KJN	Date: 09/30/2021

Curtis Road and Davis Road

3050 Curtis Road

El Paso County, Colorado

ProTeX Job No.: 8619

Appendix C

LOG OF BORING No. TP1

PROJECT: Curtis Road and David Road **PROJECT NO.:** 8619
CLIENT: Home Run Restorations, Inc.
PROJECT LOCATION: 3050 Curtis Road
LOCATION: See site map **ELEVATION:**
DRILLER: Onsite Contractor Backhoe **LOGGED BY:** TP
DRILLING METHOD: Backhoe **DATE:** 12/17/18
DEPTH TO - WATER> INITIAL: **AFTER 24 HOURS:** **CAVING>** C

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200
0	(SM) Silty Sand, non-plastic, brown, slightly damp		190007		26
2.5					
5					
7.5					
8-10'	(SC-SM) Silty Clayey Sand, low plastictiy, brown, slightly damp		190008		30
10	Boring terminated at 10 ft.				
12.5					
15					
17.5					

TEST RESULTS
Plastic Limit — Liquid Limit
Water Content - ●
Penetration -
10 20 30 40 50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.

Figure

LOG OF BORING No. TP2

PROJECT: Curtis Road and David Road **PROJECT NO.:** 8619
CLIENT: Home Run Restorations, Inc.
PROJECT LOCATION: 3050 Curtis Road
LOCATION: See site map **ELEVATION:**
DRILLER: Onsite Contractor Backhoe **LOGGED BY:** TP
DRILLING METHOD: Backhoe **DATE:** 12/17/18
DEPTH TO - WATER> INITIAL: **AFTER 24 HOURS:** **CAVING>** C

Depth (feet)	Description	Graphic	Sample No.	Blow Counts	% < #200
0					
	(SM) Silty Sand, non-plastic, brown, slightly damp		190009		17
2.5			190010		20
5	Boring terminated at 5 ft.				
7.5					
10					
12.5					
15					
17.5					

TEST RESULTS
Plastic Limit — Liquid Limit
Water Content - ●
Penetration - ▨
10 20 30 40 50

This information pertains only to this boring and should not be interpreted as being indicitive of the site.