PJC & Associates, Inc.
Consulting Engineers & Geologists

October 28, 2022 Job No. S3396.01

PPI Engineering
Attention: Matthew S. Bueno
2800 Jefferson Street
Napa, CA 94558

Subject: Geotechnical Investigation
Proposed Carneros Vista Reservoir
Duhig Road
Napa, California

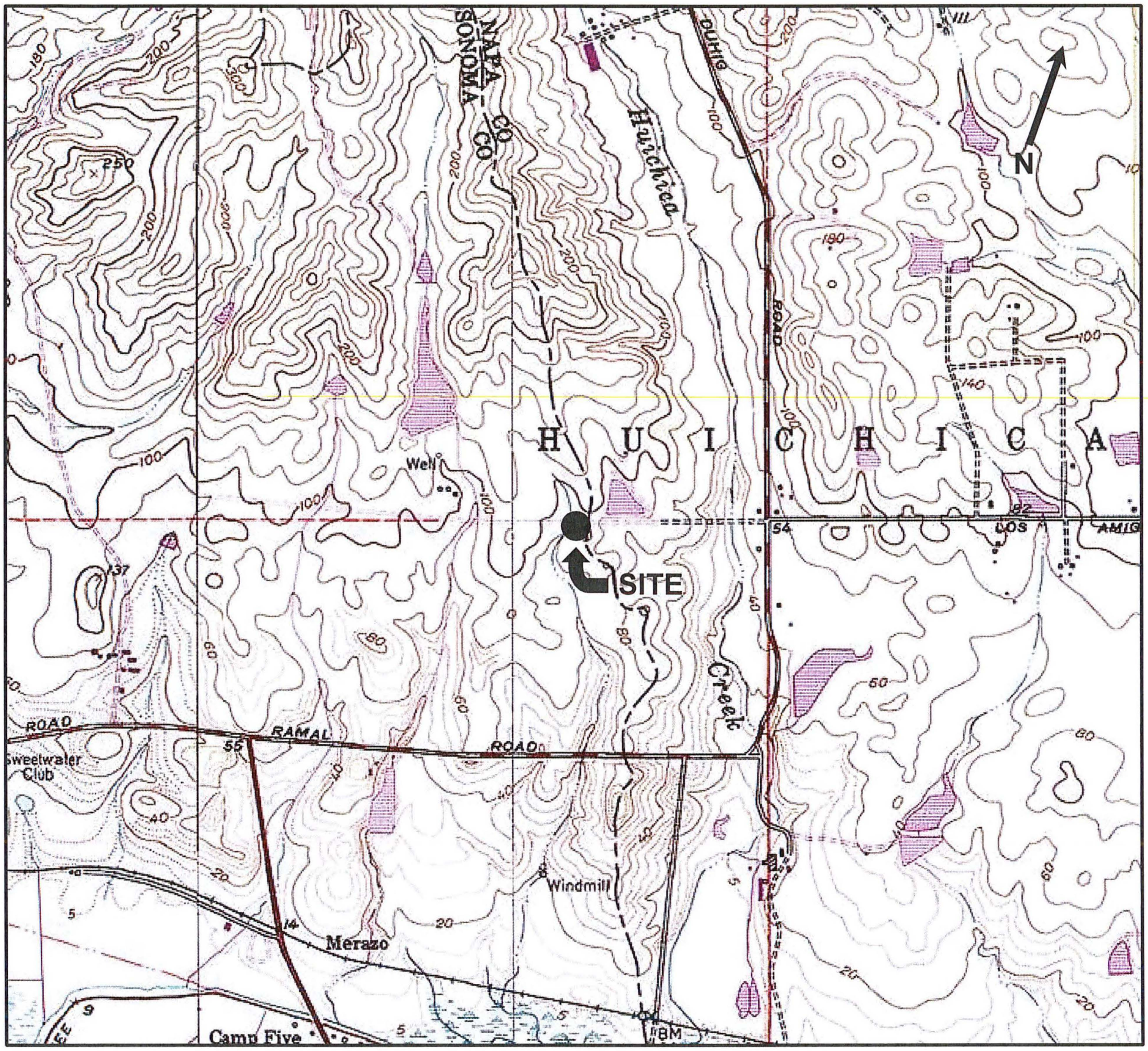
PJC & Associates, Inc. (PJC) is pleased to submit this report which presents the results of our geotechnical investigation for the proposed Carneros Vista reservoir located at Duhig Road in Napa, California. The approximate location of the site is shown on the Site Location Map, Plate 1. Our services were completed in accordance with our proposal for geotechnical engineering services, dated May 9, 2022. This report presents our engineering opinions and recommendations regarding the geotechnical aspects of the design and construction of the proposed reservoir. Based on the results of this study, it is our opinion that the project is feasible from a geotechnical engineering standpoint provided the recommendations presented herein are incorporated in the design and carried out through construction.

1. PROJECT DESCRIPTION

Based on the preliminary project plans and information provided by you, it is our understanding that the proposed project will consist of constructing an approximately 50 acre-feet earthen reservoir, with a synthetic liner. The pond will likely be graded by a combination of cutting on the interior to achieve the desired pond grade, and filling to construct an earthen embankment along the perimeter. Based on the preliminary plans, we anticipate that the project will require cuts on the order of 22 feet and less and fills on the order of 25 feet and less.

2. SCOPE OF SERVICES

The purpose of this investigation was to evaluate the subsurface conditions at the site and to develop geotechnical criteria for design and construction of the project. Specifically, the scope of our services consisted of the following:



SCALE 1:24,000

REFERENCE: USGS CUTTINGS WHARF CALIFORNIA QUADRANGLE, DATED 1981.
USGS SEARS POINT CALIFORNIA QUADRANGLE, DATED 1968.

PJC & Associates, Inc. Consulting Engineers & Geologists	SITE LOCATION MAP PROPOSED CARNEROS VISTA RESERVOIR DUHIG ROAD NAPA, CALIFORNIA	PLATE 1
	Proj. No: S3396.01 Date: 10/22 App'd by: AJD	

a. Excavate eight exploratory test pits to depths between four and one-half and six feet, and drill two exploratory boreholes to depths between 25.5 and 26.5 feet below the existing ground surface to observe the soil and groundwater conditions. Our certified engineering geologist was on site to observe the excavation and drilling, log the materials encountered in the test pits and boreholes and to obtain representative samples for visual classification and laboratory testing.

b. Perform laboratory tests on selected samples to evaluate their index and engineering properties.

c. Review seismological and geologic literature on the site area, discuss site geology and seismicity, and evaluate potential earthquake effects (i.e., liquefaction, ground rupture, settlement, lurching and lateral spreading, slope stability, etc.).

d. Perform engineering analyses to develop geotechnical recommendations for site preparation and earthwork, slope and embankment stability, maximum permissible cut and fill slope inclinations, compaction requirements and subsurface drainage control.

e. Preparation of this formal report summarizing our work on this project.

3. SITE CONDITIONS

a. General: The site is located in an agricultural area of Napa, approximately four tenths of one mile west of the intersection of Las Amigas Road and Duhig Road. The reservoir site is generally surrounded by vineyards in all directions. The site is currently located within an existing vineyard block and is occupied by its existing vines.

b. Topography and Drainage: The project site is located on relatively level to gently sloping topography, near the center of an approximately one and one-half mile wide area of the Napa Valley. According to the United States Geological Survey (USGS) Cuttings Wharf, California, 7.5 Minute Quadrangle Map (Topographic), the proposed pond is located at an elevation of approximately 90 feet above mean sea level (MSL). Site drainage appears to consist of sheet flow and surface infiltration and is provided by the Huichica Creek, which discharges into the Napa River, approximately three miles southeast of the site.

4. GEOLOGIC SETTING

The site is located in the Coast Ranges Geomorphic Province of California. This province is characterized by northwest trending topographic and geologic features, and includes many separate ranges, coalescing mountain masses and several major structural valleys. The province is bounded on the east by the Great Valley and on the west by the Pacific Ocean. It extends north into Oregon and south to the Transverse Ranges in Ventura County.

The structure of the northern Coast Ranges region is extremely complex due to continuous tectonic deformation imposed over a long period of time. The initial tectonic episode in the northern Coast Ranges was a result of plate convergence which is believed to have begun during late Jurassic time. This process involved eastward thrusting of oceanic crust beneath the continental crust (Klamath Mountains and Sierra Nevada) and the scraping off of materials that are now accreted to the continent (northern Coast Ranges). East-dipping thrust and reverse faults were believed to be the dominant structures formed.

Right lateral, strike slip deformation was superimposed on the earlier structures beginning mid-Cenozoic time, and has progressed northward to the vicinity of Cape Mendocino in Southern Humboldt County (Hart, Bryant and Smith, 1983). Thus, the principal structures south of Cape Mendocino are northwest-trending, nearly vertical faults of the San Andreas system.

According to the available geologic literature, and our experience with other projects in the area, the site has been mapped to be underlain by deposits of the Huichica Formation (T_h). These deposits are described to consist of sand, gravel, silt, and clay primarily derived of the Sonoma Volcanics Series. These deposits likely extend to great depths below the site.

5. FAULTING

Geologic structures in the region are primarily controlled by northwest trending faults. No known active fault passes through the site. The site is not located in the Alquist-Priolo Earthquake Fault Studies Zone. Based on our research, the three closest known potentially active faults to the site are the West Napa, the Rodgers Creek, and the Hayward North faults. The West Napa fault is located three and one-half miles to the northeast, the Rodgers Creek fault is located eight and one-half miles to the west, and the Hayward North fault is located ten miles southwest of the site. Table 1 outlines the nearest known active faults and their associated maximum magnitude.

TABLE 1
CLOSEST KNOWN ACTIVE FAULTS

Fault Name	Distance from Site (Miles)	Maximum Earthquakes (Moment Magnitude)
West Napa	3.5	6.7
Rodgers Creek	8.5	7.1
Hayward North	10.5	6.6

6. SEISMICITY

The site is located within a zone of high seismic activity related to active faults that transverse through the surrounding region. Future damaging earthquakes could occur on any of these fault systems during the lifetime of the proposed project. In general, the intensity of ground shaking at the site will depend upon the distance to the causative earthquake epicenter, the magnitude of the shock, the response characteristics of the underlying earth materials, and the quality of construction. Seismic considerations and hazards are discussed in the following subsections of this report.

7. SUBSURFACE CONDITIONS

a. Soils. The subsurface conditions of the site were investigated by drilling two boreholes (BH-1 & BH-2) to depths of 25.5 and 26.5 feet below the existing ground surface. Additionally, we excavated eight exploratory test pits (TP-1 through TP-8) in the vicinity of the proposed reservoir to depths between five and seven and one-half feet below the existing ground surface. The approximate borehole and test pit locations are shown on the Borehole & Test Pit Location Plan, Plate 4. The boreholes and test pits were drilled and excavated to observe the soil and groundwater conditions. The excavation procedures and descriptive borehole and test pit logs are included in Appendix B of this report. The laboratory procedures are included in Appendix C.

The boreholes and test pits generally encountered alluvial deposits underlain by soil and bedrock deposits of the Huichica Formation (T_h) that extended to the maximum explored depths. At the surface, our exploration encountered alluvial deposits consisting of sandy clays that extended to depths between two and one-half and three feet below the existing ground surface. The sandy clays appeared dry to very moist, stiff to hard, disturbed, and exhibited low to medium (PI=10, 10, & 21) plasticity characteristics. Underlying the alluvial deposits, our exploration encountered soil and bedrock deposits of the Huichica Formation (T_h) consisting of sandy clay and sandstone that extended to the maximum explored depths. The sandy clays appeared slightly moist to very moist, very stiff to hard and exhibited medium (PI=19 & 25) plasticity characteristics. The sandstone deposits appeared soft to slightly hard, friable, and highly weathered.

b. Groundwater. Groundwater was not encountered in the exploratory boreholes or test pits at the time of our exploration on June 14, 2022 and July 8, 2022. However, groundwater levels can fluctuate by several feet throughout the year due to seasonal rainfall and other factors. Evaluation of these factors is beyond the scope of this report.

8. GEOLOGIC HAZARDS & SEISMIC CONSIDERATIONS

The site is located within a region subject to a high level of seismic activity. Therefore, the purposed project could experience strong seismic ground shaking during the lifetime of the project. The following discussion reflects the possible earthquake effects which could result in damage to the proposed reservoir.

a. Fault Rupture. Rupture of the ground surface is expected to occur along known active fault traces. No evidence of existing faults or previous ground displacement on the site due to fault movement is indicated in the geologic literature or field exploration. Therefore, the likelihood of ground rupture at the site due to faulting is considered to be low.

b. Ground Shaking. The site has been subjected in the past to ground shaking by earthquakes on the active fault systems that traverse the region. It is believed that earthquakes with significant ground shaking will occur in the region within the next several decades. Therefore, it must be assumed that the proposed pond will be subjected to strong ground shaking during its design life.

c. Liquefaction. Our field exploration revealed no loose, saturated, granular soil stratums at the site. Also, relatively shallow deposits of bedrock were encountered. Therefore, it is judged that the risk of soil liquefaction at the site is low. Furthermore, according to the Association of Bay Area Governments (ABAG) liquefaction map, the site is located in an area of very low susceptibility to seismically induced liquefaction.

d. Lateral Spreading and Lurching. Lateral spreading is normally induced by vibration of near-horizontal colluvial soil layers adjacent to an exposed face. Lurching is an action, which produces cracks or fissures parallel to streams or banks when the earthquake motion is at right angles to them. There are no exposed faces or a creek embankment adjacent to the proposed reservoir. Therefore, we judge that the potential for lateral spreading and lurching at the site is low.

e. Expansive Soils. Based on visual observations and laboratory testing (PI=10, 10, 17, 19, 21, 25, & 25), the clay soils at the site are judged to have a low to moderate expansion potential.

9. SLOPE STABILITY ANALYSIS

a. Analysis Method. The overall stability of the fill embankments were analyzed for stability by conventional limit equilibrium methods to determine factors of safety against sliding. A 30-foot tall exterior fill embankment for the reservoir was computer analyzed for circular arc failure modes using Bishop's procedures. The computer program, PCSTABL5, developed by Purdue University in 1985, was used to perform the slope stability analysis. The computer program performs an automatic search for the slip surface having a minimum factor of safety. In Bishop's procedure, the interslice shear forces are neglected and the factor of safety is determined by taking moments about the center of rotation. The trial and error solution assumes many possible failure surfaces and computes the corresponding factors of safety until a minimum is determined.

The slope stability analyses for the reservoir were performed on a 30 foot tall exterior embankment with a side slope of 2H:1V and a 28-foot tall interior slope at 2.5H:1V. The cross sections used for slope stability analyses were based on topographic information provided by the preliminary plans. Optimum moisture content, maximum dry density and direct shear strength laboratory test data were also used for our analysis. Static and pseudostatic conditions were analyzed and factors of safety were determined against landsliding. Table 2, Slope Stability Analyses and Strength Parameters, presents a summary of the strength parameters used.

TABLE 2
SLOPE STABILITY ANALYSES AND STRENGTH PARAMETERS

Material	**Total Unit Weight**	**Shear Strength Parameters**	
	(pcf)	Friction Angle (Degrees)	Cohesion (psf)
Fill	120	23	437
Alluvium	120	20	200
Huichica Deposits	130	0	3000

b. Pond Embankment Slope Stability. A slope stability analysis for the overall embankment stability was performed using a cross section of a 30-foot high exterior fill slope graded to an inclination of 2H:1V for the reservoir. The results of our analysis are presented on Plates 2 and 3. Furthermore, the associated factors of safety are presented on Table 3.

TABLE 3
MINIMUM FACTORS OF SAFETY
EXTERIOR EMBANKMENT FILL SLOPE @ 2H:1V

Condition	Factor of Safety	Minimum Recommended Values**
Static	2.1	1.5
Seismic*	1.3	1.2

*Using a pseudostatic coefficient of 0.24g
** Referenced from manual titled "An Engineering Manual for Slope Stability Studies," by Duncan, Buchignan and DeWet, dated March 1987.

c. Discussion. Based on the results of our analysis, the proposed exterior fill embankments graded to 2H:1V and less have adequate factors of safety for both static and pseudostatic conditions.

10. CONCLUSIONS

Based on the results of this investigation, we judge that the project is feasible from a geotechnical engineering standpoint provided the recommendations of this report are incorporated in design and carried out through construction. The primary geotechnical consideration is the presence of weak and compressible young alluvial soils. Furthermore, the soils encountered had significant portions of coarse-grained materials unsuitable for retaining water.

The young alluvial soils at the site are weak, compressible and not suitable for support of the proposed fill embankments. Therefore, the young alluvial soils underlying the fill embankment and pond areas of the reservoir should be subexcavated and recompacted as directed by the geotechnical engineer in the field during construction. Additionally, based on our permeability testing, the soils encountered at the reservoir area do not have an adequate capacity to retain water. Therefore, we recommend that a synthetic liner be used for the reservoir. Furthermore, subsurface drainage should be provided under the liner to prevent hydrostatic uplift of the synthetic liner.

11. GRADING

a. General. Based on the preliminary plan, we anticipate that the pond grading will consist of a combination of cutting to achieve the desired pond grade, and filling to construct an earthen embankment along the perimeter. We anticipate that the exterior embankment of the reservoir will be a maximum of 30 feet tall graded to two horizontal to one vertical (2H:1V) and the interior of the embankment will be approximately 28 feet tall graded to 2.5H:1V.

b. Stripping. Soils containing roots, tree stumps and organic matter must be stripped from the pond area. The stripping should extend a minimum of five feet from the edge of all fill embankments. The stripped material should be removed from the site or should be stockpiled for later distribution on exterior graded slopes. The thickness of required stripping is expected to be generally on the order of two to four inches.

c. Removal of Existing Weak Soils. The upper two and one-half to six and one-half feet of soils underlying the fill embankment and pond areas of the reservoir should be subexcavated and recompacted as directed by the geotechnical engineer in the field during construction.

d. Keyway. To enhance stability, a keyway should be excavated under all fill embankments of the reservoir. The keyway should be at least 10 feet wide, extend at least five feet below the ground surface and two feet into firm soil deposits of the Huichica Formation. Temporary slopes of the keyway should be sloped to no steeper than ½ H:1V. The bottom of the keyway should be scarified to a depth of eight inches, moisture conditioned to over optimum moisture content and compacted to at least 90 percent relative compaction. If groundwater is encountered, de-watering will be required.

A subdrain should be installed in all keyways. The subdrain should consist of four inch diameter, SDR-35, perforated pipe sloped to drain to outlets by gravity, and of clean, free draining, three-quarter to one and one-half inch crushed rock or gravel. The crushed rock should be wrapped with filter fabric or Class II permeable material may be used in lieu of the filter fabric and drain rock. The perforated pipe should be tied to a closed rigid pipe and daylighted through the keyway.

e. Fill Material. Excavated material to be used for the construction of the embankment should not contain organic material, should have no rock or similar irreducible material with a maximum dimension greater than six inches, and should be approved by the geotechnical before use. Imported material, if required, should be approved by the geotechnical engineer before use.

f. Compaction. All fill material should be placed in uniform lifts not exceeding eight inches in loose thickness. The subgrade and all fills should be compacted, by mechanical means only, with acceptable equipment, to a minimum of 90 percent relative compaction as determined by ASTM D1557. Depressions or ruts created in the process of the grading operations should be properly backfilled with suitable fill and compacted to not less than 90 percent relative compaction. The interior of the reservoir should be lined with a synthetic liner consisting of HDPE or approved equivalent. The liner should be placed by a contractor experienced in placement and mending of such materials. Furthermore, subsurface drainage should be provided under the synthetic liner to prevent hydrostatic uplift of the synthetic liner.

g. Cut and Fill Slopes. It is recommended that exterior slopes be constructed at an inclination no steeper than 2H:1V. Interior slopes should be constructed at an inclination no steeper than 2.5H:1V. Exterior slopes should be protected from erosion as determined by the project civil engineer.

12. DRAINAGE

The site should be graded to include provisions for positive surface gradients so that the surface runoff is not permitted to pond, particularly on the fill embankments. Finished slopes should be provided with measures to control erosion. Furthermore, subsurface drainage should be provided under the liner to prevent hydrostatic uplift of the synthetic liner.

13. LIMITATIONS

The data, information, interpretations and recommendations in this report are presented solely as bases and guides for the geotechnical design of the proposed Carneros Vista Reservoir located at Duhig Road in Napa, California. PJC & Associates developed the conclusions and professional opinions presented herein in accordance with generally accepted geotechnical engineering principles and practices. As with all geotechnical reports, the opinions expressed here are subject to revisions in light of new information, which may be developed in the future, and no warranties are either expressed or implied.

This report has not been prepared for use by parties other than the designers of the project. It may not contain sufficient information for the purpose of other parties or other uses. If any changes are made in the project as described in this report, the conclusions and recommendations contained herein should not be considered valid unless the changes are reviewed by PJC, and the conclusions and recommendations are modified and approved in writing. This report and the drawings contained herein are intended only for the design of the proposed project. They are not intended to act by themselves as construction drawings or specifications.

Soil and bedrock deposits may vary in type, strength, and many other important properties between the points of observation and exploration. Additionally, changes can occur in groundwater and soil moisture conditions due to seasonal variations, or for other reasons. Therefore, it must be recognized that PJC does not and cannot have complete knowledge of the subsurface conditions underlying the subject site. The criteria presented are based upon the findings at the points of exploration and upon interpretative data, including interpolation and extrapolation of information obtained at points of observation.

14. ADDITIONAL SERVICES

Upon completion of the project plans, they should be reviewed by our firm to verify that the design is consistent with the recommendations of this report. Observation and testing services should be provided by PJC to verify that the intent of the plans and specifications is carried out during construction; these services should include observing the grading and earthwork, field density testing of fill, and installation of the subsurface drainage facilities.

These services will be performed only if PJC is provided with sufficient notice to perform the work. PJC does not accept the responsibility for items that they are not notified to observe.

It has been a pleasure working with you on this project. Please call us if you have any questions regarding the results of this investigation, or if we can be of further assistance.

Sincerely,

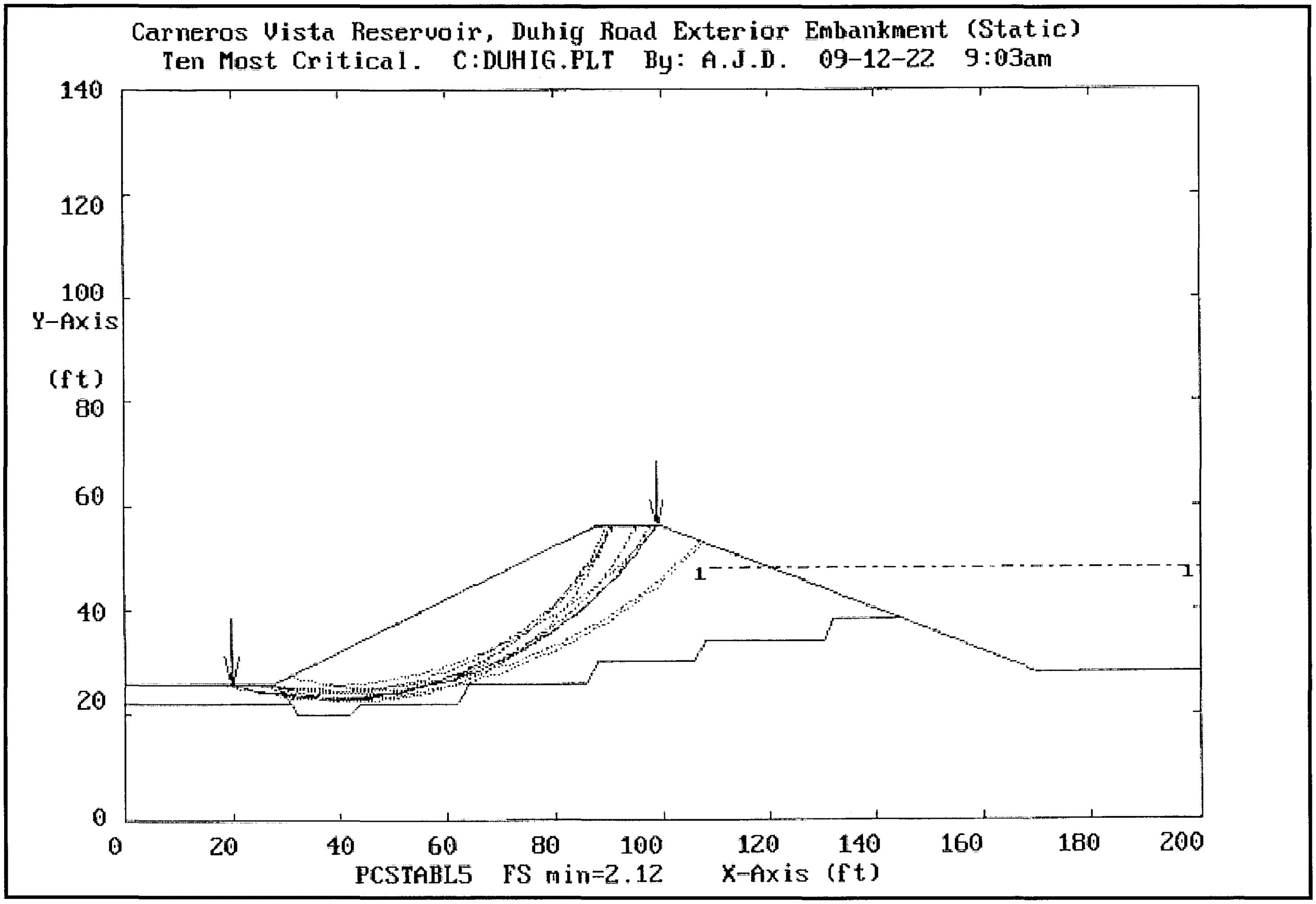
PJC & Associates, Inc.

Andrew Leavitt
Engineer-In-Training
EIT 173464, California

Anthony J. DeMartini
Geotechnical Engineer
GE 2750, California

REGISTERED PROFESSIONAL ENGINEER
ANTHONY J. DEMARTINI
No. 2750
Exp. 6-30-24
GEOTECHNICAL
STATE OF CALIFORNIA

APPENDIX A
SLOPE STABILITY ANALYSIS



<u>**Slope Stability Analysis:**</u>

Static Condition, Factor of Safety = 2.1

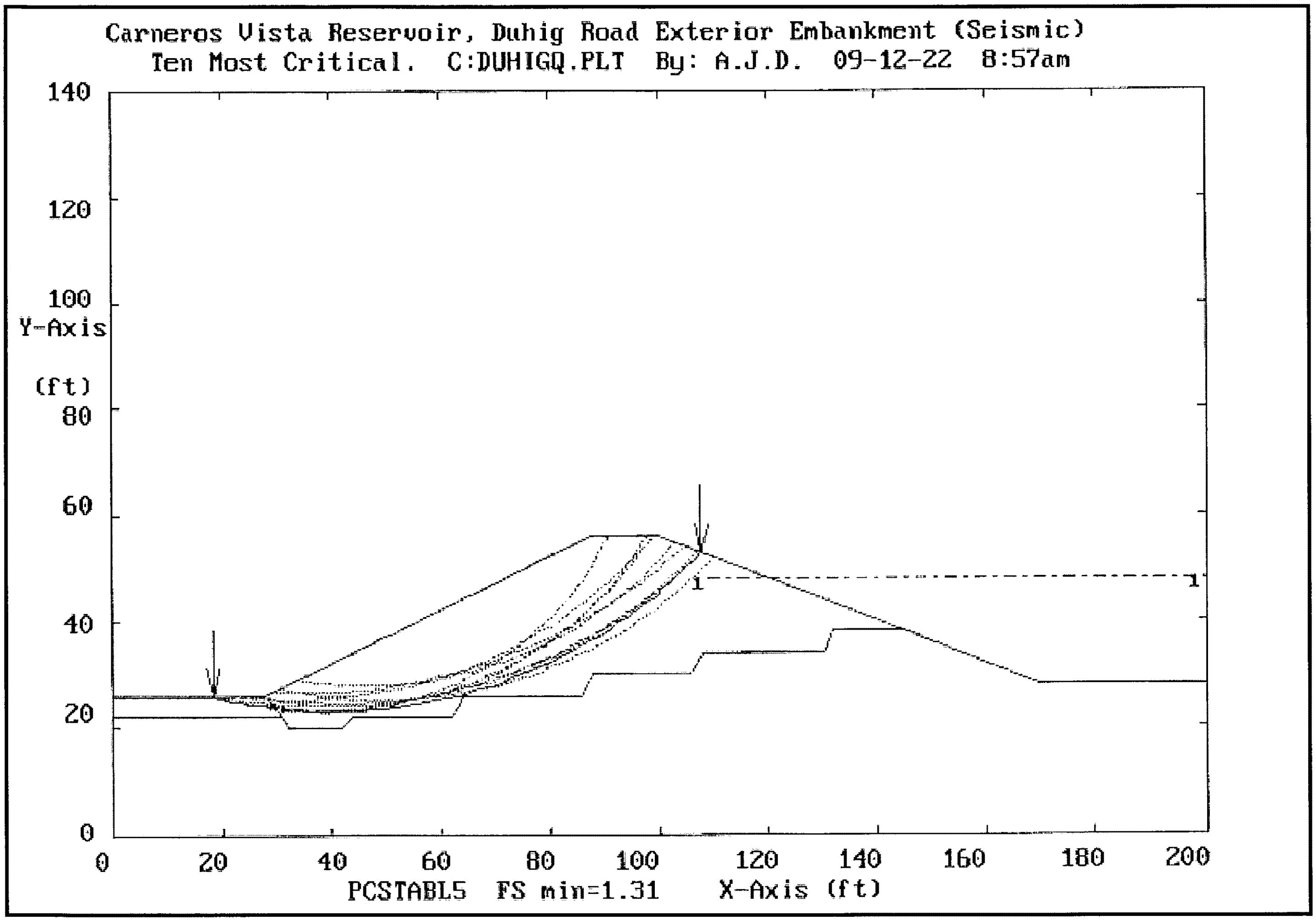
PJC & Associates, Inc.
Consulting Engineers & Geologists

STABILITY ANALYSIS (STATIC)
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE

2

Proj. No: S3396.01 Date: 10/22 App'd by: AJD



Slope Stability Seismic Condition, Factor of Safety = 1.31

PJC & Associates, Inc.
Consulting Engineers & Geologists

STABILITY ANALYSIS (SEISMIC) PROPOSED CARNEROS VISTA RESERVOIR DUHIG ROAD NAPA, CALIFORNIA	PLATE **3**
Proj. No: S3396.01 Date: 10/22 App'd by: AJD	

APPENDIX B
FIELD INVESTIGATION

1. INTRODUCTION

The field program performed for this study consisted of drilling two exploratory boreholes (BH-1 & BH-2) and excavating seven exploratory test pits (TP-1 through TP-8) in the vicinity of the proposed reservoir. The explorations were completed on June 14, 2022 and July 8, 2022, respectively. The test pit and borehole locations are shown on the Borehole & Test Pit Location Plan, Plate 4. Descriptive logs of the boreholes and test pits are presented in this appendix as Plates 5 through 14.

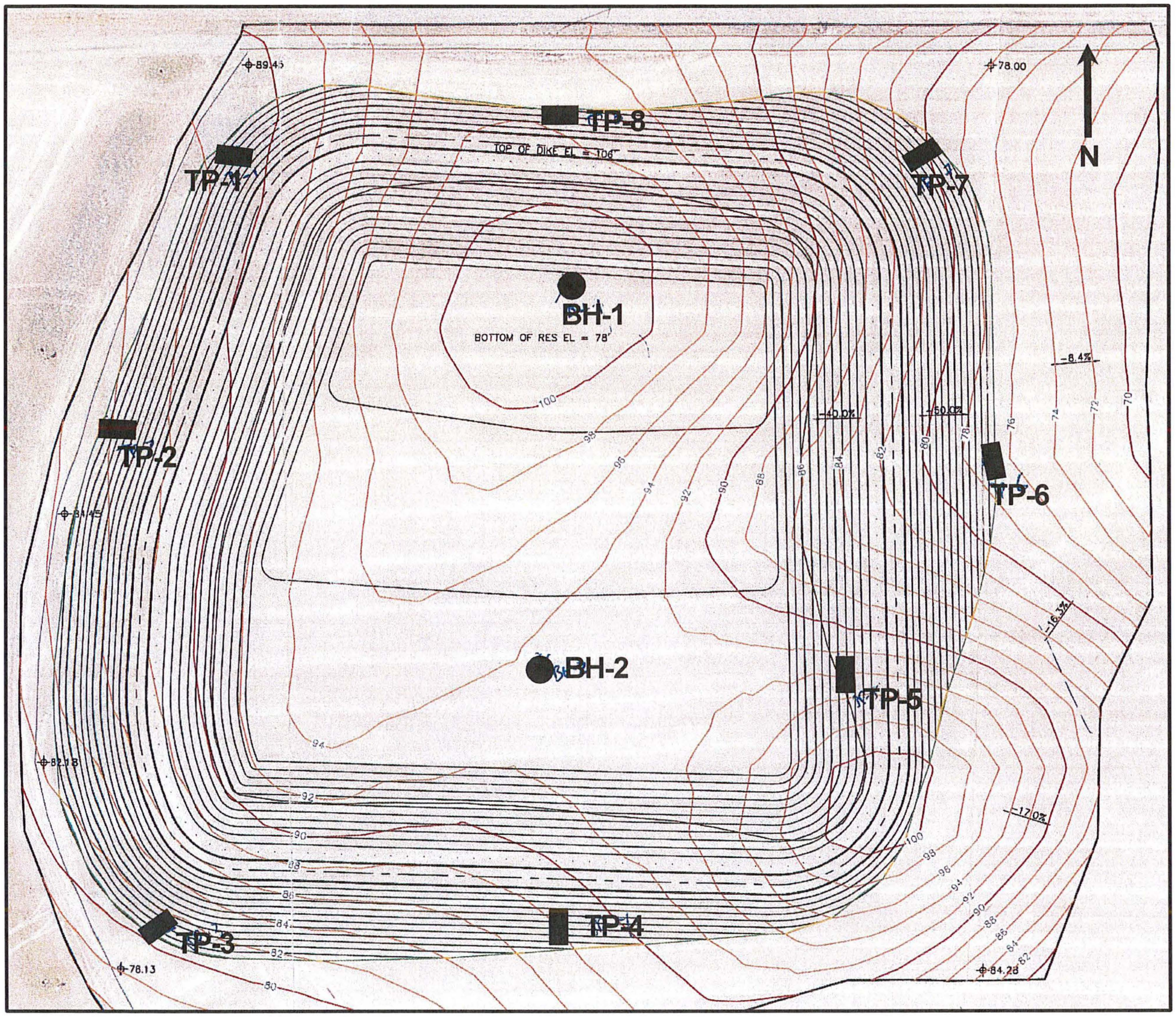
2. BOREHOLES

The boreholes were advanced using a Mobile B-53 drill with hollow stem augers on June 14, 2022. The drilling was performed under the observation of a certified engineering geologist of PJC who maintained a continuous log of soil and groundwater conditions and obtained samples suitable for laboratory testing. The soils were classified in accordance with the Unified Soil Classification System, as explained in Plate 15. The bedrock was classified according to Plate 16.

Relatively undisturbed and disturbed samples were obtained from the exploratory boreholes. A 2.43 in I.D. California Modified Sampler, or a 1.5 in I.D. Standard Sampler, was driven into the underlying soil using an automatic trip hammer with a 140 pound hammer falling 30 inches to obtain an indication of the density of the materials and to allow visual examination of at least a portion of the soil and bedrock column. Samples obtained with the split-spoon sampler were retained for further observation and testing. The number of blows required to drive the sampler at six-inch increments was recorded on each borehole log. All samples collected were labeled and transported to PJC's office for examination and laboratory testing.

3. TEST PITS

The test pits were excavated using a track-mounted excavator with a 30-inch bucket on July 8, 2022. The soil was classified according to the Unified Soil Classification System, as explained in Plate 15.



EXPLANATION

▮ TEST PIT LOCATION AND DESIGNATION

● BOREHOLE LOCATION AND DESIGNATION

NO SCALE

REFERENCE: SITE PLAN PROVIDED BY PPI ENGINEERING, DATED JUNE 14, 2022.

PJC & Associates, Inc. Consulting Engineers & Geologists	TEST PIT & BOREHOLE LOCATION PLAN PROPOSED CARNEROS VISTA RESERVOIR DUHIG ROAD NAPA, CALIFORNIA	PLATE 4
	Proj. No: 3396.01 Date: 10/22 App'd by: AJD	

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BORING NUMBER BH-1; PLATE 5A

CLIENT PPI ENGINEERING
PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR
PROJECT NUMBER S3396.01
PROJECT LOCATION DUHIG ROAD, NAPA, CA
DATE STARTED 6/14/22 **COMPLETED** 6/14/22
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD MOBILE B-53 W/ HOLLOW STEM AUGER
AT TIME OF DRILLING ---
LOGGED BY D.W. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		0.0-3.0'; SANDY CLAY (CL); olive brown, moist, stiff to hard, disturbed in upper 18", medium plasticity. (ALLUVIUM)										
2.5			MC		8-12 (20)	4.5+	105	16				
		3.0-5.0'; SANDY CLAY (CL); dark yellow brown, moist, hard, medium plasticity. (RESIDUAL SOIL)				4.5+	110	16				
5.0		5.0-6.5'; SANDY CLAY (CL); pale yellow brown with gray, moist, hard, medium plasticity. (HUICHICA FORMATION)	MC		17-32 (49)	4.5+	113	17	38	19	19	
		6.5-14.0'; SANDY CLAY (CL); orange brown, moist, hard, medium plasticity. (HUICHICA FORMATION)										
7.5			MC		18-35 (53)	4.5+	112	18				
10.0			MC		23-32 (55)	4.5+	110	17				
12.5												

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BORING NUMBER BH-1; PLATE 5B

CLIENT PPI ENGINEERING

PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR

PROJECT NUMBER S3396.01

PROJECT LOCATION DUHIG ROAD, NAPA, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
		14.0-26.5'; SANDSTONE; orange brown, soft to slightly hard, friable, highly weathered. (HUICHICA FORMATION)										
15.0												
			MC		31-35 (66)	4.5+	117	14				
17.5												
20.0												
			SPT		11-23 (34)			17				
22.5												
25.0												
			SPT		11-19 (30)			18				

TERMINATED AT 26.5'
Bottom of borehole at 26.5 feet.

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BORING NUMBER BH-2; PLATE 6A

CLIENT PPI ENGINEERING
PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR
PROJECT NUMBER S3396.01
PROJECT LOCATION DUHIG ROAD, NAPA, CA
DATE STARTED 6/14/22 **COMPLETED** 6/14/22
GROUND ELEVATION **HOLE SIZE** 6"
DRILLING CONTRACTOR Pearson Drilling
GROUND WATER LEVELS:
DRILLING METHOD MOBILE B-53 W/ HOLLOW STEM AUGER
AT TIME OF DRILLING ---
LOGGED BY D.W. **CHECKED BY**
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		0.0-3.0'; SANDY CLAY (CL); light brown, slightly moist, stiff to hard, porous, low plasticity. (ALLUVIUM)										
2.5			MC		6-8 (14)	4.5+	102	11	26	16	10	
		3.0-6.5'; SANDY CLAY (CL); dark yellow brown, moist, very stiff, medium plasticity. (RESIDUAL SOIL)										
			MC		7-9 (16)	2.5	101	23				
5.0												
		6.5-8.5'; SANDY CLAY (CL); dark orange brown with gray, moist, hard, medium plasticity. (HUICHICA FORMATION)	MC		18-34 (52)	4.5+	116	17				
7.5												
		8.5-13.0'; SILTY CLAY (CL); orange brown and gray, moist, hard, medium plasticity. (HUICHICA FORMATION)										
10.0			MC		23-28 (51)	4.5+	112	18				
12.5												

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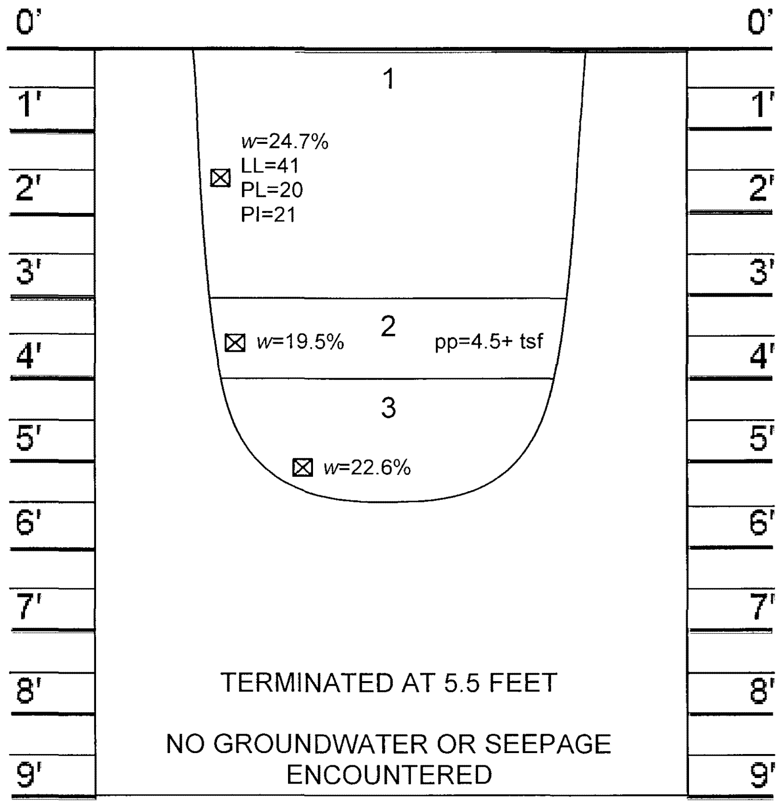
BORING NUMBER BH-2; PLATE 6B

CLIENT PPI ENGINEERING
PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR
PROJECT NUMBER S3396.01
PROJECT LOCATION DUHIG ROAD, NAPA, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
		18.0-25.5'; SANDSTONE; dark orange brown, soft, friable, highly weathered. (HUICHICA FORMATION)										
15.0			MC		25-42 (67)	4.5+	123	7				
17.5												
20.0			MC		32-35 (67)	4.5+	117	12				38
22.5												
25.0			SPT		10-16 (26)			22				

TERMINATED AT 25.5'
Bottom of borehole at 25.5 feet.

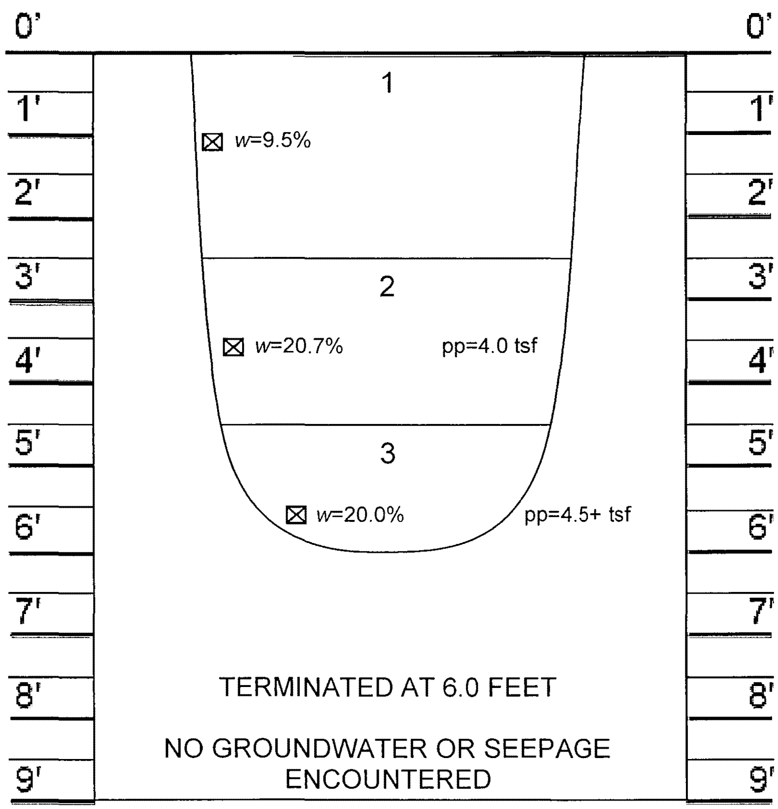


LITHOLOGY

1) 0.0-3.0'; SANDY CLAY (CL); brown, very moist, stiff, disturbed, medium plasticity. (ALLUVIUM)

2) 3.0-4.0'; SANDY CLAY (CL); olive brown, moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 4.0-5.5'; SANDY CLAY (CL); dark yellow brown, very moist, hard, medium plasticity. (HUICHICA FORMATION)



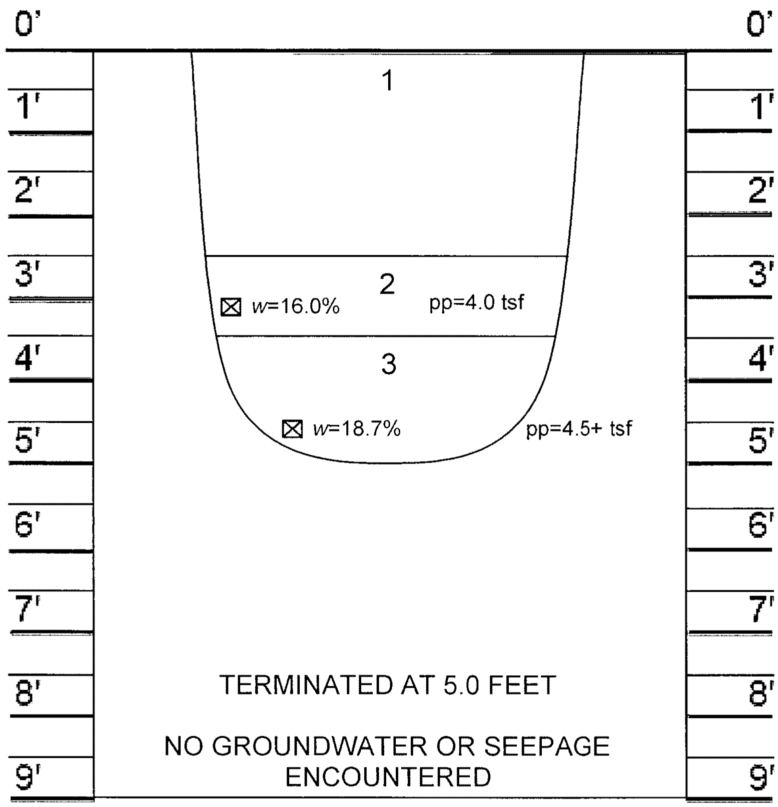
LITHOLOGY

1) 0.0-2.5'; SANDY CLAY (CL); brown, dry, stiff, disturbed in upper 18", medium plasticity. (ALLUVIUM)

2) 2.5-4.5'; SANDY CLAY (CL); olive brown, very moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 4.5-6.0'; SANDY CLAY (CL); dark yellow brown, very moist, hard, medium plasticity. (HUICHICA FORMATION)

PJC & Associates, Inc. Consulting Engineers & Geologists	LOG OF TEST PIT 2 PROPOSED CARNEROS VISTA RESERVOIR DUHIG ROAD NAPA, CALIFORNIA	PLATE 8
	Proj. No: S3396.01 Date: 10/22 App'd by: AJD	



LITHOLOGY

1) 0.0-2.5'; SANDY CLAY (CL); brown, slightly moist to moist, stiff, medium plasticity. (ALLUVIUM)

2) 2.5-3.5'; SANDY CLAY (CL); dark olive brown, moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 3.5-5.0'; SANDY CLAY (CL); orange brown and gray mottling, moist, hard, medium plasticity. (HUICHICA FORMATION)

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LOG OF TEST PIT 3
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE 9

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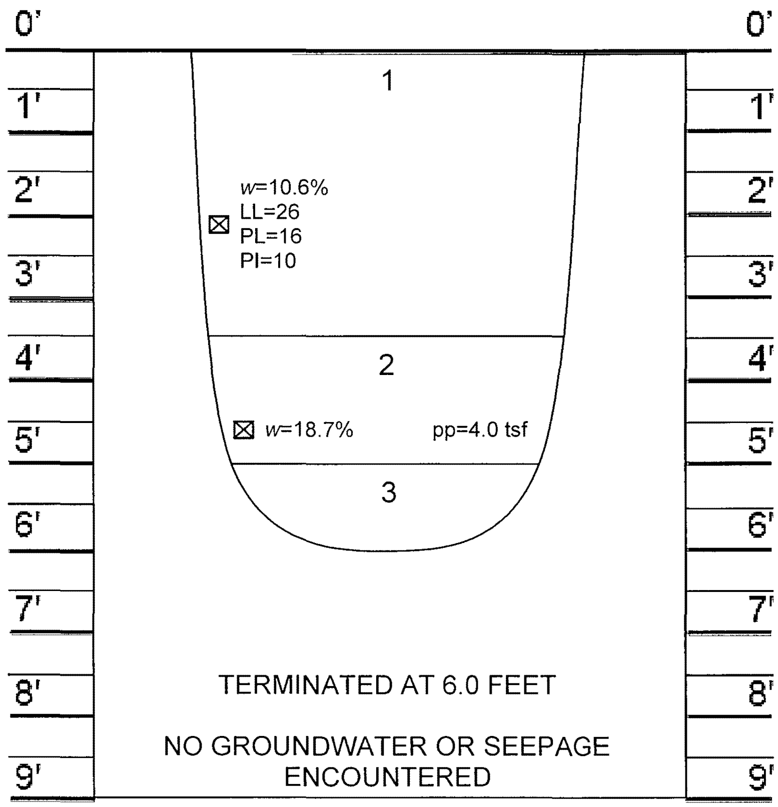

LITHOLOGY

1) 0.0-2.5'; SANDY CLAY (CL); brown, slightly moist, stiff, low plasticity. (ALLUVIUM)

2) 2.5-3.5'; SANDY CLAY (CL); dark olive brown, moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 3.5-5.0'; SANDY CLAY (CL); orange brown and gray mottling, moist, hard, medium plasticity. (HUICHICA FORMATION)

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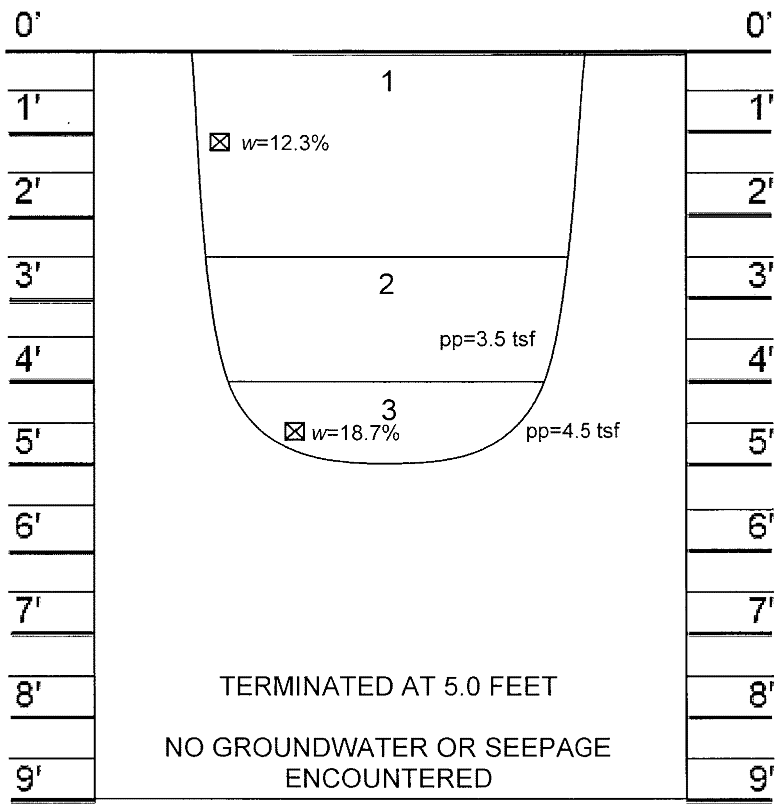
LOG OF TEST PIT 4
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE 10

Proj. No: S3396.01 Date: 10/22 App'd by: AJD



LITHOLOGY

1) 0.0-2.5'; SANDY CLAY (CL); grayish brown, slightly moist to moist, stiff, porous, disturbed, medium plasticity. (ALLUVIUM)

2) 2.5-4.0'; SANDY CLAY (CL); light olive brown, moist to very moist, very stiff, medium plasticity. (RESIDUAL SOIL)

3) 4.0-5.0'; SANDY CLAY (CL); orange brown, very moist, hard, medium plasticity. (HUICHICA FORMATION)

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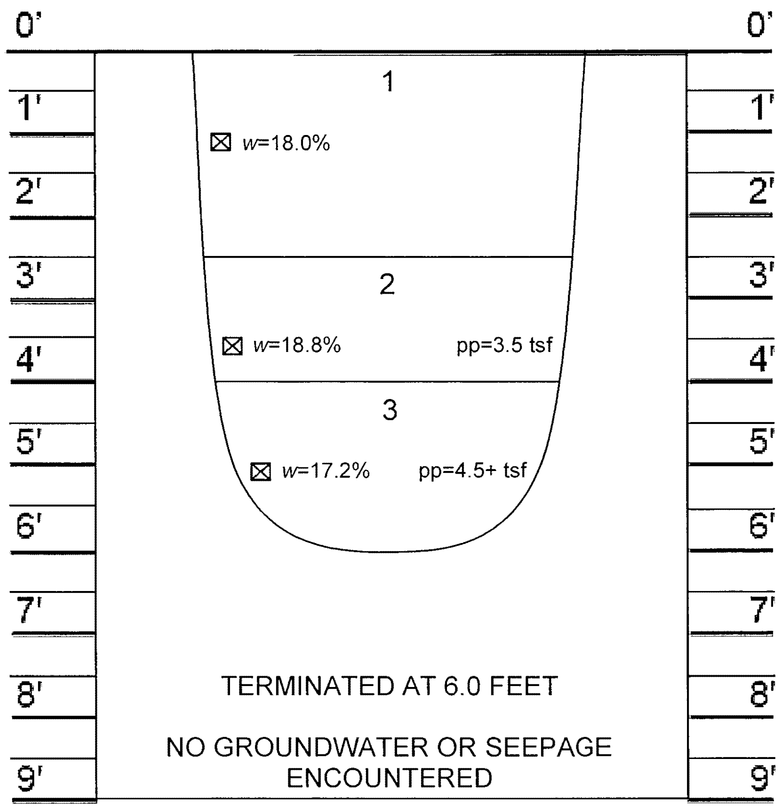
LOG OF TEST PIT 5
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE 11

Proj. No: S3396.01 Date: 10/22 App'd by: AJD



LITHOLOGY

1) 0.0-2.5'; SANDY CLAY (CL); light grayish brown, moist, stiff, disturbed, medium plasticity. (ALLUVIUM)

2) 2.5-4.0'; SANDY CLAY (CL); olive green, moist, very stiff, medium plasticity. (RESIDUAL SOIL)

3) 4.0-6.0'; SANDY CLAY (CL); dark orange brown, moist, hard, medium plasticity. (HUICHICA FORMATION)

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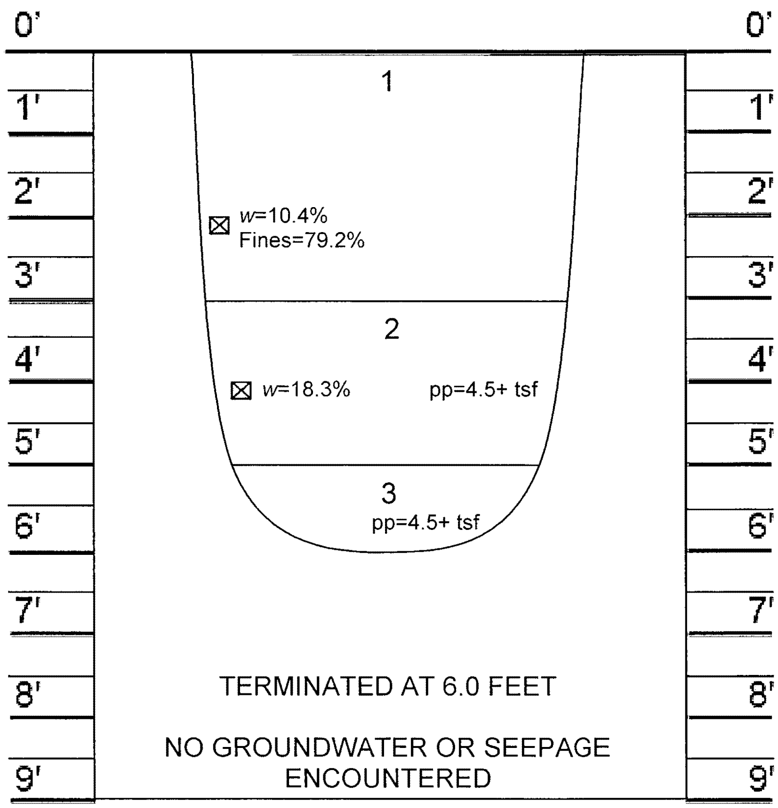
LOG OF TEST PIT 6
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE 12

Proj. No: S3396.01 Date: 10/22 App'd by: AJD



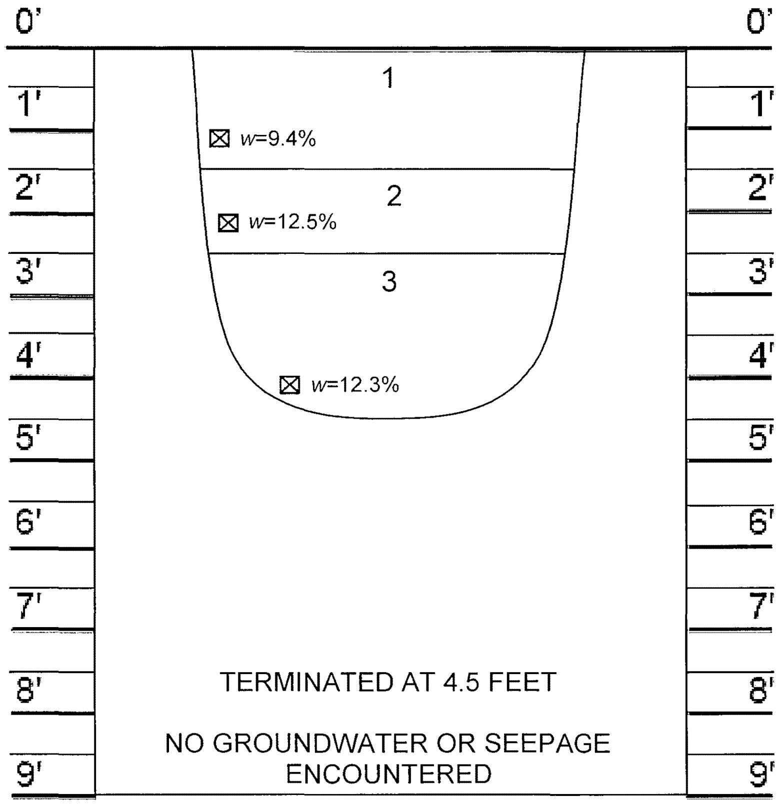
LITHOLOGY

1) 0.0-3.0'; SANDY CLAY (CL); brown, dry to slightly moist, stiff, disturbed, medium plasticity. (ALLUVIUM)

2) 3.0-5.0'; SANDY CLAY (CL); olive brown, moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 5.0-6.0'; SANDY CLAY (CL); orange brown, moist, hard, medium plasticity. (HUICHICA FORMATION)

PJC & Associates, Inc. Consulting Engineers & Geologists	LOG OF TEST PIT 7 PROPOSED CARNEROS VISTA RESERVOIR DUHIG ROAD NAPA, CALIFORNIA	PLATE 13
	Proj. No: S3396.01 Date: 10/22 App'd by: AJD	



LITHOLOGY

1) 0.0-1.5'; SANDY CLAY (CL); light brown, dry, stiff, disturbed, medium plasticity. (ALLUVIUM)

2) 1.5-2.5'; SANDY CLAY (CL); dark brown, slightly moist, hard, medium plasticity. (RESIDUAL SOIL)

3) 2.5-4.5'; SANDY CLAY (CL); dark orange brown, slightly moist, hard, medium plasticity. (HUICHICA FORMATION)

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than half is larger than #200 sieve	GRAVELS more than half coarse fraction is larger than no. 4 sieve size	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 MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND MIXTURES
	SANDS more than half coarse fraction is smaller than no. 4 sieve size	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVEL-SAND MIXTURES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than half is smaller than #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, SILTY OR CLAYEY FINE SANDS, VERY FINE SANDS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS OR 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

KEY TO TEST DATA

LL — Liquid Limit (in %)
PL — Plastic Limit (in %)
G — Specific Gravity
SA — Sieve Analysis
Consol — Consolidation
■ "Undisturbed" Sample
☒ Bulk or Disturbed Sample
☐ No Sample Recovery

	Shear Strength, psf	Confining Pressure, psf	
*Tx	320	(2600)	Unconsolidated Undrained Triaxial
Tx CU	320	(2600)	Consolidated Undrained Triaxial
DS	2750	(2000)	Consolidated Drained Direct Shear
FVS	470		Field Vane Shear
*UC	2000		Unconfined Compression
LVS	700		Laboratory Vane Shear

Notes: (1) All strength tests on 2.8" or 2.4" diameter sample unless otherwise indicated
(2) * Indicates 1.4" diameter sample

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USCS SOIL CLASSIFICATION KEY
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE
15

Proj. No: S3396.01 Date: 10/22 App'd by: AJD

ROCK TYPES

Conglomerate	Shale	Metamorphic Rocks Hydrothermally Altered Rocks
Sandstone	Sheared Shale Melange	Igneous Rocks
Meta-Sandstone	Chert	

Bedding Thickness		Joint, Fracture or Shear Spacing	
Massive	Greater than 6 feet	Very Widely Spaced	Greater than 6 feet
Thickly Bedded	2 to 6 feet	Widely Spaced	2 to 6 feet
Medium Bedded	8 to 24 inches	Moderately Widely Spaced	8 to 24 inches
Thinly Bedded	2-1/2 to 8 inches	Closely Spaced	2-1/2 inches
Very Thinly Bedded	3/4 to 2-1/2 inches	Very Closely Spaced	3/4 to 2-1/2 inches
Closely Laminated	1/4 to 3/4 inches	Extremely Closely Spaced	Less than 3/4 Inch
Very Closely Laminated	Less than 1/4 inch		

HARDNESS

Soft - Pliable, can be dug by hand

Slightly Hard - Can be gouged deeply or carved with a pocket knife

Moderately Hard - Can be readily scratched by a knife Blade; Scratch leaves heavy trace of dust and is readily visible after the powder has been blown away

Hard - Can be scratched with difficulty; scratch produced little powder and is faintly visible

Very Hard - cannot be scratched with pocket knife, leaves metallic streak

STRENGTH

Plastic- Capable of being molded by hand

Friable - Crumbles by rubbing with fingers

Weak - an unfractured specimen of such material will crumble under light hammer blows

Moderately Strong - Specimen will withstand a few heavy hammer blows before breaking

Strong - Specimen will withstand a few heaving ringing hammer blows and usually yields large fragments

Very Strong - Rock will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments

DEGREE OF WEATHERING

Highly Weathered - Abundant fractures coated with oxides, carbonates, sulphates, mud, etc., through discoloration, rock disintegration, mineral decomposition

Moderately Weathered - Some fracture coating, moderate or localized discoloration, little to no effect on cementation, slight mineral decomposition

Slightly Weathered - A few stained fractures, slight discoloration, little to no effect on cementation, no mineral decomposition

Fresh - Unaffected by weathering agents, no appreciable charge with depth

APPENDIX C
LABORATORY INVESTIGATION

1. INTRODUCTION

This appendix includes a discussion of test procedures and results of the laboratory investigation performed for the proposed project. The investigation program was carried out by employing currently accepted test procedures of the American Society of Testing and Materials (ASTM).

Disturbed samples used in the laboratory investigation were obtained during the course of the field investigation as described in Appendix A of this report. Identification of each sample is by test pit number and depth.

2. INDEX PROPERTY TESTING

In the field of soil mechanics and geotechnical engineering design, it is advantageous to have a standard method of identifying soils and classifying them into categories or groups that have similar distinct engineering properties. The most commonly used method of identifying and classifying soils according to their engineering properties is the Unified Soil Classification System described by ASTM D-2487-83. The USCS is based on a recognition of the various types and significant distribution of soil characteristics and plasticity of materials.

The index properties tests discussed in this report include the determination of natural water content and dry density, Atterberg limits and grain size distribution.

a. Natural Water Content and Dry Density. Natural water content and dry density of the soils were determined, often in conjunction with other tests, on selected undisturbed samples. The samples were extruded and visually classified, trimmed to obtain a smooth flat face, and accurately measured to obtain volume and wet weight. The samples were then dried in accordance with the procedures of ASTM 2216-80 for a period of 24 hours in an oven, maintained at a temperature of 100 degrees C. After drying, the weight of each sample was determined and the moisture content and dry density calculated. The water content and dry density results are summarized on the log of the boreholes and test pits, Plates 5 through 14.

b. Atterberg Limits Determination. The liquid and plastic limits of selected soil samples were determined by air drying and breaking down the sample. The results of the limits are shown on Plate 17.

c. Grain-Size Distribution. The gradation characteristics of selected samples were determined in accordance with ASTM D422-63. The samples were soaked in water until individual soil particles were separated and then washed on the No. 200 mesh sieve. That portion of the material retained on the No. 200 mesh sieve was oven-dried and then mechanically sieved. The grain-size distribution tests are presented on Plate 18.

3. ENGINEERING PROPERTIES TESTING

The engineering property tests consisted of moisture density testing and direct shear testing.

a. Unconfined Compression Test. Unconfined compression tests were performed on intact samples obtained from the boreholes. In the unconfined compression test, the shear strength is determined by axial loading the sample under a slow constant strain rate until failure is obtained. Failure stress is defined as the maximum stress at ten percent strain. The results of these tests are presented on Plates 19 and 20.

b. Moisture-Density (Compaction Curve). Moisture-density tests were performed on a bulk sample of the native soils according to ASTM D1557-91 Method A. The results are shown on Plates 21 and 22.

c. Direct Shear Tests. A direct shear test was performed on a remolded sample. After the initial weight and volume measurements were determined, the sample was placed in the shear machine. The designated normal load was applied and the sample was saturated with water and allowed to consolidate. The sample was then sheared horizontally at a rate of strain of 0.025 inches per minute. Shear stress and sample deformation were monitored throughout the test. The results of the direct shear test appears on Plate 23.

d. Falling Head Permeability Tests. Representative samples of the native soils were remolded to 95 percent relative compaction and falling head permeability tests were performed according to ASTM D5084. The results are shown on Plates 21 and 22.

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ATTERBERG LIMITS' RESULTS

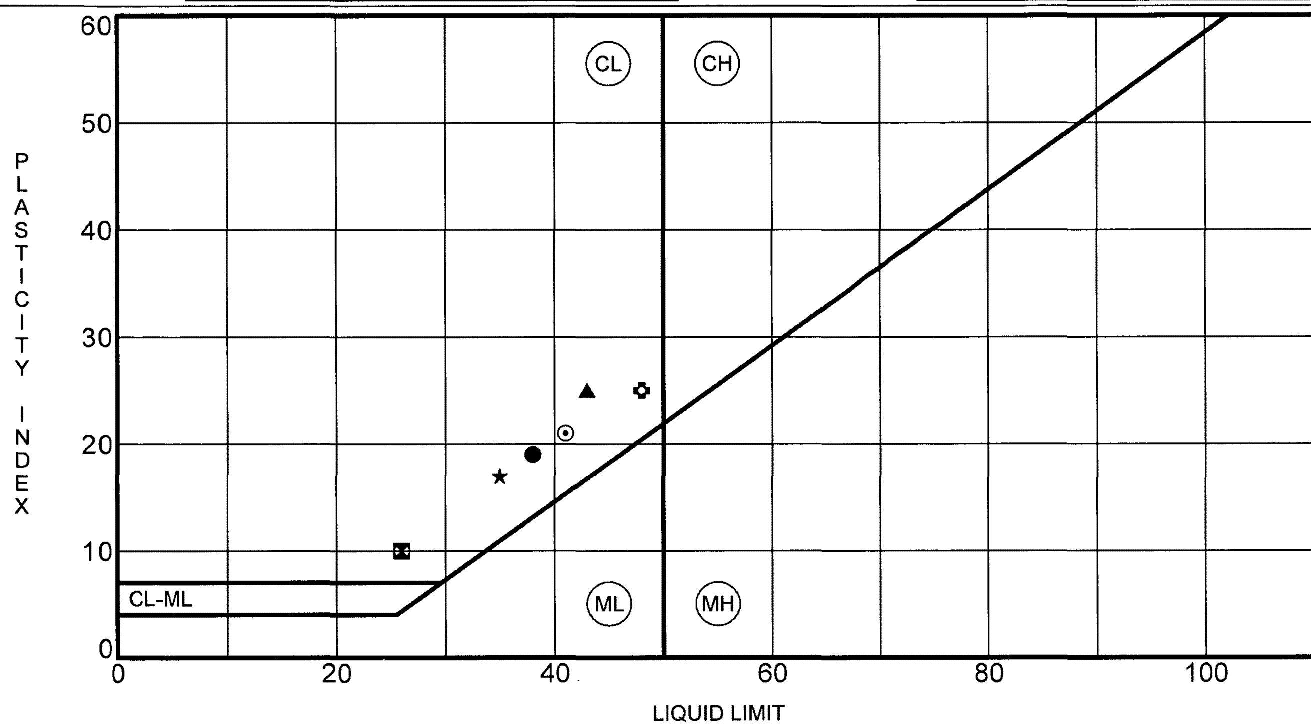
PLATE 17

CLIENT PPI ENGINEERING

PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR

PROJECT NUMBER S3396.01

PROJECT LOCATION DUHIG ROAD, NAPA, CA



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**BH-1**	**5.0**	**38**	**19**	**19**		**PALE YELLOW BROWN & GRAY SANDY CLAY (CL)**
⊠	**BH-2**	**2.0**	**26**	**16**	**10**		**LIGHT BROWN SANDY CLAY (CL)**
▲	**BULK 1**		**43**	**18**	**25**	**86**	**SANDY CLAY (CL)**
★	**BULK 3**		**35**	**18**	**17**	**89**	**SANDY CLAY (CL)**
⊙	**TP-1**	**1.5**	**41**	**20**	**21**		**BROWN SANDY CLAY (CL)**
✿	**TP-2**	**5.5**	**48**	**23**	**25**		**DARK YELLOW BROWN SANDY CLAY (CL)**
○	**TP-4**	**2.0**	**26**	**16**	**10**		**LIGHT BROWN & GRAY SANDY CLAY (CL)**

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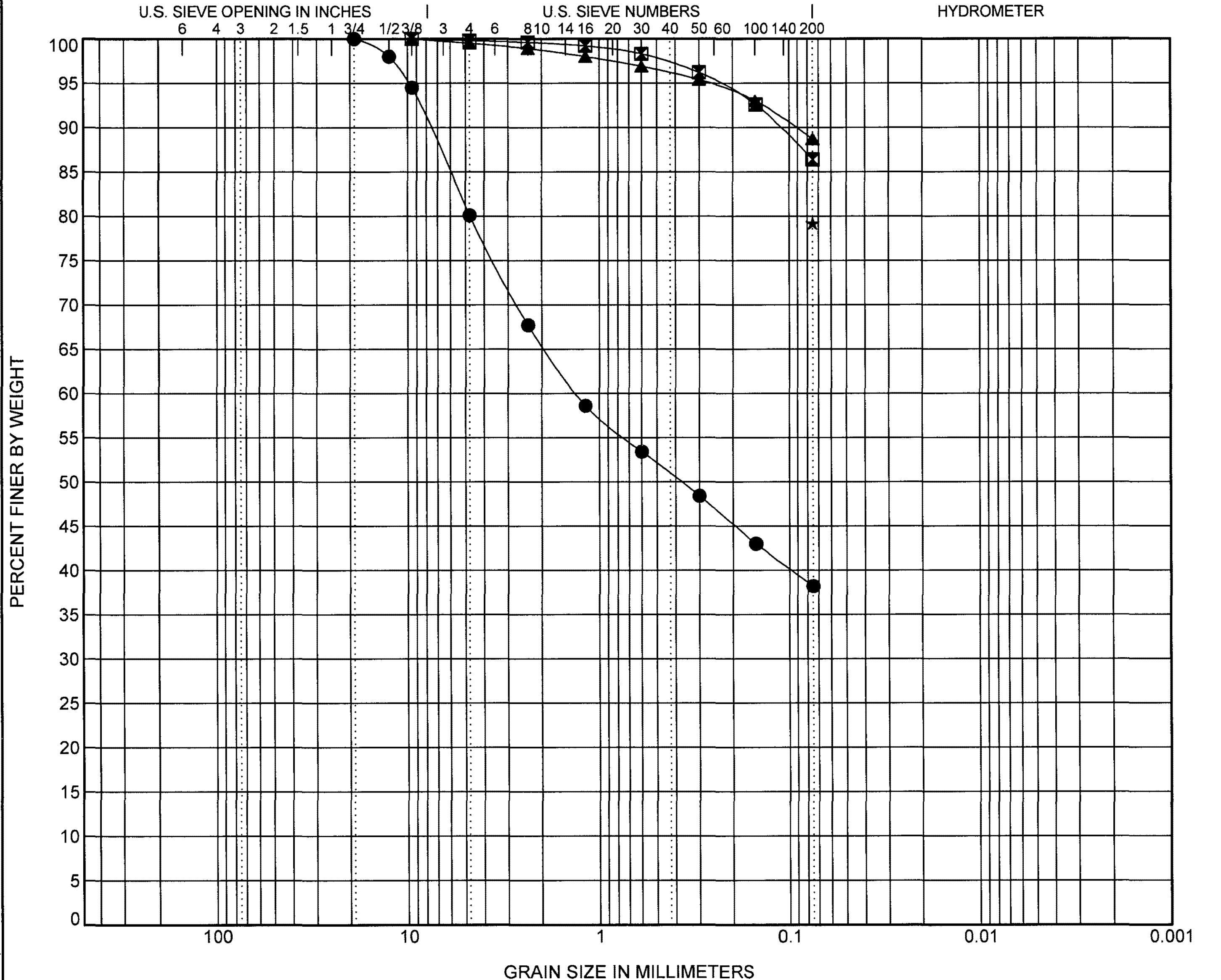
GRAIN SIZE DISTRIBUTION

PLATE 18

CLIENT PPI ENGINEERING **PROJECT NAME** PROPOSED CARNEROS VISTA RESERVOIR

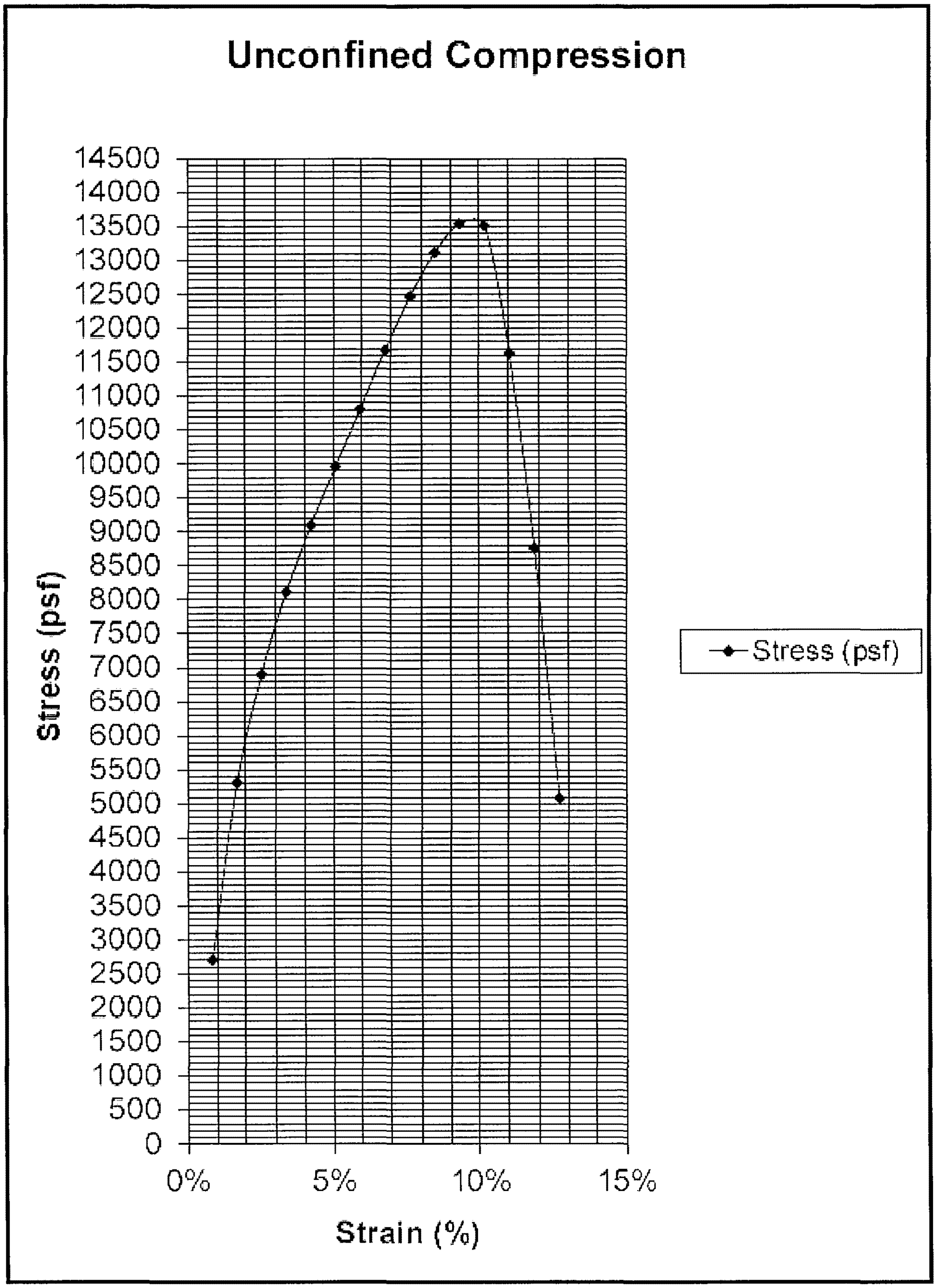
PROJECT NUMBER S3396.01 **PROJECT LOCATION** DUHIG ROAD, NAPA, CA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	**BH-2**	**19.5**	**DARK ORANGE BROWN SANDSTONE**					
⊠	**BULK 1**	**8.0**	**SANDY CLAY (CL)**	**43**	**18**	**25**		
▲	**BULK 3**	**2.5**	**SANDY CLAY (CL)**	**35**	**18**	**17**		
★	**TP-7**	**2.0**	**BROWN SANDY CLAY (CL)**					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BH-2**	**19.5**	**19**	**1.313**			**19.9**	**41.9**	**38.2**	
⊠	**BULK 1**	**8.0**	**9.5**				**0.2**	**13.4**	**86.4**	
▲	**BULK 3**	**2.5**	**9.5**				**0.5**	**10.8**	**88.7**	
★	**TP-7**	**2.0**	**0.075**						**79.2**	



LOCATION: BH-1 AT 11.0 FEET
DESCRIPTION: ORANGE BROWN SANDY CLAY (CL)
MOISTURE CONTENT: 16.7%
DRY DENSITY: 109.8 pcf
***UNCONFINED COMPRESSIVE STRENGTH :** 13650 psf

***Failure stress is defined as the maximum stress at ten percent strain.**

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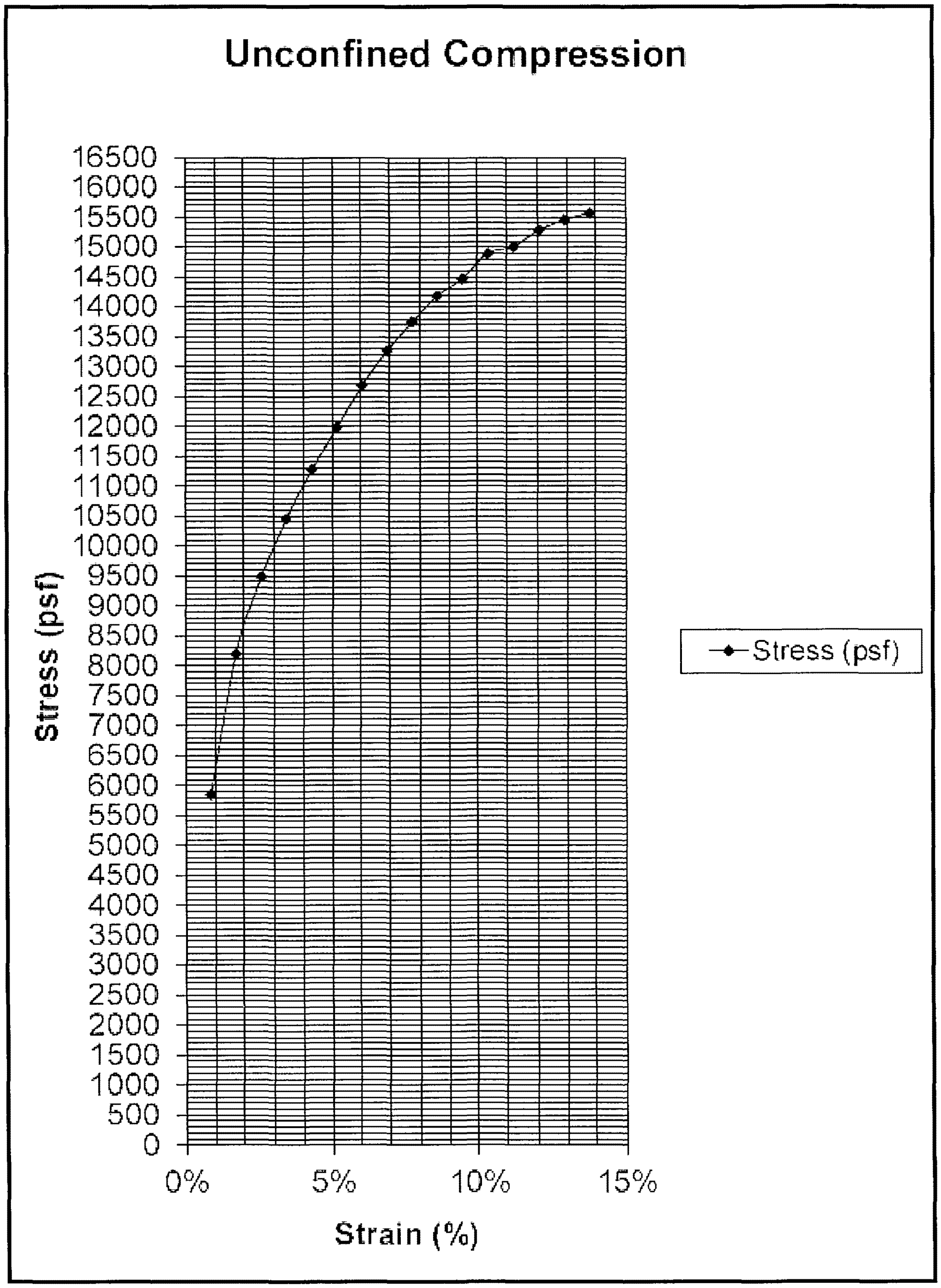
UNCONFINED COMPRESSION TEST
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE **19**

Proj. No: S3396.01 Date: 10/22 App'd by: AJD



LOCATION: BH-2 AT 15.0 FEET
DESCRIPTION: ORANGE BROWN W/ GRAY SILTY CLAY (CL)
MOISTURE CONTENT: 7.3%
DRY DENSITY: 123.5 pcf
***UNCONFINED COMPRESSIVE STRENGTH :** 14630 psf

***Failure stress is defined as the maximum stress at ten percent strain.**

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UNCONFINED COMPRESSION TEST
PROPOSED CARNEROS VISTA RESERVOIR
DUHIG ROAD
NAPA, CALIFORNIA

PLATE
20

Proj. No: S3396.01 Date: 10/22 App'd by: AJD

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MOISTURE-DENSITY RELATIONSHIP

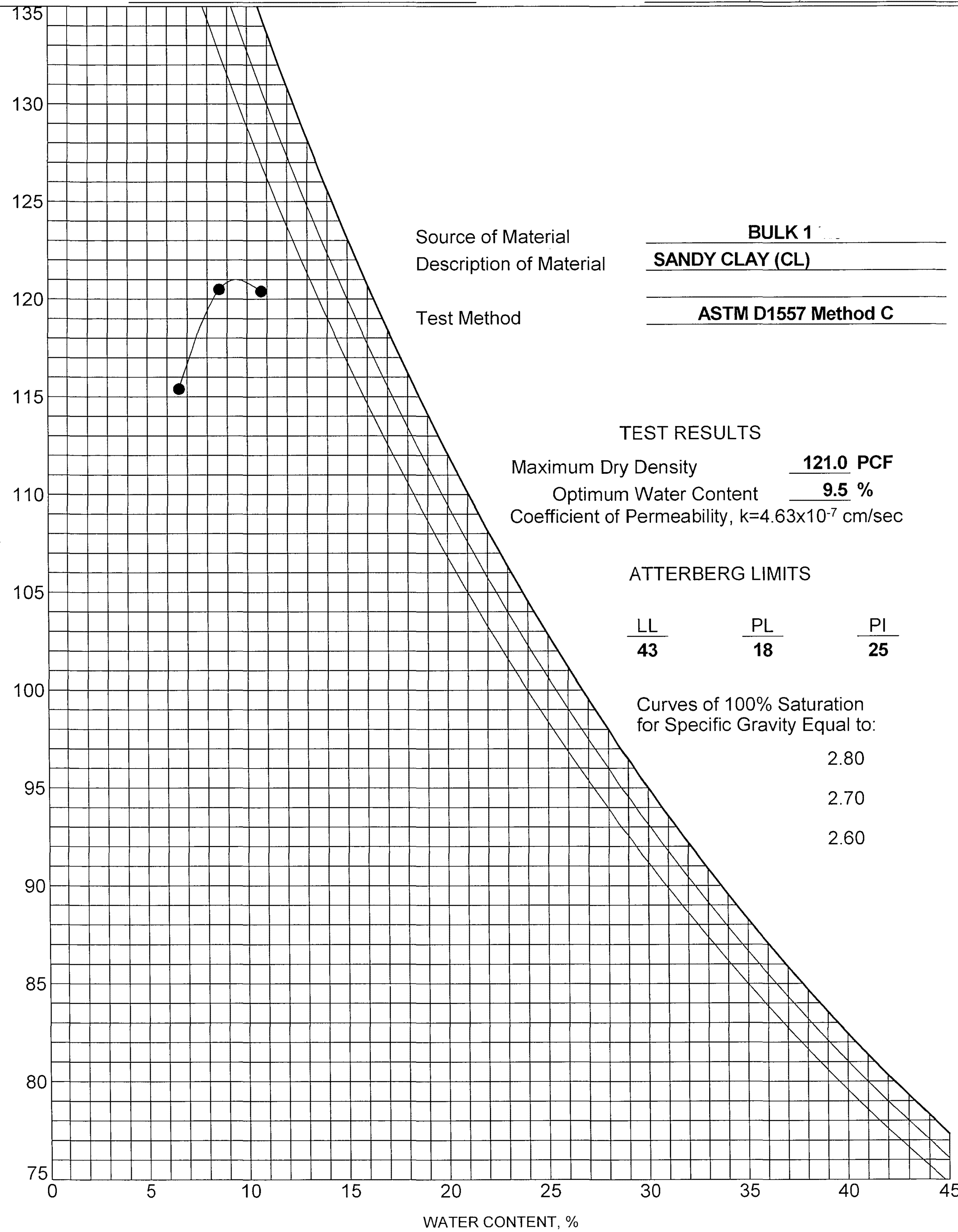
PLATE 21

CLIENT PPI ENGINEERING

PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR

PROJECT NUMBER S3396.01

PROJECT LOCATION DUHIG ROAD, NAPA, CA



Source of Material: **BULK 1**

Description of Material: **SANDY CLAY (CL)**

Test Method: **ASTM D1557 Method C**

TEST RESULTS

Maximum Dry Density **121.0 PCF**

Optimum Water Content **9.5 %**

Coefficient of Permeability, $k=4.63 \times 10^{-7}$ cm/sec

ATTERBERG LIMITS

LL	PL	PI
43	**18**	**25**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

COMPACTION - GINT STD US LAB.GDT - 10/27/22 13:39 - C:\PROGRAM FILES (X86)\GINT\PROJECTS\S3396.01 DUHIG ROAD RESERVOIR.GPJ

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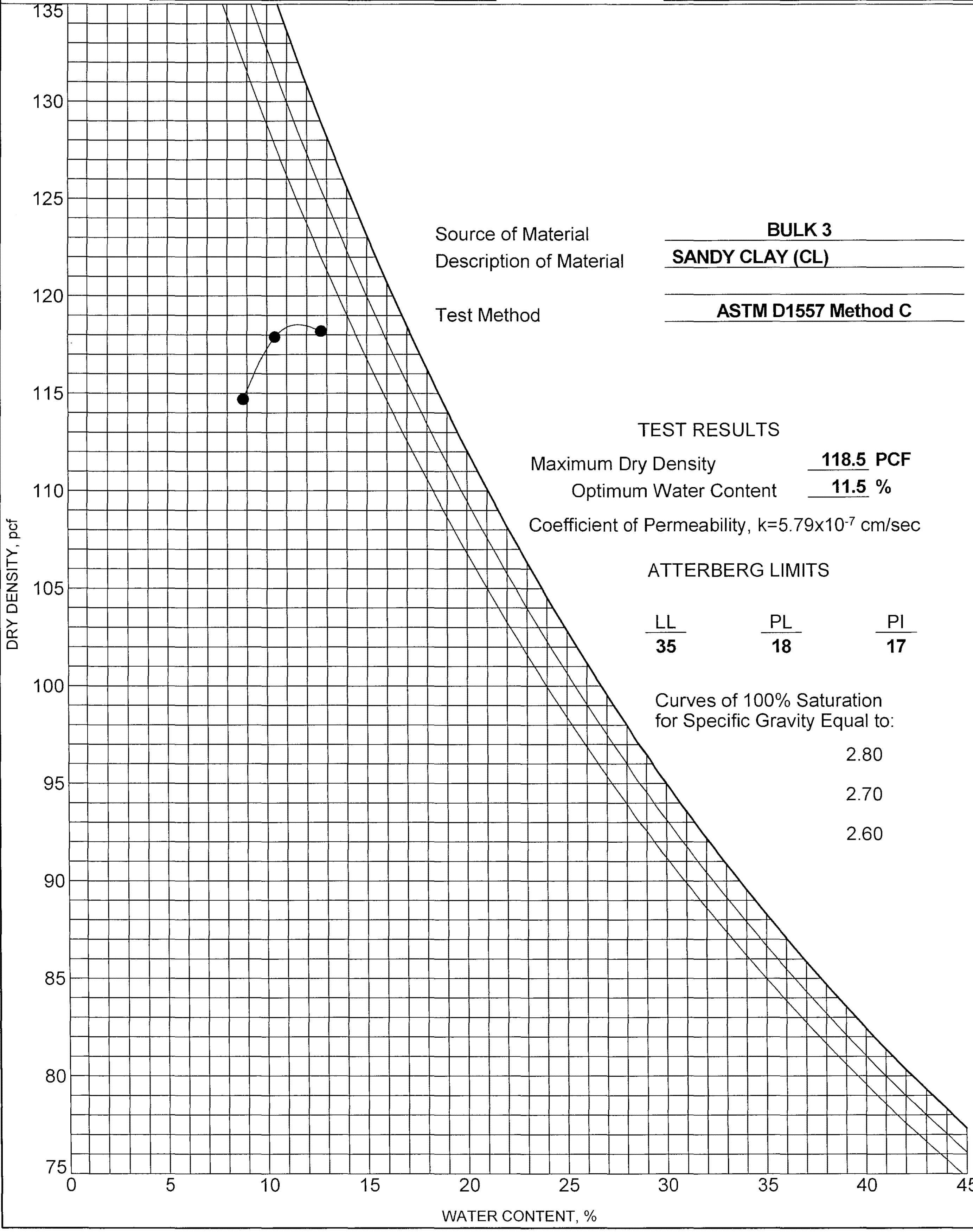
MOISTURE-DENSITY RELATIONSHIP

PLATE 22

CLIENT PPI ENGINEERING
PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR
PROJECT NUMBER S3396.01
PROJECT LOCATION DUHIG ROAD, NAPA, CA



Source of Material: **BULK 3**
Description of Material: **SANDY CLAY (CL)**
Test Method: **ASTM D1557 Method C**

TEST RESULTS

Maximum Dry Density **118.5** PCF
Optimum Water Content **11.5** %

Coefficient of Permeability, k=5.79x10^{-7} cm/sec

ATTERBERG LIMITS

LL	PL	PI
35	**18**	**17**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

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DIRECT SHEAR TEST

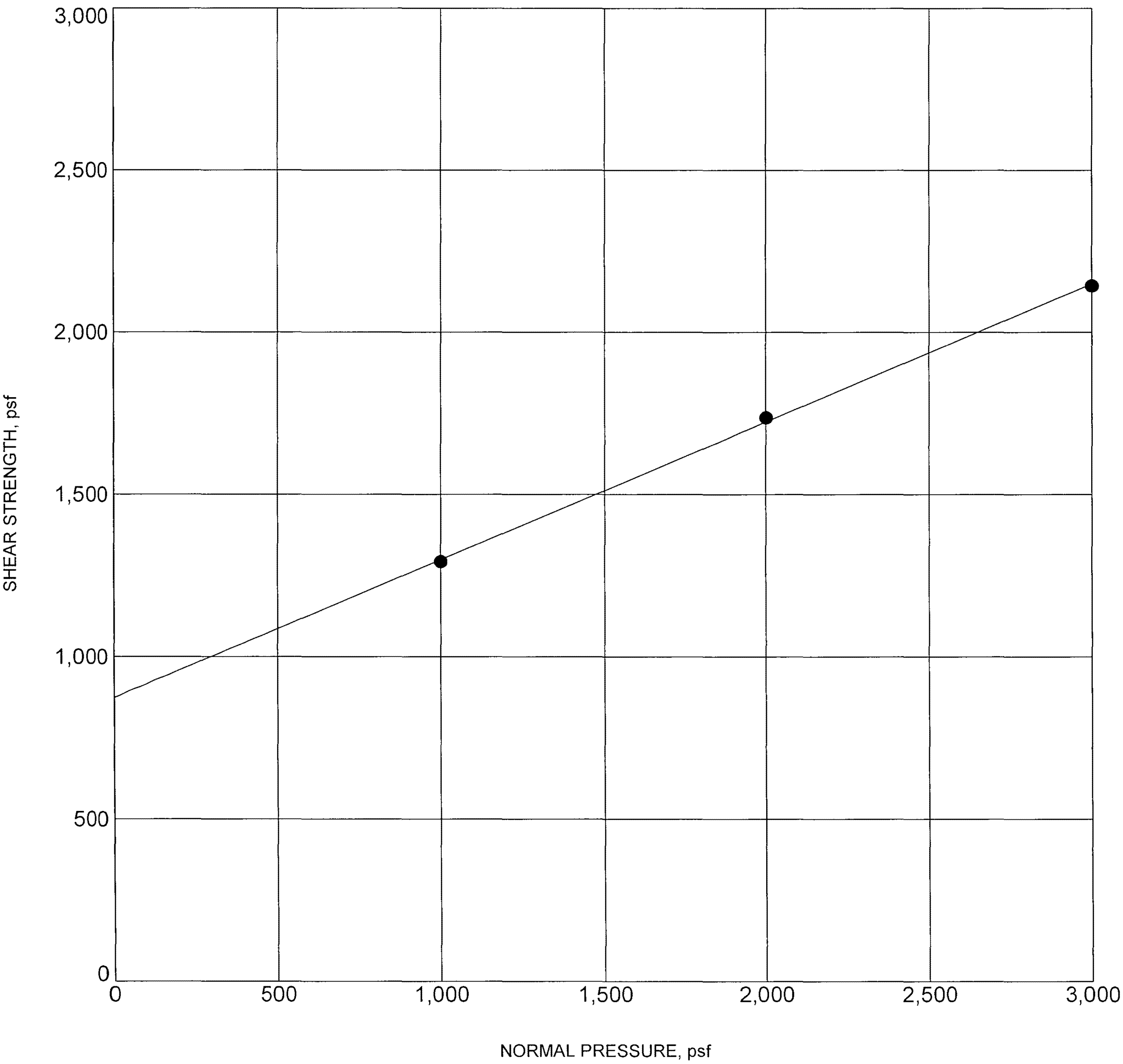
PLATE 23

CLIENT PPI ENGINEERING

PROJECT NAME PROPOSED CARNEROS VISTA RESERVOIR

PROJECT NUMBER S3396.01

PROJECT LOCATION DUHIG ROAD, NAPA, CA



	Specimen Identification	Classification	γ_d	MC%	c	ϕ
●	**BULK 3**	**SANDY CLAY (CL)**	**107**	**18**	**874.3**	**23**

APPENDIX D
REFERENCES

1. "Foundations and Earth Structures" Department of the Navy Design Manual 7.2 (NAVFAC DM-7.2), dated May 1982.

2. "Soil Dynamics, Deep Stabilization, and Special Geotechnical Construction" Department of the Navy Design Manual 7.3 (NAVFAC DM-7.3), dated April 1983.

3. Geologic Map of the Santa Rosa Quadrangle, Scale: 1:250,000, compiled by D.L Wagner and E.J. Bortugno, 1982.

4. Geologic Map of the Cuttings Wharf 7.5-Minute Quadrangle, Sonoma County, California, by Stephen P. Bezore, Kevin B. Clahan, Janet M. Sowers, and Robert C. Witter, 2005.

5. "Soil Mechanics" Department of the Navy Design Manual 7.1 (NAVFAC DM-7.1), dated May 1982.

6. USGS Cuttings Wharf California Quadrangle 7.5-Minute Topographic Map, Photorevised 1978.

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