Geotechnical Engineering Report

Las Palomas VFD Building Addition
101 W. Las Palomas Road
Sierra County, New Mexico

November 12, 2014
Terracon Project No. 68145110

Prepared for:
Bohannan Huston
Las Cruces, New Mexico

Prepared by:
Terracon Consultants, Inc.
Las Cruces, New Mexico

EXECUTIVE SUMMARY

A geotechnical exploration has been performed for the proposed Las Palomas VFD Building Addition to be located at 101 W. Las Palomas Road near Williamsburg, New Mexico. Terracon's geotechnical scope of work included the advancement of one (1) test boring to an approximate depth of 21-1/2 feet below ground surface (bgs).

Based on the information obtained from our subsurface exploration, the site is suitable for development of the proposed project. The following geotechnical considerations were identified:

- The site soils in the addition area generally consisted of silty sand from the surface to a depth of about 15 feet bgs. The upper sand soils were underlain by lean clay with sand to the total explored depth of 21-1/2 feet bgs. Groundwater was not encountered in the test boring advanced at the site.

- Conventional spread and continuous footings bearing on engineered fill may be used for support of the addition. The on-site silty sand soils appear suitable for use as engineered fill beneath foundations and floor slabs.

- Construction of floor slabs on engineered fill composed of approved on-site or imported soils is considered acceptable for the project provided some movement can be tolerated.

- The 2009 International Building Code, Table 1613.5.2 IBC seismic site classification for this site is D.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to monitor this portion of the work.

This geotechnical executive summary should be used in conjunction with the entire report for design and/or construction purposes. It should be recognized that specific details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

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Terracon

November 12, 2014

Bohannan Huston
Suite C-103
425 South Telshor Blvd.
Las Cruces, NM 88011-7237

Attn: David M. Shields, C.E.T.
P: 575.644.4813
E: dshields@bhinc.com

Re: Geotechnical Engineering Report
Las Palomas VFD Building Addition
101 W. Las Palomas Road
Sierra County, New Mexico
Terracon Project No. 68145110

Dear Mr. Shields:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This geotechnical engineering report presents the results of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

JAMES D. COSPER, II
NEW MEXICO
14477
REGISTERED PROFESSIONAL ENGINEER
11-12-14

for Debbie Daniels
Daniel Balderrama
Staff Professional

J. Dan Cosper, P.E.
Senior Associate

Copies to: Addressee (1 via email, 3 via mail)

GEOTECHNICAL ENGINEERING REPORT
LAS PALOMAS VFD BUILDING ADDITION
101 W. LAS PALOMAS ROAD
SIERRA COUNTY, NEW MEXICO

Terracon Project No. 68145110
November 12, 2014

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed Las Palomas VFD Building Addition to be located at 101 W. Las Palomas Road near Williamsburg, New Mexico. One (1) boring, designated B-1, was performed to a depth of approximately 21-1/2 feet below the existing ground surface within the proposed building area. A log of the boring along with a site location map and boring location plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- seismic considerations
- foundation design and construction
- floor slab design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	Refer to the Site Location Map and Boring Location Plan (Exhibits A-1 and A-2)
Structures	Single-story bay addition to the existing building, approximately 800 square feet in ground contact area with an eve height of 14 feet.
Building construction	It is assumed that the addition will be a metal building supported by spread and continuous footings with a slab-on-grade floor system.
Finished floor elevation (FFE)	To match the existing building grade.
Assumed maximum loads	Columns: 15 kips Walls: 1.5 klf Slabs: 150 psf

2.2 Site Location and Description

Item	Description
Location	101 W. Las Palomas Road near Williamsburg, New Mexico.
Existing site features	Las Palomas VFD Building
Surrounding developments	North: Las Palomas Rd. West: Undeveloped East: Undeveloped South: Undeveloped
Current ground cover	Exposed native subgrade
Existing topography	Relatively level

3.0 SUBSURFACE CONDITIONS

3.1 Typical Subsurface Profile

Specific conditions encountered at the boring locations are indicated on the individual boring logs included in Appendix A of this report. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Stratum 1	15	Silty Sand	Very Loose to Loose
Stratum 2	21-1/2	Lean Clay with Sand	Medium Stiff

Laboratory test results indicate that the near surface soils exhibit moderate compressibility potential at in-situ moisture contents. The test results indicate that the soils exhibit a low to moderate tendency for hydro-compaction when elevated in moisture content. The soils do not exhibit expansion under a surcharge load of 1,000 psf.

3.2 Groundwater

The borehole was observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the boring while drilling, or for the short duration that the boring was allowed to remain open. However, this does not necessarily mean the boring terminated above groundwater. Long term observations in piezometers or

observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The site appears suitable for the proposed construction based upon geotechnical conditions encountered in the test boring. Low density, compressible soils below foundation areas will require particular attention in the design and construction.

Based on the geotechnical engineering analyses, subsurface exploration and laboratory test results, we recommend that the proposed addition be supported by spread and continuous footings bearing on engineered fill. Construction of floor slabs on engineered fill is considered acceptable for this project, provided some movement can be tolerated. On-site silty sand soils appear suitable for use as engineered fill.

Geotechnical engineering recommendations for foundation systems and other earth connected phases of the project are outlined below. The recommendations contained in this report are based upon the results of field and laboratory testing (which are presented in Appendices A and B), engineering analyses, and our current understanding of the proposed project.

4.2 Earthwork

The following presents recommendations for site preparation, subgrade preparation, excavation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations and slabs are contingent upon following the recommendations outlined in this section. All grading for the structure should extend a minimum of five feet beyond proposed perimeter building walls (where applicable).

Earthwork on the project should be observed and evaluated by Terracon. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundation bearing soils, and other geotechnical conditions exposed during the construction of the project.

4.2.1 Site Preparation

Prior to construction or placing any fill, all vegetation and any otherwise unsuitable material should be removed from the construction areas. Wet or dry material should either be removed or moisture conditioned and compacted. Exposed areas which will receive fill, once properly

cleared, should be scarified to a minimum depth of 10 inches, conditioned to near optimum moisture content, and compacted.

The site should be initially graded to create a relatively level surface to receive fill, and to provide for a relatively uniform thickness of fill beneath the proposed addition.

Although evidence of underground facilities such as septic tanks, cesspools, utilities and basements was not observed during the site reconnaissance, such features could be encountered during construction. If unexpected fills or underground facilities are encountered, such features should be removed and the excavation thoroughly cleaned prior to backfill placement.

4.2.2 Fill Material Types

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Near Surface On-Site Soils	SM	The near surface on-site soils typically appear suitable for use as engineered fill.
Granular	SM or SC [2]	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Imported silty sand or clayey sand.

4.2.3 Fill Material Placement and Compaction Requirements

Item	Description
Fill Lift Thickness	10 inches or less in loose thickness
Minimum Compaction Requirements [1]	95% of the materials maximum modified Proctor dry density (ASTM D 1557)
Moisture Content	Within 2% of optimum moisture content value as determined by the modified Proctor test at the time of placement and compaction

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.2.4 Grading and Drainage

Positive drainage should be provided during construction and maintained throughout the life of the project. Infiltration of water into utility trenches or foundation excavations should be prevented during construction. Planters and other surface features which could retain water in areas adjacent to the addition should be sealed or eliminated. In areas where sidewalks or

paving do not immediately adjoin the addition, we recommend that protective slopes be provided with a minimum grade of approximately 5 percent for at least 5 feet from perimeter walls (where applicable). Backfill against footings, exterior walls, and in utility and sprinkler line trenches should be well compacted and free of all construction debris to reduce the possibility of moisture infiltration.

Downspouts, roof drains or scuppers should discharge into splash blocks or extensions when the ground surface beneath such features is not protected by exterior slabs or paving. Sprinkler systems should not be installed within five feet of foundation walls. Landscaped irrigation adjacent to the foundation system should be minimized or eliminated.

4.2.5 Earthwork Construction Considerations

Although the exposed subgrade is anticipated to be relatively stable upon initial exposure, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/or subjected to repetitive construction traffic. The use of light construction equipment would aid in reducing subgrade disturbance. The use of remotely operated equipment, such as a backhoe, would be beneficial to perform cuts and reduce subgrade disturbance. Should unstable subgrade conditions develop, stabilization measures will need to be employed.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of foundations and floor slabs. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to foundation and floor slab construction.

Temporary excavations will probably be required during grading operations. The grading contractor, by his contract, is usually 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. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; moisture conditioning; re-compaction; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of foundations and floor slabs.

4.3 Foundation Recommendations

The structure can be supported by spread and continuous footings bearing on engineered fill. Design recommendations for foundations for the proposed structure and related structural elements are presented in the following paragraphs.

4.3.1 Foundation Design Recommendations

Description	Value
Foundation Type	Spread and Continuous Footings
Bearing Material	Minimum of 2 feet of engineered fill placed and compacted in accordance with the Earthwork section of this report.
Allowable Bearing Pressure	1,500 psf
Minimum Embedment Depth Below Finished Grade	18 inches
Total Estimated Settlement	1 inch
Estimated Differential Settlement	½ inch

Finished grade is defined as the lowest adjacent grade within five feet of the foundation for perimeter (or exterior) footings and finished floor level for interior footings. The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations.

The new foundation excavations should include removal and replacement of any loose backfill found adjacent to the existing foundations. However, when excavating adjacent to existing foundations, the bottom of the foundation should not be undermined. The potential area of undermining can be defined as an imaginary, 45-degree line extending down and away from the bottom of the footing. If excavation is required directly adjacent to the existing footings, underpinning of the existing footings may be required to reduce the potential for foundation movement. Terracon assumes that the existing building is supported by spread and continuous footings.

Footings should be proportioned to reduce differential foundation movement. Proportioning on the basis of equal total movement is recommended; however, proportioning to relative constant dead-load pressure will also reduce differential movement between adjacent footings. Additional foundation movements could occur if water from any source infiltrates the foundation soils; therefore, proper drainage must be provided in the final design and during construction.

Footings and foundations should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement.

Foundation excavations and engineered fill placement should be observed by the geotechnical engineer. If the soil conditions encountered differ significantly from those presented in this report, supplemental recommendations will be required.

4.3.2 Foundation Construction Considerations

A minimum of 2 feet of engineered fill is recommended below all footings. The subgrade soils should be removed to a minimum depth of 2 feet and a minimum of 2 feet horizontally beyond the edge of footings (where applicable). The engineered fill should extend laterally an additional distance of 8 inches for each additional foot of excavation beyond the 2-foot minimum depth. The soils should be replaced with approved engineered fill, conditioned to near optimum moisture content and compacted.

4.4 Seismic Considerations

Description	Value
2009 International Building Code Site Classification (IBC) [1]	D[2]
Site Latitude	33.0806
Site Longitude	-107.3341
Spectral Response Accelerations SMs and SM1 SMs = FaSs and SM1 = FvS1 Site Class D - Fa = 1.57, Fv = 2.4	
SM_S Spectral Acceleration for a Short Period (0.2 sec)	0.438g
SM1 Spectral Acceleration for a 1-Second Period	0.211g
SDs = 2/3 x SMs and SD1 = 2/3 x SM1	
SD_S Spectral Acceleration for a Short Period (0.2 sec)	0.292g
SD1 Spectral Acceleration for a 1-Second Period	0.140g

[1] Note: In general accordance with the *2009 International Building Code,* Table 1613.5.2.

[2] Note: The 2009 International Building Code (IBC) requires a site soil profile determination extending to a depth of 100 feet for seismic site classification. The current scope does not include the required 100 foot soil profile determination. The borings extending to a maximum depth of 21-½ feet, and this seismic site class definition considers that dense soil may be encountered below the maximum depth of the subsurface exploration. Additional exploration to deeper depths would be required to confirm the conditions below the current depth of exploration.

4.5 Floor Slabs

4.5.1 Floor Slab Design Recommendations

Description	Value
Interior floor system	Slab-on-grade concrete for use with standard spread and continuous footings.
Floor slab support	24 inches of engineered fill soils placed and compacted in accordance with Earthwork section of this report.
Modulus of subgrade reaction	150 pounds per square inch per inch (psi/in)

Construction of floor slabs on compacted fills composed of approved soils is considered acceptable for the project.

In areas of exposed concrete, control joints should be saw cut into the slab after concrete placement in accordance with ACI Design Manual, Section 302.1R-37 8.3.12 (tooled control joints are not recommended). Additionally, dowels should be placed at the location of proposed construction joints. To control the width of cracking (should it occur) continuous slab reinforcement should be considered in exposed concrete slabs.

Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement. Interior trench backfill placed beneath slabs should be compacted in accordance with recommendations outlined in the Earthwork section of this report. Other design and construction considerations, as outlined in the ACI Design Manual, Section 302.1R are recommended.

4.5.2 Floor Slab Construction Considerations

A minimum of 24 inches of engineered fill is recommended below slabs-on-grade. The engineered fill should extend horizontally a minimum distance of 5 feet beyond the outside edge of perimeter footings (where applicable). Some differential movement of a slab-on-grade floor system is possible should the subgrade soils become elevated in moisture content. Such movements are anticipated to be within general tolerance for normal slab-on-grade construction. To reduce potential slab movements, the subgrade soils should be prepared as outlined in the Earthwork section of this report.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and

testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

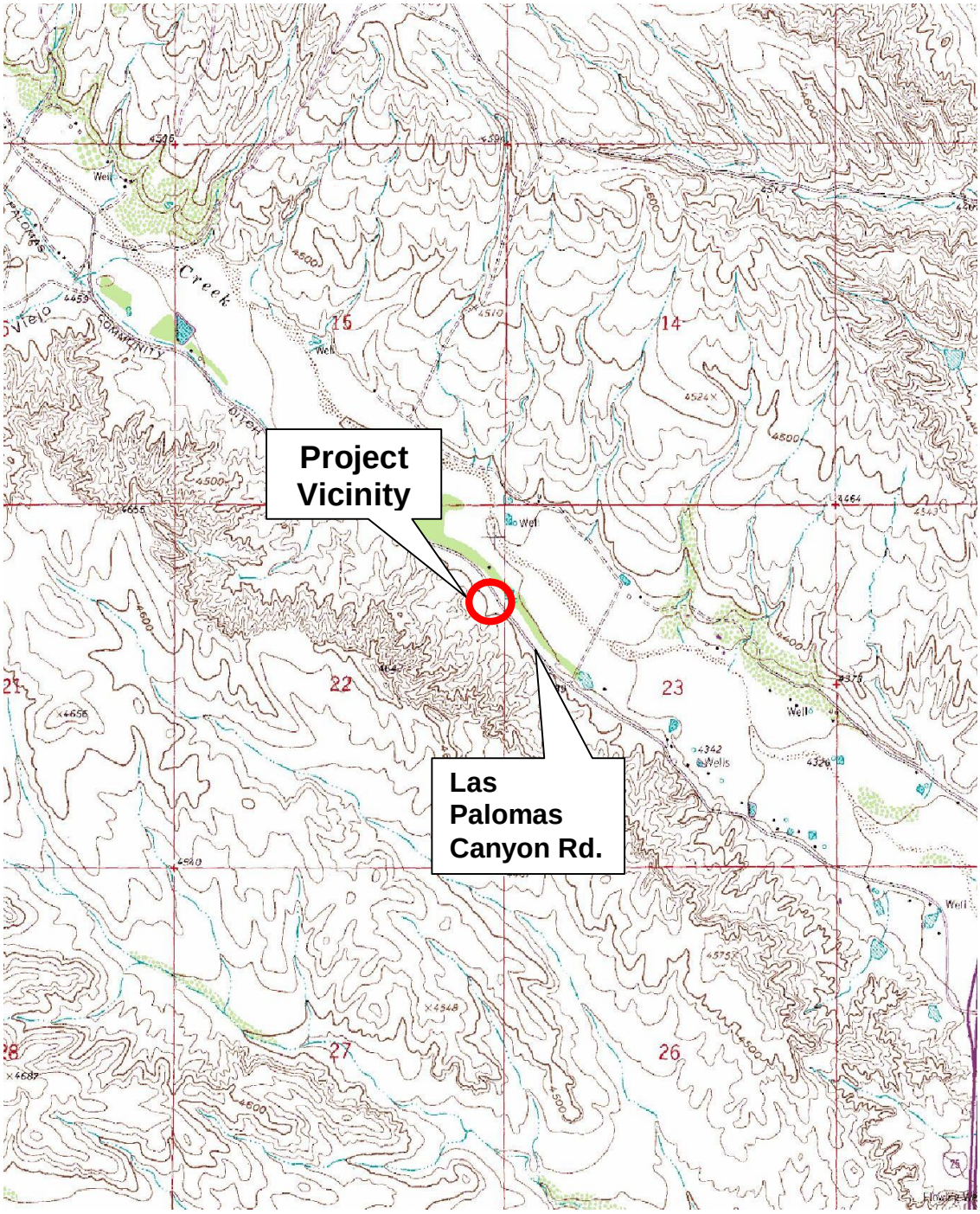
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION



N

Source: U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: WILLIAMSBURG, NM (1/1/1980).

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

Project Mngr: DB	Project No. 68145110	Terracon Consulting Engineers & Scientists 1640 Hickory Loop, Suite 105 Las Cruces, New Mexico 88005 575.527.1700 Fax: 575.527.1092	SITE LOCATION MAP	FIG No.
Drawn By: ST	Scale Not to Scale		LAS PALOMAS VFD BUILDING ADDITION 101 W. LAS PALOMAS RD. WILLIAMSBURG, NEW MEXICO	A-1
Checked By: JDC	File No. Boring Location			
Approved By: JDC	Date: 11/07/14			

Source: Bohannan Huston

N

Approximate Boring Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES.

Project Mngr:	DB
Drawn By:	ST
Checked By:	JDC
Approved By:	JDC

Project No.	68145110
Scale	Not to Scale
File No.	Boring Location
Date:	11/07/14

Terracon
Consulting Engineers & Scientists
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico 88005
575.527.1700 Fax: 575.527.1092

BORING LOCATION PLAN

LAS PALOMAS VFD BUILDING ADDITION
101 W. LAS PALOMAS RD.
WILLIAMSBURG, NEW MEXICO

FIG No.

A-2

Field Exploration Description

A single test boring was drilled at the site on October 24, 2014. The boring was drilled to a depth of about 21-1/2 feet below the ground surface at the approximate locations shown on the attached Boring Location Plan, Exhibit A-2. The test borings were located as follows:

Borings	Location	Depth (feet)
B-1	Addition Footprint	21-1/2

The test boring was advanced with a truck-mounted CME-75 drill rig utilizing 8-inch diameter hollow-stem augers.

The boring was located in the field by using the proposed site plan and an aerial photograph of the site, and measuring from existing property lines. The accuracy of the boring location should only be assumed to the level implied by the method used.

A lithologic log of the boring was recorded by the field engineer during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon or ring-barrel samplers. Bulk samples of subsurface materials were also obtained.

Penetration resistance measurements were obtained by driving the split-spoon and ring-barrel samplers into the subsurface materials with a 140-pound automatic hammer falling 30 inches. The penetration resistance value is a useful index in estimating the consistency or relative density of materials encountered.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the boring performed on this site. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Groundwater conditions were evaluated in the boring at the time of site exploration.

BORING LOG NO. B-1

PROJECT: LAS PALOMAS VFD BUILDING ADDITION

CLIENT: BOHANNAN HUSTON LAS CRUCES, NM

SITE: 101 W. LAS PALOMAS ROAD WILLIAMSBURG, NEW MEXICO

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), trace gravel, brown, loose								
				X	3-3-2 N=5	12		NP	40
	very loose	5		X	3-2	12	82		
	very loose	10		X	1-1-1 N=2				
	15.0								
	LEAN CLAY WITH SAND (CL), brown, medium stiff	15		X	2-3-5 N=8	19		32-21-11	75
		20		X	1-2-2 N=4				
	21.5								
	Boring Terminated at 21.5 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Hollow Stem Auger

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Terracon
1640 Hickory Loop, Suite 105
Las Cruces, New Mexico

Boring Started: 10/24/2014 | Boring Completed: 10/24/2014
Drill Rig: CME 75 | Driller: Tierra Drilling
Project No.: 68145110 | Exhibit: A-4

APPENDIX B

LABORATORY TESTING

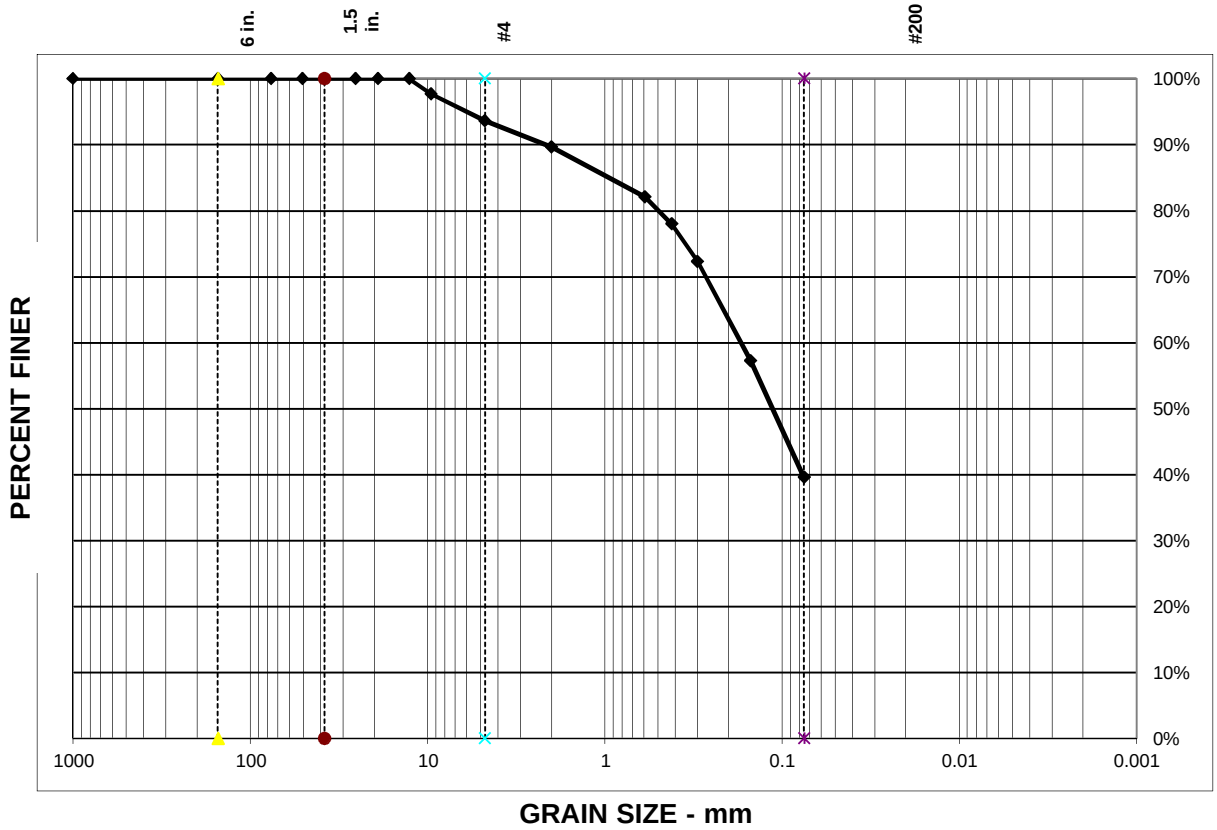
Laboratory Testing

Soil samples were tested in the laboratory to measure their dry unit weight and natural water content. Grain size analyses and consolidation testing were also performed on selected samples. The test results are provided on the boring logs and presented in Appendix B.

Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report in Appendix C. All classification was by visual/manual procedures, (ASTM D2487). Selected samples were further classified using the results of Atterberg limit testing, (ASTM D4318). The Atterberg limit test results are also provided on the boring logs.

Procedural standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

GRAIN SIZE DISTRIBUTION GRAPH



TEST SUMMARY

Sieve Size	1 1/2"	3/4"	3/8"	#4	#10	#40	#100	#200
% Passing (Cumulative)	100%	100%	98%	94%	90%	78%	57%	39.6%
Specification								

% GRAVEL = 6%
% SAND = 54%
% SILT & CLAY = 40%

D_{85} = 0.9
D_{60} = 0.2
D_{50} = 0.1
D_{30} =

D_{15} =
D_{10} =
C_U =
C_C =

Project Name: Las Palomas VFD Building Addition
Project No.: 68145110
Sample Location: B1 at 2.5'
Liquid Limit: NV Plasticity Index: NP
USCS Classification: SM
Material Description: Silty Sand

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Las Cruces, NM 88005
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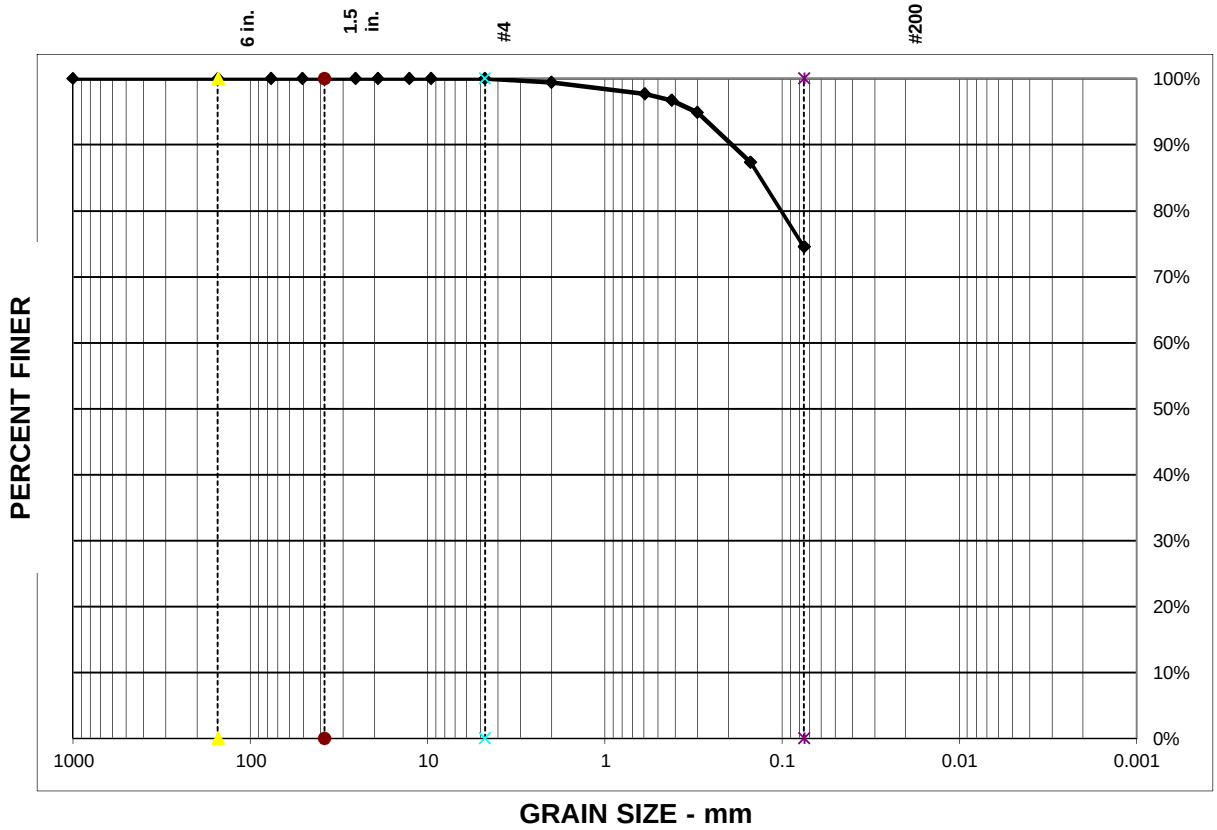
GRAIN SIZE DISTRIBUTION GRAPH



TEST SUMMARY

Sieve Size	1 1/2"	3/4"	3/8"	#4	#10	#40	#100	#200
% Passing (Cumulative)	100%	100%	100%	100%	99%	97%	87%	74.5%
Specification								

% GRAVEL =	0%	**D_{85} =** 0.1	**D_{15} =**
% SAND =	26%	**D_{60} =**	**D_{10} =**
% SILT & CLAY =	74%	**D_{50} =**	**C_U =**
		D_{30} =	**C_C =**

Project Name: Las Palomas VFD Building Addition
Project No.: 68145110
Sample Location: B1 at 15'
Liquid Limit: 32 Plasticity Index: 11
USCS Classification: CL
Material Description: Lean Clay with Sand

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LAS PALOMAS VFD BUILDING ADDITION
101 W. LAS PALOMAS
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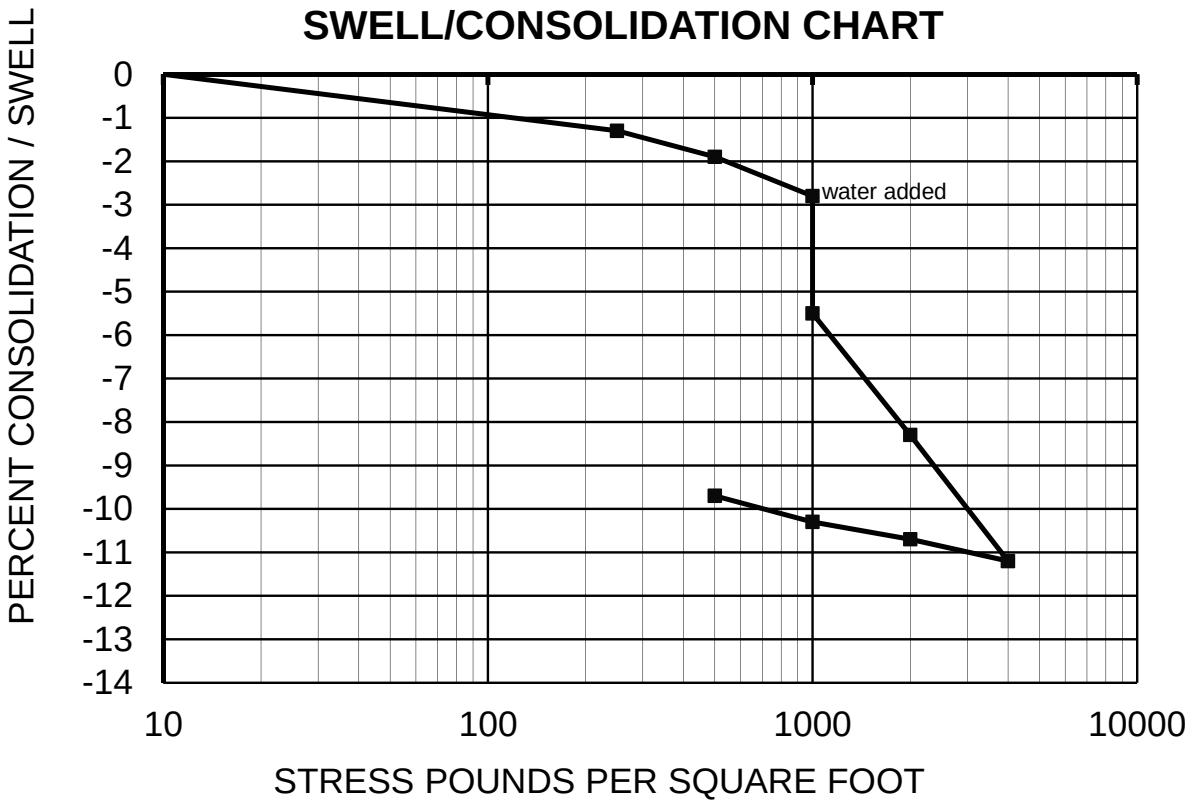

BORING B-1 @ 5'
SILTY SAND
USCS Classification:
SM
DRY DENSITY= 81.8 lbs/ft3
MOISTURE CONTENT=
12.1%

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-Value Blows/Ft.	Ring Sampler Blows/Ft.
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

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UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	$PI > 7$ and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			$PI < 4$ or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay [K,L,M,N]
						Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OH	Organic clay [K,L,M,P]
						Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.

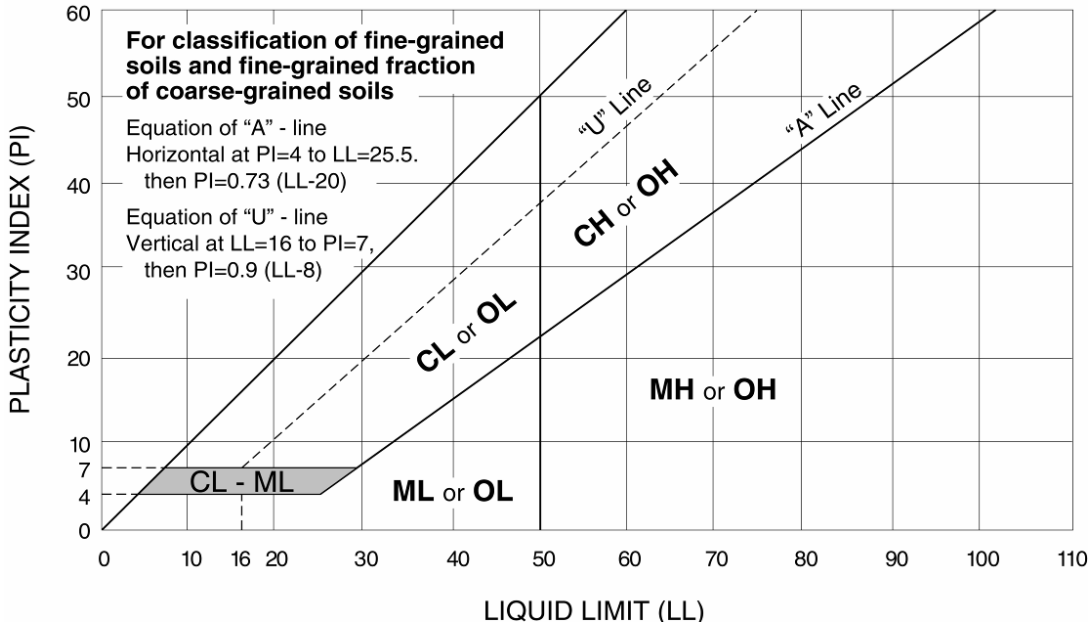

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Exhibit C-2