GEOTECHNICAL INVESTIGATION REPORT
PALOS VERDES DRIVE NORTH AND DAPPLEGRAY ELEMENTARY SCHOOL INTERSECTION IMPROVEMENTS
ROLLING HILLS ESTATES, CALIFORNIA

PREPARED FOR

WILLDAN ENGINEERING
2401 EAST KATELLA AVENUE, SUITE 300
ANAHEIM, CALIFORNIA 92806

PREPARED BY

WILLDAN ENGINEERING
GEOTECHNICAL GROUP
1515 SOUTH SUNKIST STREET, SUITE E
ANAHEIM, CALIFORNIA 92806
WILLDAN PROJECT NO. 110176-2000-400

JULY 22, 2021

July 22, 2021

Mr. Fred Wickman
Willdan Engineering
2401 E. Katella Avenue, Suite 300
Anaheim, CA 92806

Subject: Geotechnical Investigation Report
Palos Verdes Drive North and Dapplegray Elementary School Intersection Improvements Project, Rolling Hills Estates, California
Willdan Project No. 110176-2000-400

Dear Mr. Wickman,

Willdan Engineering, Geotechnical Group (Willdan Geotechnical), is pleased to submit this report for the proposed Palos Verdes Drive North and Dapplegray Elementary School Intersection Improvements Project in the City of Rolling Hills Estates, California. This report presents our geotechnical findings, conclusions and recommendations for the design and construction of the proposed improvements. Based on the results of our investigation, the proposed improvements are feasible from a geotechnical standpoint, provided the recommendations in this report are followed.

We appreciate the opportunity to assist you and look forward to future projects. If you have any questions, please contact us.

Respectfully submitted,
WILLDAN ENGINEERING

Mohsen Rahimian, PE, GE
Supervising Engineer

Distribution: Addressee

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APPENDICES

1. INTRODUCTION

This report presents the results of our geotechnical investigation and percolation testing performed for the proposed Palos Verdes Drive North and Dapplegray Elementary School Intersection Improvements Project in the City of Rolling Hills Estates, California. This report includes our recommendations for the design and construction of the proposed improvements from a geotechnical standpoint. The recommendations provided within this submittal are based on the results of our field investigation and testing, laboratory testing and engineering analyses.

2. SCOPE OF SERVICES

This investigation was conducted to explore and evaluate the site soil engineering conditions to the depths that may be significantly influenced by the proposed improvements. Our scope of services included the following:

- A site reconnaissance by a member of our engineering staff to evaluate the surface conditions at the project site;
- Review of selected published geologic maps, reports and literature pertinent to the site and surrounding areas;
- A field exploration consisting of drilling four (4) exploratory borings to the maximum depth of 31.2 feet below ground surface (bgs) to evaluate subsurface soils conditions at the subject project sites;
- Performing laboratory tests on representative soil samples obtained from the borings to evaluate the physical and engineering properties of the subsurface soils;
- Engineering evaluation of the data obtained from the field investigation and laboratory testing program; and
- Preparation of this report summarizing our findings, results of geotechnical laboratory and field testing, and our conclusions and recommendations for the geotechnical aspects of the project design and construction.

3. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

It is our understanding that the City of Rolling Hills Estates (City) is planning to improve the Palos Verdes Drive North (PVDN) at and adjacent to the intersection of Dapplegray Elementary School entrance. The proposed improvements consist of widening of PVDN, as well as construction of retaining walls, pedestrian path and associated hardscapes.

The latitude and longitude at the approximate center of the subject project site are 33.7730° N and 118.3389° W, respectively. The project site location is shown on Figure 1 in Appendix A.

4. EOTECHNICAL INVESTIGATIONS

4.1. FIELD EXPLORATION

Field exploration for this investigation consisted of drilling and sampling four (4) borings to the maximum depth of 31.2 feet bgs. Approximate locations of the borings are shown on Figure 2 in Appendix A. The boring logs are provided in Appendix B. Prior to field exploration, a site visit was performed to mark the boring locations and evaluate access conditions for drilling equipment.

Soil borings for the current investigations were advanced using a truck-mounted CME 75 rig equipped with 8-inch diameter hollow-stem augers. Bulk and relatively undisturbed soil samples were collected from each soil boring during drilling. Bulk samples were collected from auger cuttings obtained from within the near-surface soils. At selected intervals throughout the boring depths, relatively undisturbed soil samples were collected by driving a 3-inch outside diameter Modified California Sampler lined with brass rings. The samplers were driven into the underlying soil to a depth of 18 inches, or the interval noted on the boring logs, with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler was recorded for each 6-inch penetration interval and is shown on the boring logs. Soil samples were retained for possible laboratory testing. The number of blows required to drive the sampler the last 12 inches was used to estimate the in-situ relative density of granular soils and to less accuracy, the consistency of cohesive soils. Upon completion of drilling, the boring was backfilled with soil cuttings and tamped. Soil samples collected from the borings were delivered to Willdan's laboratory for testing.

Classification of the soils encountered in our exploratory borings was made in general accordance with the Unified Soil Classification System (USCS), using visual-manual procedure (ASTM D2488) and/or based on laboratory testing (ASTM D2487). A key for the classification of the soils (USCS classification) along with the boring logs are provided in Appendix B.

4.2. LABORATORY TESTING

Laboratory tests were performed on selected soil samples to evaluate their physical characteristics and engineering properties. Laboratory testing included determination of in-situ moisture content and dry density, gradation, passing #200 sieve, Atterberg limits, shear strength characteristics, R-value and corrosion potential. Laboratory tests were conducted in general accordance with American Society for Testing of Materials (ASTM) Standards or California Test Methods (CTM). The in-situ dry density and moisture content test results are shown on the boring logs. The remaining laboratory test results are provided in Appendix C.

4.3. SUBSURFACE CONDITIONS

Based on the field exploration and the results of laboratory tests on the soils samples, in Borings B-1 and B-2, a layer of silty sand is present in the upper 3 feet, underlain by sandstone and siltstone bedrock to the maximum drilled depth. In Borings B-3 and B-4, layers of clay and/or clayey sand is present in the upper 15 to 25 feet, underlain by claystone and sandstone bedrock to the maximum drilled depth. Based on our findings, the subsurface conditions encountered appear typical of those

found in the geologic region of the site.

The above is a general description of soil conditions encountered at the site in the borings drilled for this investigation. For more detailed description of the subsurface soil conditions encountered, please refer to the boring logs in Appendix B.

4.4. GROUNDWATER

The subject project site is located within an area where historically highest groundwater has not been identified. The exploratory boring conducted for the current investigation was monitored for visible signs of free groundwater during and immediately after completion of the borehole. Groundwater was not encountered during our field explorations in June 16, 2021.

Depth to groundwater can be expected to fluctuate both seasonally and from year to year. Fluctuations in the groundwater level may occur due to variations in precipitation, flow in nearby creeks, irrigation practices at the site and in the surrounding areas, climatic conditions, pumping from wells, and possibly as the result of other factors that were not evident at the time of our investigation. Because of the type of the proposed improvements and expected depth of grading and/or excavation, it is unlikely that groundwater would be encountered during construction for the proposed improvements.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. GENERAL

Based on our geotechnical investigation, the proposed improvements are feasible from a geotechnical point of view, provided the recommendations contained in this report are implemented in the design and construction of the project.

5.2. EARTHWORK

5.2.1. Site Preparation

During grading, the contractor should take all necessary measures to protect existing utilities within the grading limits. All abandoned utilities encountered should be removed or otherwise drained for all content, if any, and properly capped.

Any soils disturbed during site clearing operations in the construction areas should be removed down to the required depth within the suitable undisturbed soils. After removal of unsuitable soils and prior to placement of fill, the bottom of removal shall be observed and confirmed to be competent by the Geotechnical Engineer of Record. Following the over-excavation, the areas to receive engineered fill shall be scarified to a minimum depth of 8 inches, moisture-conditioned within optimum and 3% above optimum moisture content and compacted to at least 90% of the maximum dry density obtained per ASTM D1557.

Unless stated otherwise, all fill materials should be placed in loose lifts of 8 inches or less,

moisture-conditioned within optimum and 3% above optimum moisture content and compacted to at least 90% relative compaction of the maximum density as determined by the ASTM D1557. Compaction should be verified by observation, probing, and testing by a geotechnical consultant's representative.

Once the subgrade and fill soil have been moisture conditioned and compacted, the soil should not be allowed to dry out prior to additional fill placement or concrete placement at finished grade. If it is dried out prior to compaction of the fill or prior to foundation and slab-on-grade construction, reprocessing of the soil is required to reestablish the recommended soil moisture content.

When the work is interrupted by heavy rains, fill operations shall not be resumed until the Geotechnical Engineer indicates that the moisture content, density and stability of previously placed fill are as specified. All soft or wet subgrade soil encountered during construction should be stabilized prior to the placement of new fill and further construction. Wet to saturated soils may become unstable or "pump" under dynamic loading such as equipment movement during grading and may not respond to densification techniques. Typical remedial measures include discing and aerating the soil during dry weather, mixing the soil with dryer materials, removing and replacing the soil with an approved fill material, or mixing the soil with an approved lime or cement product. Our firm should be consulted prior to implementing remedial measures to observe the unstable subgrade conditions and provide appropriate recommendations.

5.2.2. Fill Materials

The on-site sandy/silty soils free of organic materials, debris and cobbles larger than 3 inches may be used for backfilling purposes. Also, imported granular soils may be used in the required compacted fills within the subject project site. Imported materials should contain sufficient fines (binder material) to be relatively impermeable and result in a stable subgrade when compacted. The imported materials should also be low expansive, with an EI less than 35 and free of organic materials, debris and cobbles larger than 3 inches, with no more than 25 percent of materials being larger than 2 inches in size and no more than 25 percent passing #200 Sieve. Within the upper 2 feet of fills the materials should be free of particles greater than 2 inches in size. A bulk sample of potential import material, weighing at least 30 pounds, should be submitted to the Geotechnical Consultant at least 48 hours before fill operations. All proposed import materials should be approved by the Geotechnical Consultant prior to being placed at the site.

5.2.3. Utility Trench Bedding and Backfill

Bedding materials consisting of sand, gravel, or crushed aggregate should be used to backfill around utility pipes to approximately one foot above the top of the pipe. Onsite soils which have a Sand Equivalent (SE) of 30 or greater can also be used as bedding material. Prior to placing the pipes, the pipe trench subgrade should be observed by a representative of the project geotechnical engineer. If the exposed subgrade is loose or unstable, the unsuitable subgrade soil must be excavated and replaced with bedding material. Bedding must be placed uniformly on each side of the pipe and mechanically compacted. Flooding or jetting to densify the bedding materials is

allowed unless clayey material is encountered at the bottom of trench. The fill should be placed in loose lifts not to exceed 8 inches, moisture-conditioned within optimum and 3% above optimum moisture content, and mechanically compacted to at least 90% relative compaction in accordance with ASTM D1557. Thinner lifts may be necessary to achieve the recommended level of compaction of the backfill due to equipment limitations.

5.2.4. Temporary Excavation

Temporary excavations must be properly sloped or shored. Based on the earth materials encountered in our borings, excavation of 5 feet or less in depth may be performed with vertical sidewalls. Deeper excavation up to a depth of 15 feet can be accomplished in accordance with the Occupational Safety and Health Administration (OSHA) requirements for Type B soils and shall be laid back at 1H:1V gradient.

The contractor is responsible for maintaining the stability of the cuts and personnel safety in the field during construction. All excavations shall be performed in accordance with applicable requirements established by the State, County, or local government. The regulatory requirement may supersede the recommendations presented in this section. The Geotechnical Engineer of Record's representative should be present during all excavations.

5.3. RETAINING WALLS

5.3.1. Wall Backfill

The backfill behind the walls should be placed and compacted per recommendations provided in Section 5.2 of this report. Retaining wall backfill and typical subdrain details for conditions of native soil, imported sand, or crushed rock are provided in Appendix D.

5.3.2. Lateral Earth Pressure

For design of the conventional retaining walls and their footings, the lateral earth pressures may be assumed to be equal to hydrostatic pressure of an equivalent liquid with the densities listed in the following Table 1. Active pressure should be used for lateral earth pressure of the backfill behind the wall. The passive pressure and friction factor should be used for design of the footings for lateral loads. The provided values in Table 1 are based on the assumption that the fill material as recommended in Section 5.2.2, as well as the bearing material below the foundations, will have a minimum friction angle of 34 degrees.

Table 1. Earth Lateral Pressures and Resistance Factors

Active Pressure – Drained Soil (Equivalent Fluid Density)	Level Backfill	35 pcf
	1.5H:1V Ascending Backfill	82 pcf
Active Pressure – Undrained Soil (Equivalent Fluid Density)	Level Backfill	80 pcf
	1.5H:1V Ascending Backfill	102 pcf
Passive Pressure (Equivalent Fluid Density)	Level Backfill	285 pcf
	1.5H:1V Descending Backfill	55 pcf
Friction Factor (Between Soil and Concrete Footing)		0.35

In addition to the above active earth pressure, walls more than 6 feet high, should be designed to support a seismic active pressure. The seismic active lateral earth pressure may be assumed to be equal to hydrostatic pressure of an equivalent liquid with a density of 24 pounds per cubic foot (pcf).

Also, the retaining walls should be designed to resist any lateral surcharges due to the traffic, nearby buildings or construction loads. Surcharge loads within a 1H:1V plane extending up from the base of the wall should be included in the design lateral pressures by taking 35% of the surcharge pressure applied as a uniform load along the height of the wall.

5.3.3. Wall Foundation

The footing for the retaining wall should be embedded a minimum of 18 inches below the lowest adjacent finish grade, supported on minimum of 12 inches within competent bedrock or at least 24 inches of soil compacted to at least 90% relative compaction in accordance with ASTM D1557. The retaining wall may be supported on strip footings designed using a maximum allowable bearing pressure of 2,500 psf. A one-third increase in the bearing capacity may be used when considering wind or seismic loads. Also, foundations on or adjacent to slopes shall comply with the requirements addressed in Section 1808.7 of CBC 2019.

The footings may be designed for resisting against lateral loads using the passive pressure and friction factor values provided in Table 1. When combining both frictional and passive resistance, the passive resistance should be reduced by one-third. The recommended values may be increased by one-third for short-term loading.

Settlements: Based on the results of our investigation, the total settlements due to wall loads are expected to be less than 1.0 inch, and the maximum differential settlements are expected to be of the order of ½ inch over a 50-foot span.

5.4. Surface Drainage

Inadequate control of run-off water and/or heavy irrigation after construction of the proposed

improvements may lead to adverse conditions. Maintaining adequate surface drainage, proper disposal of run-off water, and control of irrigation will help reduce the potential for future moisture related problems and differential movements from soil heave/settlement.

Surface drainage should be carefully taken into consideration during grading, landscaping and building construction. Positive surface drainage should be provided to direct surface water away from wall and toward a suitable drainage device.

5.5. PAVEMENT DESIGN

Pavement sections have been designed in accordance with the procedures presented in the Caltrans Highway Design Manual (HDM). This pavement design procedure is based on the Traffic Index (TI) and the R-value of the subgrade soils. Based on our field observations and laboratory testing results obtained from the current investigation, the subgrade soils have an R-value of 21. The following alternative pavement sections presented in Table 2, are recommended for traffic indices of 6 through 9 and design R-value of 21.

Table 2. Pavement Design

TI	HMA/AB (in/in)	Full Depth HMA (in)	Full Depth RHMA/HMA (in/in)
6.0	3.5/9.5	8.0	2.0/4.5
7.0	4.0/12.0	9.5	2.0/6.0
8.0	5.0/13.0	11.0	2.0/7.5
9.0	5.5/15.5	12.5	2.0/9.0

HMA: Hot Mix Asphalt
AB: Aggregate Base
RHMA: Rubberized Hot Mix Asphalt

The exposed subgrade should be scarified to a minimum depth of 8 inches, moisture-conditioned between optimum and 3% above optimum moisture content and compacted to a minimum relative compaction of 90% and 95% of the maximum dry density obtained per ASTM D1557 for asphalt over aggregate base and full depth asphalt options, respectively.

AB sections may utilize crushed aggregate base (CAB) or crushed miscellaneous base (CMB) complying with applicable sections of the Standard Specifications for Public Works Construction (Greenbook) or Class 2 AB complying with the applicable sections of the Caltrans Standard Specifications, latest edition. The AB material should have a minimum R-value of 78 and should be compacted to at least 95% of the maximum dry density obtained per ASTM D1557. Asphalt concrete shall comply with the requirements addressed in the latest edition of the Caltrans Standard

Specifications or Greenbook. All the construction operations related to earthwork and pavement section should follow the Caltrans Standard Specifications or Greenbook, as they are applicable.

5.6. SOIL CORROSIVITY

A representative bulk sample obtained from the borings drilled within the subject project site was tested for pH, minimum resistivity, soluble chloride content and soluble sulfate content. The test results indicate that the onsite soils show moderate sulfate exposure. As such, sulfate resistant cement is required for concrete in contact with onsite soils, and Type II or V Portland cement may be used. The measured resistivity and pH indicate that onsite soils are corrosive to buried ferrous metals. Further interpretation of the corrosivity test results and providing corrosion design and construction recommendations are referred to corrosion specialists.

5.7. REVIEW OF CONSTRUCTION PLANS

Recommendations contained in this report are based on preliminary plans. The geotechnical consultant should review the final construction plans and specifications in order to confirm that the general intent of the recommendations contained in this report have been implemented into the final construction documents. Recommendations contained in this report may require modification or additional recommendations may be necessary based on the final design.

5.8. GEOTECHNICAL OBSERVATION AND TESTING

It is recommended that inspection and testing be performed by the geotechnical consultant during the following stages of construction:

- Grading operations, including over-excavation and placement of compacted fill;
- Observation of foundation excavation;
- Excavations and backfilling for utility trenches; and
- When any unusual subsurface conditions are encountered.

6. CLOSURE

This report is intended for use by the City of Rolling Hills Estates and its consultants for design and construction associated with the proposed PVDN and Dapplegray ES Intersection Improvements Project in the City of Rolling Hills Estates, California, at the location indicated on Figure 1 in Appendix A.

The findings and recommendations contained in this report are based on the results of the field investigation, laboratory tests, and engineering analyses, combined with an extrapolation of subsurface conditions between and beyond the boring/exploration locations.

Services performed by Willdan Geotechnical have been conducted in accordance with generally accepted professional geotechnical engineering principles and practices at this time. No other representation, expressed or implied, and no warranty or guarantee is included or intended.

7. REFERENCES

- American Society for Testing and Materials (ASTM), Annual Book of Standards, Soil and Rock; Dimension Stone; Geosynthetics, Vol. 04.08.
- California Building Code, CBC 2019.
- California Department of Conservation, Division of Mines and Geology, Seismic Hazard Zone Report 038, Seismic Hazard Zone Report for the Torrance 7.5-Minute Quadrangle, Los Angeles County, California.

APPENDIX A. FIGURES

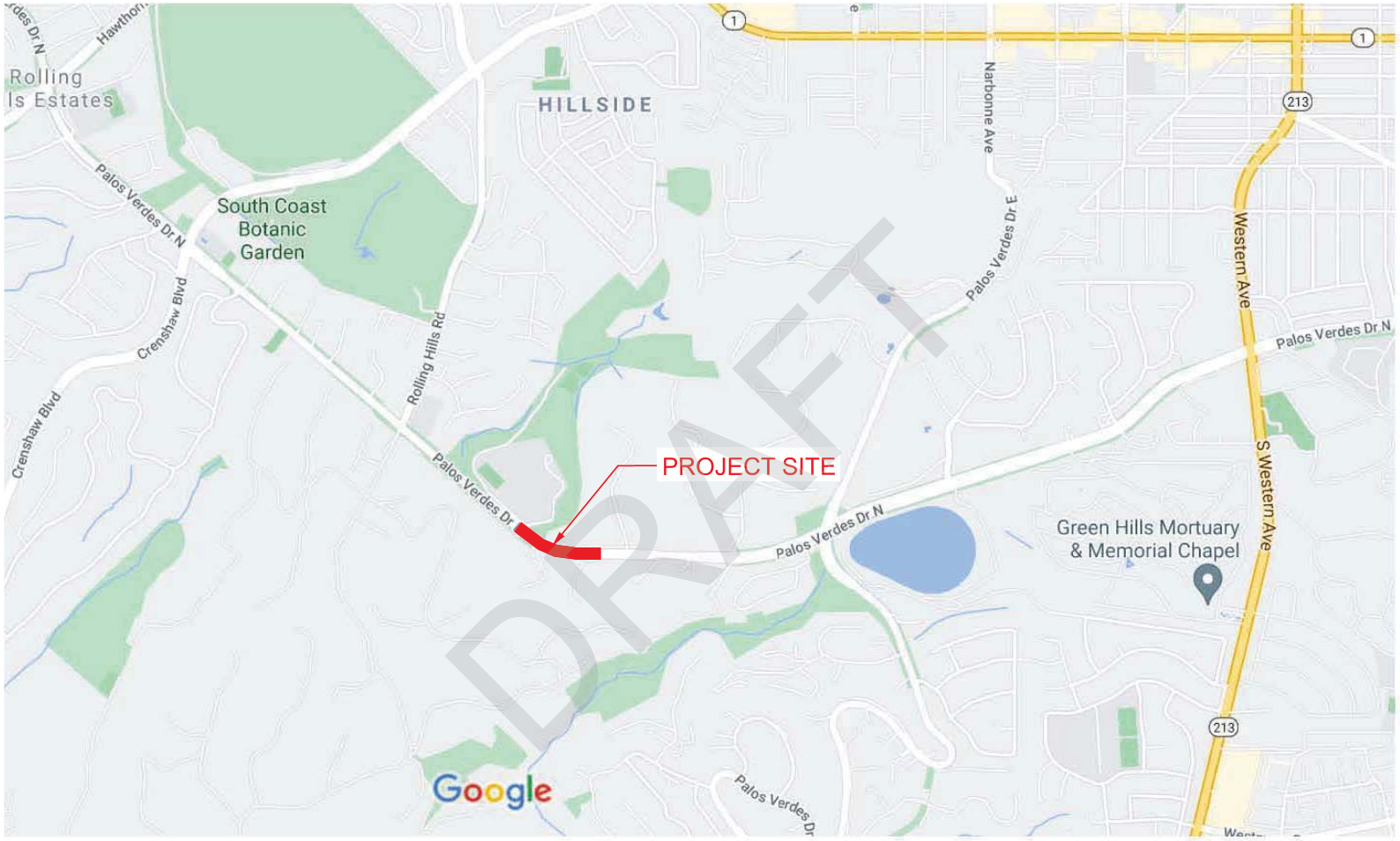

FIGURE 1. SITE LOCATION MAP

PVDN & DAPPLEGRAY SCHOOL ENTRANCE INTERSECTION IMPROVEMENTS
ROLLING HILLS ESTATES, CALIFORNIA

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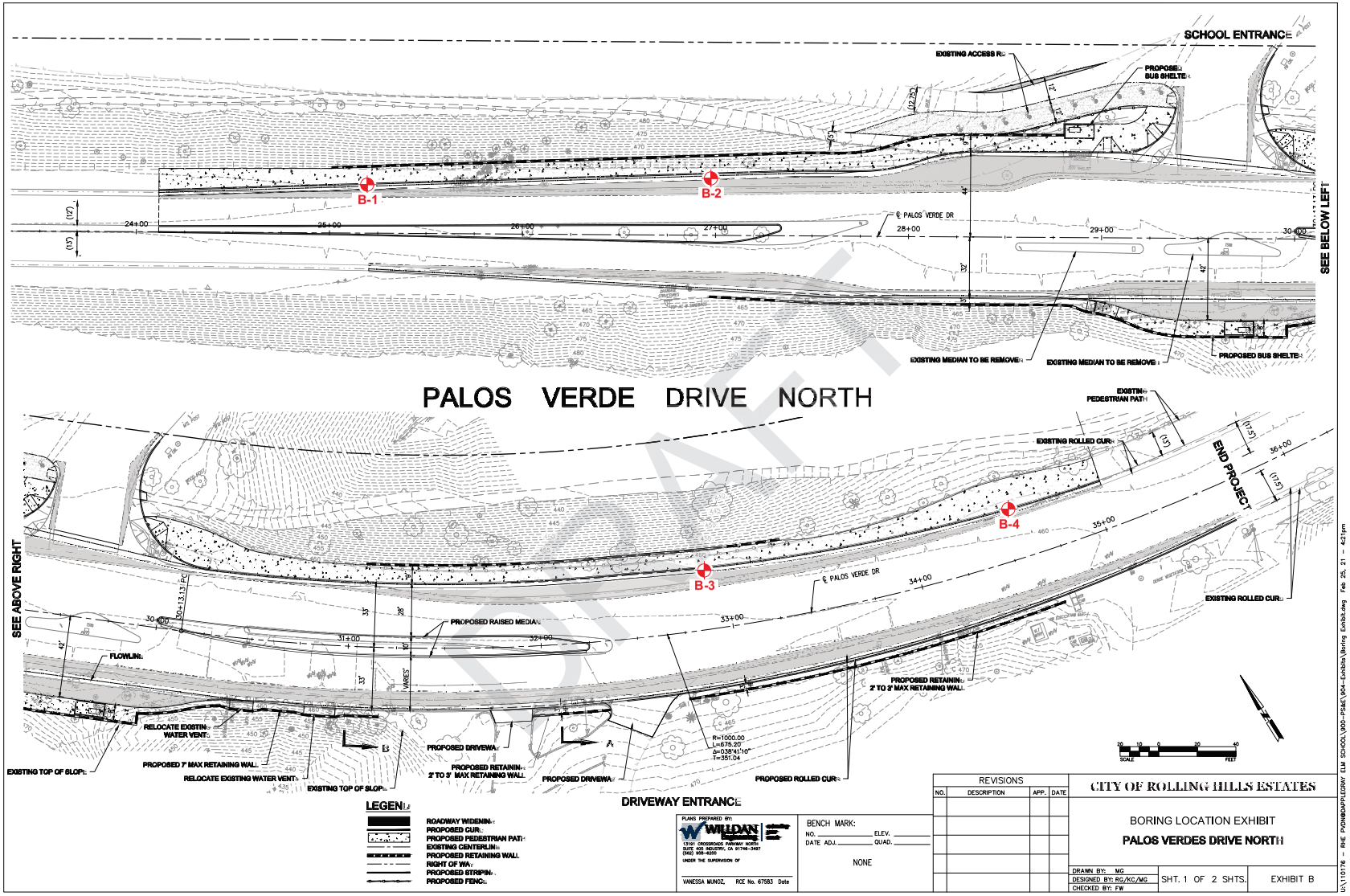
Drawn By: MR	Date: 06-23-2021
Approved By: MR	Project No.: 110176-2000-400



REVISIONS			
NO.	DESCRIPTION	APP.	DATE

CITY OF ROLLING HILLS ESTATES

BORING LOCATION EXHIBIT

PALOS VERDES DRIVE NORTH

PLANS PREPARED BY:
WILLDAN Geotechnical
13191 CROSSROADS PARKWAY NORTH
SUITE 405 INDUSTRY, CA 91746-3487
(562) 908-4200
UNDER THE SUPERVISION OF
VANESSA MUNOZ, RCE No. 67583 Date

BENCH MARK:
NO. _____ ELEV. _____
DATE ADJ. _____ QUAD. _____
NONE

DRAWN BY: MG
DESIGNED BY: RG/KC/MG
CHECKED BY: FW

SHT. 1 OF 2 SHTS.

EXHIBIT B

U:\110176 - RHE PVDN&DAPPLEGRAY ELM SCHOOL\800-PS&E\804-Exhibits\Boring Exhibit.dwg Feb 25, 21 - 4:21pm

B-4 Approximate Boring Location

FIGURE 2. BORING LOCATION PLAN

PVDN & DAPPLEGRAY SCHOOL ENTRANCE INTERSECTION IMPROVEMENTS ROLLING HILLS ESTATES, CALIFORNIA

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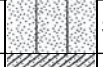
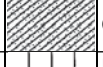
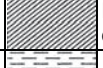
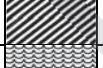
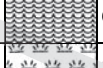
Drawn By: MR Date: 06-23-2021

Approved By: MR Project No.: 110176-2000-400

APPENDIX B. BORING LOGS

MAJOR DIVISIONS			SYMBOLS		TYPICAL NAMES
COARSE GRAINED SOILS Half is larger than no. 200 sieve	GRAVELS More than half coarse fraction is larger than no. 4 sieve	Clean gravels with little or no fines	GW		Well graded gravels, gravel-sand mixtures
			GP		Poorly graded gravels, gravel-sand mixtures
		Gravels with over 12% fines	GM		Silty gravels, poorly graded gravel-sand-silt mixtures
			GC		Clayey gravels, poorly graded gravel-sand-clay mixtures
	SANDS More than half coarse fraction is smaller than no. 4 sieve	Clean sands with little or no fines	SW		Well graded sands, gravelly sands
			SP		Poorly graded sands, gravelly sands
		Sands with over 12% fines	SM		Silty sands, poorly graded sand-silt mixtures
			SC		Clayey sands, poorly graded sand-clay mixtures
FINE GRAINED SOILS Half is smaller than no. 200	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 clays and organic silty clays of low plasticity
	SILTS AND CLAYS Liquid limit greater than 50		MH		Inorganic silts, micaceous or diatomaceous fine, sandy or silty soils, elastic silts
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			Pt		Peat and other highly organic soils

GRANULAR SOILS

RELATIVE DENSITY	BLOWS/FOOT* SPT	BLOWS/FOOT* CD
VERY LOOSE	0 - 4	0 - 8
LOOSE	5 - 10	9 - 18
MEDIUM DENSE	11 - 30	19 - 54
DENSE	31 - 50	55 - 90
VERY DENSE	OVER 50	OVER 90

FINE-GRAINED SOILS

CONSISTENCY	BLOWS/FOOT* SPT	BLOWS/FOOT* CD
SOFT	0 - 4	0 - 4
FIRM	5 - 8	5 - 9
STIFF	9 - 15	10- 18
VERY STIFF	16 - 30	19 - 39
HARD	OVER 30	OVER 39

*Conversion between California Drive (CD) and Standard Penetration Test (SPT) blow count has been calculated using "Foundation Engineering Hand Book" by H.Y. Fang.

STANDARD PENETRATION TEST SAMPLE
Split Barrel sampler in accordance with

MODIFIED CALIFORNIA SAMPLE
2.416" inside diameter

SHELBY TUBE SAMPLE

BULK SAMPLE

WATER TABLE

TEST TYPE
Results shown in Appendix B

	OTHER
Corrosion Analysis	CA
Sieve Analysis	SA
Unconfined Compression	UC
Hydrometer Analysis	HA
Expansion Index	EI
California Bearing Ratio	CBR
% Passing #200 Sieve	W
Pocket Penetrometer	PP
Direct Shear	DS
Direct Shear (Remolded)	DS_R
Atterberg Limits	AL
Consolidation	CN
R-Value	R
Undrained-Unconsolidated Shear	UU

EXPLORATION LOG KEY

BORING LOG B-1

Borehole Location: **See Figure 2**	Approximate Grade Elevation:	Sheet **1** of **1**
Borehole Coordinates: **33.773831N 118.339984W**	Date Started: **06/16/21**	Date Finished: **06/16/21**
Drilling Equipment: **CME 75**	Total Depth: **12.8 ft**	Depth to Groundwater: **GW Not Encountered.**
Drilling Method: **Hollow Stem Auger**	Borehole Diameter: **8"**	
Driller: **Choice Drilling, Inc.**	Logged By: **RC**	Checked By: **MR**
Hammer Information: **140 lb and 30" Drop Height**		

Elevation (ft)	Depth (ft)	Lithology	Description	Remarks	Sampler	Number	Blows/6"	Moisture Content (%)	Dry Density (pcf)	Additional Tests
	0		4" Asphalt Concrete							
			Silty SAND (SM); brown, moist			B-1				
			Bedrock							
			SANDSTONE (SM); very dense, brown, moist							
	5		(disturbed)			R-1	30/50(5")	20.9		SA
	10					R-2	33/50(6")	39.9	62	DS
						R-3	50(3")			
			refusal to drill at 12.5' (no recovery)							
			Total Depth 12.8 ft							
			GW Not Encountered.							
	15		Backfilled with Excavation Spoils and Compacted.							
	20									
	25									
	30									

WILLDAN Geotechnical

PVDN & Dapplegray Intersection Improvements

Project Number: 110176-2000-400

FIGURE B-2

BORING LOG B-2

Borehole Location: **See Figure 2**	Approximate Grade Elevation:	Sheet **1** of **1**
Borehole Coordinates: **33.773494N 118.339495W**	Date Started: **06/16/21**	Date Finished: **06/16/21**
Drilling Equipment: **CME 75**	Total Depth: **20.7 ft**	Depth to Groundwater: **GW Not Encountered.**
Drilling Method: **Hollow Stem Auger**	Borehole Diameter: **8"**	
Driller: **Choice Drilling, Inc.**	Logged By: **RC**	Checked By: **MR**
Hammer Information: **140 lb and 30" Drop Height**		

Elevation (ft)	Depth (ft)	Lithology	Description	Remarks	Sampler	Number	Blows/6"	Moisture Content (%)	Dry Density (pcf)	Additional Tests
	0		4" Asphalt Concrete							
			Silty SAND (SM); brown, moist			B-1				SA
			Bedrock							
	5		SANDSTONE (SM); dense, brown, moist			R-1	15/23/50(5")	28.6	79	DS
	10		SILTSTONE (MH); hard, light gray, moist			R-2	30/50(6")	27.5	81	W, AL
	15		SANDSTONE (SC); very dense, light brown, moist			R-3	34/50(5")	29.3	76	
	20					R-4	30/50(2")	26.1	83	DS
			Total Depth 20.7 ft GW Not Encountered. Backfilled with Excavation Spoils and Compacted.							
	25									
	30									

WILLDAN Geotechnical

PVDN & Dapplegray Intersection Improvements

Project Number: 110176-2000-400

FIGURE B-3

BORING LOG B-3

Borehole Location: **See Figure 2**	Approximate Grade Elevation:	Sheet **1** of **1**
Borehole Coordinates: **33.772549N 118.337952W**	Date Started: **06/16/21**	Date Finished: **06/16/21**
Drilling Equipment: **CME 75**	Total Depth: **31.2 ft**	Depth to Groundwater: **GW Not Encountered.**
Drilling Method: **Hollow Stem Auger**	Borehole Diameter: **8"**	
Driller: **Choice Drilling, Inc.**	Logged By: **RC**	Checked By: **MR**
Hammer Information: **140 lb and 30" Drop Height**		

Elevation (ft)	Depth (ft)	Lithology	Description	Remarks	Sampler	Number	Blows/6"	Moisture Content (%)	Dry Density (pcf)	Additional Tests
	0		4" Asphalt Concrete							
			Sandy CLAY (CL); brown, moist			B-1				R, CA
	5		very stiff (disturbed)			R-1	11/18/20	15		
	10		hard			R-2	26/35/50(4")			
	15		Fat CLAY (CH); hard, dark brown, moist			R-3	16/22/34	26	92	W, AL, DS
	20					R-4	24/31/37	25.5	90	
	25		Bedrock CLAYSTONE (CH); hard, dark brown, moist			R-5	15/30/42	23.5	95	
	30					R-6	13/32/50(2")	21.5	80	DS
			Total Depth 31.2 ft GW Not Encountered. Backfilled with Excavation Spoils and Compacted.							

WILLDAN Geotechnical

PVDN & Dapplegray Intersection Improvements

Project Number: 110176-2000-400

FIGURE B-4

BORING LOG B-4

Borehole Location: **See Figure 2**	Approximate Grade Elevation:	Sheet **1** of **1**
Borehole Coordinates: **33.772412N 118.337458W**	Date Started: **06/16/21**	Date Finished: **06/16/21**
Drilling Equipment: **CME 75**	Total Depth: **21.5 ft**	Depth to Groundwater: **GW Not Encountered.**
Drilling Method: **Hollow Stem Auger**	Borehole Diameter: **8"**	
Driller: **Choice Drilling, Inc.**	Logged By: **RC**	Checked By: **MR**
Hammer Information: **140 lb and 30" Drop Height**		

Elevation (ft)	Depth (ft)	Lithology	Description	Remarks	Sampler	Number	Blows/6"	Moisture Content (%)	Dry Density (pcf)	Additional Tests
	0		3" Asphalt Concrete over 7" Aggregate Base							
			Clayey SAND with Gravel (SC); brown, moist			B-1				
	5		medium dense			R-1	8/10/10	17.5	79	SA
	10					R-2	10/13/16	21.9	77	DS
	15		Bedrock SANDSTONE (SC); medium dense, brown, moist			R-3	12/15/17	20.9	77	
	20					R-4	13/17/22	22.5	82	SA, AL, DS
			Total Depth 21.5 ft GW Not Encountered. Backfilled with Excavation Spoils and Compacted.							
	25									
	30									

WILLDAN Geotechnical

PVDN & Dapplegray Intersection Improvements

Project Number: 110176-2000-400

FIGURE B-5

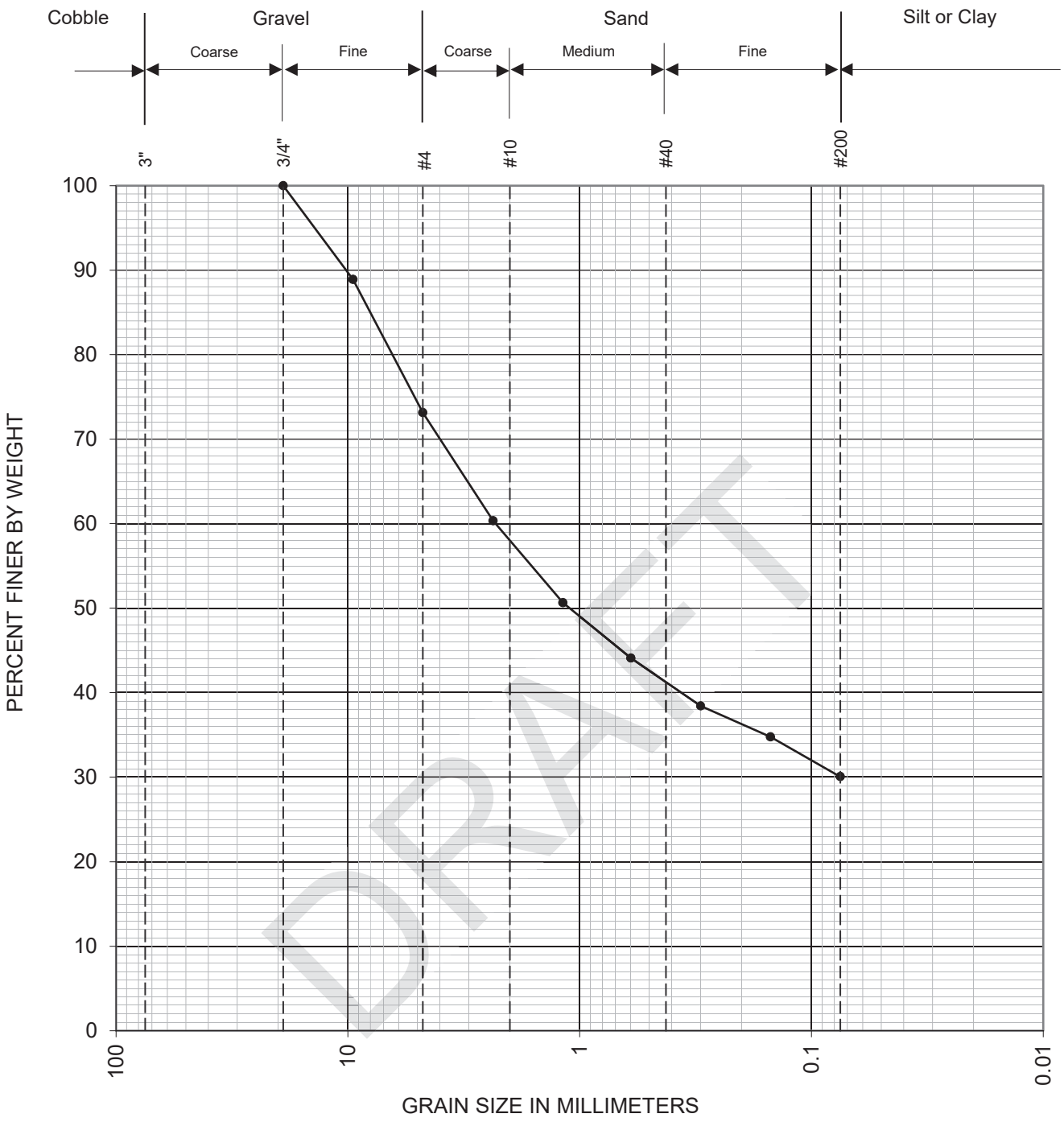
APPENDIX C. LABORATORY TEST RESULTS

TABLE C-1. SUMMARY OF LABORATORY TEST RESULTS

PVDN & Dapplegray Intersection Improvements, Rolling Hills Estates, California

Willdan Project No. 110176-2000-400

Sample		USCS Soil Description	Gradation (ASTM D422)	Passing #200 Sieve (ASTM D1140)	Atterberg Limits (ASTM D4318)		R-Value (CTM 301)	Direct Shear (ASTM D3080)				Corrosivity (CTM 422, 417, 643)			
								Peak		Ultimate					
Boring No.	Depth (ft)		(% G : S : F)	(% F)	Liquid Limit	Plasticity Index		c (psf)	ϕ (°)	c (psf)	ϕ (°)	pH	Soluble Sulfate (ppm)	Soluble Chloride (ppm)	Minimum Resistivity (ohm-cm)
B-1	5.0 - 5.9	SANDSTONE (SM)	27 : 43 : 30												
	10.0 - 11.0	SANDSTONE (SM)						1060	30.5	835	30.0				
B-2	0.0 - 5.0	Silty SAND (SM)	11 : 45 : 44												
	5.0 - 6.4	SANDSTONE (SM)						695	25.0	390	25.0				
	10.0 - 11.0	SILTSTONE (MH)		62	68	32									
	20.0 - 20.7	SANDSTONE (SC)						170	33.0	165	27.0				
B-3	0.0 - 5.0	Sandy CLAY (CL)					21					8.00	315	150	987
	15.0 - 16.5	Fat CLAY (CH)		87	80	53		1140	25.5	590	23.0				
	30.0 - 31.2	CLAYSTONE (CH)						415	27.5	125	27.5				
B-4	5.0 - 6.5	Clayey SAND with Gravel (SC)	25 : 32 : 43												
	10.0 - 11.5	Clayey SAND with Gravel (SC)						665	30.5	545	30.5				
	20.0 - 21.5	SANDSTONE (SC)	21 : 51 : 28		61	33		415	27.0	310	26.5				



Boring No.	Sample No.	Depth	USCS Symbol	Classification	Natural W %	LL	PL	PI
B-1	R-1	5.0'	SM	Silty SAND with Gravel				

% +3"	% Gravel	% Sand	% Fines
0	27	43	30

C_u	C_c

Project Name: PVDN & Dapplegray Intersection Improvements

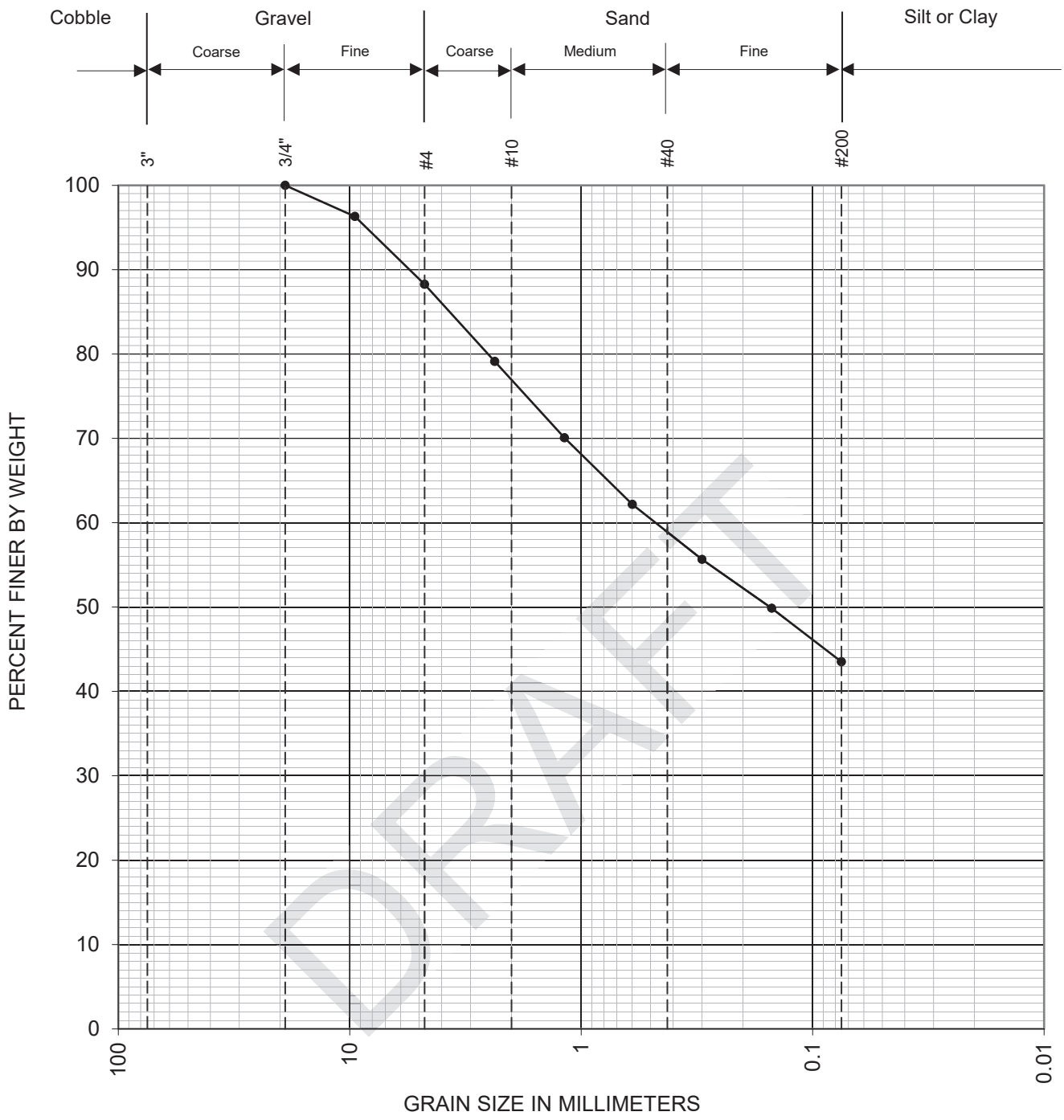
Project No.: 110176-2000-400

PARTICLE SIZE CURVE

(ASTM D6913)

WILLDAN Geotechnical

extending your reach



Boring No.	Sample No.	Depth	USCS Symbol	Classification	Natural W %	LL	PL	PI
B-2	Bulk	0.0' - 5.0'	SM	Silty SAND				

% +3"	% Gravel	% Sand	% Fines
0	11	45	44

C_u	C_c

Project Name: PVDN & Dapplegray Intersection Improvements

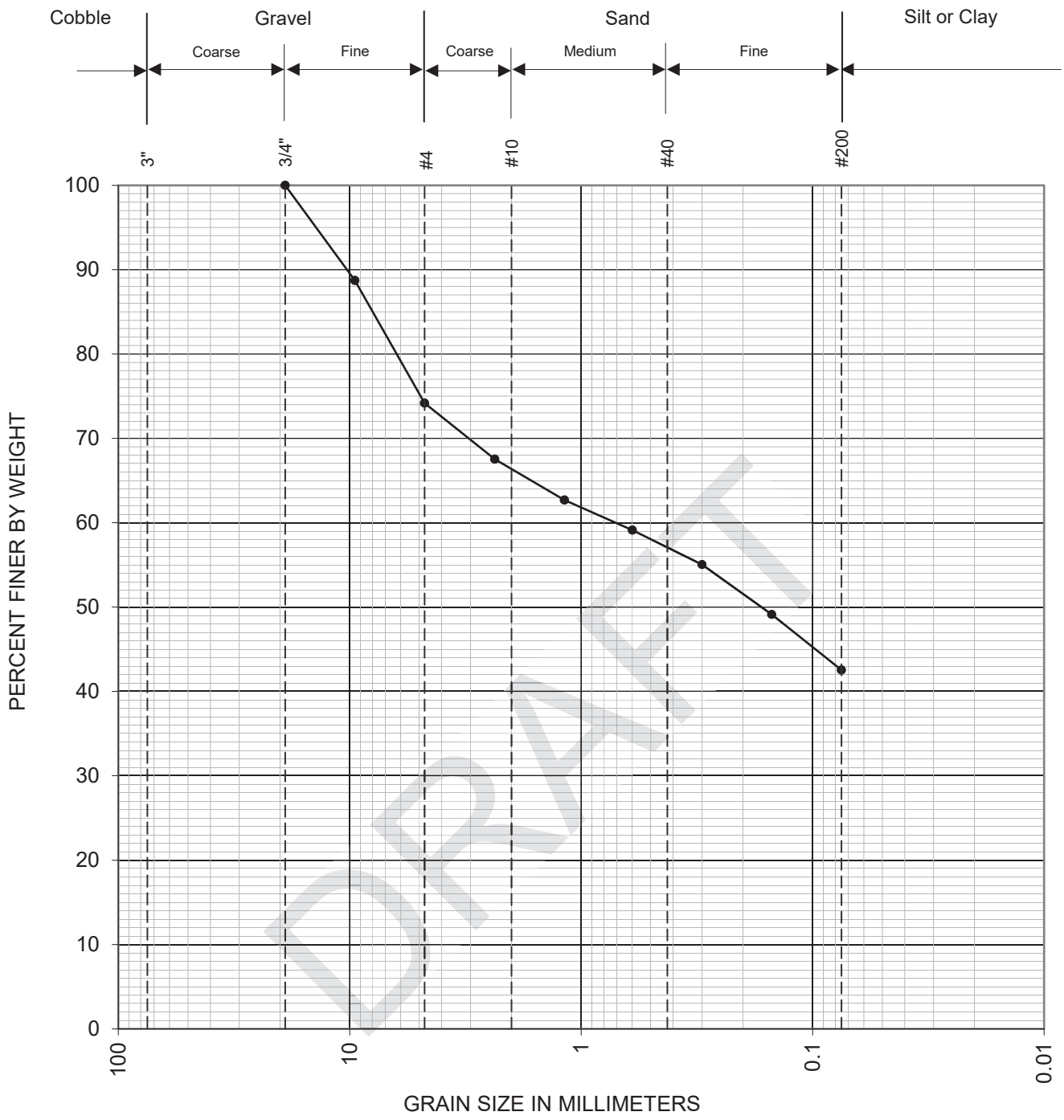
Project No.: 110176-2000-400

PARTICLE SIZE CURVE

(ASTM D6913)

WILLDAN Geotechnical

extending your reach



Boring No.	Sample No.	Depth	USCS Symbol	Classification	Natural W %	LL	PL	PI
B-4	R-1	5.0'	SC	Clayey SAND with Gravel				

% +3"	% Gravel	% Sand	% Fines
0	25	32	43

C_u	C_c

Project Name: PVDN & Dapplegray Intersection Improvements

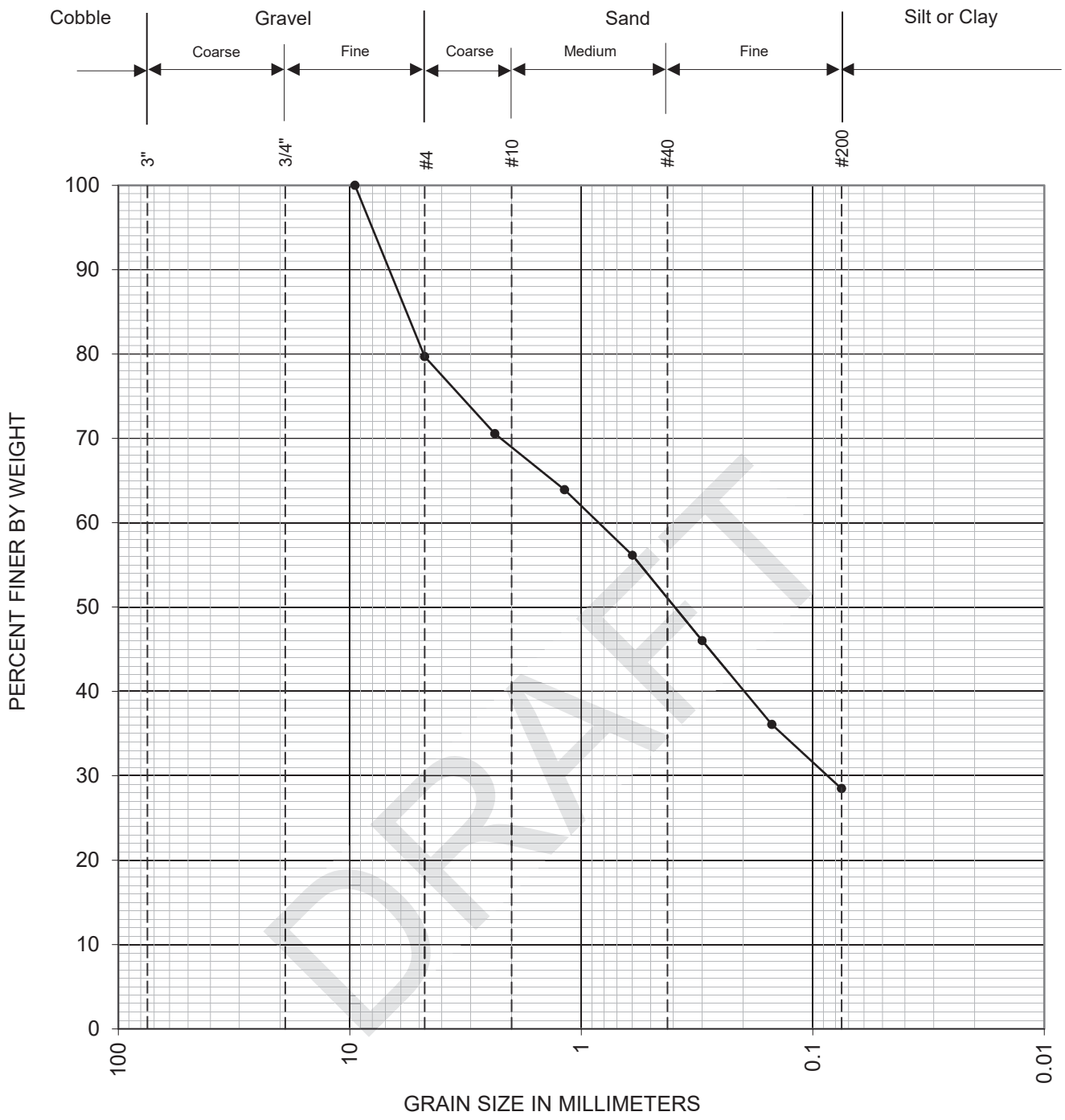
Project No.: 110176-2000-400

PARTICLE SIZE CURVE

(ASTM D6913)

WILLDAN Geotechnical

extending your reach



Boring No.	Sample No.	Depth	USCS Symbol	Classification	Natural W %	LL	PL	PI
B-4	R-4	20.0'	SC	Clayey SAND with Gravel				

% +3"	% Gravel	% Sand	% Fines
0	21	51	28

C_u	C_c

Project Name: PVDN & Dapplegray Intersection Improvements

Project No.: 110176-2000-400

PARTICLE SIZE CURVE

(ASTM D6913)

WILLDAN Geotechnical

extending your reach

Project Name :	PVDN & Dapplegray Intersection Improvements	Project No.:	110176-2000-400
Sample Location / Source :	B-2	Tested by :	RMC
Sample Depth / No. :	10.0'	Sampled by:	
Sample Description / Classification :	SILTSTONE (MH)		

Date: 6/23/2021

Date:

PLASTIC LIMIT

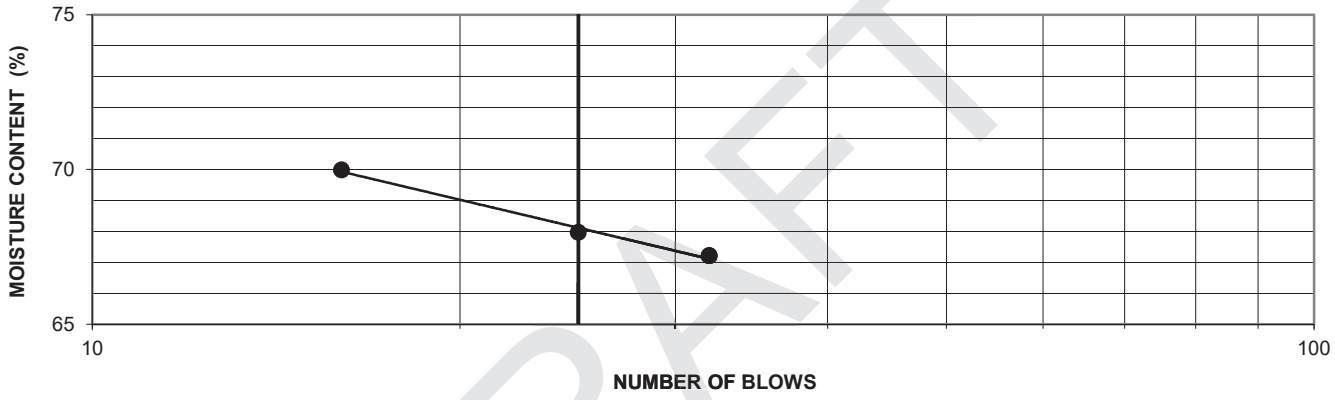
DETERMINATION NO.		1	
DISH NO.		9	
MASS, DISH + WET SOIL	(g)	42.27	
MASS, DISH + DRY SOIL	(g)	36.66	
MASS OF WATER	(g)	5.61	
MASS OF DISH	(g)	21.12	
MASS OF DRY SOIL	(g)	15.54	
MOISTURE CONTENT	(%)	36.1	

LIQUID LIMIT

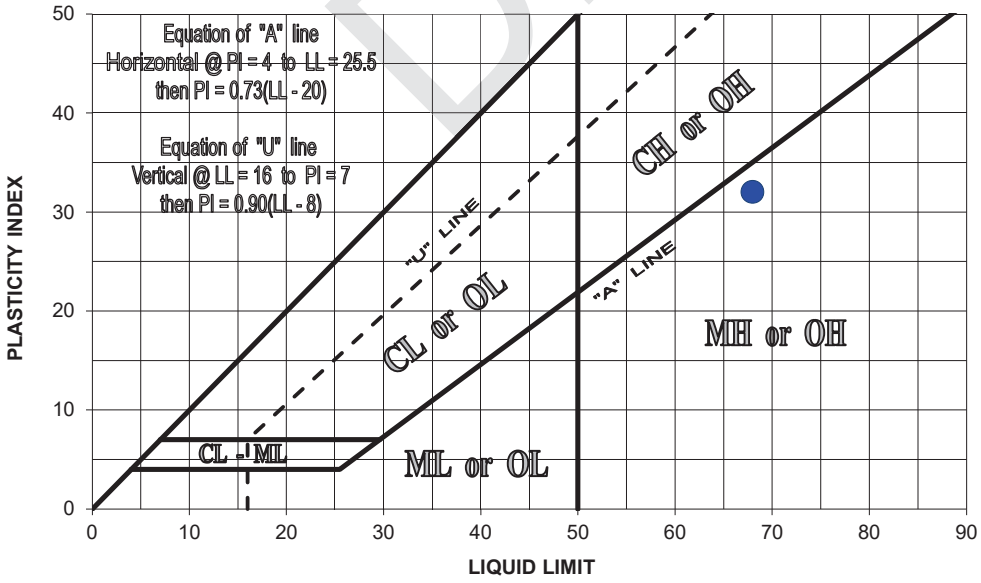
DETERMINATION NO.		1	2	3
DISH NO.		21	20	7
MASS, DISH + WET SOIL	(g)	32.27	37.63	35.65
MASS, DISH + DRY SOIL	(g)	28.75	32.75	31.90
MASS OF WATER	(g)	3.52	4.88	3.75
MASS OF DISH	(g)	23.72	25.57	26.32
MOISTURE CONTENT	(%)	70.0	68.0	67.2
NUMBER OF BLOWS		16	25	32

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	**68**
PLASTIC LIMIT (PL)	**36**
PLASTICITY INDEX (PI)	**32**
SYMBOL FROM PLASTICITY CHART	**MH**

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

WILLDAN Geotechnical — extending your reach

Project Name :	PVDN & Dapplegray Intersection Improvements	Project No.:	110176-2000-400
Sample Location / Source :	B-3	Tested by :	RMC
Sample Depth / No. :	15.0'	Sampled by:	
Sample Description / Classification :	Fat CLAY (CH)		

Date: 6/23/2021

Date:

PLASTIC LIMIT

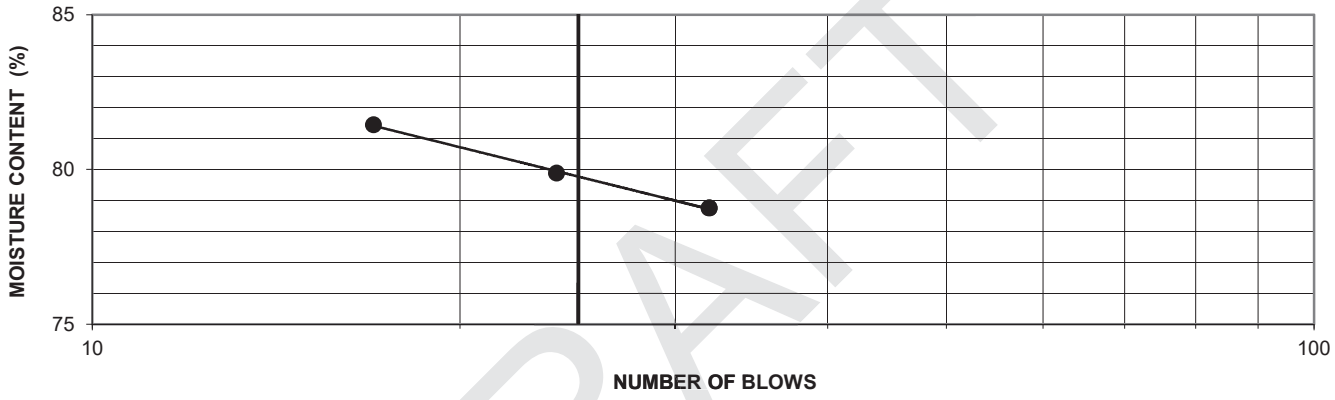
DETERMINATION NO.		1	
DISH NO.		15	
MASS, DISH + WET SOIL	(g)	39.72	
MASS, DISH + DRY SOIL	(g)	36.26	
MASS OF WATER	(g)	3.46	
MASS OF DISH	(g)	23.62	
MASS OF DRY SOIL	(g)	12.64	
MOISTURE CONTENT	(%)	27.4	

LIQUID LIMIT

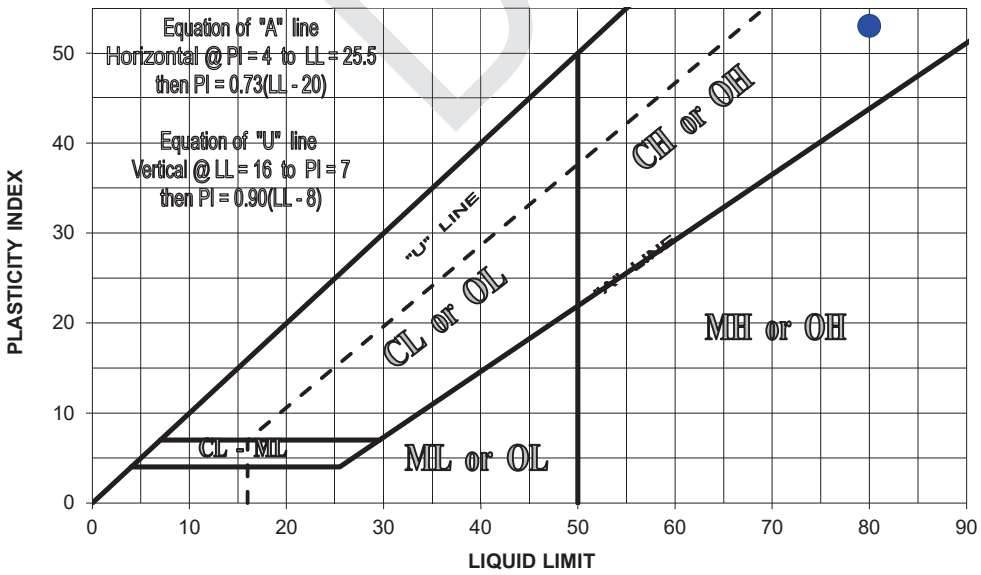
DETERMINATION NO.		1	2	3
DISH NO.		18	12	4
MASS, DISH + WET SOIL	(g)	35.67	33.04	32.82
MASS, DISH + DRY SOIL	(g)	30.80	29.07	28.15
MASS OF WATER	(g)	4.87	3.97	4.67
MASS OF DISH	(g)	24.82	24.10	22.22
MOISTURE CONTENT	(%)	81.4	79.9	78.8
NUMBER OF BLOWS		17	24	32

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	**80**
PLASTIC LIMIT (PL)	**27**
PLASTICITY INDEX (PI)	**53**
SYMBOL FROM PLASTICITY CHART	**CH**

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

WILLDAN Geotechnical — extending your reach

Project Name :	PVDN & Dapplegray Intersection Improvements	Project No.:	110176-2000-400
Sample Location / Source :	B-4	Tested by :	RMC
Sample Depth / No. :	20.0'	Sampled by:	
Sample Description / Classification :	SANDSTONE (SC)		

Date: 6/23/2021

Date:

PLASTIC LIMIT

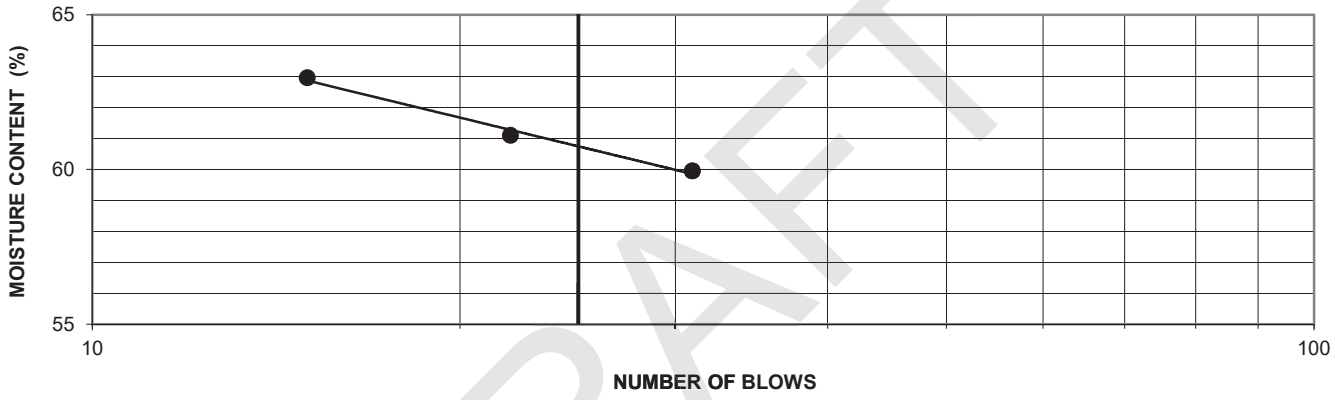
DETERMINATION NO.		1	
DISH NO.		17	
MASS, DISH + WET SOIL	(g)	42.13	
MASS, DISH + DRY SOIL	(g)	38.01	
MASS OF WATER	(g)	4.12	
MASS OF DISH	(g)	23.3	
MASS OF DRY SOIL	(g)	14.71	
MOISTURE CONTENT	(%)	28.0	

LIQUID LIMIT

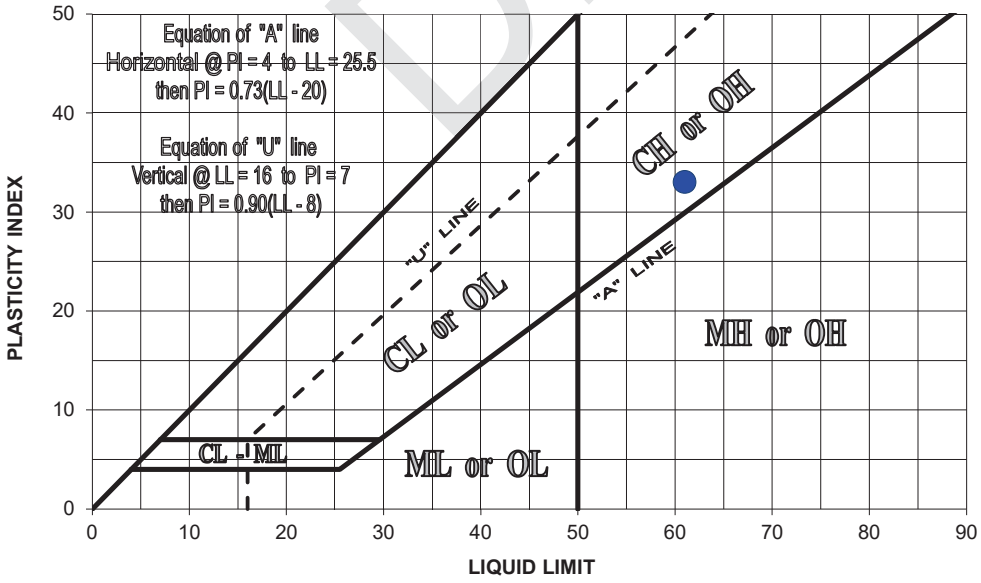
DETERMINATION NO.		1	2	3
DISH NO.		13	29	14
MASS, DISH + WET SOIL	(g)	37.80	43.29	38.46
MASS, DISH + DRY SOIL	(g)	32.77	38.39	33.94
MASS OF WATER	(g)	5.03	4.90	4.52
MASS OF DISH	(g)	24.78	30.37	26.40
MOISTURE CONTENT	(%)	63.0	61.1	59.9
NUMBER OF BLOWS		15	22	31

NATURAL MOISTURE CONTENT,%

FLOW CURVE



PLASTICITY CHART



RESULT SUMMARY

NATURAL MOISTURE CONTENT, (%)	
LIQUID LIMIT (LL)	**61**
PLASTIC LIMIT (PL)	**28**
PLASTICITY INDEX (PI)	**33**
SYMBOL FROM PLASTICITY CHART	**CH**

METHOD OF PREPARATION		METHOD OF LL DETERMINATION	
DRY	X	MULTIPOINT	X
WET		ONE-POINT	

REMARKS :

ATTERBERG LIMITS

(ASTM D4318)

WILLDAN Geotechnical — extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-1 Depth : 10.0 ft

Tested By : RMC Date: 22-Jun-21

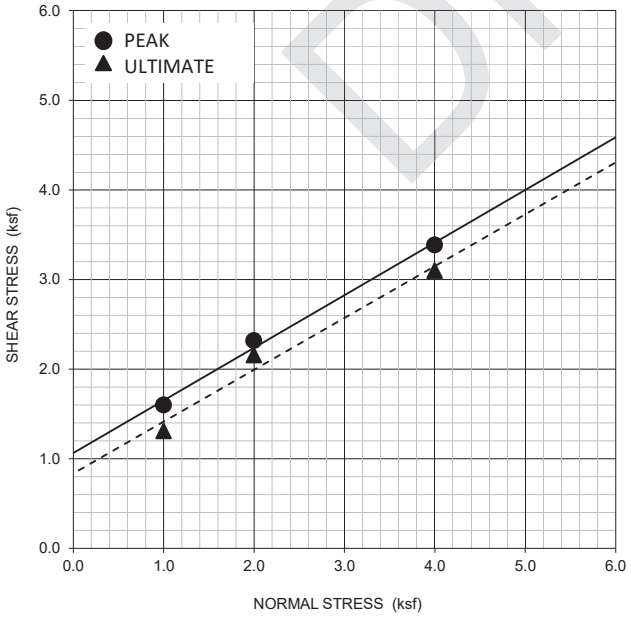
Sample Descriptions / Classification : SANDSTONE (SM)

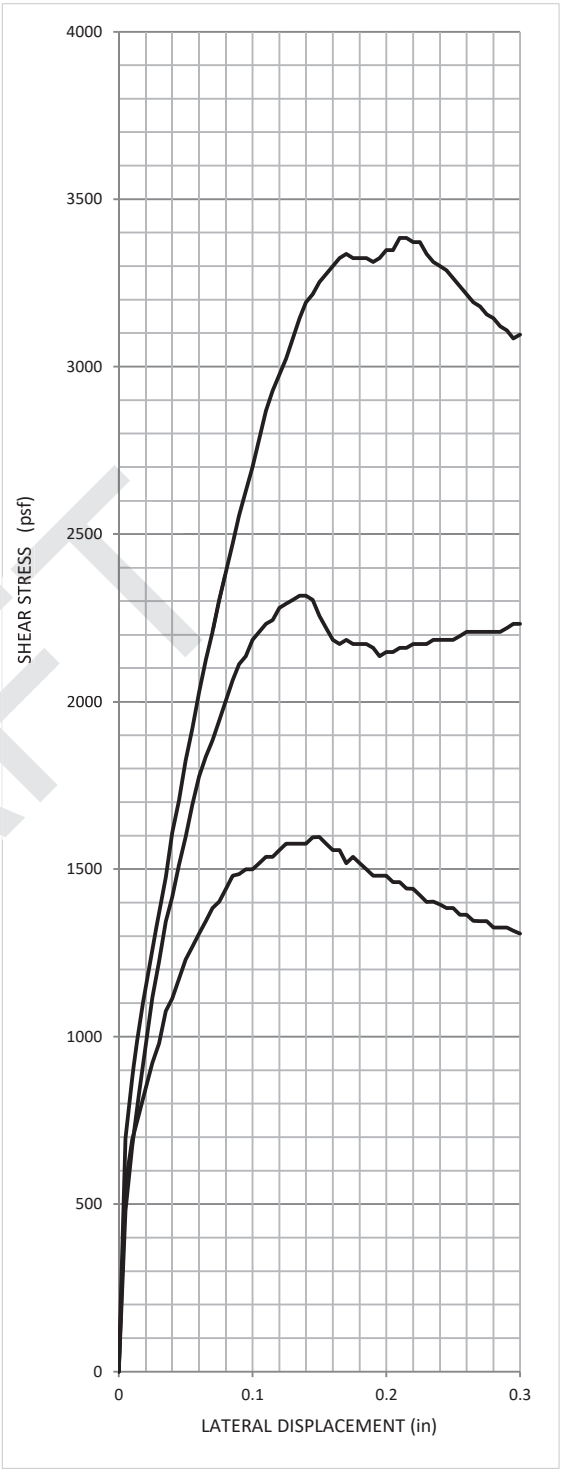
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	1.596		2.316		3.384	
Shear Stress,Ultimate(ksf)	1.307		2.152		3.096	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	145.69	159.7	146.9	162.2	153.6	165.0
Dry Wt. of Soil + Ring (g)		116.2		118.0		122.4
Weight of Water (g)	29.5	43.4	28.9	44.2	31.1	42.5
Weight of Ring (g)		42.3		45.5		44.5
Weight of Dry Soil (g)		73.9		72.5		78.0
Moisture Content (%)	39.9	58.8	39.9	61.0	39.9	54.5
Wet Density (pcf)	85.8	97.4	84.2	96.9	90.5	100.0
Dry Density (pcf)		61.3		60.2		64.7
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	61.9	91.3	60.1	91.9	67.5	92.3
Void Ratio		1.727		1.779		1.584

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	1060	835
Friction Angle, ϕ (degree)	30.5	30.0





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-2 Depth : 5.0 ft

Tested By : RMC Date: 21-Jun-21

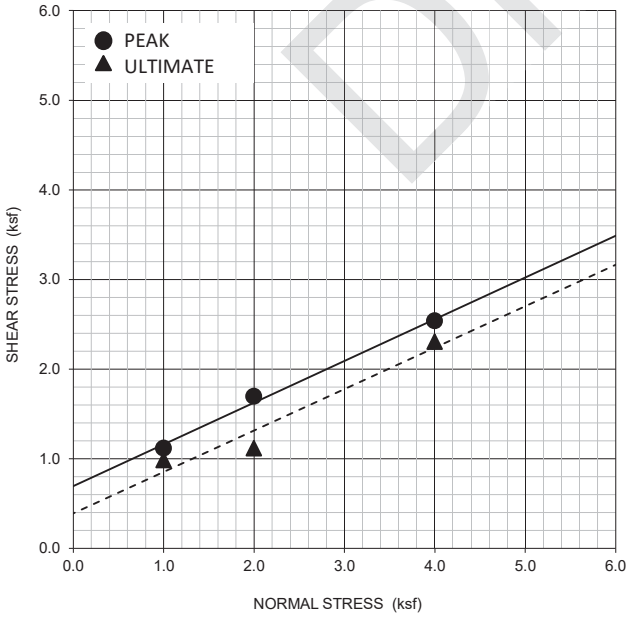
Sample Descriptions / Classification : SANDSTONE (SM)

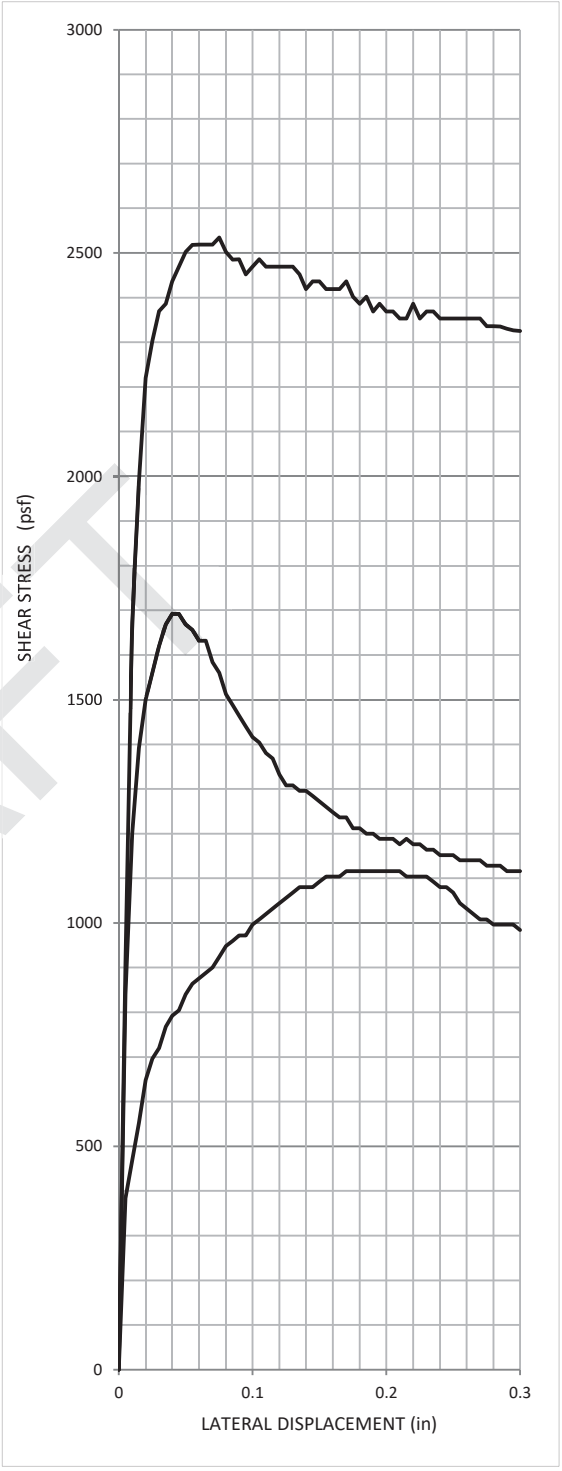
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	1.116		1.692		2.535	
Shear Stress,Ultimate(ksf)	0.984		1.116		2.305	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	165.32	175.1	163.8	174.1	167.1	176.6
Dry Wt. of Soil + Ring (g)		138.6		137.5		140.2
Weight of Water (g)	26.7	36.5	26.3	36.6	26.9	36.4
Weight of Ring (g)		45.2		45.4		46.0
Weight of Dry Soil (g)		93.4		92.1		94.2
Moisture Content (%)	28.6	39.1	28.6	39.7	28.6	38.6
Wet Density (pcf)	99.7	107.9	98.3	106.8	100.5	108.4
Dry Density (pcf)		77.6		76.5		78.2
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	66.3	90.6	64.6	89.6	67.3	90.9
Void Ratio		1.156		1.187		1.139

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	695	390
Friction Angle, ϕ (degree)	25.0	25.0





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-2 Depth : 20.0 ft

Tested By : RMC Date: 22-Jun-21

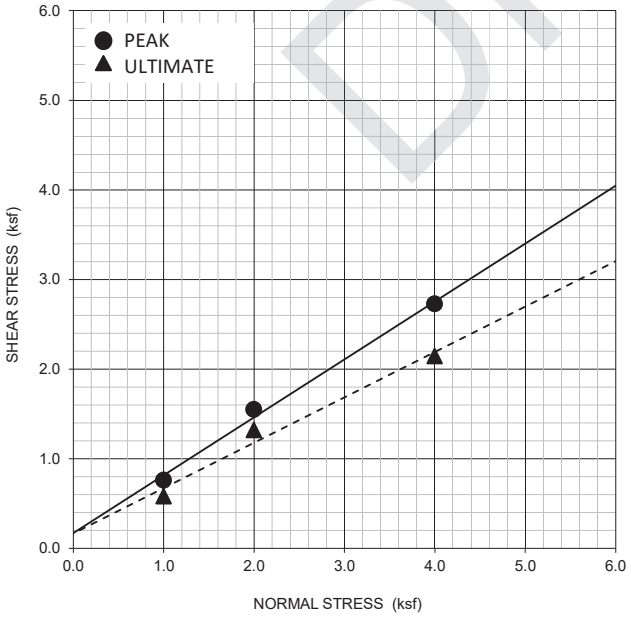
Sample Descriptions / Classification : SANDSTONE (SC)

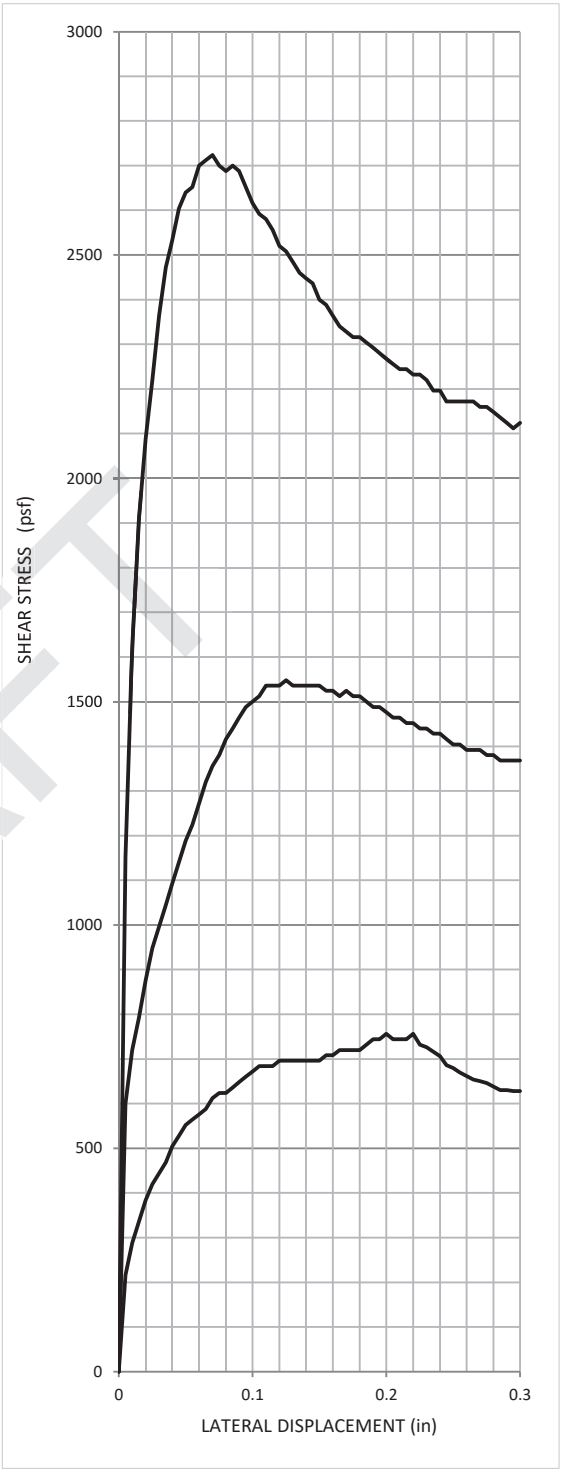
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.756		1.548		2.724	
Shear Stress,Ultimate(ksf)	0.578		1.318		2.144	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	162.57	173.4	168.7	179.2	170.9	178.7
Dry Wt. of Soil + Ring (g)		136.4		141.6		143.4
Weight of Water (g)	26.2	37.0	27.2	37.6	27.5	35.3
Weight of Ring (g)		41.2		42.8		43.3
Weight of Dry Soil (g)		95.2		98.8		100.1
Moisture Content (%)	27.5	38.9	27.5	38.1	27.5	35.3
Wet Density (pcf)	100.7	109.7	104.6	113.2	106.0	112.4
Dry Density (pcf)		79.0		82.0		83.1
Specific Gravity (Assumed)	2.68					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	66.0	93.3	70.9	98.2	72.8	93.5
Void Ratio		1.116		1.039		1.012

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	170	165
Friction Angle, ϕ (degree)	33.0	27.0





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-3 Depth : 15.0 ft

Tested By : RMC Date: 23-Jun-21

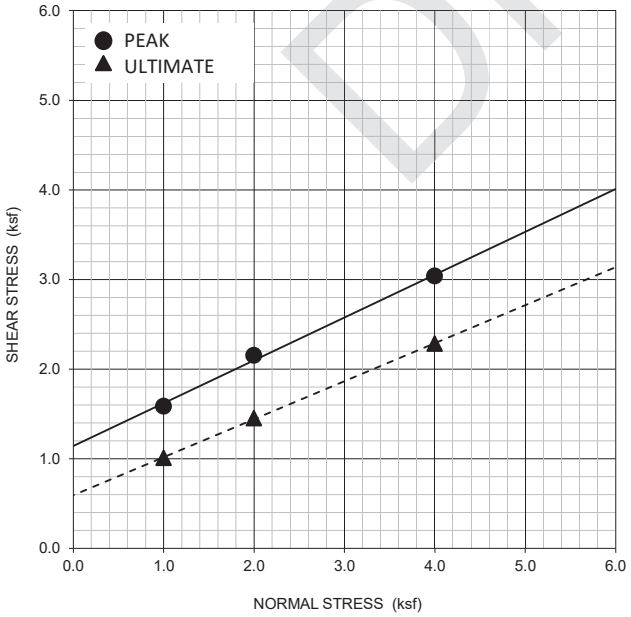
Sample Descriptions / Classification : Fat CLAY (CH)

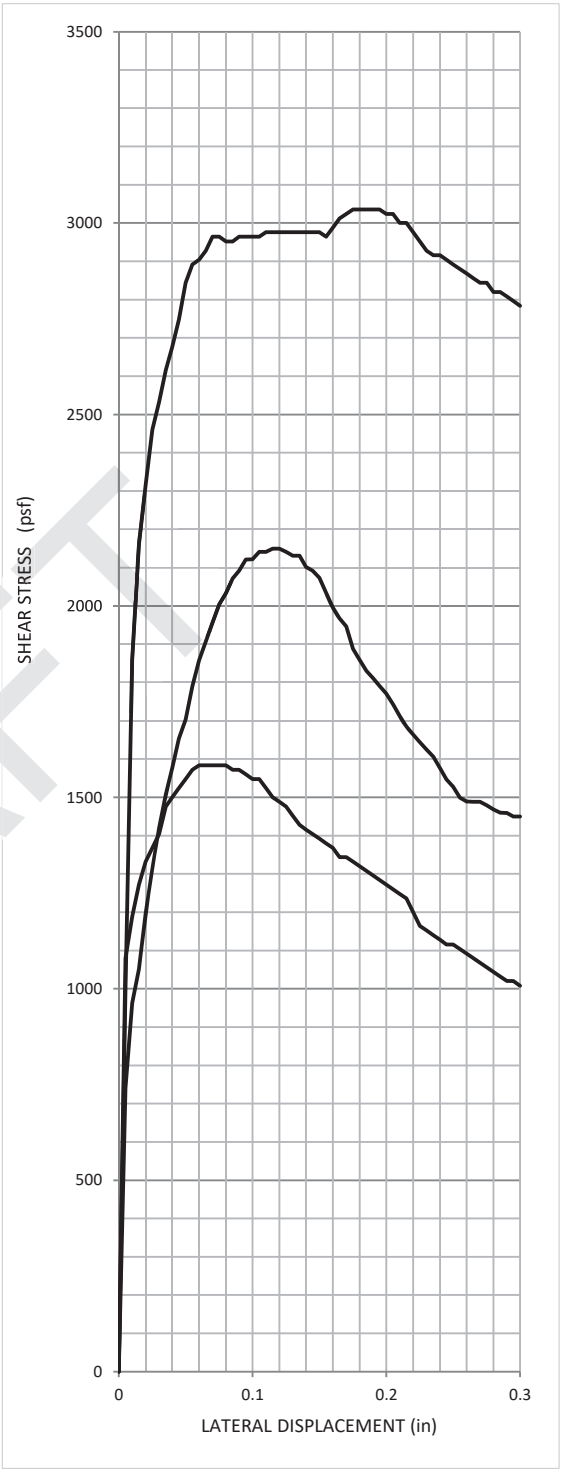
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	1.584		2.150		3.036	
Shear Stress,Ultimate(ksf)	1.008		1.450		2.284	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	170.57	173.4	171.7	179.2	173.9	178.7
Dry Wt. of Soil + Ring (g)		143.9		145.1		147.1
Weight of Water (g)	26.7	29.5	26.7	34.1	26.9	31.7
Weight of Ring (g)		41.4		42.6		43.8
Weight of Dry Soil (g)		102.5		102.5		103.3
Moisture Content (%)	26.0	28.8	26.0	33.2	26.0	30.6
Wet Density (pcf)	107.3	109.6	107.2	113.4	108.0	112.0
Dry Density (pcf)		85.1		85.1		85.7
Specific Gravity (Assumed)	172.1					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	35.8	39.5	35.7	45.7	36.0	42.5
Void Ratio		125.155		125.165		124.244

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	1140	590
Friction Angle, ϕ (degree)	25.5	23.0





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-3 Depth : 30.0 ft

Tested By : RMC Date: 23-Jun-21

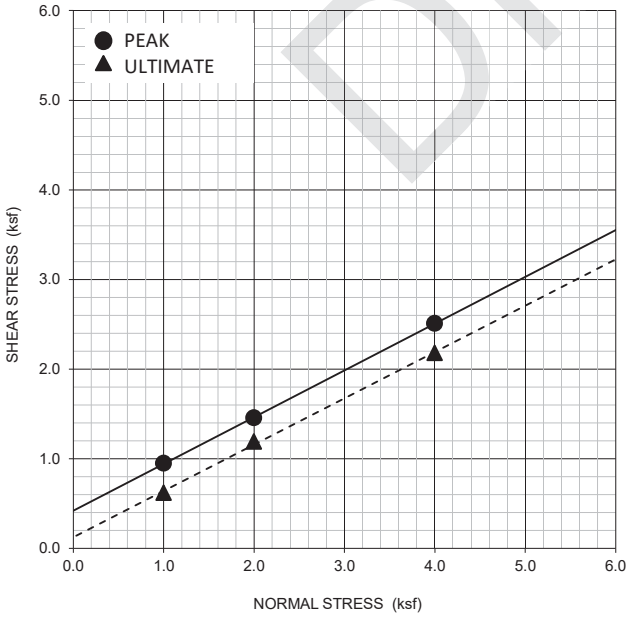
Sample Descriptions / Classification : CLAYSTONE (CH)

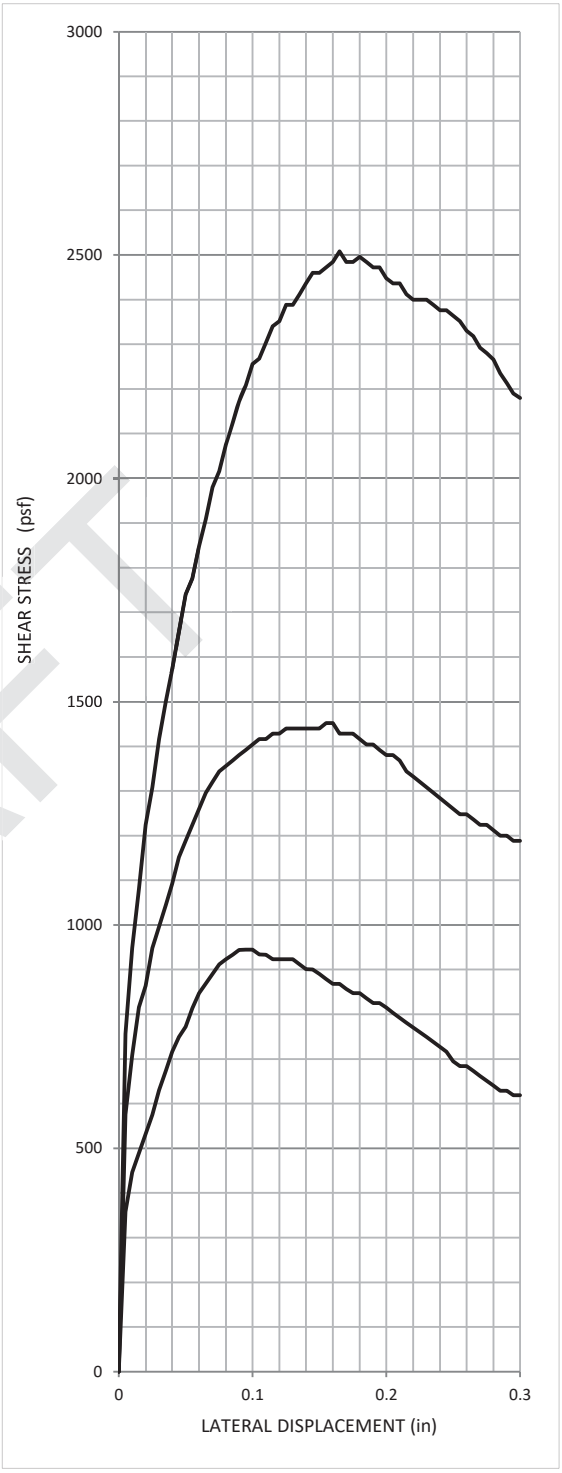
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.945		1.452		2.508	
Shear Stress,Ultimate(ksf)	0.619		1.188		2.180	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	163.91	204.6	168.5	206.9	164.5	206.2
Dry Wt. of Soil + Ring (g)		142.5		146.5		142.9
Weight of Water (g)	21.4	62.1	22.0	60.5	21.5	63.3
Weight of Ring (g)		42.8		44.1		42.7
Weight of Dry Soil (g)		99.7		102.4		100.2
Moisture Content (%)	21.5	62.3	21.5	59.1	21.5	63.1
Wet Density (pcf)	100.6	134.3	103.3	135.2	101.1	135.8
Dry Density (pcf)		82.8		85.0		83.2
Specific Gravity (Assumed)	172.1					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	28.7	83.2	29.5	81.1	28.9	84.9
Void Ratio		128.744		125.354		128.052

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	415	125
Friction Angle, ϕ (degree)	27.5	27.5





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-4 Depth : 10.0 ft

Tested By : RMC Date: 23-Jun-21

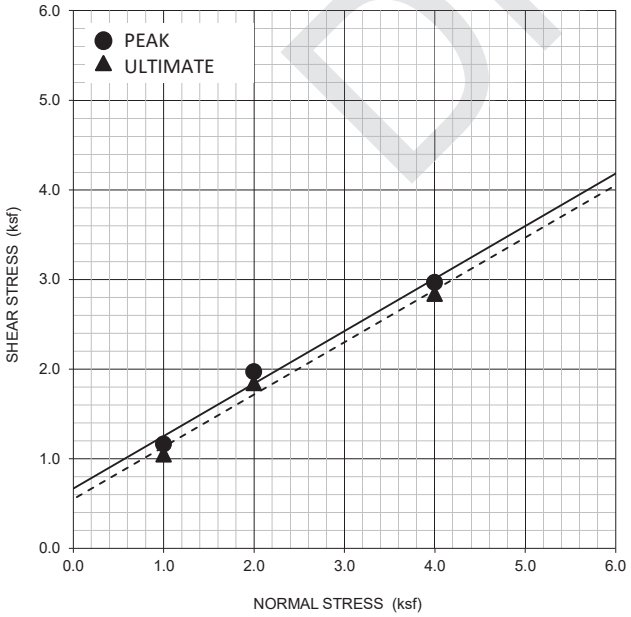
Sample Descriptions / Classification : Clayey SAND with Gravel (SC)

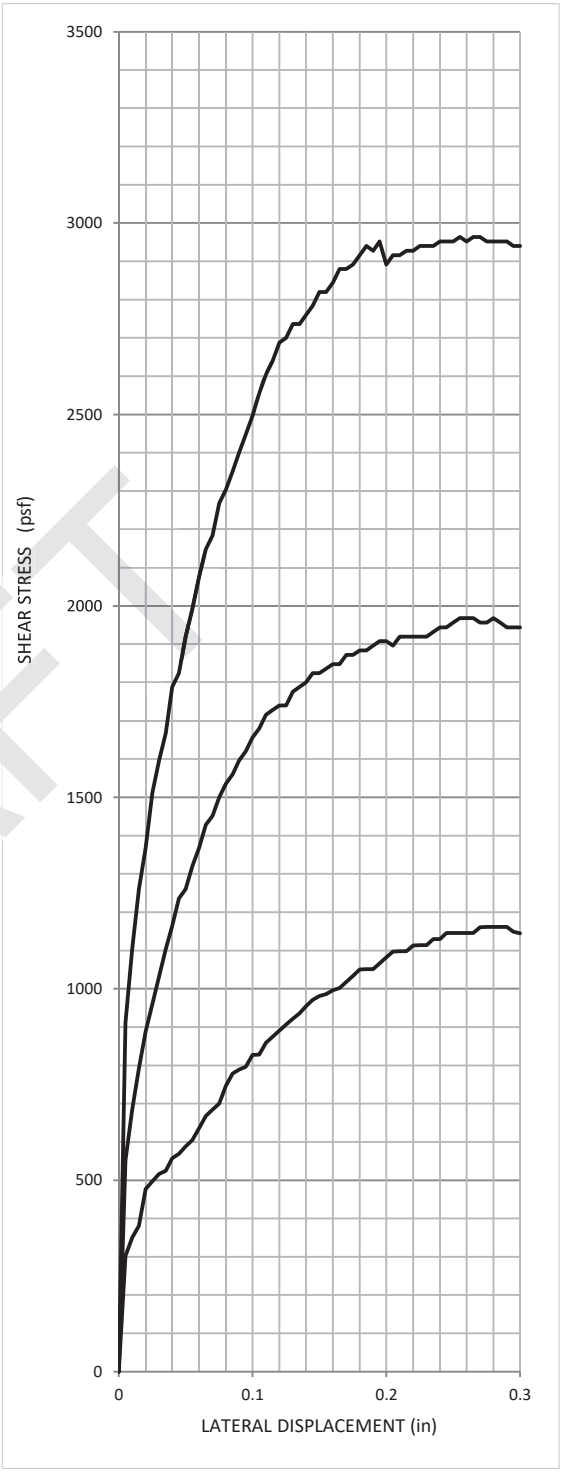
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	1.162		1.968		2.964	
Shear Stress,Ultimate(ksf)	1.045		1.844		2.840	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	159.66	201.6	163.1	202.8	166.6	205.9
Dry Wt. of Soil + Ring (g)		134.9		137.1		140.4
Weight of Water (g)	24.8	66.7	26.0	65.7	26.2	65.5
Weight of Ring (g)		44.7		42.6		45.3
Weight of Dry Soil (g)		90.1		94.6		95.1
Moisture Content (%)	27.5	74.0	27.5	69.5	27.5	68.8
Wet Density (pcf)	95.4	130.2	100.1	133.0	100.7	133.3
Dry Density (pcf)		74.8		78.5		79.0
Specific Gravity (Assumed)	172.1					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	33.2	89.3	34.9	88.0	35.1	87.7
Void Ratio		142.509		135.795		135.005

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	665	545
Friction Angle, ϕ (degree)	30.5	30.5





Remarks :

DIRECT SHEAR TEST

(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name : PVDN & Dapplegray Intersection Improvements

Project No. : 110176-2000-400

Boring / Sample No : B-4 Depth : 20.0 ft

Tested By : RMC Date: 25-Jun-21

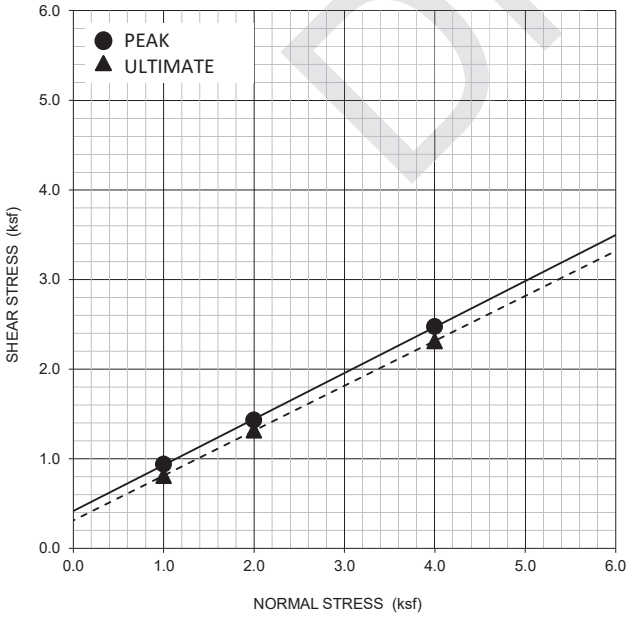
Sample Descriptions / Classification : SANDSTONE (SC)

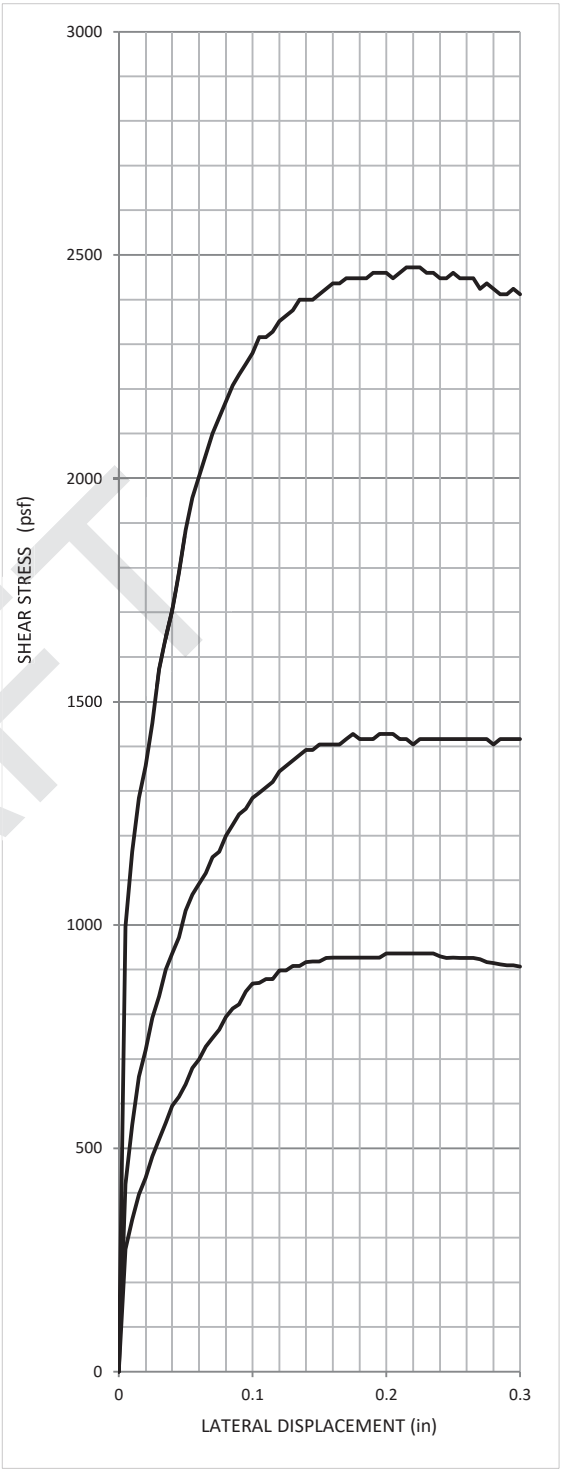
Sampled By : Date:

Applied Normal Load (ksf)	1.0		2.0		4.0	
Shear Stress,Peak (ksf)	0.936		1.428		2.472	
Shear Stress,Ultimate(ksf)	0.807		1.316		2.312	
Density and Saturation	Initial	Final	Initial	Final	Initial	Final
Wet Wt. of Soil + Ring (g)	159.67	204.1	165.9	207.8	164.1	206.6
Dry Wt. of Soil + Ring (g)		135.5		140.8		139.4
Weight of Water (g)	24.2	68.6	25.0	67.0	24.7	67.2
Weight of Ring (g)		42.9		44.9		44.6
Weight of Dry Soil (g)		92.6		95.9		94.8
Moisture Content (%)	26.1	74.1	26.1	69.9	26.1	71.0
Wet Density (pcf)	97.0	133.9	100.4	135.2	99.2	134.5
Dry Density (pcf)		76.9		79.6		78.7
Specific Gravity (Assumed)	172.1					
Specimen Thickness (in)	1.00					
Specimen Diameter (in)	2.416					
Degree of Saturation (%)	32.4	91.9	33.5	89.8	33.2	90.1
Void Ratio		138.636		133.901		135.493

Lateral Displacement, d_h (in)		0.3
Displacement Rate, d_r (in/min)		0.02
Elapsed Time of Test, t_e (min)		15.00
Specimen	Undisturbed	X
	Remolded	-
	Reconstituted	-

SHEAR STRESS	PEAK	ULTIMATE
Cohesion, c (psf)	415	310
Friction Angle, ϕ (degree)	27.0	26.5





Remarks :

DIRECT SHEAR TEST

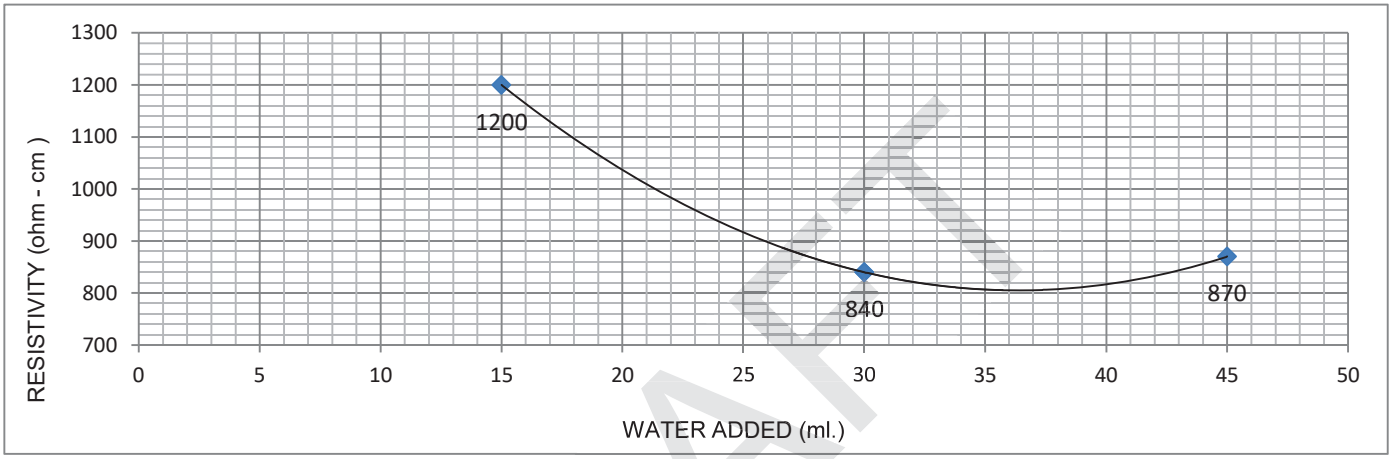
(ASTM D3080)

WILLDAN Geotechnical extending your reach

Project Name :	PVDN & Dapplegray Intersection Improvements	Project No.:	110176-2000-400
Sample Location / Source :	B-3	Tested by :	RMC Date: 7/7/2021
Sample Depth / No. :	0.0' - 5.0'	Sampled by:	Date:
Sample Description / Classification :	Sandy CLAY (CL)		

A. MINIMUM RESISTIVITY (CTM 643)

WATER ADDED, (ml)	15	30	45	
RESISTIVITY MEASURED, (ohm-cm)	1200	840	870	
TEMPERATURE MEASURED, (^{0}C)	25.5			
MINIMUM RESISTIVITY (ohm-cm)	800			
MIN. RESISTIVITY CORRECTED , $R_{min\ -15.5}$ (ohm-cm)	987			



B. SULFATE CONTENT OF SOILS (CTM 417)

SOIL - WATER RATIO	100 : 300
SO_4 DILUTION (ALIQUOT : DISTILLED H_2O)	5 : 20
FACTOR	15
SULFATE READING (ppm)	21
WATER SOLUBLE SULFATES, (ppm)	315

C. CHLORIDE CONTENT OF SOILS (CTM 422, SILVER NITRATE METHOD)

CHLORIDE DILUTION (ALIQUOT:DISTILLED H_2O)	50 : 50
NUMBER OF DIGITS REQUIRED	50
WATER SOLUBLE CHLORIDES, (ppm)	150

D. pH OF SOILS (CTM 643)

pH VALUE	8.00

REMARKS :

Project Name: PVDN & Dapplegray Intersection Improvements, Rolling Hills Estates, California
Willdan Geotechnical Project No.: 110176-2000-400

'R' VALUE CA 301

Client: Willdan Geotechnical Date: 6/26/21 By: LD

Client's Job No.: 110176-2000-400 Sample No.: B-3 @ 0' - 5'

GLA Reference: 2005-224 Soil Type: Sandy CLAY (CL)

TEST SPECIMEN		A	B	C	D
Compactor Air Pressure	psi	**70**	**150**	**100**	
Initial Moisture Content	%	**8.0**	**8.0**	**8.0**	
Water Added	ml	**70**	**50**	**60**	
Moisture at Compaction	%	14.3	12.5	13.4	
Sample & Mold Weight	gms	**3220**	**3268**	**3222**	
Mold Weight	gms	**2098**	**2115**	**2096**	
Net Sample Weight	gms	1122	1153	1126	
Sample Height	in.	**2.53**	**2.497**	**2.483**	
Dry Density	pcf	117.6	124.4	121.2	
Pressure	lbs	**3300**	**7005**	**4990**	
Exudation Pressure	psi	263	558	397	
Expansion Dial	x 0.0001	**20**	**92**	**63**	
Expansion Pressure	psf	87	398	273	
Ph at 1000lbs	psi	**50**	**34**	**42**	
Ph at 2000lbs	psi	**118**	**78**	**91**	
Displacement	turns	**3.85**	**3.19**	**3.48**	
R' Value		19	45	35	
Corrected 'R' Value		**19**	**45**	**35**	

FINAL 'R' VALUE	
By Exudation Pressure (@ 300 psi):	**24**
By Epansion Pressure :	**21**
TI = 5	

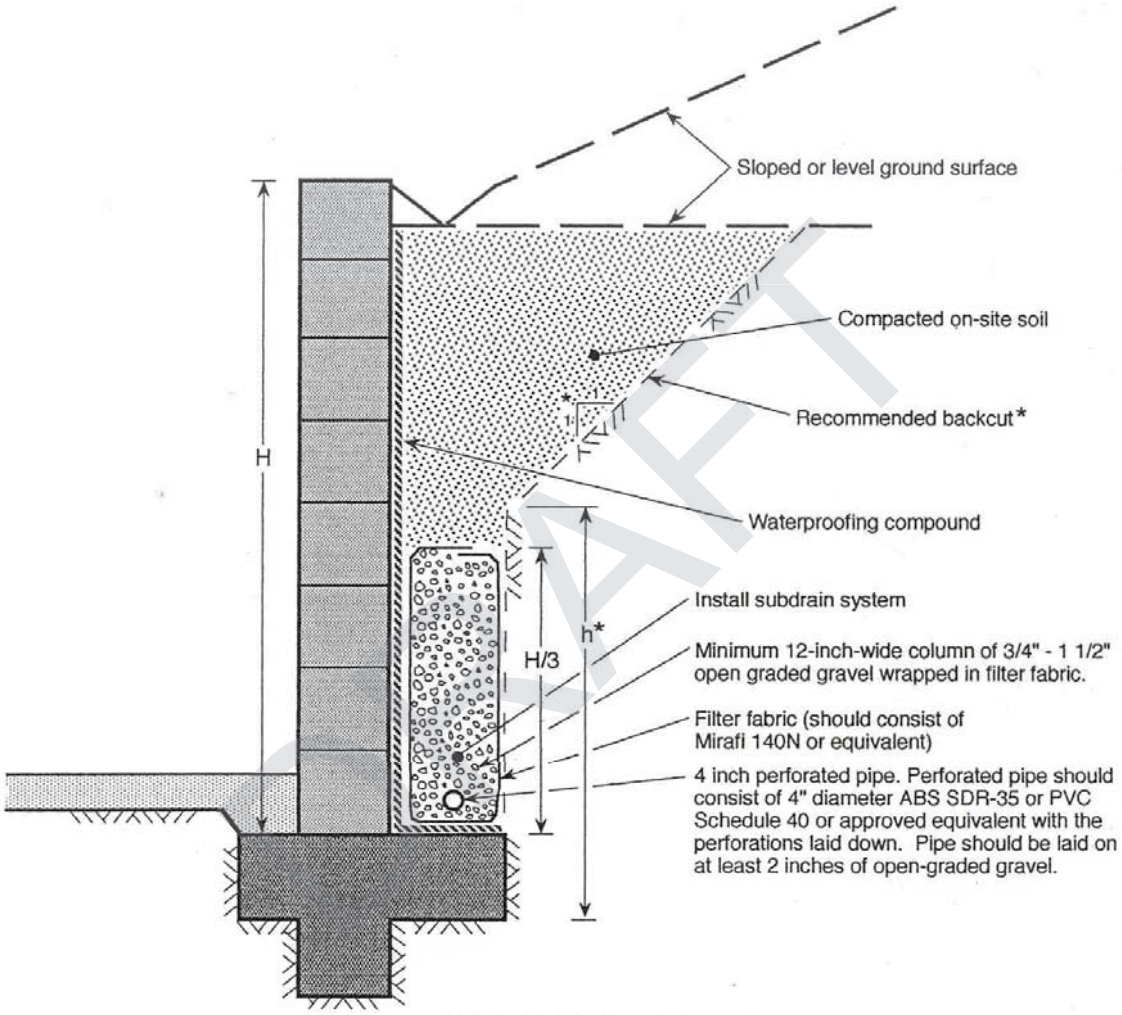
Geo-Logic ASSOCIATES

R-VALUE TEST
(CTM 301)

WILLDAN Geotechnical extending your reach

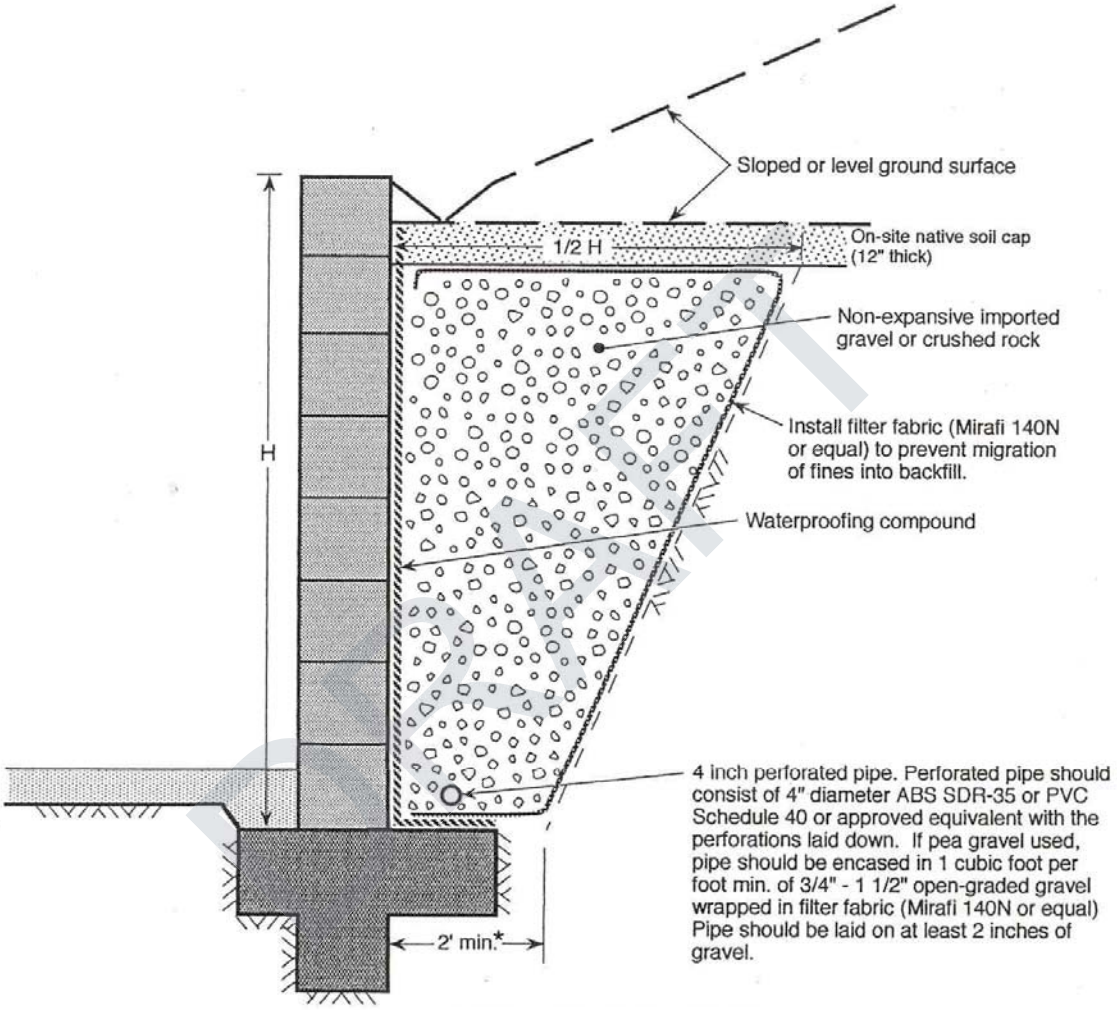
APPENDIX D. TYPICAL RETAINING WALL BACKFILL DETAILS

NATIVE SOIL BACKFILL



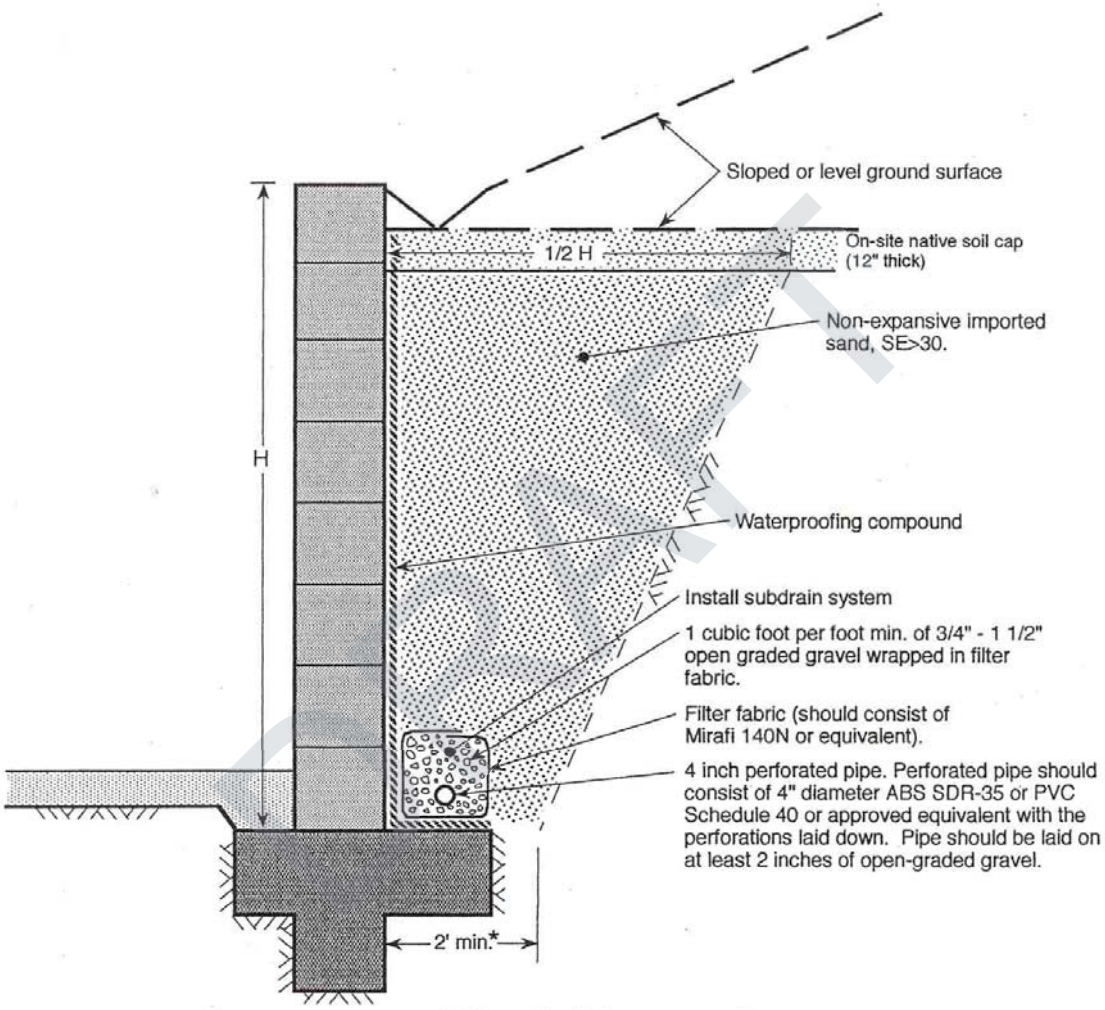
* Vertical height (h) and slope angle of backcut per soils report. Based on geologic conditions, configuration of backcut may require revisions (i.e. reduced vertical height, revised slope angle, etc.)

IMPORTED GRAVEL OR CRUSHED ROCK BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.

IMPORTED SAND BACKFILL



* At base of wall, the non-expansive backfill materials should extend to a min. distance of 2' or to a horizontal distance equal to the heel width of the footing, whichever is greater.