

CONTACT INFORMATION

PREPARER INFORMATION

AAG PROJECT NUMBER: AAG21-111

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CLIENT INFORMATION

CLIENT: FULLER DESIGNS

TELEPHONE: (360) 880-4927

BILLING ADDRESS: 1101 KRESKY AVENUE
CHEHALIS, WASHINGTON 98532

SITE ADDRESS: 2945 JACKSON HIGHWAY
ONALASKA, WASHINGTON

PARCEL: 017808001006

GPS LOCATION: 46.620014 -122.890064 AT PIT 2.

ALL AMERICAN GEOTECHNICAL, INC.

SITE VISIT AND EVALUATION

**FULLER DESIGNS
1101 KRESKY AVENUE
CHEHALIS, WA 98531**

**RE: COSSER – TINY HOMES
2945 JACKSON HIGHWAY
CHEHALIS, WASHINGTON
PARCEL: 017808001006**

AUGUST 26, 2021

Dear Fuller Designs

All American Geotechnical, Inc (AAG) was commissioned by Fuller Design (client) in July, 2021, to do a site visit and pitting program to determine the geology of the soils for the above parcel. This is in reference to a proposed development of tiny homes on a parcel of unknown acreage off Jackson Highway. The program was done by Curtis D Cushman, L.G., L.E.G. and Blaise Jelinek E.I.T. of AAG, on July 6, 2021. The client was not on site. Jody Mills did the digging with an excavator. The day was clear and dry.

The parcel will be subdivided into individual units, hence this report looks at the general conditions of the subsurface soil and the underlying geology.

The site has been cleared for most of its flat, western part, with the surface materials in a loose, locally powdery, condition with areas of mulch. The area in the east rises overall around 60 feet and is covered in second-growth trees and scrub.

The western $\frac{3}{4}$ of the parcel is almost flat, rising from the 276 contour in the west to the 290 contour 700 feet to the east at the toe of the rise for a slope of 2%. The property then rises to maximum of just over 256 feet at the eastern property line. At no point measured did this slope reach 35% for a height of 10 feet.

SITE GEOLOGY

The parcel is slit by mapped landslide deposits (**Qls**) to the east and Hayden Creek drift (**Qapo(h)**) on the west (Lewis County GIS and confirmed on the Centralia 100:000 Quadrangle).

Geologic Unit Label:Qls

Geologic Age:Quaternary

Lithology:mass-wasting deposits, mostly landslides

Symbology:Quaternary mass-wasting deposits

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Geologic Unit Label:Qapo(h)

Geologic Age:Pleistocene

Lithology:alpine glacial outwash, pre-Fraser

Named Units:Hayden Creek Drift, outwash deposits of

Symbology:Pleistocene alpine glacial drift

The Geologic Map of the Centralia Quadrangle, Washington compiled by Schasse, H. W., DNR OFR 87-11 labels this **Qoh** which is specifically Hayden Creek outwash. The eastern part, mapped as landslide deposits is too large of an area and cannot be reconciled with LiDAR imagery which shows an ancient, relic landslide just to the north of the property and what appears to be outwash deposits onto the client property. The field work and laboratory analysis indicate the material in the flat area of the parcel is either alluvial origin associated with the floodplain of Berwick Creek and the Chehalis River to the west or is eroded and redeposited alluvium from the Hayden Creek/landslide deposits.

The deposits on site were dominantly silt at pits 1 and 2 with mottled clay-like soils a few feet below the surface, while the surface silt in pits 3 and 4 yield to sand at -5 in Pit 3 and abundant gravel at a depth of -5 feet in Pit 4 (see pit logs, below).

There was no evidence of faulting, failure, or cracking on a large scale. Overall, there is no evidence of creep or downslope displacement. No erosion hazard areas are mapped on site. The 100K DNR Landslide Area extends too far to the west to describe most of the parcel.

Liquefaction follows the geologic mapping with liquefaction **Very Low** in the Hayden Creek deposits and **Low to Moderate** in the purported landslide deposits in the east.

SITE HYDROLOGY

There was no ponding seen on the property. The course of a stream seen on the GIS map does not exist.

SITE SOILS

The USDA WSS maps the north part of the parcels as *Reed silty clay loam*

172—Reed silty clay loam

Map Unit Setting

- *National map unit symbol:* 2hbk
- *Elevation:* 30 to 500 feet
- *Mean annual precipitation:* 40 to 80 inches
- *Mean annual air temperature:* 50 to 54 degrees F
- *Frost-free period:* 150 to 200 days
- *Farmland classification:* Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season

Map Unit Composition

- *Reed, drained, and similar soils:* 95 percent

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Description of Reed, Drained

Setting

- *Landform:* Flood plains, terraces
- **Typical profile**
 - *H1 - 0 to 6 inches:* silty clay loam
 - *H2 - 6 to 14 inches:* silty clay loam
 - *H3 - 14 to 60 inches:* clay
- **Properties and qualities**
 - *Slope:* 0 to 3 percent
 - *Depth to restrictive feature:* More than 80 inches
 - *Drainage class:* Poorly drained
 - *Capacity of the most limiting layer to transmit water (Ksat):* Moderately low to moderately high (0.06 to 0.20 in/hr)
 - *Depth to water table:* About 18 to 36 inches
 - *Frequency of flooding:* None, Frequent
 - *Frequency of ponding:* None
 - *Available water supply, 0 to 60 inches:* High (about 10.1 inches)

The main point of the soil notes, above, is that the material is a silt/clay loam, which, in the field, appears to be dominantly silt in the upper few feet, then underlain by material that is clay or is a clay/silt mix. This is locally modified by sand (as in Pit 3) and abundant gravels found notably in pit 4.

PITTING

Test pits 1 through 4 were dug with an excavator.

Pit 1

The fluffy surface soil is up to 1' thick. All depths are to the top of this "duff."

0-1' Powdery "duff"

1'-6' Material is a grey brown silty (or clayey) sand. It is massive. Sample 1 (Mayes 4892) taken from 4' to 6' in depth is approximately 37% sand with 33% silt and around 30% clay. This would classify as a **SM Silty/clayey sand**.

6'- 8' (TD) Red mottling appears and material becomes clay. Sample 2 (Mayes 4893) is a fat clay (**CH**).

Pit 2

0 -1' Heavily mulched and disturbed topsoil, locally powdery and "fluffy."

1' to 4' Gray sandy silt with possibly some clay. Water seeping into pit at -4 ½ feet in depth. At -6' the soil is more clay-like and mottled with abundant red and white "blebs" and clasts. This profile is similar to Pit 1 except for the presence of water which is likely perched.

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6' – TD

Pit 3

0 -1' duff

1' – 5' Silt, similar to above, much sandier. Grab sample from spoils after 5' scoop represents the 4' to 6' interval. This is an **SM Silty sand with gravel**. The -200 fraction (silt/clay) is nearly 21%. Sample 3 (Mayes 4894).

6' TD Some mottling seen at bottom of pit at this depth.

Pit 4

0 -1' duff

1' - 5' Silt, but mottling seen at -3 ½'. Water at the depth of -5' on top of gravel layer.

5' – 7 ½' Heavily mottled silt with abundant gravel. TD

LAB RESULTS

Lab results follow. These are noted in “Geology,” above.

These are not suitable for structural fill.

BEARING STRENGTH

Bearing strength calculations using Terzaghi are on page 8. The sand/silt/clay found near the surface has a bearing strength (from Pit 1) of over 3400 psf, while the sand found in Pit 3 is just over 4000 psf.

INFILTRATION RATE

Infiltration rates were calculated on three samples submitted to Mayes Lab of Tacoma. The finds are presented on page 9 of this report.

CONCLUSIONS

In the eastern part of the parcel, the profile is one of silt/clay mix over a fat clay, commonly occurring at - 6 feet or so as seen in Pits 1 and 2. On the western part, Pit 3 encountered a definite sand at -5 feet and in Pit 4, gravel is hit at a similar depth. Design will have to rely on the silt/clay common at shallower depths in all the pits. The clay found deeper is less prevalent in the western area marked by Pits 3 and 4, but it is present in some measure throughout. The sand in Pit 3 and the gravels in Pit 4 were firm and the gravels were notably difficult to excavate.

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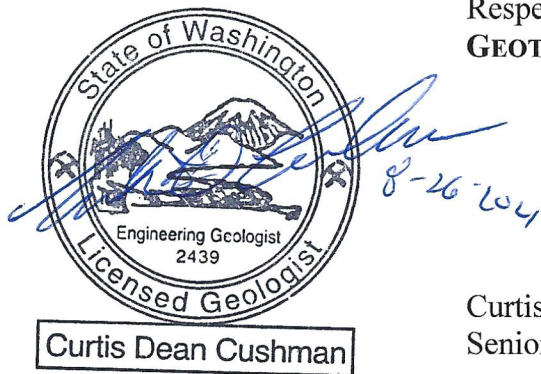
REPORT LIMITATIONS AND GUIDELINES FOR USE

We have prepared this report for the exclusive use of Fuller Design and their authorized agents for the proposed building location in Lewis County, Washington. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, expressed or implied, should be understood.

READ THESE PROVISIONS CLOSELY

Some clients, design professionals, and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. All American Geotechnical includes these explanatory "limitations" provisions in our reports to help reduce such risks.

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, geotechnical engineering or geologic reporting does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.



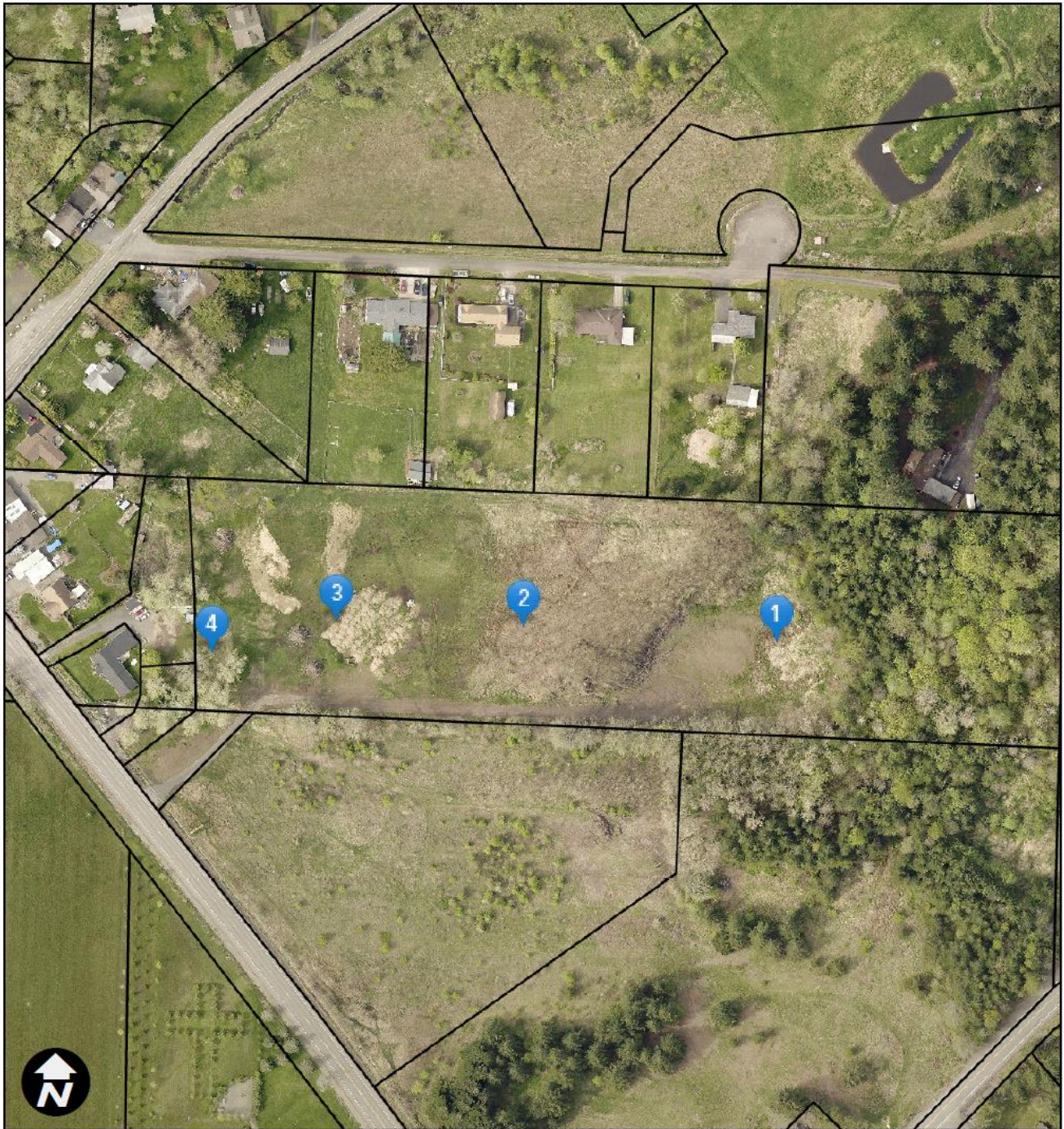
Respectfully Submitted,
GEOTECHNICAL TESTING LABORATORY

Curtis D. Cushman, L.G., L.E.G.
Senior Engineering Geologist

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PIT LOCATIONS

Cosser - Tiny Homes Pit Locations



8/14/2021, 4:58:25 PM

1:2,257

 Parcels

0 100 200 400 ft
NAD 1983 StatePlane Washington South FIPS 4602 Feet

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BEARING CALCULATION

Tiny Homes

UNIT WEIGHTS		lb	oz	decimal oz	7.6875 lb/halfgal	15.375 lb/gallon	115.013 lb/ft ³	Ny	Nc	Nq
Pit 4	Sand SM	7	11	0.6875						
		0 Cohesion								
		34 Ø						34°	35.23	52.64
Pit 1	ML-CL 100 Cohesion 32 Ø	7	4	0.25	7.25	14.5	108.4675		26.2	44.04
								32°		28.52

BEARING		1/2 * y *	B * Ny	+ c *	Nc	+ (pq+ ignored)	y *	Df * Nq)	Nq)	Bearing	F. O. S.	ULTIMATE BEARING
Pit 4		0.5	115	1	35.23	+	0	115.013	2	36.5		
					0	52.64						
					0							
					2025.954							
					0					10421.9	3	3473.967
Pit 1		0.5	108	1	26.2	+	0	108.4675	2	28.52		
					1420.925							
					4404					12011.91	3	4003.971

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MASSMANN CALCULATION

TINY HOMES

$\log_{10}(K_{sat})$	$=$	-1.57	$+$	1.9	$*$	D_{10}	$+$	0.015	$*$	D_{60}	$+$	-0.013	$*$	D_{90}	$+$	-2.08	$*$	$fines$
$\log_{10}(K_{sat})$	$=$	-1.57	$+$	0.0228				0.00108				-0.00443				-1.30416		

$K_{sat} = 0.001397291 \text{ cm/sec}$
 $0.000558917 \text{ in/sec}$
 $0.033534995 \text{ in/min}$
 2.01209968 in/hr

Pit 1, 4-6'

$\log_{10}(K_{sat})$	$=$	-1.57	$+$	1.9	$*$	D_{10}	$+$	0.015	$*$	D_{60}	$+$	-0.013	$*$	D_{90}	$+$	-2.08	$*$	$fines$
$\log_{10}(K_{sat})$	$=$	-1.57	$+$	0.152				0.000675				-0.00088				-2.08		

Pit 1, 6-8'

$\log_{10}(K_{sat})$	$=$	-3.498209	$+$	$0.000317535 \text{ cm/sec}$	$0.000127014 \text{ in/sec}$	$0.007620829 \text{ in/min}$	$0.457249766 \text{ in/hr}$
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$\log_{10}(K_{sat})$	$=$	-1.57	$+$	1.9	$*$	D_{10}	$+$	0.015	$*$	D_{60}	$+$	-0.013	$*$	D_{90}	$+$	-2.08	$*$	$fines$
$\log_{10}(K_{sat})$	$=$	-1.57	$+$	0.0684				0.069045				-0.53407				-0.43056		

Pit 3, 4-6'

$\log_{10}(K_{sat})$	$=$	-2.397181	$+$	$0.004006997 \text{ cm/sec}$	$0.001602799 \text{ in/sec}$	$0.096167924 \text{ in/min}$	5.77007545 in/hr
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DATA

Sample id	D10	D60	D90	F-fines
Pit 1, 4-6'	0.012	0.072	0.341	0.627
Pit 1, 6-8'	0.08	0.045	0.068	1
Pit 3, 4-6'	0.036	4.603	41.082	0.207

LABORATORY ANALYSIS

SIEVE REPORT PIT 1, 4 TO 6 FEET



Gradation Analysis / Sieve Report

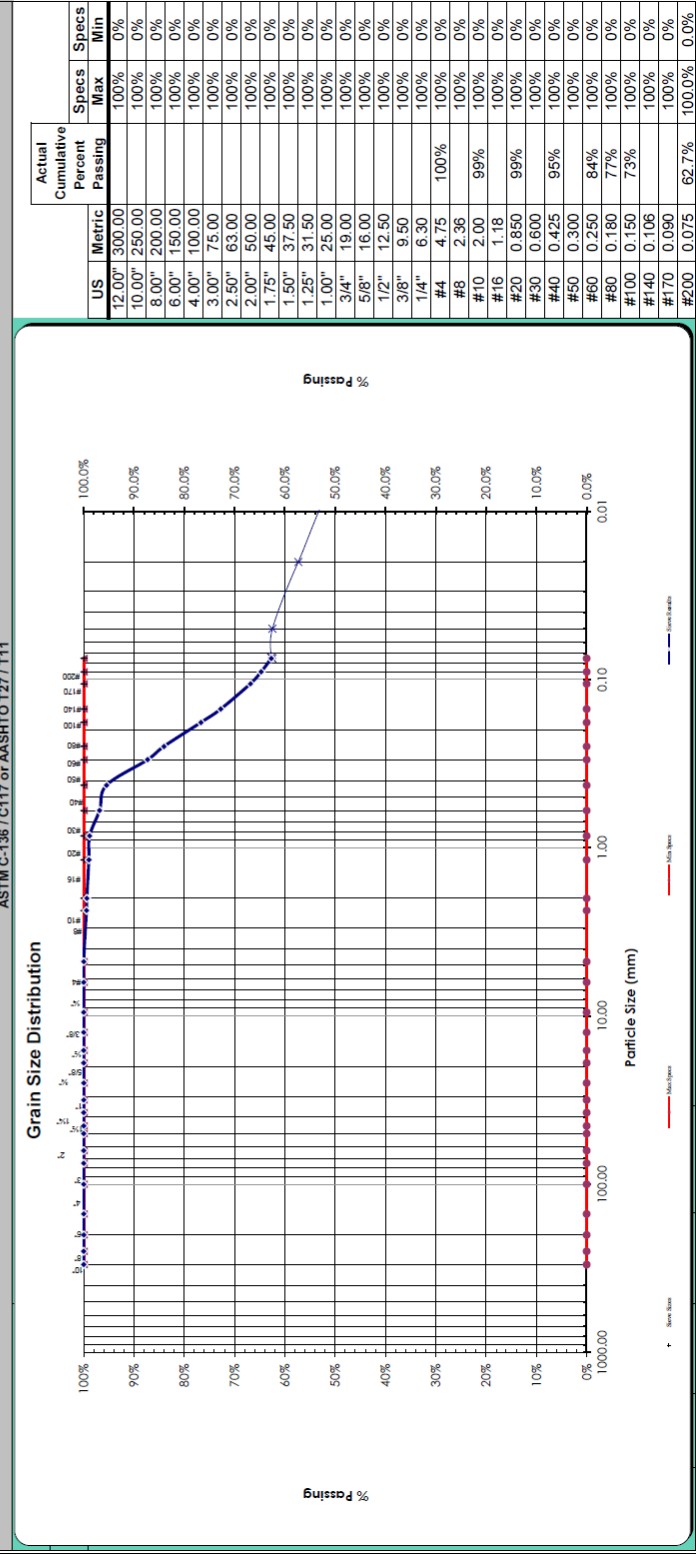
Project: QC Lab All American Geotechnical 2021
Project #: M8211030
Client: All American Geotechnical Inc
Source: Cosser
Sample#: 4892

Date Received: 8/9/21
Date Tested: 8/13-19/21
Tested By: M. Gordon
Sample Location: Pit 1 4' to 6'

ASTM D-2487 Unified Soils Classification System
 Need Atterberg Limits to classify sample
Sample Description:
 Orange Brown Gray Silts and Sand

ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821
Specifications
 No Specs
 Sample Meets Specs.: Yes

ASTM C-136 / C117 or AASHTO T27 / T11
ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821
 D₁₀ = 0.006 mm % Gravel = 0.0% Coeff. of Curvature, C_c = 1.50
 D₁₀ = 0.012 mm % Sand = 37.3% Coeff. of Uniformity, C_u = 6.00
 D₃₀ = 0.036 mm % Silt & Clay = 62.7% Fineness Modulus = 0.45
 D₆₀ = 0.060 mm Liquid Limit = n/a
 D₁₀₀ = 0.072 mm Plastic Limit = n/a
 D₂₀₀ = 0.341 mm Moisture % = 2.9% Plasticity Index = n/a



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HYDROMETER PIT 1, 4 TO 6 FEET



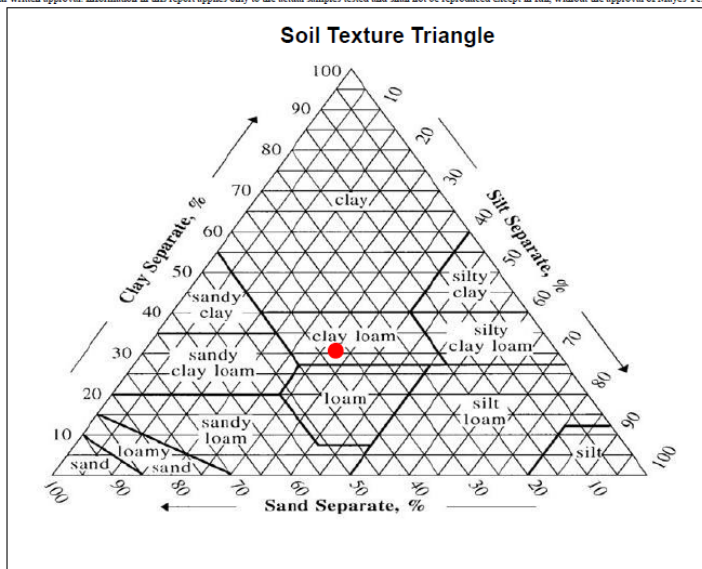
Hydrometer Report

Project: QC Lab All American Geotechnical	Date Sampled: 08/09/21	ASTM D 2487 Soils Classification
Project #: M8211030	Sampled By: Client	Need Atterberg Limits to classify sample
Client: All American Geotechnical Inc	Date Tested: 8/13-19/21	Sample Color
Source: Cossar	Tested By: M. Gordon	Orange Brown Gray Silts and Sand
Sample#: 4892		

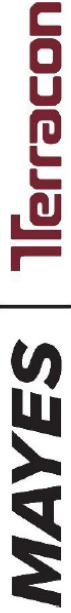
ASTM D-422, HYDROMETER ANALYSIS				ASTM C-136/C117 or AASHTO T22.11		
Assumed Sp Gr :	2.45			Sieve Analysis		
Sample Weight:	113.38	grams		Grain Size Distribution		
Hydroscopic Moist.:	2.92%			Sieve Size	Percent Passing	Soils Particle Diameter
Adj. Sample Wgt :	110.16	grams		3.0"	100%	75.000 mm
Hydrometer				2.0"	100%	50.000 mm
Reading	Corrected	Percent	Soils Particle	1.5"	100%	37.500 mm
Minutes	Reading	Passing	Diameter	1.25"	100%	31.500 mm
2	55.5	52.6%	0.0278 mm	1.0"	100%	25.000 mm
5	49.5	46.9%	0.0188 mm	3/4"	100%	19.000 mm
15	42.5	40.3%	0.0115 mm	5/8"	100%	16.000 mm
30	37.7	35.7%	0.0085 mm	1/2"	100%	12.500 mm
60	34.7	32.9%	0.0061 mm	3/8"	100%	9.500 mm
250	27.8	26.3%	0.0032 mm	1/4"	100%	6.300 mm
1440	22.8	21.6%	0.0014 mm	#4	100%	4.750 mm
% Gravel:	0.0%		Liquid Limit: n/a	#10	99%	2.000 mm
% Sand:	37.3%		Plastic Limit: n/a	#20	99%	0.850 mm
% Silt:	32.3%		Plasticity Index: n/a	#40	95%	0.425 mm
% Clay:	30.3%			#100	73%	0.150 mm
				#200	62.7%	0.075 mm
				Silts	62.5%	0.074 mm
					57.3%	0.050 mm
					47.7%	0.020 mm
				Clays	30.3%	0.005 mm
					23.3%	0.002 mm
				Colloids	15.8%	0.001 mm

USDA Soil Textural Classification		
	Particle Size	
% Sand:	42.3	2.0 - 0.05 mm
% Silt:	34.3	0.05 - 0.002 mm
% Clay:	23.4	< 0.002 mm
CLAY LOAM		

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SIEVE REPORT PIT 1, 6 TO 8 FEET

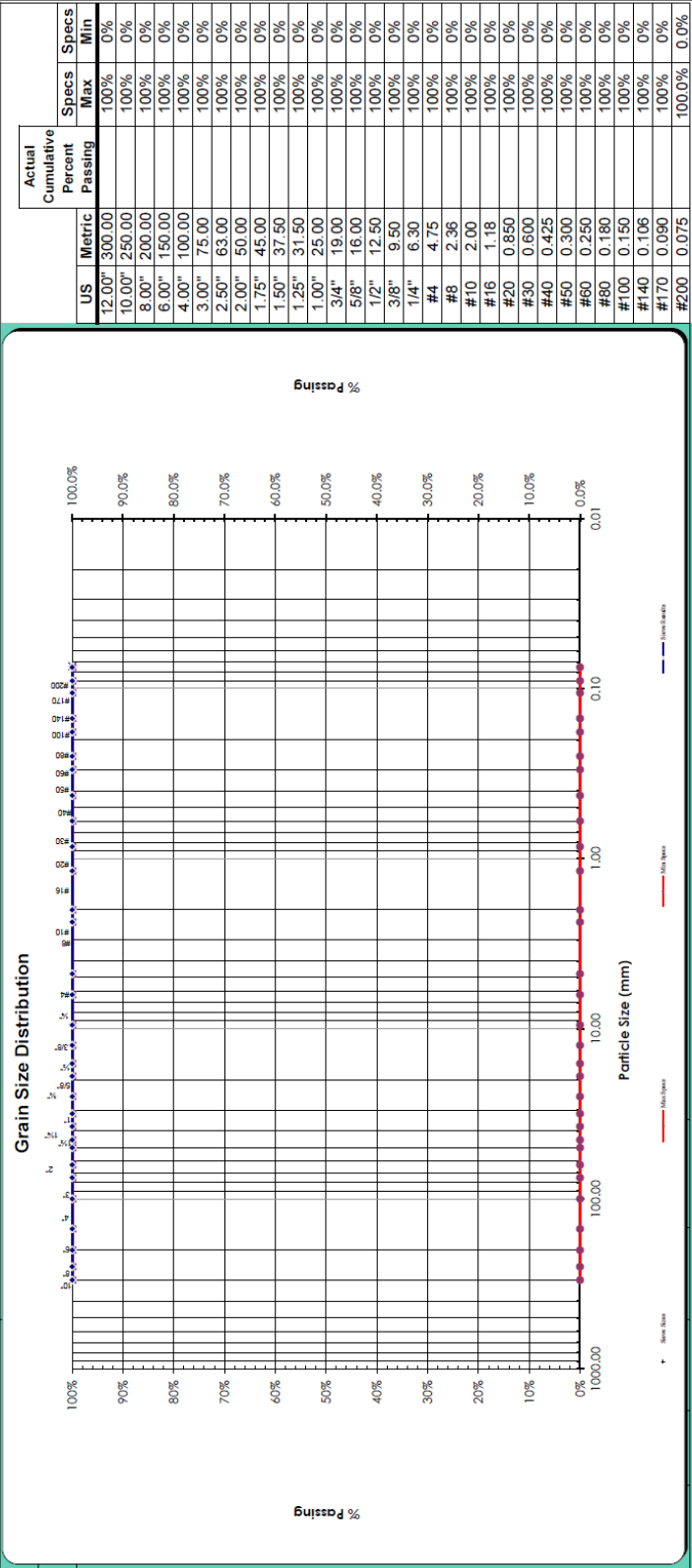


Gradation Analysis / Sieve Report

Project: QC Lab All American Geotechnical 2021 **Date Received:** 8/9/21 **ASTM D-2487 Unified Soils Classification System**
Project #: M&Z11030 **Sampled By:** Client **No Data Provided**
Client: All American Geotechnical Inc **Date Tested:** 8/16-19/21 **Sample Description:**
Source: Cosser **Tested By:** M. Gordon **Gray Brown Clay**
Sample#: 4893 **Sample Location:** Pit 1.6' to 8'

ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821
Specifications
 No Specs
Sample Meets Specs.: Yes
D₁₀ = 0.004 mm **% Gravel = 0.0%** **Coeff. of Curvature, C_u = 1.50**
D₃₀ = 0.008 mm **% Sand = 0.0%** **Coeff. of Uniformity, C_u = 6.00**
D₆₀ = 0.023 mm **% Silt & Clay = 100.0%** **Fineness Modulus = 0.00**
D₁₀₀ = 0.038 mm **Liquid Limit = 80.1%**
D₄₀ = 0.045 mm **Plastic Limit = 28.5%**
D₆₀ = 0.068 mm **Moisture % = N/A** **Plasticity Index = 51.6%**

ASTM C-136 / C117 or AASHTO T27 / T11



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HYDROMETER, PIT 1, 6 TO 8 FEET



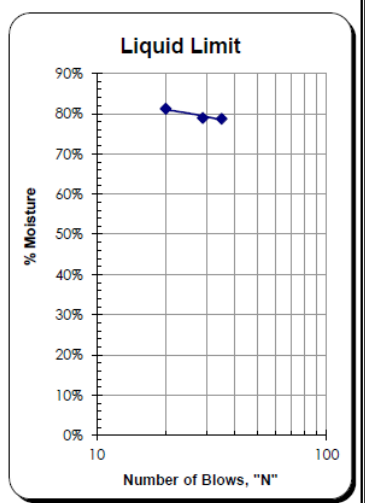
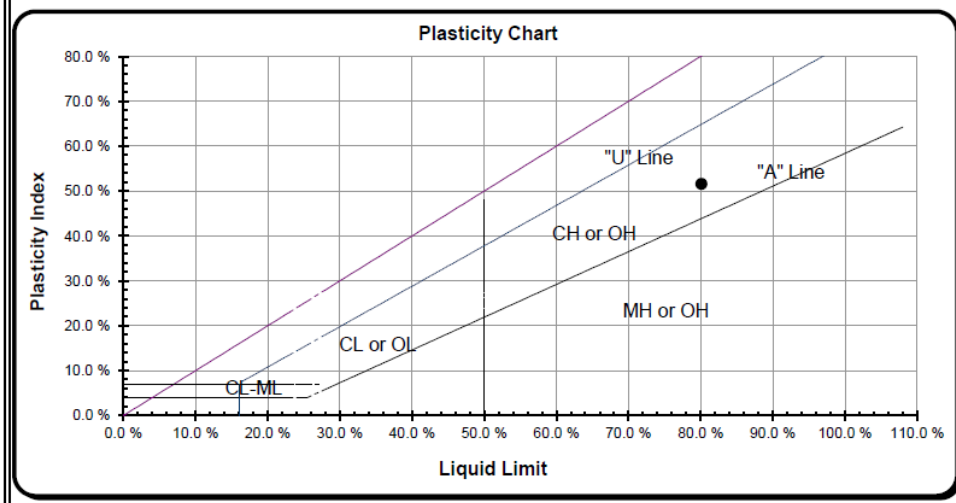
ASTM D4318 - Liquid Limit, Plastic Limit and Plasticity Index of Soils

Project: QC Lab All American Geotecl	Date Received: 08/09/21	Unified Soils Classification System, ASTM D-2487
Project #: M8211030	Sampled By: Client	No Data Provided
Client: All American Geotechnical In	Date Tested: 8/16-19/21	Sample Color
Source: Cossar	Tested By: M. Gordon	Gray Brown Clay
Sample #: 4893		

Liquid Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	42.01	47.56	41.17			
Weight of Dry Soils + Pan:	36.13	41.25	35.61			
Weight of Pan:	28.66	33.25	28.76			
Weight of Dry Soils:	7.47	8.00	6.85			
Weight of Moisture:	5.88	6.31	5.56			
% Moisture:	78.7 %	78.9 %	81.2 %			
Number of Blows:	35	29	20			

Liquid Limit @ 25 Blows: 80.1 %
 Plastic Limit: 28.5 %
 Plasticity Index, I_p: 51.6 %

Plastic Limit Determination						
	#1	#2	#3	#4	#5	#6
Weight of Wet Soils + Pan:	34.42	34.95				
Weight of Dry Soils + Pan:	33.16	33.52				
Weight of Pan:	28.66	28.59				
Weight of Dry Soils:	4.50	4.93				
Weight of Moisture:	1.26	1.43				
% Moisture:	28.0 %	29.0 %				



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Comments: _____

SIEVE REPORT, PIT 3, 4 TO 6 FEET



Gradation Analysis / Sieve Report

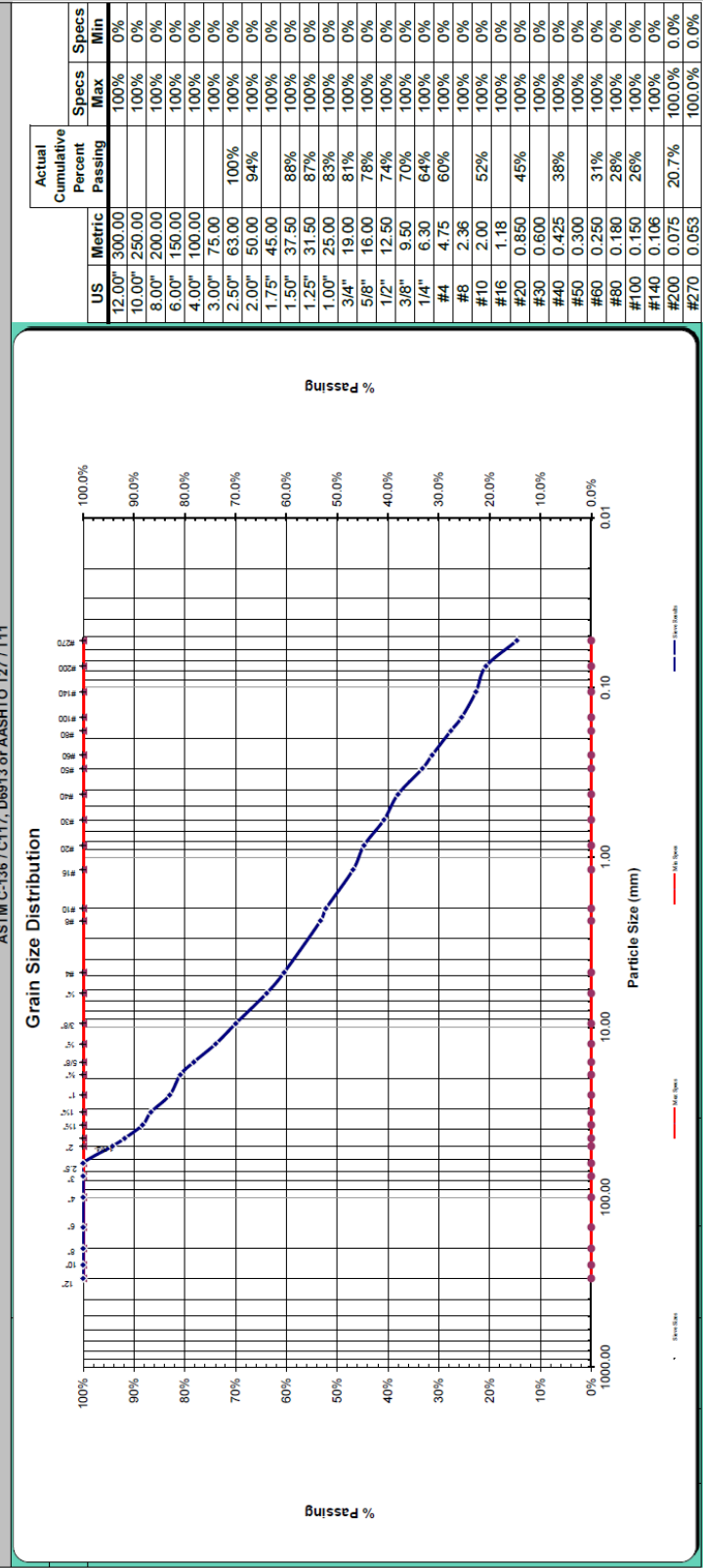
Project: QC Lab All American Geotechnical 2021
Project #: M8211030
Client: All American Geotechnical Inc
Source: Cossier Pit 3
Sample#: 4894

Date Sampled: 8/6/2021
Date Received: 8/9/2021
Date Tested: 8/23-25/21
Tested By: M. Gordon

ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821
ASTM D-2487 Unified Soils Classification System
SM, Silty Sand with Gravel
Sample Description:
Light Brown Silt Sand Gravel

Specifications
 No Specs
 Sample Meets Specs.: Yes

ASTM C-136 / C117, D6913 or AASHTO T27 / T11
ASTM D-2216, ASTM D-2419, ASTM D-4318, ASTM D-5821
 $D_{60} = 0.018$ mm % Gravel = 39.6% Coef. of Curvature, $C_c = 0.30$
 $D_{100} = 0.036$ mm % Sand = 45.8% Coef. of Uniformity, $C_u = 127.04$
 $D_{300} = 0.225$ mm % Silt & Clay = 20.7% Fineness Modulus = 3.95
 $D_{500} = 1.662$ mm
 $D_{600} = 4.603$ mm
 $D_{900} = 41.082$ mm



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