Appendix F

Preliminary Geotechnical Percolation Study

Rio Rockwell Site

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

February 12, 2019
J.N.: 2551.00

Mr. Steve Sheldon
Sheldon Development, LLC
901 Dove Street, Suite 140
Newport Beach, California 92660

Subject: **Preliminary Geotechnical Percolation Study for Proposed Water Quality Improvements, Proposed Residential Development, Intersection of Old Grove Road and Frazee Road, Oceanside, California.**

Dear Mr. Sheldon,

Pursuant to your request, ***Albus-Keefe & Associates, Inc***. has completed a geotechnical investigation of the site for preliminary evaluation of the percolation characteristics of the site soils. The scope of this investigation consisted of the following:

- Exploratory drilling and percolation test well installation
- Field percolation testing
- Laboratory testing of selected samples
- Engineering analysis of the data
- Preparation of this report

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

Site Location and Description,

The site is located north of the intersection of Old Grove Road and Frazee Road within Oceanside, California. The property is bordered by Frazee Road to the southeast, Old Grove Road to the south, and by an undeveloped lot adjacent to the San Luis Rey River Valley to the north. Single-family residential tracts are also located in close vicinity to the subject site to the east, south, and west. The location of the site and its relationship to the surrounding areas is shown on Figure 1, Site Location Map.

The irregular-shaped site encompasses approximately 8.4 acres of land and is currently undeveloped. A concrete-lined storm drain culvert abuts the site at the east and west corners of the property. The storm drain culvert measures approximately 15 feet below adjacent grades and drains in a northerly direction away from the site. According to the referenced report by Christian Wheeler Engineering (dated May 13, 2005), a 24-inch-diameter storm drain line also runs in the east-west direction adjacent the north property line of the site. The report states the north property line is located within the center of a 40-foot-wide easement associated with the subject storm drain improvements.

Topographically, elevations range from approximately 58 feet to 69 feet above Mean Sea Level (MSL). In general, the site is situated approximately 2 feet to 8 feet below the adjacent streets.

N

SITE LOCATION MAP

Sheldon Development, LLC
Proposed Residential Development
Old Grove Road and Frazee Road
Oceanside, California

NOT TO SCALE

FIGURE 1

Drainage is generally directed as sheet flow towards the north. Vegetation within the site consists of minor shrubs and medium-size trees scattered throughout the site.

Proposed Development

We anticipate the proposed site development will consist of 83 single-family, 2-story residential structures. We anticipate the development will be constructed on grade with associated interior driveways, parking bays, decorative hardscape, landscaping elements and underground utilities.

No grading or structural plans were available in preparing of this report. However, we anticipate that rough grading of the site will be required to achieve future surface configurations.

SUMMARY OF FIELD AND LABORATORY WORK

Subsurface Investigation

Subsurface exploration for this investigation was conducted by this firm in several phases on November 10, 2016, June 12, 2018, and October 23, 2018 through October 25, 2018. The subsurface exploration consisted of drilling a total of six (6) geotechnical borings and fifty-five (55) cone penetration test (CPT) soundings to the maximum depth of approximately 50 feet below the existing ground surface (bgs). The CPT soundings were advanced using a 30-ton CPT truck. The geotechnical borings were drilled using a truck-mounted, continuous flight, hollow-stem-auger drill rig. Representatives of *Albus-Keefe & Associates, Inc*. logged the exploratory borings. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1. Only those CPT soundings in close proximity to the proposed infiltration area are included in Appendix A.

Bulk, relatively undisturbed, and Standard Penetration Test (SPT) samples were obtained at selected depths within the exploratory borings for subsequent laboratory testing. Relatively undisturbed samples were obtained using a 3-inch O.D., 2.5-inch I.D., California split-spoon soil sampler lined with brass rings. SPT samples were obtained from the boring using a standard, unlined SPT soil sampler. During each sampling interval, the sampler was driven 18 inches with successive drops of a 140-pound automatic hammer free falling approximately 30 inches. The number of blows required to advance the split-spoon sampler was recorded for each six inches of advancement. The total blow count for the lower 12 inches of advancement per soil sample is recorded on the exploration logs. Samples were placed in sealed containers or plastic bags and transported to our laboratory for analyses. The borings were backfilled with cement and bentonite upon completion of sampling.

In addition, two borings (P-1 and P-2) were drilled to the depth of 9.4 and 7.3 feet, respectively. A 2-inch-diameter screened casing was installed in each boring for subsequent percolation testing. The annular space of the well screen section was filled with pea gravel. Casings for the test wells were removed and the borings were backfilled upon completion of testing.

Laboratory Testing

Selected soil samples of representative earth materials were tested to assist in the formulation of conclusions and recommendations presented in this report. Tests consisted of grain-size analysis in conformance with ASTM D-422. Laboratory test results are presented on Plates B-1 and B-2 in appendix B.

Percolation Testing

Percolation testing was performed on June 20, 2018, in general conformance with the constant-head test procedures outlined in the referenced Well Permeameter Method (USBR 7300-89). A water hose attached to a water source on site was connected to an inline flowmeter to measure the water flow. The flowmeter is capable of measuring flow rates up to 13 gallons per minute and as low as 0.06 gallons per minute. A valve was connected in line with the flowmeter to control the flow rate. A filling hose was used to connect the flowmeter and the test wells. Water was introduced by the filling hose near the bottom of the test wells. A water level meter with 1/100-foot divisions was used to measure the depths to water surface from the top of well casings.

Flow to the wells was terminated upon either completion of testing of all the pre-determined water levels or the flow rate exceeded the maximum capacity of the flowmeter. Measurements obtained during the percolation testing are provided on Plates C-1 and C-2.

ANALYSIS OF DATA

Subsurface Conditions

Descriptions of the earth materials encountered during our investigation are summarized below and are presented in detail on the Exploration Logs presented in Appendix A.

Soil materials encountered at the site consisted of artificial fill materials blanketing portions of the site and alluvial deposits to the maximum depth explored, 51.5 feet below the ground surface (bgs). The artificial fill materials typically consisted of grayish brown to tan silty sand and sandy silt with occasional layers of finer-grained material in the upper 5 feet within portions of the site. These materials are typically dry to damp and loose/soft to medium stiff/medium dense. The alluvial deposits typically consist of brown, gray, and light gray with orange sand and silty sand in the upper 18 to 25 feet (bgs). These materials are typically damp to wet and very loose to medium dense/soft to stiff. Between approximately 25 and 40 feet below the ground surface (bgs), the alluvial deposits generally consist of interlayered medium brown, grayish brown, and gray sandy silt, silty sand, silt, and clay. These materials are typically wet to saturated and loose/very soft to medium dense/medium stiff. Below 40 feet, the alluvial deposits typically consist of brown to grayish brown sand and silty sand with occasional layers of increased silt. These materials are typically wet to saturated and medium dense to dense/very stiff.

Groundwater

Groundwater was encountered during this firm's exploration to the depth of approximately 13 to 24 feet below the existing ground surface. The referenced geotechnical report by Christian Wheeler

Engineering indicated groundwater at depths 10 to 12 feet below ground surface. Based on CPT pore pressure dissipation tests throughout the site, the average groundwater throughout the site was determined to be 15.5 feet below ground surface. Search of well records from the Water Data Library of the California Department of Water Resources resulted in sparse historical groundwater data for this area, mostly indicating groundwater deeper than 60 feet below ground surface.

Percolation Data

Analyses were performed to evaluate permeability using the flow rate obtained at the end of the field percolation testing. The analyses were performed in accordance with the procedures provided in the referenced USBR 7300-89. The procedure essentially uses a closed-form solution to the percolation out of a small-diameter well. The results are summarized in Table 1 below and the supporting analyses are included in Appendix C, Plates C-3 and C-4.

TABLE 1
Summary of Back-Calculated Permeability Coefficient from Constant Head Test

Location	Total Depth of Well (ft.)	Depth to Water in Well (ft.)	Height of Water in Well (ft.)	Static Flow Rate (gal./min.)	Estimated Permeability, ks (in/hr.)
P-1	9.4	8.0	1.4	0.32	3.30
P-2	7.3	6.2	1.1	1.20	17.29

Design of Infiltration BMP

Owing to the groundwater currently present at the site as well as historical data for the general area, we estimate the average unmounded seasonally high groundwater along the northern boundary of the site may be taken at 10 feet below existing ground surface. As such, shallow chamber systems are considered feasible BMP's for storm water disposal at the site.

The infiltration rate is dependent upon several factors including the soil permeability, hydraulic gradient of water pressure head in the soil mass, depth to groundwater, and depth to any impeding aquitard layers. The infiltration rate is related to the permeability by Darcy's equation:

$V = ki$

Where V= water velocity (infiltration rate)
k= permeability
i=hydraulic gradient

For a shallow ponding depth of water in the BMP, the hydraulic gradient may be taken as equal to 1. Therefore, the unadjusted infiltration rate may be taken as equal to the permeability coefficient.

Generally, where the unmounded groundwater surface or an aquitard has a clearance below a continuous infiltration chamber of at least 3 times the chamber width, the effects of groundwater or aquitard may be ignored. The proposed chamber system is anticipated to have a width of 5 feet and be founded at existing grades along the northern edge of the project. Based on our subsurface data, the unmounded seasonal high ground water is anticipated to be at a depth of 10 feet below ground surface. Therefore, the presence of groundwater will affect the infiltration rate since it is located less than two times the chamber width. The soil profile varies somewhat across the proposed alignment of the chamber system. Within some areas an aquitard layer is present at a depth of about 10 feet and will therefore also affect the infiltration rate. To "correct" for the reduction due to shallow groundwater or an aquitard, the reduction can be approximated by using a weighted average of the permeabilities for the infiltration zone and the aquitard/saturated zone. The weight factor is based on the vertical distance between the infiltration surface and the aquitard/saturation zone versus the distance of three times the chamber width. The resulting "corrected" infiltration rate is thus:

$$I = \frac{K_U D}{3W} + \frac{K_L(3W - D)}{3W}$$

Where:

I= Corrected Infiltration Rate
K_U= Permeability of Upper Layer
K_L= Permeability of Lower Layer
D= Depth below Chamber to Aquitard
W= Width of Chamber

Using the lower of the two test results, we have assigned a permeability of 3.5 inches to the infiltration zone. The presence of an aquitard will be the controlling factor in affecting the infiltration rate rather than the presence of groundwater. Applying a permeability of zero to the aquitard layer at a depth of 10 feet, we obtain an adjusted "measured" infiltration rate of 2.3 in./hr. using the above equation.

CONCLUSIONS AND RECOMMENDATIONS

Review of the City of Oceanside's urban storm water mitigation requirements indicates a minimum of 10 feet vertical distance between any infiltration device to seasonal high groundwater. Since groundwater was observed to be a least 10 feet from ground surface, the site according to the city's guidelines is feasible. Based on results of our testing, infiltration of storm water at the site is feasible using a shallow chamber system at the site.

Infiltration of storm water is not anticipated to result in adverse geotechnical conditions at the site or surrounding sites. Although the site is subject to effects of liquefaction, infiltration is not anticipated to result in a permanent raising of the groundwater levels. Site soils exhibit Very Low expansion characteristics and as such, increases in moisture due to infiltration is not anticipated to cause adverse swelling. The short-term infiltration along the proposed alignment is not anticipated to result in instability of the nearby slope. Following site grading, the site will not be underlain by soils with hydrocollapse potential and as such, infiltration is not anticipated to cause adverse effects due to soil collapse.

Infiltration should not occur into manmade fill materials. Based on results of our percolation testing and correlation with grain-size tests, design of shallow chamber systems may use a "measured" infiltration rate of 2.3 inches/hour provided the chamber system is no more than 5 feet in width and is founded at the current surface grades along the northerly boundary.

An appropriate factor of safety should be applied to this measured value to obtain a "design" value per the manual. To determine the factor of safety, the Factor Values associated with Factor Category A are summarized in Table 3 below. The civil engineer should assign factors of safety for Factor Category B to determine the final design factor of safety.

TABLE 3
Partial Factors of Safety

Infiltration Facility Safety Factor Determination Worksheet					
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w * v
A	Suitability Assessment	Soil assessment methods	0.25	1	0.25
		Predominant soil texture	0.25	2	0.5
		Site soil variability	0.25	2	0.5
		Depth to groundwater / impervious layer	0.25	3	0.75
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2

The excavations for the shallow chamber system should be observed by the geotechnical consultant to confirm they expose native alluvial soils at the bottom.

The testing performed for this report was limited in nature and was intended for preliminary design. Additional testing is recommended prior to final design to confirm the design parameters provided herein. The final plan should also be reviewed by this office to confirm the recommendations presented herein were properly incorporated.

LIMITATIONS

This report is based on the geotechnical data as described herein. The materials encountered in our boring excavations and utilized in our laboratory testing for this investigation are believed representative of the project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil and bedrock materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observations by a geotechnical consultant during the construction phase of the storm water infiltration systems are essential to confirming the basis of this report.

This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty.

This report should be reviewed and updated after a period of one year or if the site ownership or project concept changes from that described herein.

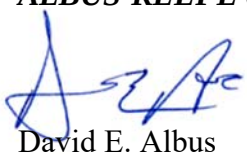
This report has been prepared for the exclusive use of **Sheldon Development, LLC** to assist the project consultants in the design of the proposed development. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling governmental agency.

We appreciate this opportunity to be of service to you. If you should have any questions regarding the contents of this report, please do not hesitate to call.

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.



David E. Albus
Principal Engineer
G.E. 2455

Enclosures: Plate 1- Geotechnical Map
Appendix A - Exploratory Logs and Summary CPT Data
Appendix B - Percolation Testing and Analyses

REFERENCES

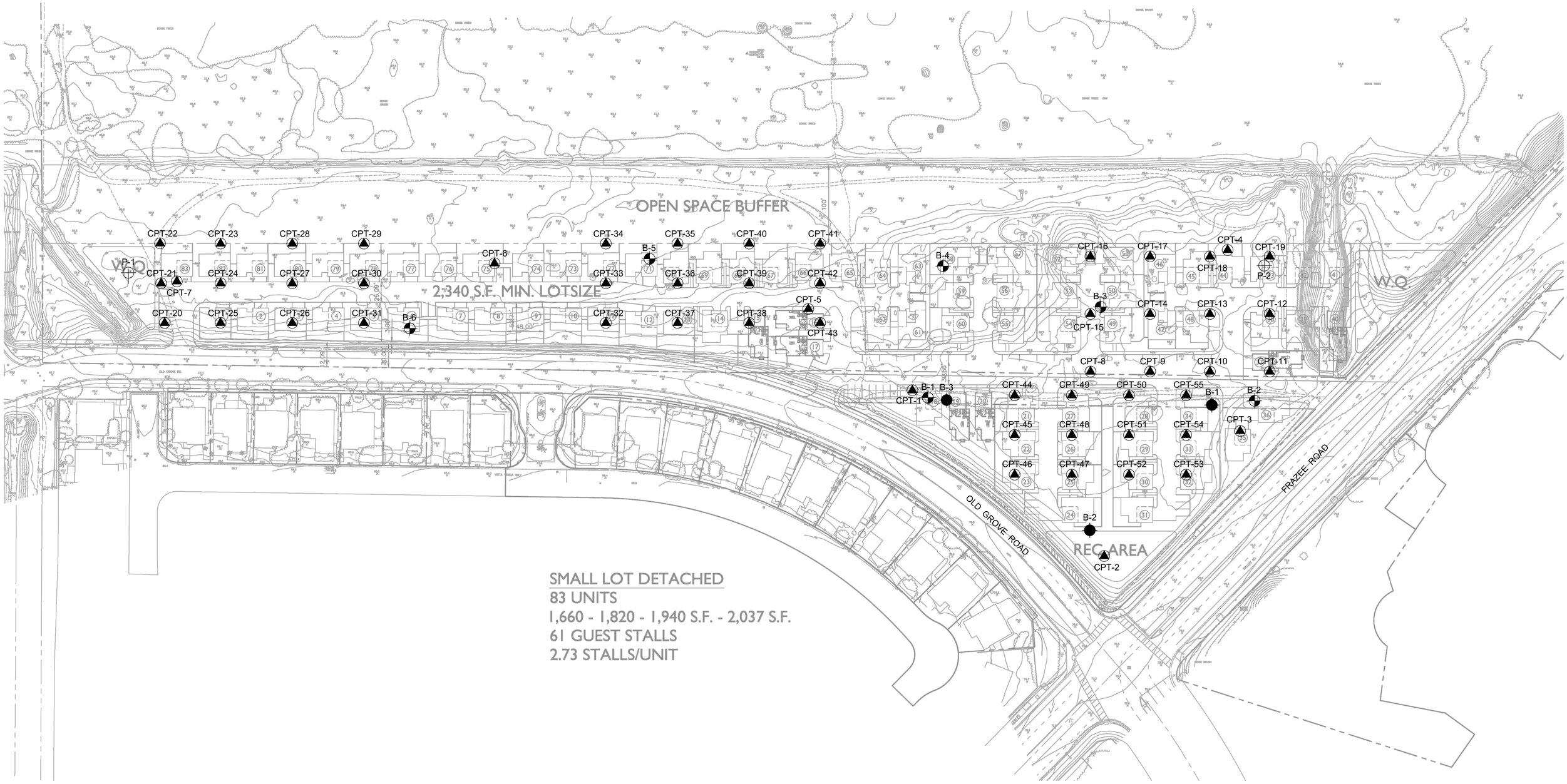
Publications

Procedure for Performing Field Permeability Testing by the Well Permeameter Method, by United States Department of The Interior, Bureau of Reclamation (USBR 7300-89).

City of Oceanside SUSMP, Standard Urban Storm Water Mitigation Plan Requirements for Development and Redevelopment Projects, by City of Oceanside, dated March 2010.

Reports

"Report of Preliminary Geotechnical Investigation, Proposed Condominium Complex, Old Grove Road and Frazee Road, Oceanside, California," Prepared by Christian Wheeler Engineering (Project No. CWE 2050171.01), dated May 13, 2005.



SMALL LOT DETACHED
83 UNITS
1,660 - 1,820 - 1,940 S.F. - 2,037 S.F.
61 GUEST STALLS
2.73 STALLS/UNIT

OLD GROVE - FRAZEE DETACHED HOMES

CONCEPTUAL SITE PLAN

SEPTEMBER 22, 2017

0 30 60 120

SUMMA ARCHITECTURE
5256 S. Mission Road, Suite 404
Bonsall, CA 92003
www.summarch.com
760.724-1198

1

EXPLANATION
(Locations Approximate)

- Exploratory Boring (this report)
- Cone Penetrometer Test (CPT)(this report)
- Percolation Well (this report)
- Exploratory Boring (Christian Wheeler Eng. (05/13/2005)

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

GEOTECHNICAL MAP

Job No.: 2551.00 | Date: 02/12/2019 | Plate: 1

APPENDIX A

Exploratory Logs and Summary CPT Data

EXPLORATION LOG

Project:		Location:
Address:		Elevation:
Job Number:	Client:	Date:
Drill Method:	Driving Weight:	Logged By:

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		EXPLANATION							
		Solid lines separate geologic units and/or material types.							
		Dashed lines indicate unknown depth of geologic unit change or material type change.							
5		**Solid black rectangle** in Core column represents California Split Spoon sampler (2.5in ID, 3in OD).							
		Double triangle in core column represents SPT sampler.							
10		**Vertical Lines** in core column represents Shelby sampler.							
		Solid black rectangle in Bulk column respresents large bag sample.							
		Other Laboratory Tests:							
15		Max = Maximum Dry Density/Optimum Moisture Content							
		EI = Expansion Index							
		SO4 = Soluble Sulfate Content							
		DSR = Direct Shear, Remolded							
		DS = Direct Shear, Undisturbed							
		SA = Sieve Analysis (1" through #200 sieve)							
		Hydro = Particle Size Analysis (SA with Hydrometer)							
20		200 = Percent Passing #200 Sieve							
		Consol = Consolidation							
		SE = Sand Equivalent							
		Rval = R-Value							
		ATT = Atterberg Limits							

EXPLORATION LOG

Project:		Location: B-1
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 65.1
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af)							Max EI SO4 DS
		Silty Sand (SM): Grayish brown, dry, loose, fine grained sand, trace fine gravel, trace organics, mica		6		■	1.6	Dist.	200
		ALLUVIUM (Qal)		6		■	1.6	94	
5		Silty Sand (SM): Gray, damp, loose, fine to medium grained sand, trace silt, mica		6	■		11	92.3	200
		Silt (ML): Medium brown, damp, medium stiff, trace clay, mica		7	■		1.8	87.6	
10		Silty Sand (SM): Gray, damp, loose, fine grained sand, trace silt, mica		6	■		7.4	Dist.	SA
				7	■		1.2	91.7	
15		@ 15', Dark grayish brown, moist, fine to medium grained sand		7	■		1.8	92.1	
		Sand (SP): Gray, moist, medium dense, fine to medium grained sand, trace fine gravel, mica		8	■		18.1	86.7	
				16	■		3	96.4	
20				15	■		3.7	86.3	SA
				8	■		36.8	85.5	
		Silt (ML): Medium brown, saturated, medium stiff, fine to medium grained sand, some clay, few sand, mica	▽						
					■		30.4	91.5	

Albus-Keefe & Associates, Inc.

Plate A-2

EXPLORATION LOG

Project:		Location: B-1
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 65.1
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
30		@ 30 ft, very soft to soft, fine grained sand, increased sand content, some sand		2	■				ATT
35		Sandy Silt (ML): Medium brown, saturated, medium stiff		6	■				
40		Silty Sand (SM): Medium grayish brown, saturated, medium dense, fine grained sand, mica		16	■				200
45				17	■				

Albus-Keefe & Associates, Inc.

Plate A-3

EXPLORATION LOG

Project:		Location: B-1
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 65.1
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand (SM): Brown, saturated, medium dense, fine to medium grained sand, mica		15					
		End of boring at 51.5 feet. Groundwater encountered at 24 feet. Backfilled with cement and bentonite.							

EXPLORATION LOG

Project:		Location: B-2
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 72.5
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af)							
		Silty Sand (SM): Light grayish brown, dry, medium dense, fine grained sand, trace organics, mica		19	■	■	1.7	93.1	Consol
		ALLUVIUM (Qal)		12	■	■	2.5	89.4	200
5		Sand (SP): light gray orange, dry, medium dense, fine to medium grained sand, trace silt							
		Silt (ML): Medium brown, dry, medium stiff to stiff, fine grained sand, mica		5	■		3.5	88.4	
		Sand (SP): Light gray orange, dry, loose, fine to medium grained sand, some silt, mica		9	■		3.1	97	200
10				8	■		1.8	83.2	
				11	■		1.9	88.2	
15		@ 15 ft, damp to moist, medium dense, decrease silt content, trace silt		12	⧗				
20		@ 20 ft, moist, dense		30	⧗				

Albus-Keefe & Associates, Inc.

Plate A-5

EXPLORATION LOG

Project:		Location: B-2
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 72.5
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silt (ML): Medium brown, saturated, medium stiff, fine grained sand, trace sand, mica		6					
30		Sandy Silt (ML): Medium brown, saturated, medium stiff, some silt, mica		4					ATT
35		Silty Sand (SM): Medium brown, saturated, medium dense, fine grained sand, trace sand, mica		13					200
40		@ 40', Grayish brown, saturated		8					200
45		Sand with Silt (SP-SM): Grayish brown, saturated, medium dense, fine grained sand, mica		16					200

EXPLORATION LOG

Project:		Location: B-2
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 72.5
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 11/10/2016
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				14					
		End of Boring at 51.5 feet. Groundwater at 25 feet. Backfilled with cement and bentonite							

EXPLORATION LOG

Project:		Location: B-3
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 68.1
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand (SM): Light gray, dry, fine grained sand							
		Sand (SP): Light gray, dry to damp, loose to medium dense, fine grained sand		13	■		2	92.5	
				12	■		N.R.		
5		@ 6 ft, medium dense		18	■		11.7	90.6	Consol
		Sandy Silt (ML): Tan to light gray, damp to moist, stiff, fine grained sand, trace pinhole pores and roots, some siltstone fragments							
		Sand with Silt (SP-SM): Light gray, damp, medium dense, fine grained sand							
10		Sand (SP): Light gray, damp, loose, fine to coarse grained sand		12	■		1.9	Dist.	
15		@ 15 ft, wet, medium dense		11	⧗				
		@ 17 ft, Ground Water	▽						
20				3	⧗				
		Silty Sand / Sandy Silt (SM/ML): Grayish brown, wet, very loose to loose / soft, fine grained sand							

Albus-Keefe & Associates, Inc.

Plate A-8

EXPLORATION LOG

Project:		Location: B-3
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 68.1
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Sand (SP): Gray, wet, loose, fine to coarse grained sand		4					
		Silty Sand / Sandy Silt (SM/ML): Grayish brown, wet, loose / soft to medium stiff, fine grained sand							
30				4					SA Hydro
		Total Depth 31.5 feet Ground water at 17 feet Boring backfilled with bentonite 0-31.5 feet							

EXPLORATION LOG

Project:		Location: B-4
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 61.7
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand (SM): Light gray, dry, fine grained sand							
		Sand (SP): Light gray, damp, loose, fine to coarse grained sand		11	■		1.2	Dist.	
		@ 4 ft, , damp to moist		7	■		2.2	93.8	
5		@ 6 ft, , moist		8	■		3.2	95.1	
10		@ 10 ft, , very moist to wet, medium dense		15	■		24.3	90.6	
15		Silty Sand (SM): Gray, wet, loose to medium dense, fine to coarse grained sand @ 15.5 ft, Ground water	▽	8	■				
20		Sand (SP): Gray, wet, loose, fine to coarse grained sand		5	■				
		Total Depth 21.5 feet Ground water at 15.5 feet Boring backfilled with bentonite 0-20 feet							

Albus-Keefe & Associates, Inc.

Plate A-10

EXPLORATION LOG

Project:		Location: B-5
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 58.7
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand (SM): Light gray, damp, fine grained sand							
		Sand (SP): Gray, moist, medium dense, fine to coarse grained sand		20	■		2.7	99.9	
				18	■		4.6	96.3	
5		@ 6 ft, , very moist		15	■		24.4	91.6	
10		@ 10 ft, , wet		16	■		24	95.2	
		@ 11.5 ft, Ground water	▽						
15		Sand trace Silt (SP): Gray, wet, medium dense, fine to medium grained sand		9	⧗				
20		@ 20 ft, loose to medium dense		8	⧗				
		Total Depth 21.5 feet Ground water at 11.5 feet Boring backfilled with bentonite 0-21.5 feet							

EXPLORATION LOG

Project:		Location: B-6
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 63.4
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) Silty Sand (SM): Tan to light gray, dry to damp, fine grained sand							Max EI SO4 DS
		Sandy Silt / Interbedded Sand (ML/SP): Tan to light gray, damp, medium stiff / loose, fine grained sand, some debris		12			11	85.9	
		ALLUVIUM (Qal)		7			2.1	Dist.	
5		Sand (SP): Light gray, damp to moist, loose, fine to coarse grained sand							
				2			1.8	92.3	
		@ 7.5 ft, , very moist, very loose							
10		@ 10 ft, , wet		12			20.1	97.2	
			▽						
		@ 13 ft, Ground water							
15		Sand with Silt (SP-SM): Gray, wet, loose to medium dense, fine to medium grained sand, some coarse grained sand		8					200
20		@ 20 ft, medium dense, fine to coarse grained sand		11					200

Albus-Keefe & Associates, Inc.

Plate A-12

EXPLORATION LOG

Project:		Location: B-6
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 63.4
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

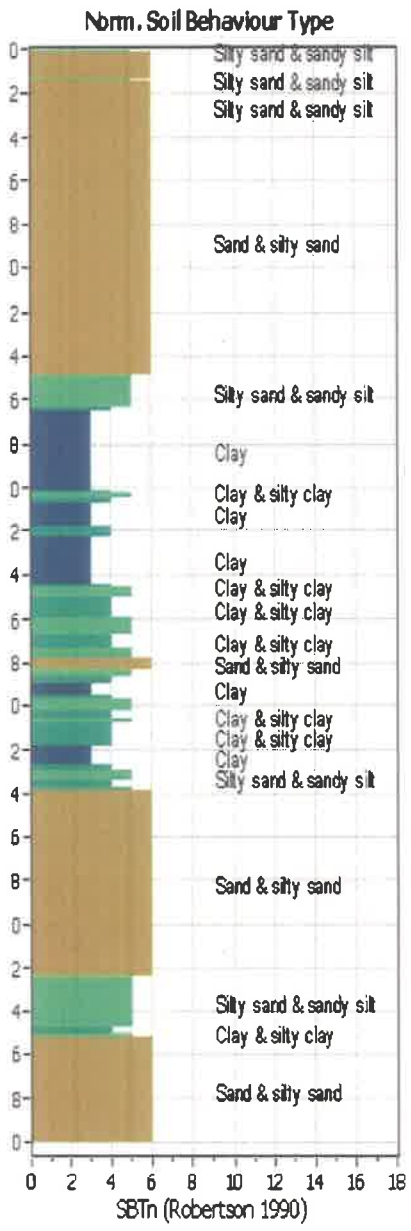
Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Silty Sand (SM): Grayish brown, wet, loose to medium dense, fine grained sand		8	■				200
30		Sandy Silt (ML): Grayish brown, wet, soft, fine grained sand		3	■				200
35		Sand with Silt (SP): Gray, wet, very loose, fine to medium grained sand		3	■				200
40		@ 40 ft, medium dense to dense		14	■				
45		@ 45 ft, medium dense		12	■				200

EXPLORATION LOG

Project:		Location: B-6
Address: 391 Frazee Rd, Oceanside, CA 92057		Elevation: 63.4
Job Number: 2551.00	Client: Sheldon Development, LLC	Date: 6/12/2018
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: DDA

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				11					
		Total Depth 51.5 feet Ground water at 13.0 feet Boring backfilled with bentonite 0-51.5 feet							

CPT-22



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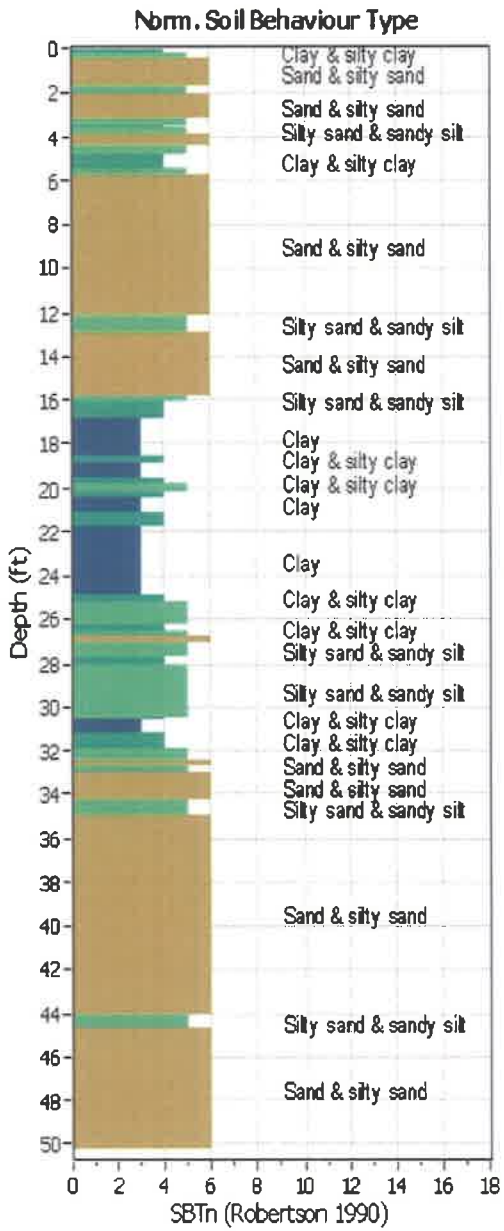

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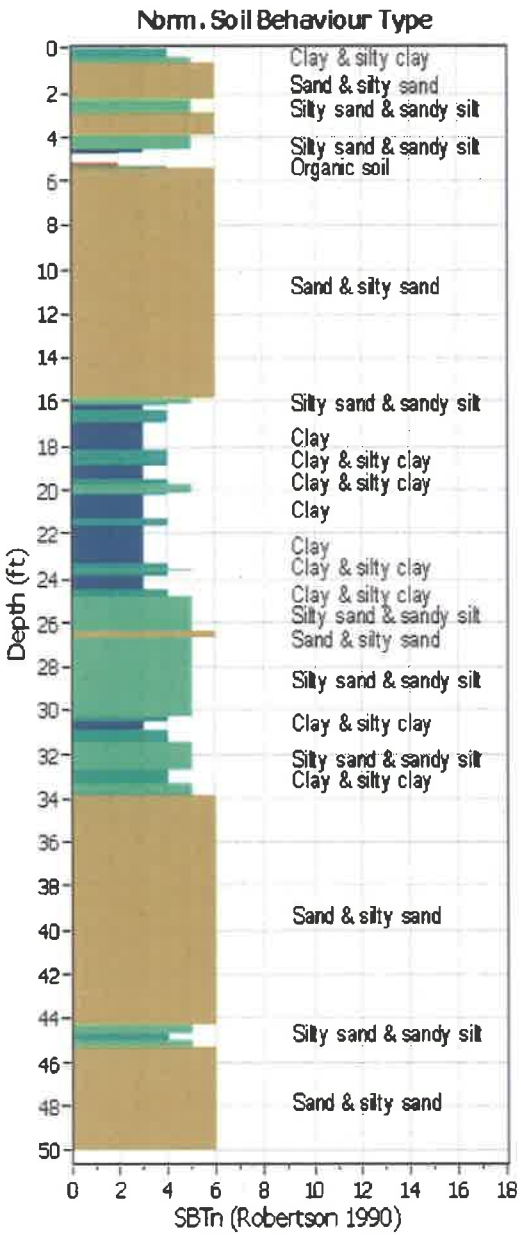

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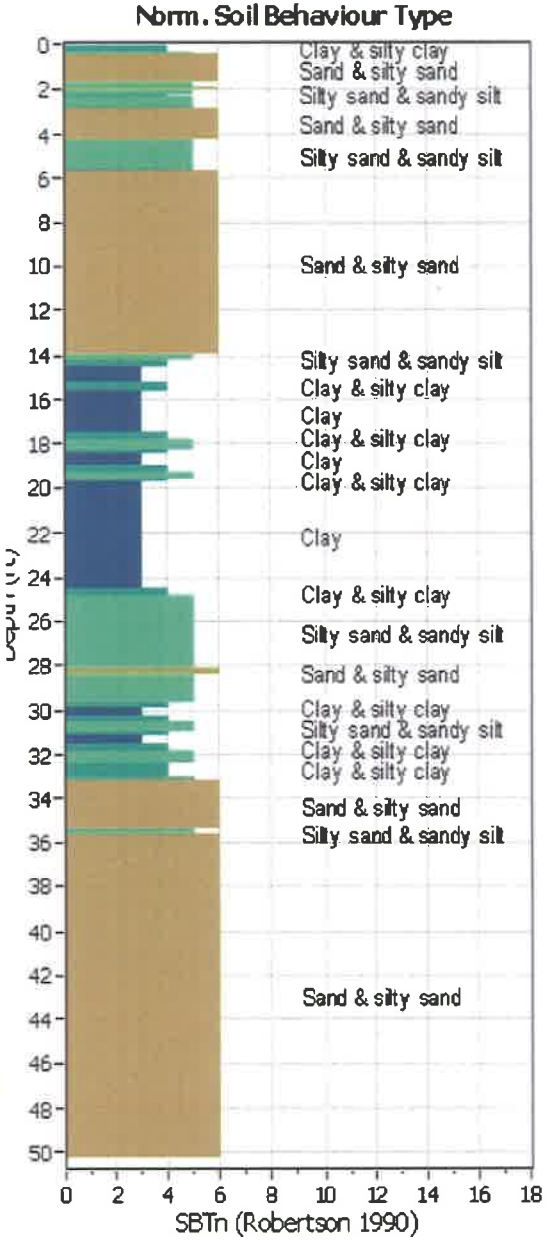

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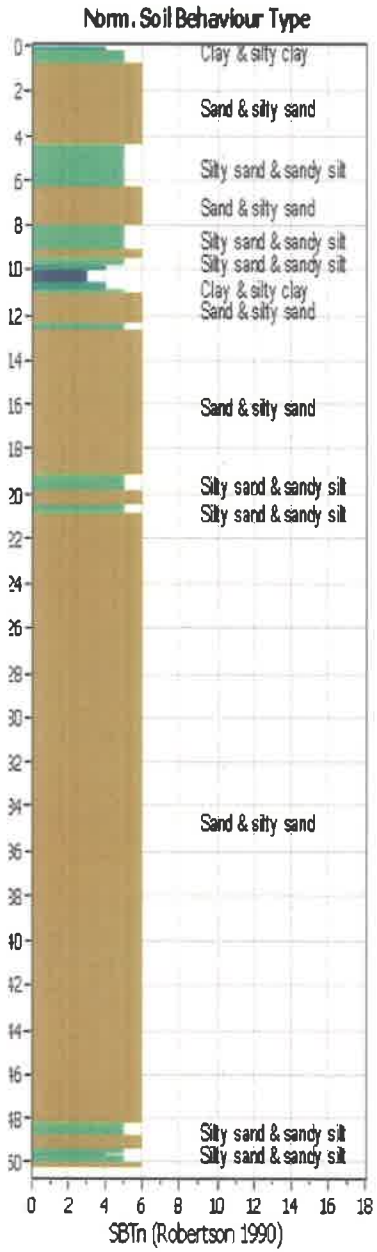

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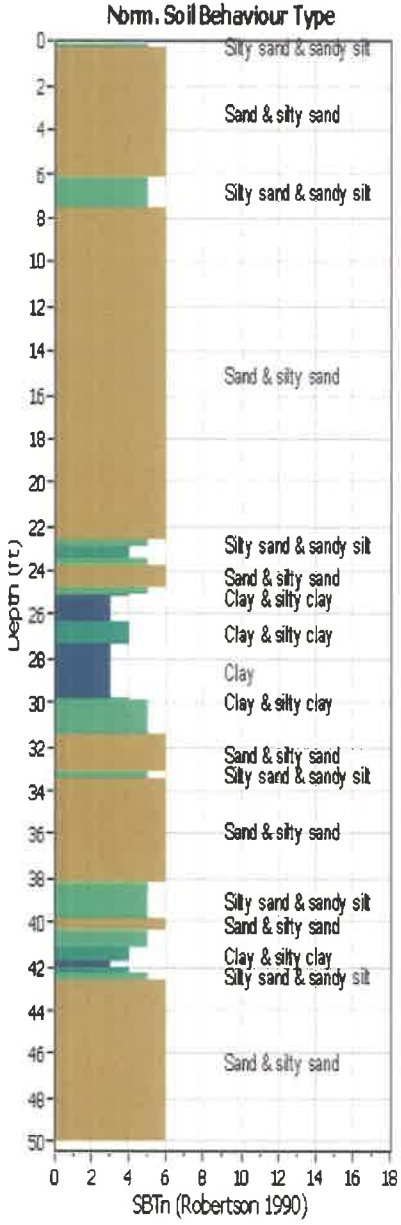

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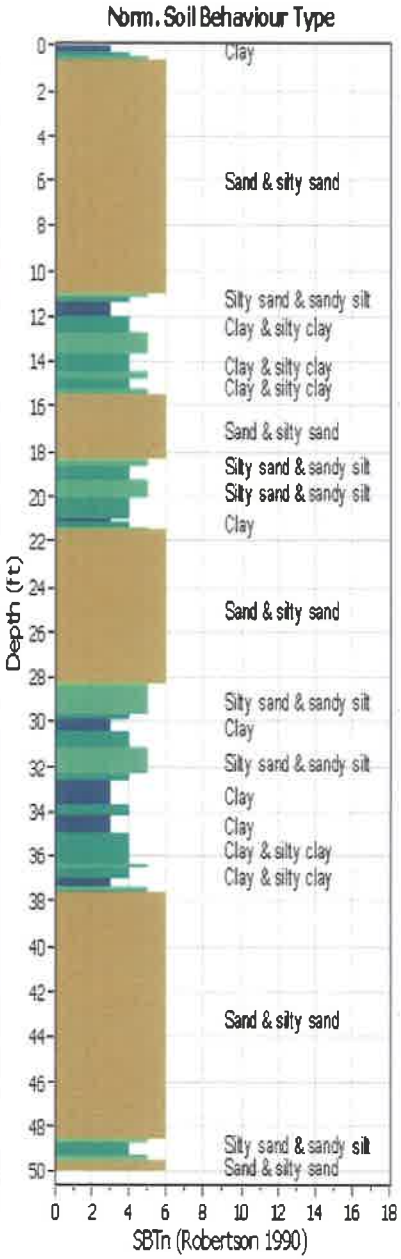

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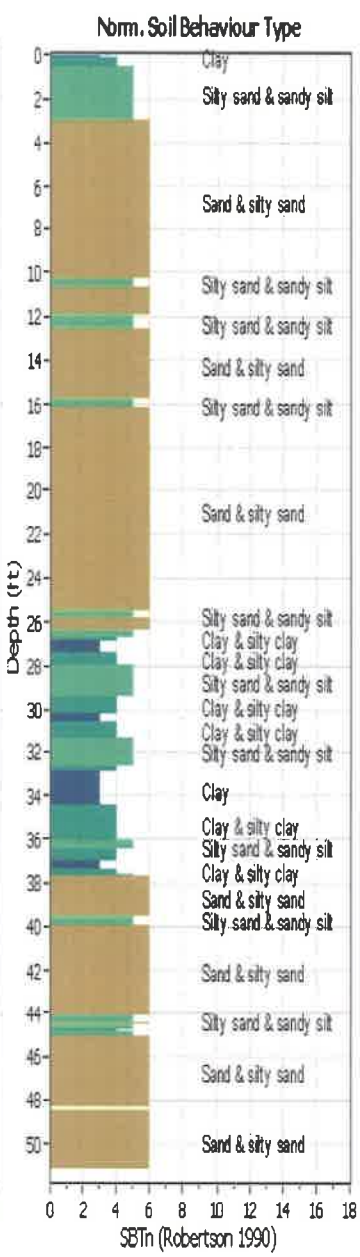

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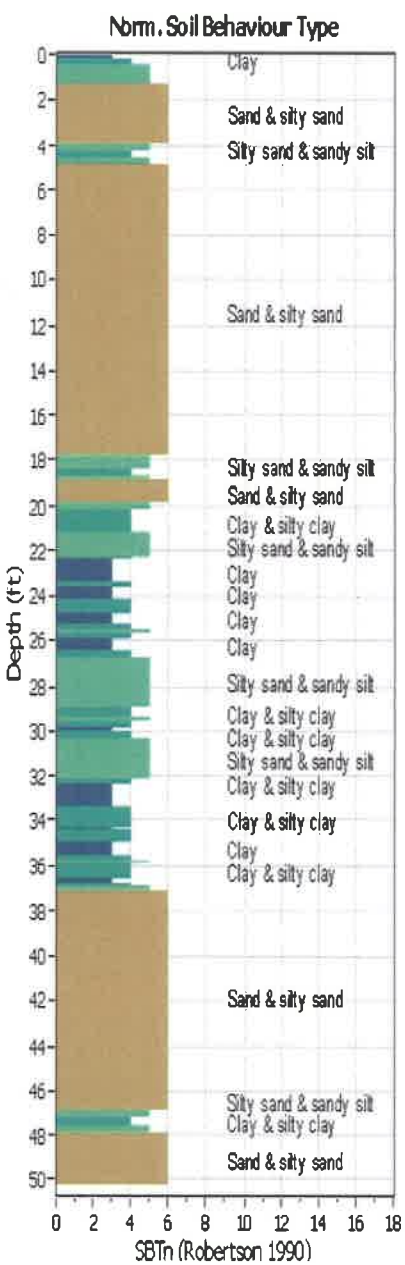

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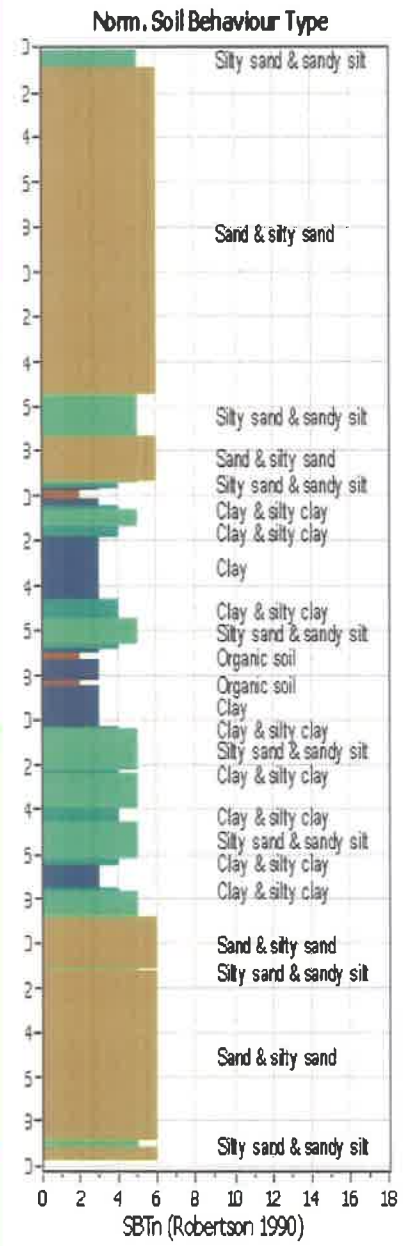

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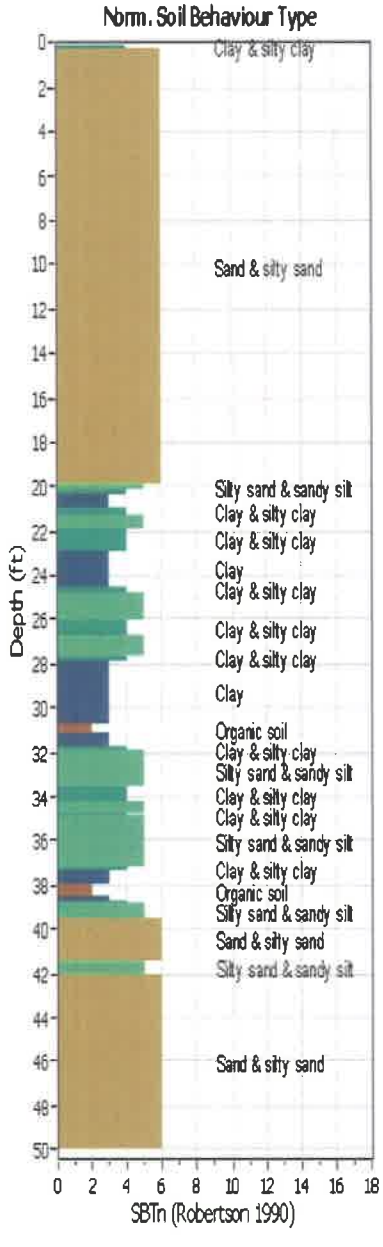

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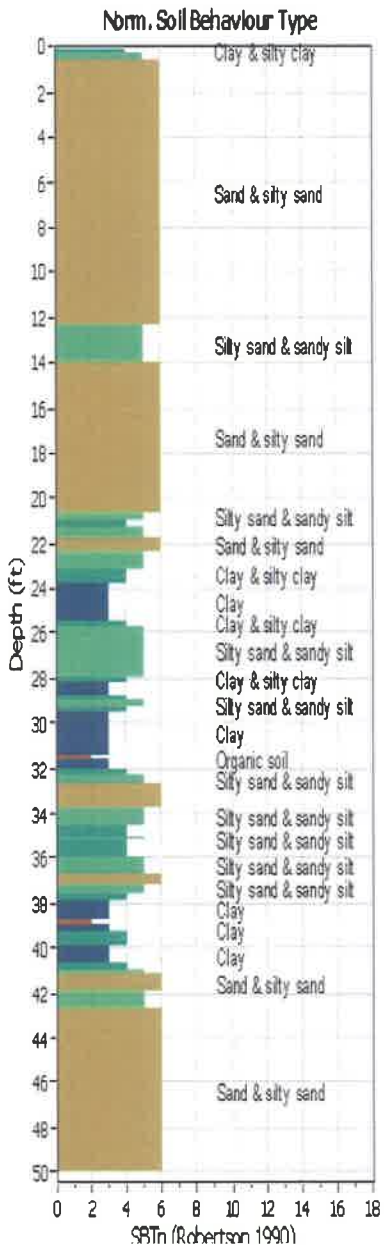
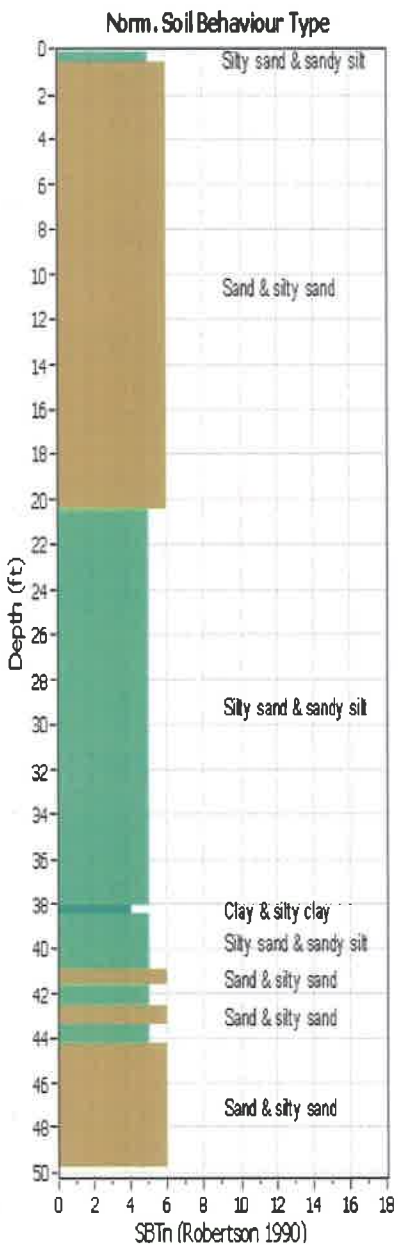


CPT-4



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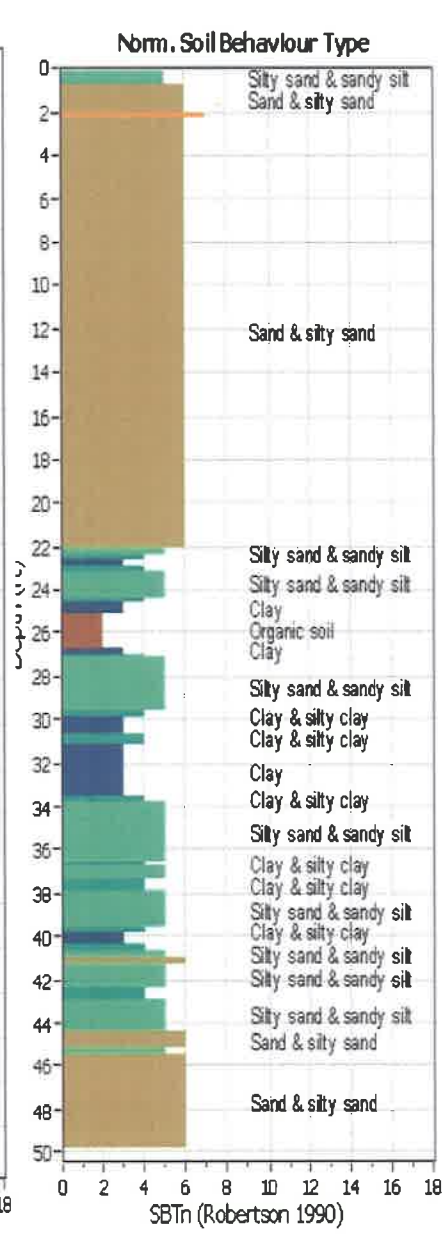
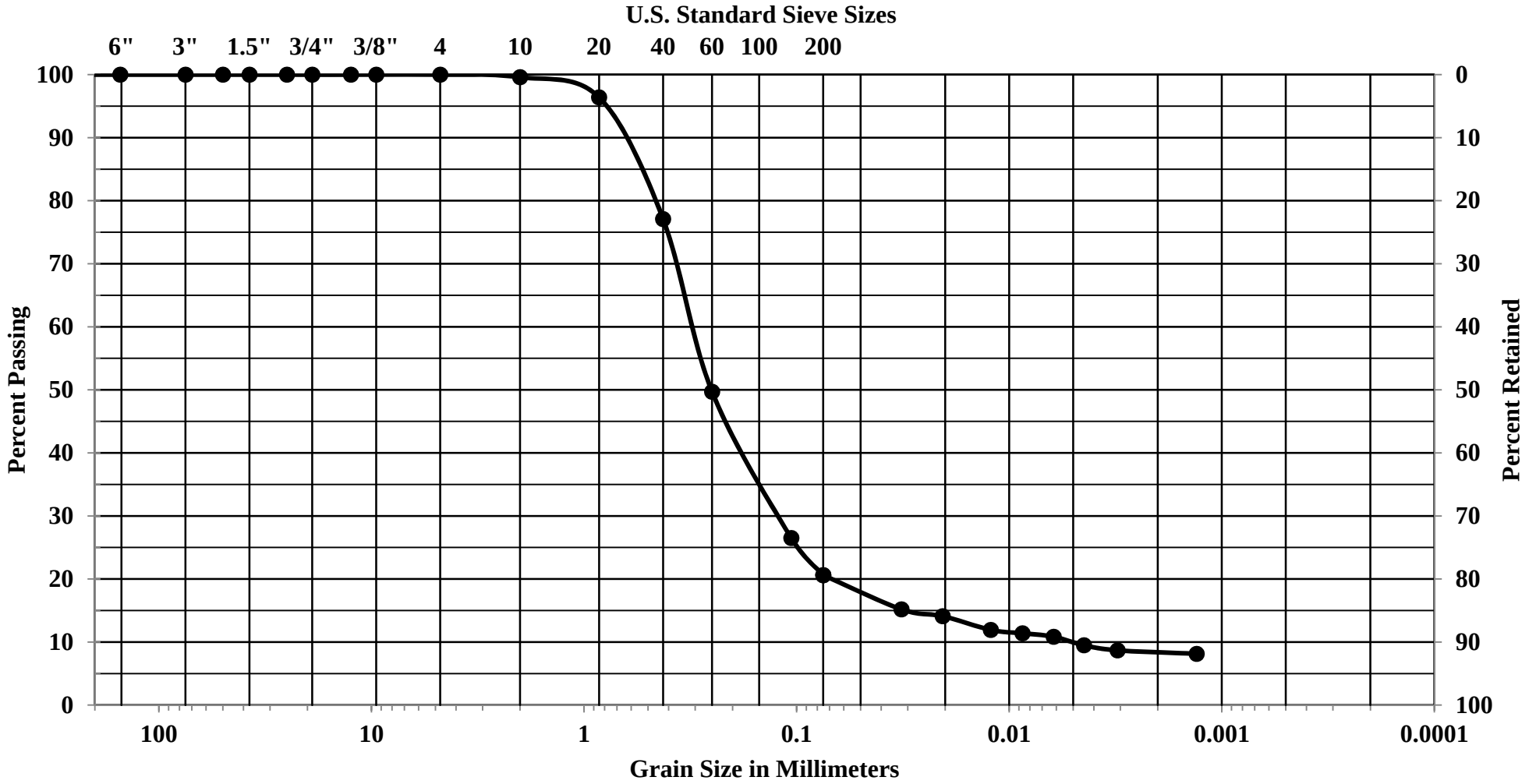


APPENDIX B

LABORATORY TESTING

GRAIN SIZE DISTRIBUTION

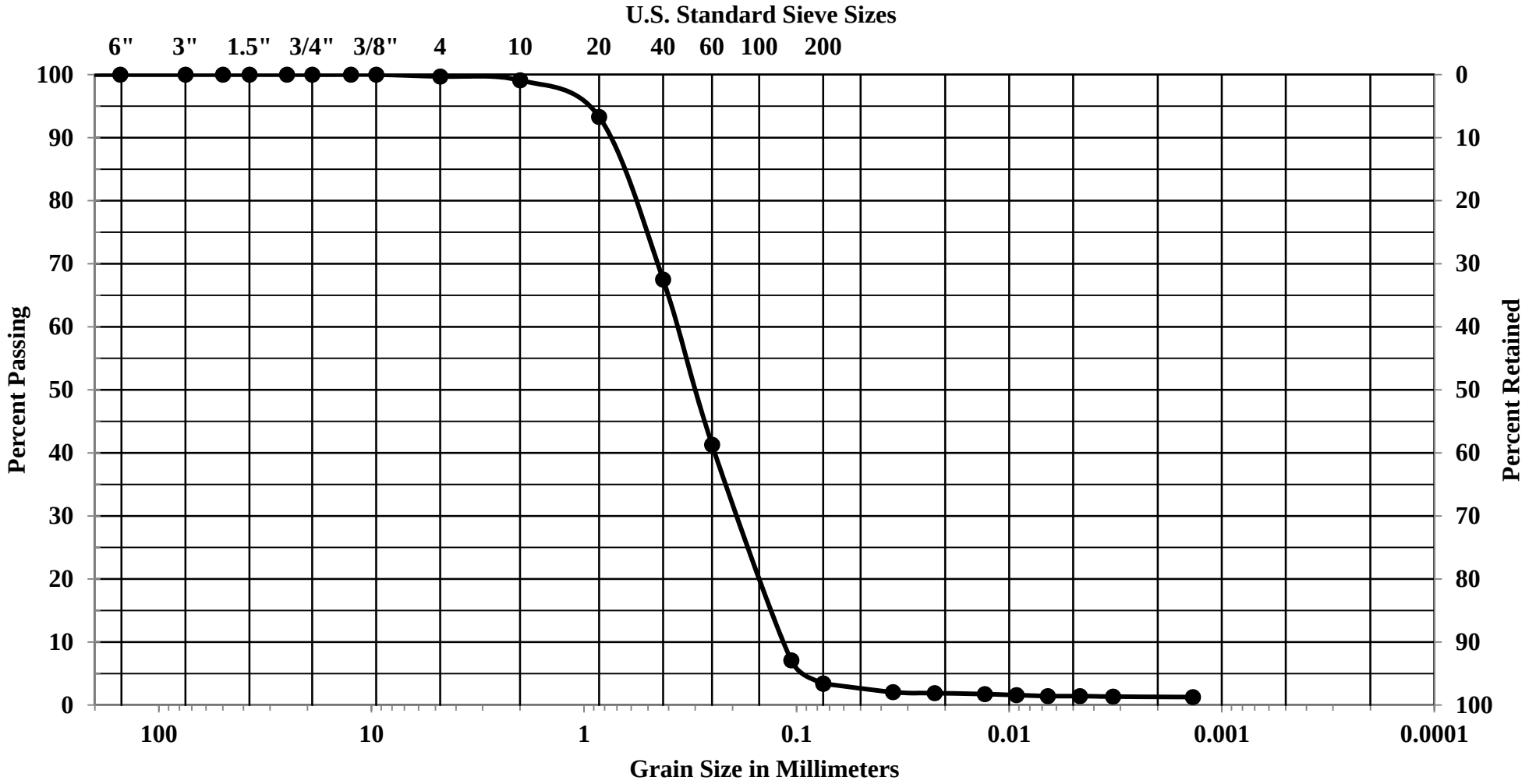
COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Job Number	Location	Depth	Description
2551.00	P-1	9 feet	Silty Sand (SM)

GRAIN SIZE DISTRIBUTION

COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	



Job Number	Location	Depth	Description
2551.00	P-2	6 feet	Sand trace Silt (SP)

APPENDIX C

PERCOLATION TESTING AND ANALYSIS

Field Percolation Testing

Client: Sheldon Development, LLC
Job. No.: 2551.00
Date Tested: 6/20/2018
Test by: DDA
Location: P-1

Top of Casing to Bottom of Well (ft): 10
Elev. of Ground Surface (ft):
Diam. of Test Hole (in): 8
Diam. of Casing (in): 3
Ht. to Top of Casing (ft): 0.6
Water Tempurature (C°): 21

Constant Head

Elapsed Time (minutes)	Time	Depth to H2O (ft)	Flow Rate (gal./min.)
0.0	7:30	8	0.5
5.0	7:35	8	0.48
8.0	7:38	8	0.46
10.0	7:40	8	0.44
12.0	7:42	8	0.42
20.0	7:50	8	0.38
21.0	7:51	8	0.36
26.0	7:56	8	0.32
40.0	8:10	8	0.32
50.0	8:20	8	0.32
60.0	8:30	8	0.32

Falling Head

Elapsed Time (minutes)	Time	Depth to H2O (ft)
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		

Field Percolation Testing

Client: Sheldon Development, LLC
Job. No.: 2551.00
Date Tested: 6/20/2018
Test by: DDA
Location: P-2

Top of Casing to Bottom of Well (ft): 10
Elev. of Ground Surface (ft):
Diam. of Test Hole (in): 8
Diam. of Casing (in): 3
Ht. to Top of Casing (ft): 2.7
Water Tempurature (C°): 21

Constant Head

Elapsed Time (minutes)	Time	Depth to H2O (ft)	Flow Rate (gal./min.)
0.0	9:00	8.75	1.60
2.0	9:02	8.75	1.58
4.0	9:04	8.75	1.56
7.0	9:07	8.75	1.54
0.0	9:20	8.90	1.20
5.0	9:25	8.90	1.20
10.0	9:30	8.90	1.20
15.0	9:35	8.90	1.20
20.0	9:40	8.90	1.20
30.0	9:50	8.90	1.20
40.0	10:00	8.90	1.20

Falling Head

Elapsed Time (minutes)	Time	Depth to H2O (ft)
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		
0.0		

INFILTRATION WELL DESIGN

Constant Head
USBR 7300-89 Method
J.N.: 2551.00
Client: Sheldon Development, LLC
Well No.: P-1

Low Water Table	Condition 1	
High Water Table & Water Below Bottom of Well	Condition 2	
High water Table with Water Above the Well Bottom	Condition 3	
		Units:
Enter Condition (1, 2 or 3):	1	
Ground Surface to Bottom of Well (**h_1**):	9.4	feet
Depth to Water (**h_2**):	8	feet
Height of Water in the Well (h_1-h_2=**h**):	1.4	feet
Radius of Well (**r**):	4.0	Inches
Minimum Volume Required:	98.7	Gal.
Discharge Rate of Water Into Well for Steady-State Condition (**q**):	0.32	Gal/min.
Temperature (**T**):	21	Celsius
(Viscosity of Water @ Temp. T) / (Viscosity of water @ 20° C) (**V**):	0.9647	ft^3/min.
Unsaturated Distance Between the Water Surface in the Well and the Water table (**T_u**):		Ignore T_u
Factor of Safety:	1	
Coefficient of Permeability @ 20° C (**k_{20}**):	4.58E-03	ft/min.
Design k_{20}:	3.30	in./hr.

The presence or absence of a water table or impervious soil layer within a distance of less than three times that of the water depth in the well (measured from the water surface) will enable the water table to be classified as **Condition I**, **Condition II**, **Condtion III**.

Low Water Table-When the distance from the water surface in the test well to the ground water table, or to an impervious soil layer which is considered for test puposes to be equivalent to a water table, is greater than three times the depth of water in the well, classify as **Condition I**.

High Water Table-When the distance from the water surface in the test well to the ground water table or to an impervious layer is less than three times the depth of water in the well, a high water table condition exists. Use **Condition II** when the water table or impervious layer is below the well bottom. Use **Condition III** when the water table or impervious layer is above the well bottom.

INFILTRATION WELL DESIGN

Constant Head
USBR 7300-89 Method
J.N.: 2551.00
Client: Sheldon Development, LLC
Well No.: P-2

Low Water Table	Condition 1	
High Water Table & Water Below Bottom of Well	Condition 2	
High water Table with Water Above the Well Bottom	Condition 3	
		Units:
Enter Condition (1, 2 or 3):	1	
Ground Surface to Bottom of Well (**h_1**):	7.3	feet
Depth to Water (**h_2**):	6.2	feet
Height of Water in the Well (h_1-h_2=**h**):	1.1	feet
Radius of Well (**r**):	4.0	Inches
Minimum Volume Required:	67.4	Gal.
Discharge Rate of Water Into Well for Steady-State Condition (**q**):	1.2	Gal/min.
Temperature (**T**):	21	Celsius
(Viscosity of Water @ Temp. T) / (Viscosity of water @ 20° C) (**V**):	0.9647	ft^3/min.
Unsaturated Distance Between the Water Surface in the Well and the Water table (**T_u**):		Ignore T_u
Factor of Safety:	1	
Coefficient of Permeability @ 20° C (**k_{20}**):	2.40E-02	ft/min.
Design k_{20}:	17.29	in./hr.

The presence or absence of a water table or impervious soil layer within a distance of less than three times that of the water depth in the well (measured from the water surface) will enable the water table to be classified as **Condition I**, **Condition II**, **Condtion III**.

Low Water Table-When the distance from the water surface in the test well to the ground water table, or to an impervious soil layer which is considered for test puposes to be equivalent to a water table, is greater than three times the depth of water in the well, classify as **Condition I**.

High Water Table-When the distance from the water surface in the test well to the ground water table or to an impervious layer is less than three times the depth of water in the well, a high water table condition exists. Use **Condition II** when the water table or impervious layer is below the well bottom. Use **Condition III** when the water table or impervious layer is above the well bottom.