FINAL GEOTECHNICAL REPORT

Elk Grove Civic Center – Phase 1

Civic Center Aquatics Facility (WCC002)
Civic Center Community Senior & Veterans Center (WCC010)
Civic Center Commons Site Area Phase 1 (WCC024)
Elk Grove, California

Prepared by:

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October 28, 2016

Prepared for:

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BCI File No. 2951.X 001
October 28, 2016

Mr. Alvin Wong
Willdan Engineering
8401 Laguna Palms Way
Elk Grove, CA 95758

Subject: **Final Geotechnical Report**
Elk Grove Civic Center – Phase 1
(WCC002, WCC010, WCC024)
Big Horn Boulevard and Civic Center Drive
Elk Grove, California

Dear Mr. Wong,

Blackburn Consulting (BCI) is pleased to submit this Geotechnical Report for the Elk Grove Civic Center – Phase 1 project. BCI prepared this report in accordance with Task Order No. BCI 106312.2002.PE.112 to our July 19, 2016 Master Services Agreement with Willdan Engineering.

Thank you for selecting BCI to be on your design team. Please call if you have questions or require additional information.

Sincerely,

BLACKBURN CONSULTING

REGISTERED PROFESSIONAL ENGINEER
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FINAL GEOTECHNICAL REPORT
Elk Grove Civic Center – Phase 1
(WCC002, WCC010, WCC024)
Elk Grove, CA

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1 INTRODUCTION

1.1 Purpose

Blackburn Consulting (BCI) prepared this Geotechnical Report for design and construction of the proposed Elk Grove Civic Center – Phase 1 project on the southeast corner of Civic Center Drive and Big Horn Boulevard in Elk Grove, California. It contains descriptions of the surface and subsurface conditions, site geology, and geotechnical design/construction recommendations.

BCI prepared this report for Willdan Engineering and the project design team to use during design and construction. This report shall not be used or relied upon by others, or for different locations or improvements without the written consent of BCI.

1.2 Scope of Services

To prepare this report, BCI:

- Discussed the proposed improvements with Mr. Alvin Wong with Willdan Engineering.
- Reviewed a July 2016 Master Plan for the project provided by Willdan Engineering.
- Observed the subsurface conditions in 17 exploratory borings drilled at the site on November 19-20, 2014 for our previous geotechnical report for the formerly proposed Elk Grove Aquatic Facility. On March 6, 2015 we extended 1 of these borings to a depth of 81.5 feet to evaluate foundation alternatives for the previously proposed Olympic dive tower.
- Observed the conditions in 12 additional borings drilled at the site on August 17, 2016.
- Performed laboratory tests on soil samples obtained from the exploratory borings.
- Performed near-surface borehole permeability tests for our previous geotechnical report to provide recommended infiltration rates for evaluation and design of a stormwater infiltration system by others.
- Performed engineering analysis and calculations to develop our conclusions and recommendations.
- Prepared a September 26, 2016 Draft Geotechnical Report for the project and reviewed/responded to design team comments in order to prepare this final report.

1.3 Project Description

Based on our review of the project plans and discussions with the design team, we understand that the project will include:

- A single-story Aquatic Center building (estimated 14,000 ft^2) with concrete slab-on-grade floor, including a pool mechanical room founded about 10 feet below finish grade;
- A single-story Community, Senior & Veterans Center building (29,000-30,000 ft^2) with concrete slab-on-grade floor;

- Flag poles;
- Olympic sized pool (including spring boards) and two other swimming pools;
- Trellis shade structures;
- Asphalt concrete and concrete pavement;
- Exterior concrete flatwork;
- Underground utility lines; and
- Landscaping.

We understand that site grading for the project will involve minor cuts and fills less than 1 to 2 feet.

1.4 Site Description

The project site is located on the southeast corner of Civic Center Drive and Big Horn Boulevard in Elk Grove, California. Figure 1 displays a site Vicinity Map.

The site is relatively level with elevations ranging from about 32 to 36.5 feet, and is primarily undeveloped land that was covered with a moderate growth of short grasses/weeds during our 2014-2016 subsurface explorations. A few widely scattered trees are present along a gravel road (Johnston Road) that extends into the site on the north from Civic Center Drive. A pump station and associated paved driveway are located just east of Big Horn Boulevard in the southern site area.

Review of satellite photographs (via Google Earth) of the site show that three former residential structures existed just east of Johnston Road in the north-central site area. These photographs show that the structures were demolished and removed from the site in 2014.

Review of 2006 satellite imagery shows that a small pond was located on the site about 450 feet south of Civic Center Drive just west of Johnston Road. 2007 satellite imagery shows that the pond was filled in sometime in 2006-2007.

Figure 2 shows the site boundaries, former pond area, our subsurface exploratory locations and the proposed improvements.

2 SITE GEOLOGY AND SUBSURFACE CONDITIONS

2.1 Site Geology

The site lies within the Great Valley Geomorphic Province (Sacramento Valley portion). The Great Valley is bordered by the Cascade and Klamath Ranges to the north, the Coast Ranges to the west, and the Sierra Nevada to the east. The valley was formed by tilting of the Sierran Block with the western side dropping to form the valley and the eastern side uplifted to form the Sierra Nevada. The valley deposits are characterized by a thick sequence of alluvial, lacustrine, and marine sediments. The thickness of the sediments varies from a thin veneer at the edges of the valley, to thousands of feet in the central portion.

Based on review of the published geologic map, Wagner et al, 1981, our site review, and available subsurface information from the project area, the project area is predominantly underlain by clay, sand, and silt of the lower Riverbank Formation.

2.2 Exploratory Borings and Soil Conditions

To characterize the site subsurface conditions, BCI drilled, logged and sampled 17 borings (B1 through B17) at the site on November 19-20, 2014 for our previous geotechnical report for the formerly proposed Elk Grove Aquatic Facility. On March 6, 2015 we extended Boring B1 to a depth of 81.5 feet to evaluate foundation alternatives for the previously proposed Olympic dive tower. BCI drilled, logged and sampled 12 additional borings (B1-16 through B12-16) at the site to supplement our previous subsurface explorations. Figure 2 shows the approximate boring locations. We include the borings in Appendix A.

Our subcontractor, Taber Drilling, drilled the borings to depths ranging from about 5 to 81.5 feet using either 6-inch to 8-inch hollow stem augers or 4-inch solid stem augers. BCI obtained soil samples at various intervals using both 3.0-inch O.D. Modified California samplers (equipped with 2.4-inch diameter brass liners) and 2–inch O.D. Standard Penetration (SPT) samplers. Samples were driven with an automatic hammer, weighing 140-pounds and falling approximately 30-inches per blow. We also collected bulk samples at various depths within the borings.

We generally encountered stiff to very stiff lean to fat clay to sandy lean clay within the upper 2 to 4½ feet below existing grade, which is underlain by variably cemented layers of very stiff to hard lean clay, hard sandy silt, hard silt, and dense to very dense silty to clayey sand to the maximum depths explored.

2.3 Groundwater

We encountered groundwater at a depth of 57.5 feet during drilling of Boring B1 in 2015. We did not observe static or perched groundwater during drilling of any of the other borings. We reviewed groundwater level data for nearby wells available at the California Department of Water Resources website (http://www.water.ca.gov/waterdatalibrary/), which indicate that seasonal groundwater levels at the site are at least 50 feet below existing grade. Relatively shallow perched water may occur within the near-surface soils during the winter and spring months.

Groundwater and perched water levels can fluctuate due to changes in precipitation, irrigation, pumping of wells, and other factors.

3 LABORATORY TESTS

We performed the following laboratory tests on representative soil samples from the exploratory borings:

- Unit weight and moisture content tests for in-situ soil property characterization.
- Sieve analysis and plasticity index for soil classification and expansion potential.
- Expansion index and swell tests for expansion potential.
- Direct shear and triaxial compression (unconsolidated, undrained) for bearing and lateral capacity analysis.
- Resistance value (R-value) for pavement design.
- pH for lime stabilization to provide lime treated subgrade recommendations.
- Soil corrosivity (pH, resistivity, sulfate and chlorides).

Appendix B presents the laboratory test results.

4 GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

4.1 Expansive Soil

Our laboratory tests indicate that the near-surface clay is generally moderately expansive to a depth of about 6 feet below existing grade, although one of our expansion index tests showed high expansion potential (Boring B6-16, 1.5-3’ depth). The deeper clay exhibits very low to moderate expansion potential based on the swell test results. The remaining sandy silt and silty to clayey sand layers exhibit low to very low expansion potential based on our boring observations and visual/manual soil classification.

We present recommendations to mitigate the effects of expansive soil in Section 4.6. These recommendations will significantly reduce but not eliminate the risk of damage due to expansive soil movement.

4.2 Liquefaction

Liquefaction can occur when loose to medium dense, granular, saturated soils (generally within 50 feet of the surface) are subjected to ground shaking. We consider the potential for liquefaction at the site to be nonexistent based on the deep groundwater level and the competent soil conditions encountered in the borings.

4.3 2013/2016 California Building Code Seismic Parameters

Based on our boring data, BCI recommends a Site Class “D”. Table 1 includes our recommended 2013/2016 California Building Code and ASCE 7-10 seismic design parameters for the site.

Table 1: CBC Seismic Design Parameters (Site Class D)	
S_s – Acceleration Parameter	0.679 g
S_1 – Acceleration Parameter	0.291 g
F_a – Site Coefficient	1.257
F_v – Site Coefficient	1.817
S_{MS} – Adjusted MCE* Spectral Response Acceleration Parameter	0.853 g
S_{M1} – Adjusted MCE* Spectral Response Acceleration Parameter	0.530 g
S_{DS} – Design Spectral Acceleration Parameter	0.569 g
S_{D1} – Design Spectral Acceleration Parameter	0.353 g
Seismic Design Category	D
T_L – Long Period Transition Period	12

* Maximum Considered Earthquake
** Figure 22-12, ASCE 7-10

4.4 Soil Corrosivity

Our sulfate and chloride content tests indicate that Type II or V Portland cement can be used for concrete mix design.

Our pH and resistivity tests generally indicate that the onsite soil is moderately corrosive to metallic pipes. A corrosion consultant should provide specific corrosion protection recommendations if buried metallic pipe is used at the site. Table 2 presents the soil corrosivity test results.

Table 2: Soil Corrosivity Test Results

Sample No.	Depth (ft.)	pH	Minimum Resistivity (ohm-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
B1-5	20-20.5	7.38	1,370	6.2	20.6
B2-2	5.5-6.0	6.45	2,140	14.8	16.4
B3-1	1.5-2.0	5.61	5,900	1.6	9.9
B4-16 Bulk B	1.5-3.0	7.64	1,550	1.9	8.6
B8-16 Bulk B	1.5-3.0	6.69	2,950	6.5	10.7
B11-16 Bulk B	1.5-3.0	6.81	2,730	11.3	8.6

4.5 Near-Surface Soil Infiltration Rates

In order to evaluate soil infiltration potential for design of a site stormwater management system within the proposed main parking area, BCI completed shallow borehole permeability/infiltration tests in Borings B6, B7, and B8 in 2014.

Within Borings B6 and B8, we performed the tests in general accordance with the Gravity Permeability Test (Method 1) procedure outlined in Chapter 17 of the United States Bureau of Reclamation (USBR) Engineering Geology Field Manual[1].

The gravity permeability tests involved:

- Selecting appropriate test intervals within the borings using engineering judgment of the anticipated infiltration potential based on the subsurface soil conditions encountered. The test interval height should be at least 5 times the diameter of the borehole per the USBR method.
- Placing a thin layer of clean pea gravel in the bottom of hole followed by a 1¼-inch diameter PVC feed pipe for introducing water into the test section, and a 2-inch diameter perforated PVC pipe for measuring water levels.
- Placing additional pea gravel in the hole up to several feet above the test section interval.
- Presoaking the test interval with water and using water surging and bailing to clean and develop the test interval.
- Introducing metered water into the test section interval through the feed pipe until 3 water level readings at 5-minute intervals are within 0.2 feet of each other and recording the associated flow rate.
- Using the test section data, including flow rate, to estimate the permeability of the test section interval using equations in the USBR manual.

Table 3 provides the gravity permeability test results for Borings B6 and B8.

Table 3: Gravity Permeability Test Results

Boring No.	Test Interval Depth (ft.)	Final Flow Rate (gallons per minute)	Permeability (inches/hour)
B6	5.75-11.5	3.62×10^{-2}	0.09
B8	3.4-8.0	8.85×10^{-3}	0.03

In Boring B7, the flow rate to maintain a constant water level was too low to be accurately measured following presaturation of the test interval depth (4.0-9.2 ft.). Therefore, over a 4-hour period, we measured the drop in water level in the test section of less than 0.01 feet, which corresponds to an infiltration rate of less than 0.03 inches/hour.

[1] U.S. Department of the Interior, Bureau of Reclamation, Engineering Geology Field Manual, Second Edition, Volume II, 2001.

We also reviewed United States Department of Agriculture (USDA) Soil Survey data (http://websoilsurvey.nrcs.usda.gov/app/) for the project area, which indicated that average permeability of the near-surface soil units ranged from 0.02 to 0.05 inches/hour, consistent with our field test results.

Based on our testing and review of USDA soil data, the near-surface soil at the site has very low permeability not suitable for design of shallow stormwater infiltration systems.

4.6 Grading

Where referenced in this report, use ASTM D 1557 test methods to determine relative compaction and optimum moisture. Compacted soil should not be considered suitable (even if it meets relative compaction requirements) if it is unstable and pumps or flexes excessively under construction equipment loads.

4.6.1 Excavations

We anticipate that the site soil will be excavatable with conventional earthmoving equipment.

On a preliminary basis, we generally anticipate that temporary excavation sloping and shoring for Type A soil requirements (Federal Register, 29 CFR, Part 1926, Subpart P; Occupational Safety and Health Standards – Excavations) will be necessary.

All excavations must be sloped, shored, and/or shielded in accordance with current Cal/OSHA requirements. The contractor is responsible for site safety, final excavation and shoring design and construction based on actual excavation conditions encountered during construction, and for the protection of existing facilities and improvements. The impact of construction traffic vibrations, actual soil conditions exposed in the open excavations, surcharges adjacent to excavations, proximity of excavations to existing structures, and other factors that may promote excavation wall instability must be evaluated at the time of construction and excavation sloping/shoring adjusted accordingly.

4.6.2 Undocumented Fill

As discussed in Section 1.4, a small pond was previously located along the north site boundary just west of Johnston Road (See Figure 2, Site Plan). The pond was filled in sometime between 2006/2007 based on our review of satellite imagery. The former pond depth is unknown. BCI drilled Boring B3-16 in the former pond area noting very stiff soil conditions.

If the pond was not backfilled and compacted properly, the undocumented fill could settle over time and cause damage and distress to the proposed parking lot improvements. Therefore, we recommend that the contractor perform several pothole excavations during site grading in the former pond area in order for BCI to determine whether the fill should be removed and recompacted or if it can be left in place. BCI should select the pothole locations and depths, and be present during pothole excavation.

4.6.3 Expansive Soil Mitigation

We provide the following recommendations to mitigate the effects of expansive soil on the proposed improvements:

- Construct building pads such that the upper 18 inches below finish pad grade, and 5 feet beyond building/foundation lines, consists of compacted non-expansive imported fill or lime treated on-site soil (lime treated subgrade).
- Overexcavate the below-grade mechanical room floor area to a depth of 12 inches below finish subgrade and backfill the excavation with non-expansive imported fill.
- Construct concrete flatwork areas such that the upper 12 inches below finish flatwork subgrade consists of compacted non-expansive imported fill or lime treated subgrade. Section 4.14 provides additional recommendations for minimum concrete flatwork section thickness for expansive soil mitigation.
- Overexcavate any below grade walls including swimming pool walls to provide at least 3 feet of compacted non-expansive imported fill laterally behind the walls. As an alternative to constructing nonexpansive fill behind swimming pool walls, we provide an increased design at-rest earth pressure in Section 4.11 to help mitigate potential detrimental impacts of expansive soil behind the walls.
- Overexcavate swimming pool bottom areas to a depth of 12 inches below pool bottom subgrade level, and backfill the excavation with compacted non-expansive imported fill. Retaining wall backfill should consist of compacted non-expansive imported fill extending at least 3 feet back-of-wall.

Prior to placement of non-expansive fill or construction of lime treat subgrade, the civil engineer should verify elevations and develop a final grading plan to maintain the minimum recommended non-expansive fill and/or lime treated subgrade thicknesses.

Non-expansive imported fill and lime treated subgrade should meet the requirements of Section 4.6.5.

4.6.4 Original Ground and Subgrade Preparation

Prior to site grading, remove trees and associated root systems (larger than 1-inch diameter), debris, abandoned utilities, any remaining foundations or floor slabs from the previously demolished residences, soft or unstable areas, or other deleterious materials. *If the former residences had septic systems/leach fields, the locations should be identified and the areas overexcavated to undisturbed native soil to remove any septic tanks and loose/soft soil.*

Strip the site to a depth of approximately 2 inches to remove surface vegetation and associated organics where present. Where only minor vegetation is present, BCI may waive the requirement for stripping. Do not use strippings as fill in building, pool, pavement, exterior flatwork, or other structural areas. Consult the landscape architect to determine if strippings are acceptable for use as fill in landscape areas.

Process and compact the exposed subgrade in at-grade, cut, and fill areas as follows:

1. Scarify the subgrade to a depth of 8 inches.
2. Uniformly moisture condition scarified native subgrade material to 1% to 3% above the optimum moisture content. To reduce soil expansion potential, maintain this moisture content until additional fill is placed or the subgrade is covered by concrete or aggregate base.
3. Uniformly moisture condition scarified imported soil subgrade materials to -1% to 2% above the optimum moisture content.
4. Compact the scarified soil to at least 90 percent relative compaction. Compact the upper 6 inches of pavement subgrade to at least 95 percent relative compaction.

4.6.5 Fill and Compaction

On-site soil may be used as fill outside the non-expansive imported fill or lime treated subgrade zones (see Section 4.6.3) provided it is free of debris and visible concentrations of vegetation, and has a maximum particle size of 1 inch.

Imported fill (non-expansive fill) must meet the following requirements:

- No concentrations of organics, debris, and other deleterious materials,
- Maximum particle size of 1-inch, with at least 75 percent passing the No. 4 Sieve, and at least 15 percent passing the No. 200 Sieve.
- Plasticity Index less than or equal to 12, per ASTM D4318.

Place and compact on-site and imported fill as follows:

1. Place fill in loose lifts no thicker than 8 inches prior to compaction.
2. Uniformly moisture condition native fill to 1% to 3% above the optimum moisture content. To reduce soil expansion potential, maintain this moisture content until additional fill is placed or the fill is covered by concrete or aggregate base.
3. Uniformly moisture condition imported fill to -1% to 2% above the optimum moisture content.
4. Compact fill to at least 90 percent relative compaction.
5. Compact the upper 6 inches of fill in pavement areas to at least 95 percent relative compaction.

Construct lime treated subgrade in accordance with Section 24-2 (Lime Stabilized Soil) of the 2015 Caltrans Standard Specifications with the following modifications:

- High calcium quicklime application rate shall be 5 percent per dry unit weight of soil. Use a soil dry unit weight of 100 pounds per cubic foot to determine the specified application rate per square foot of treated subgrade.
- In Section 24-2.03D, the mellowing period can be reduced to at least 16 hours. The entire mixing operation shall be completed within 72 hours of the initial spreading of lime instead of "within 7 days".
- Within building and pedestrian flatwork areas, minimum relative compaction can be reduced to 92 percent. At least 95 percent relative compaction should be specified for lime treated subgrade in hot mix asphalt and concrete pavement areas subject to vehicular traffic.

Lime treated soil is deleterious to plants since it has a pH of about 12.4 initially after treatment, which generally drops to around a pH of 9 over several years. We recommend that a landscape architect review any lime treatment plans and provide mitigation recommendations as necessary to protect landscape plants and turf grass areas from the harmful effects of lime treated soil.

4.6.6 Over-optimum Soil Moisture

Excessively over-optimum (wet) soil conditions can make proper compaction difficult or impossible. Wet soil is commonly encountered during the winter and spring months, or in excavations where groundwater or perched ground water is encountered.

In general, wet soil can be mitigated by:

- Discing the soil during prolonged periods of dry weather,
- Overexcavating and replacement with drier material,
- Lime treatment or stabilization using aggregate and stabilization fabric or grid.

If wet, unstable soil is encountered, BCI can observe the conditions and provide more specific mitigation recommendations.

4.6.7 Slopes

Construct cut and fill slopes no steeper than 2:1 (horizontal to vertical). To mitigate potential erosion and subsequent surficial slumping, vegetate slopes as soon as possible after construction, and direct surface drainage away from the top of slopes.

4.7 Utility Trenches

4.7.1 Trench Stability

Trenches should remain stable in the upper 4 feet. Refer to Section 4.6.1 for excavation sloping and shoring considerations.

4.7.2 Dewatering

BCI did not observe static ground water in any of our borings. Our experience indicates that perched water may be encountered during the winter and spring months.

Sump pumps should be adequate to dewater temporary construction excavations if perched water is encountered. The contractor is responsible for selecting the actual dewatering methods based on the conditions encountered.

4.7.3 Backfill

On-site and imported soil is suitable for trench backfill provided it meets fill requirements in Section 4.6.5.

Place and compact trench backfill as follows:

1. Place trench backfill in maximum 12-inch loose lifts.
2. Uniformly moisture condition trench backfill to -1% to 2% above optimum.
3. Compact trench backfill to at least 90 percent relative compaction, per ASTM D1557.
4. Compact the upper 6 inches of backfill in pavement areas to at least 95 percent relative compaction, per ASTM D1557.

Jetting is not acceptable for compaction.

Soil excavated during trenching may have a moisture content well over optimum, especially during the winter and spring months or if perched water is encountered. In this case, it will be necessary to dry back the soil prior to use as backfill.

4.8 Spread Footing Foundations

Provided site grading is performed in accordance with Section 4.6, shallow perimeter and isolated spread footings are adequate for support of the proposed buildings, shade trellis structures, light standards and flagpoles.

- Footings should be at least 12 inches wide and extend a minimum of 18 inches below the lowest adjacent soil grade. Isolated spread footings should have a minimum width of 18 inches.
- Use the following allowable bearing capacities for footing design:
  - 2,600 psf (dead plus live load) to design footings with a minimum embedment depth of 18 inches below lowest adjacent soil grade.
  - 3,000 psf (dead plus live load) to design footings with a minimum embedment depth of 24 inches below lowest adjacent soil grade.
  - 3,400 psf (dead plus live load) to design footings with a minimum embedment depth of 30 inches below lowest adjacent soil grade.

  - These values may be increased by one-third for transient loads such as wind or seismic.
- For the above allowable bearing capacities, we estimate total settlement ≤ ½ inch and differential settlement ≤ ¼-inch.
- To resist lateral movement, use a coefficient of friction of 0.40 and passive earth pressure of 200 psf per foot of depth. If both friction and passive pressure are used, reduce the passive pressure by 50 percent. The passive earth pressure can be increased by one-third for transient loads such as wind or seismic.
- Clean footing excavations of debris and loose soil prior to placing concrete.
- Slope the ground surface away from foundations at a minimum of 2 percent for a distance of at least 5 feet.
- BCI must observe all footing excavations prior to reinforcement placement to verify that competent bearing materials have been exposed.

BCI understands that the Community, Senior & Veterans Center building layout and square footage could change from that shown on Figure 2. BCI should review the final building layout to confirm that this report is suitable for use in design of the building, or whether additional subsurface exploration and laboratory testing is needed based on the final layout.

4.9 Alternative Drilled Pier Foundations

The proposed shade trellis structures, light standards and flagpoles can alternatively be supported on drilled, cast-in-place concrete pier foundations designed in accordance with the following recommendations:

- Provide a minimum pier diameter of 18 inches, minimum pier depth of 36 inches and minimum pier spacing of 3 diameters, center-to-center (3D Spacing).
- Table 4 provides allowable skin friction values to resist uplift and compression loads:

Table 4: Allowable Skin Friction

Depth Below Finish Grade (ft)	Allowable Skin Friction (psf)	
	Compression Resistance	Uplift Resistance
0 to 1	50	35
1 to 3	100	75
3 to 6	300	225
6 to 15	650	485
In combination with skin friction resistance, an allowable soil bearing pressure of 3,000 pounds per square foot may also be used for end bearing resistance to resist compression loads for the piers. Pier bottoms must be cleaned to remove any loose soil or debris prior to concrete placement if end bearing resistance is used for design.		

- Table 5 provides allowable passive pressure values to resist pier lateral loads:

Table 5: Allowable Passive Pressure	
Depth Below Finish Grade (ft)	**Allowable Passive Pressure (psf/ft)**
0 to 6	200
>6	300

- The above allowable skin friction, bearing pressure and passive pressure values may be increased by one-third for transient loads such as wind or seismic.
- Group reduction factors for axial and lateral resistance are not necessary provided the minimum 3D spacing is maintained.
- *For drilled pier foundations not located within concrete flatwork or pavement areas, neglect skin friction and passive pressure resistance within the upper 2 feet of finish grade due to the potential for the native clay to shrink away from the drilled pier foundations.*

4.10 Retaining Wall Design

BCI provides the following recommendations for design of site retaining walls, including the below-grade mechanical room walls. Refer to Section 4.11 for recommendations related to pool wall design.

4.10.1 Lateral Earth Pressures

Provided expansive soil is mitigated and backfill is compacted as recommended in Section 4, the following lateral earth pressures may be used to design site retaining walls and the below-grade mechanical pit walls:

Table 6: Retaining Wall Lateral Earth Pressures	
Pressure Condition	**Lateral Earth Pressure**
Active	36 pcf equivalent fluid weight
At-Rest	55 pcf equivalent fluid weight
For the active pressure condition, the top-of-wall should be free to rotate outward at least 1 percent of the wall height; otherwise, the at-rest pressure condition should be used for “non-yielding” walls.	

The above pressures assume level backfill, no loads within 10 feet behind the wall, and backfill drainage as recommended below. BCI should be notified if this assumption is not accurate so that we may assess the situation and provide additional recommendations if necessary.

4.10.2 Wall Drainage

Construct a vertical layer of ¾-inch crushed rock, or a geosynthetic drain behind retaining walls. The layer of crushed rock should be at least 12 inches thick and wrapped in a nonwoven geotextile such as Mirafi 140N or equivalent. Place a minimum 4-inch-diamater, perforated pipe (with perforations facing down) at the bottom of the crushed rock within the geotextile. Slope the pipe a minimum of 2% to discharge onto a suitable surface or into a storm drain.

The geosynthetic drain should consist of a geocomposite specifically designed for retaining wall drainage, and approved by BCI prior to installation. The drainage material shall be placed in accordance with manufacturers recommendations.

4.10.3 Waterproofing

The below grade mechanical room walls and floor should be designed with a waterproofing system to prevent significant moisture vapor transmission through the walls and floor system which could cause excessive indoor air humidity and damage to sensitive equipment.

4.10.4 Foundations

Use Section 4.8 for retaining wall foundation design.

4.11 Swimming Pool Design

BCI provides the following swimming pool design and construction recommendations:

- Perform expansive soil mitigation per recommendations in Section 4.6.3.
- Design pool walls using an at-rest equivalent fluid pressure of 55 pcf if the nonexpansive fill thickness behind the walls meets requirements of Section 4.6.3. Use an at-rest equivalent fluid pressure of 65 pcf for pool wall design if the pool walls are constructed directly against the native soil (eliminating the nonexpansive fill section).
- The above at-rest pressure assumes that the walls are fully drained and do not include hydrostatic forces. Therefore, the pool designer should design an adequate wall drainage system connected to a storm drain or an automatic sump pump system to remove collected water (potential sources of water include pool leaks, landscape irrigation and precipitation/splash water infiltrating through the deck system).
- The above at-rest pressure also does not include any potential surcharge loads adjacent to the pool walls. Surcharge loads located within one wall height of the top of pool wall could cause additional wall loading that should be taken into consideration by the pool

designer. BCI's scope of services did not include evaluating wall surcharge loading, but we can provide these services for an additional scope and fee.

- Excavations for the pools should remain stable in the upper 4 feet. Refer to Section 4.6.1 for additional excavation and shoring considerations.

4.12 Concrete Slab-on-Grade Floors

4.12.1 Slab Underlayment

Underlay concrete floor slabs with a minimum of 4 inches of washed, crushed, and compacted rock to provide uniform support. Crushed rock used beneath floor slabs should be graded so that 100% passes the ¾ inch sieve and less than 5% passes the No. 4 sieve. Compact crushed rock with at least two passes of a vibratory type compactor.

4.12.2 Design Considerations for Moisture

We did not observe groundwater or seepage in the exploratory borings. However, after development, irrigation, stormwater and/or pool splash water can accumulate near the ground surface and around structures. While we don't expect water accumulations to be significant enough to require underfloor drainage systems, it could be enough to cause higher than normal moisture vapor to pass through concrete floor slabs. Excessive vapor can cause floor covering damage and mold.

The designer must consider the potential for excessive water vapor, its potential impact on proposed improvements, and design the slabs and underlayment accordingly. References providing guidelines for vapor mitigation and slab underlayment include ASTM E 1643, ACI 302.1R-04, PCA, and flooring manufacturer requirements for the intended use.

No matter how extensive the vapor mitigation design, some vapor will pass through the slabs and, the slabs themselves will absorb and release some moisture. Therefore, consult with floor covering and mold specialists, and include a contingency to replace some floor coverings and mitigate potential mold growth.

4.12.3 Slab Design

Concrete slabs with crushed rock underlayment may be designed using a Modulus of Subgrade Reaction, ks, of 125 pounds per cubic inch (psi). Design concrete floors to resist the anticipated loading conditions. Use a minimum concrete slab thickness of 4 inches.

4.13 Pavement

4.13.1 Hot Mix Asphalt (HMA) Pavement

Based on an evaluation of the subsurface conditions encountered in the borings, the R-value test results, and our experience, we recommend an R-value of 17 (lowest R-value test reduced due to test expansion pressure) for design. BCI used the Caltrans Flexible Pavement Design Methods (Highway Design Manual, Chapter 630), an R-value of 17, and traffic indexes ranging from 5.0 to 8.0 to provide the new pavement section recommendations shown in Table 7 and Table 8 below. The actual traffic indexes should be selected by the civil engineer based on the anticipated traffic loading and frequency.

Table 7: Recommended HMA Pavement Sections				
Pavement Section	**Traffic Index**			
	5.0	**6.0**	**7.0**	**8.0**
Hot Mix Asphalt, Type A (inches)	3.0	3.5	4.0	4.5
Class 2 Aggregate Base (inches)	9.0	10.0	13.0	15.0

Table 8: Recommended HMA Pavement Sections (With Lime Treated Subgrade)				
Pavement Section	**Traffic Index**			
	5.0	**6.0**	**7.0**	**8.0**
Hot Mix Asphalt, Type A (inches)	3.0	3.5	4.0	4.5
Class 2 Aggregate Base (inches)	5.0	5.0	7.0	8.0
***Lime Treated Subgrade (inches)**	10.0	10.0	12.0	12.0

Construct lime treated subgrade in accordance with Section 4.6.5.

Aggregate base (AB) should conform to Caltrans Class 2 requirements. Moisture condition and compact AB to a minimum 95% relative compaction based on ASTM D1557. Prior to placing asphalt, the aggregate base should be stable under the weight of a loaded water truck. Mitigate unstable areas as recommended by BCI.

Premature failure of flexible pavement is often caused by water migrating into the aggregate base and subgrade. Construct cut-off curbs where landscaping abuts the pavement to help prevent premature failure. Provide a minimum cut-off curb width of 4 inches. Extend curbs a minimum of 4 inches into the soil underlying the aggregate base.

4.13.2 Concrete Pavement (Vehicular Traffic)

BCI used StreetPave 12 Software (American Concrete Pavement Association) to evaluate suitable unreinforced concrete pavement section thicknesses for the project for traffic indexes between 5.0 and 8.0. The actual traffic indexes should be selected by the civil engineer based on the anticipated traffic loading and frequency.

We used the following input parameters for unreinforced concrete pavement section thickness design:

- 20-year design life.
- 95% reliability.
- 15% slabs cracked at end of design life.
- Subgrade Resilient Modulus of 4,456 psi for clay subgrade with a design R-value of 21.
- Composite modulus of subgrade reaction of 175 psi/in for 12 inches of lime treated subgrade or Class 2 Aggregate Base over clay subgrade.
- RCC 28-day flexural strength (modulus of rupture) of 580 psi, which should be generally equivalent to a concrete compressive strength of 4,000 psi.
- BCI adjusted the software traffic data inputs until the output Equivalent Single Axle Loads (ESALs) were equivalent to the designated traffic index.

Tables 9 provides our unreinforced concrete pavement section thickness recommendations.

Table 9: Unreinforced Concrete Pavement Section Recommendations

Pavement Section	**Traffic Index**			
	5.0	**6.0**	**7.0**	**8.0**
Unreinforced Concrete (inches)	7.0	7.5	8.0	8.5
Class 2 Aggregate Base <u>or</u> Lime Treated Subgrade (inches)	12.0	12.0	12.0	12.0
BCI recommends that concrete pavement should be underlain by at least 12 inches of Class 2 Aggregate Base or lime treated subgrade (LTS) to mitigate potential damage caused by expansive soil movement and to provide uniform support for the pavement.				

Construct lime treated subgrade in accordance with Section 4.6.5.

Aggregate base (AB) should conform to Caltrans Class 2 requirements. Moisture condition and compact AB to a minimum 95% relative compaction based on ASTM D1557. Prior to placing asphalt, the aggregate base should be stable under the weight of a loaded water truck. Mitigate unstable areas as recommended by BCI.

Concrete pavement must meet the following requirements:

- Minimum 28-day compressive strength of 4,000 psi.
- Maximum joint spacing of 12 feet.

The Civil Engineer is responsible for designing the final joint types/spacing and for specifying the appropriate concrete mix design.

4.14 Concrete Sidewalks, Pool Decks and Miscellaneous Flatwork

We provide the following recommendations for concrete sidewalks, pool decks and miscellaneous flatwork subjected to pedestrian traffic only.

Provide a minimum section consisting of 6 inches of concrete over 12 inches of non-expansive imported fill or lime treated subgrade meeting requirements of Section 4.6.5. Compact subgrade, AB and fill per Section 4.6.5.

Construct concrete joints in accordance with Portland Cement Association guidelines to help control shrinkage cracking.

5 RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the geotechnical engineer of record to provide additional services during design and construction. For this project, BCI should be retained to:

- Review and provide comments on the civil and structural plans and specifications prior to construction.
- Monitor construction to check and document our report assumptions. At a minimum, BCI should monitor grading, lime treated subgrade, trench backfill, pool wall backfill, pavement subgrade and aggregate base compaction, and footing/pier excavations.
- Update this report if design changes occur, 2 years or more lapse between this report and construction, and/or site conditions have changed.

If we are not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions.

6 LIMITATIONS

BCI performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. Where referenced, we used ASTM or Caltrans standards as a general (not strict) *guideline* only. We do not warrant our services.

BCI based this report on the current site conditions. We assumed the soil and groundwater conditions encountered in our borings are representative of the subsurface conditions across the site. Actual conditions between these locations could be different.

Our scope did not include evaluation of on-site hazardous material, flood potential, aerial photograph review, or biological pollutants. Please contact BCI if you would like an evaluation of one or more of these potentially issues.

Appendix A presents our exploratory boring logs. The lines designating the interface between soil types are approximate. The transition between soil types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs, laboratory test results and general knowledge of the site and geological conditions.

Modern design and construction is complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

GEOTECHNICAL REPORT
Elk Grove Civic Center – Phase 1
Elk Grove, California

FIGURES

blackburn consulting

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www.blackburnconsulting.com

VICINITY MAP

Elk Grove Civic Center - Phase 1
Elk Grove, California

File No. 2951.x 001

September 2016

Figure 1

9/1/2016 2951.x 001 Fig1 Elk Grove Civic Center-Ph 1.dwg

LEGEND

B1 Boring Location 2014-2015

B1-16 Boring Location 2016

Site Boundary

1. THE COMMONS
2. COMMUNITY/SENIOR CENTER
3. * ~~VETERANS MEMORIAL HALL~~
4. AQUATICS CENTER
5. PARKING
6. PARKING WITH TRANSIT PARK & RIDE
7. FUTURE TRANSIT
8. FUTURE LIBRARY/CULTURAL ARTS
9. FUTURE CHILDREN'S DISCOVERY MUSEUM
10. FUTURE NATURE CENTER
11. FUTURE MEADOW

* Veterans Memorial Hall has been relocated to the Community/Senior Center Building. Former building area to be additional park space.

Source: Elk Grove Civic Center Master Plan by Group 4, SWA, Wood Rodgers, dated July 2016.

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SITE PLAN

Elk Grove Civic Center - Phase 1
Elk Grove, California

File No. 2951.x 001

October 2016

Figure 2

10/26/2016 2951.x 001 Fig2 Elk Grove Civic Center-Ph 1.dwg

GEOTECHNICAL REPORT
Elk Grove Civic Center – Phase 1
Elk Grove, California

APPENDIX A

Boring Logs

Boring Log Legend

LOG OF BORING B01-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16
LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")
SURFACE ELEVATION (ft): 33.6
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; dark brown; moist							
						Lean CLAY with Sand; hard; dark yellowish brown; moist						32	
5													
						Bottom of Boring at 5'; No Groundwater Encountered; Bulk Samples Obtained: B1-16 Bulk A (0-1.5'); B1-16 Bulk B (1.5-3')							
10													
15													

LOG OF BORING B02-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 35.1
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; strong brown; moist							
						becomes hard, weakly cemented							
5													
						Bottom of Boring at 5'; No Groundwater Encountered; Bulk Samples Obtained: B2-16 Bulk A (0-1.5'); B2-16 Bulk B (1.5-3')							
10													
15													

LOG OF BOREHOLE -- GEOTECHNICAL TEMPLATE.GPJ THE LIBRARY_2016.GLB 9/26/16

LOG OF BORING B03-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 34.9
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; dark brown; moist							
		1	18	>4.5									
						becomes hard							
5		2	19	3.7									
						Bottom of Boring at 6.5'; No Groundwater Encountered; Bulk Samples Obtained: B3-16 Bulk A (0-1.5'); B3-16 Bulk B (1.5-3')							
10													
15													

LOG OF BOREHOLE -- GEOTECHNICAL TEMPLATE.GPJ THE LIBRARY_2016.GLB 9/26/16

LOG OF BORING B04-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16
LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")
SURFACE ELEVATION (ft): 34.8
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD					GRAPHIC LOG	DESCRIPTION	LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; strong brown; moist							
		1	54	>4.5			109	16					
		2	50/5"	>4.5		Lean CLAY with SAND; CL; hard; brown; moist; moderately cemented							
5		3	22	>4.5									
						SANDY SILT; ML; hard; dark yellowish brown; moist; weakly cemented	105	13					
10		4	53	>4.5									
						Lean CLAY; CL; hard; yellowish brown; moist	100	19					
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B4-16 Bulk A (0-1.5'); B4-16 Bulk B (1.5-3')							
15													

LOG OF BOREHOLE -- GEOTECHNICAL TEMPLATE.GPJ THE LIBRARY_2016.GLB 9/26/16

LOG OF BORING B05-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 36.0
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						SANDY lean CLAY; CL; very stiff; dark yellowish brown; dry to moist;							
		1	13	>4.5									
		2	12	>4.5									
						Lean CLAY; CL; hard; dark yellowish brown; moist; moderately cemented							
5		3	50/6"	>4.5			105	11					
10		4	42	>4.5									
						Poorly-graded SAND; SP; dense; reddish brown; moist	107	7					
						SANDY lean CLAY; CL; hard; dark yellowish brown; moist; weakly cemented							
						SILT; ML; hard; olive brown; moist; moderately cemented							
15		5	67	>4.5									
						Bottom of Boring at 16.5'; No Groundwater Encountered; Bulk Samples Obtained: B5-16 Bulk A (0-1.5'); B5-16 Bulk B (1.5-3')							

LOG OF BORING B06-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 35.4
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean to Fat CLAY; CL/CH; stiff to very stiff; dark brown; moist							
		1	15	>4.5									
							100	12					
			34	>4.5									
						becomes hard, weakly cemented							
5			50/11"	>4.5									
						SANDY lean CLAY; hard; yellowish brown; moist; moderately cemented	112	16					
10			57			Well-graded SAND; very dense; brown; moist							
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B6-16 Bulk A (0-1.5'); B6-16 Bulk B (1.5-3')							
15													

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LOG OF BORING B07-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16
LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")
SURFACE ELEVATION (ft): 36.1
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; brown; moist							
		1	35	>4.5			111	6					
		2	35	>4.5		becomes hard, moderately cemented							
5		3	50/6"	>4.5		becomes yellowish brown	109	12					
10		4	34			CLAYEY SAND; SC; dense; brown; moist							
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B7-16 Bulk A (0-1.5'); B7-16 Bulk B (1.5-3')							
15													

LOG OF BOREHOLE -- GEOTECHNICAL TEMPLATE.GPJ THE LIBRARY_2016.GLB 9/26/16

LOG OF BORING B08-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 35.8
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; very stiff; strong brown; moist							
		1	19	>4.5			101	10					
		2	50/6"	>4.5		Lean CLAY with SAND; CL; hard; strong brown; moist; moderately cemented							
						Lean CLAY; CL; hard; brown; moist; moderately cemented							
5		3	50/5"	>4.5			111	13					
						Lean CLAY with SAND; CL; hard; brown; moist; moderately cemented							
10		4	48	>4.5									
						SILTY SAND; SM; very dense; brown; moist							
						Lean CLAY; CL; hard; grayish brown; moist							
15		5	47	>4.5									
						Poorly-graded SAND; SP; very dense; light grayish brown; moist	112	14					
						Bottom of Boring at 16.5'; No Groundwater Encountered; Bulk Samples Obtained: B8-16 Bulk A (0-1.5'); B8-16 Bulk B (1.5-3')							

LOG OF BORING B09-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 36.4
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; stiff to very stiff; reddish brown; moist							
		1	12										
		2	35										
						becomes hard, moderately cemented							
5		3	50/4"			becomes brown							
						CLAYEY SAND; SC; medium dense; dark yellowish brown; moist							
10		4	9				101	8					
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B9-16 Bulk A (0-1.5'); B9-16 Bulk B (1.5-3')							
15													

LOG OF BORING B10-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 36.5
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY; CL; stiff to very stiff; brown; dry							
		1	16	>4.5									
		2	34	>4.5		Lean to Fat CLAY; CL/CH; hard; brown; moist							
5						SANDY lean CLAY; CL; hard; dark yellowish brown; moist; weakly cemented							
		3	50	>4.5									
							107	14					
10													
		4	59	>4.5									
							97	18					
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B10-16 Bulk A (0-1.5'); B10-16 Bulk B (1.5-3')							
15													

LOG OF BORING B11-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16
LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")
SURFACE ELEVATION (ft): 36.3
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
						Lean CLAY with SAND; CL; very stiff; reddish brown; dry							
		1	22	>4.5			102	5					
		2	27	>4.5		Lean CLAY; CL; hard; reddish brown; moist							
						becomes weakly cemented							
						Lean CLAY with SAND; CL; hard; strong brown; moist							
5		3	37	>4.5			110	16					
10		4	13	2.75		SANDY lean CLAY; CL; very stiff; dark yellowish brown; moist							
						Bottom of Boring at 11.5'; No Groundwater Encountered; Bulk Samples Obtained: B11-16 Bulk A (0-1.5'); B11-16 Bulk B (1.5-3')							
15													

LOG OF BOREHOLE -- GEOTECHNICAL TEMPLATE.GPJ THE LIBRARY_2016.GLB 9/26/16

LOG OF BORING B12-16

PROJECT: Elk Grove Civic Center - Phase 1
FILE NO.: 2951.X 01
LOCATION: Civic Center Drive/Big Horn Blvd
CLIENT: Willdan Engineering
DRILLING DATE: 8-17-16

LOGGED BY: KAC
CHECKED BY: DJM
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Safety semi-automatic drop (140#/ 30")

SURFACE ELEVATION (ft): 35.0
WATER DEPTH (ft): None
WATER READING DATE: 8/17/2016

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	FIELD BLOW COUNT	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	R VALUE	OTHER TESTS
0–5						Lean CLAY; CL; very stiff; dark yellowish brown; moist						23	
5						Bottom of Boring at 5'; No Groundwater Encountered; Bulk Samples Obtained: B12-16 Bulk A (0-1.5'); B12-16 Bulk B (1.5-3')							
10													
15													

LOG OF BORING B01

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/19/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH: 57.5
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry;							
		1	23										
						Lean CLAY; CL; hard; yellowish brown; dry to moist; moderately cemented							
5		2	50/6"	4.0			113	15					
						SANDY SILT; ML; hard; mottled light gray to olive brown; moist; weakly to moderately cemented							
10		3	91/11"	4.5+			109	18					
15		4	50/5"	4.25			112	11					
						Lean CLAY; CL; hard; mottled olive brown and brown; moist; moderately cemented							
20		5	50/6"	4.5+									
						SANDY SILT; ML; hard; brown; moist; weakly to moderately cemented							
25		6	70	4.5+			108	16					
30		7	26	4.5+			89	20					
35		8	61	4.5+		Poorly graded SAND; SP; very dense; olive brown; moist							
						Lean CLAY; CL; hard; olive brown; moist; weakly to moderately cemented							
40		9	83	4.5+									
						Completed Boring to 41.5-foot Depth on 11/19/2014; Continued Drilling on 3/6/2015 Using Hollow Stem Auger with Sampling Starting at 45-foot Depth.							
						SILTY SAND; SM; very dense; mottled brown and light olive brown; moist; weakly to moderately cemented							
45		10	73	4.5+			109	19					

LOG OF BOREHOLE (2442.2) 2101.050LOGS.GPJ BLACKBURN.GDT 4/10/15

LOG OF BORING B01

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/19/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH: 57.5
DATE OF READING:
TIME OF READING:

blackburn consulting

FIELD					GRAPHIC LOG	DESCRIPTION	LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)			DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		11	82/10"	4.5+		SILTY SAND; SM; very dense; mottled brown and light olive brown; moist; weakly to moderately cemented	103	21					
55		12	50/6"	4.5+									
						SILT; ML; hard; olive brown; moist; moderately cemented							
60		13	97/9"	4.5+			91	32					
						SANDY SILT; ML; hard; light olive brown; moist; weakly cemented							
65		14	59	4.5+			87	35					
						SILT; ML; hard; light olive brown; moist; moderately cemented							
70		15	50/3"	4.5+									
						SANDY SILT; ML; hard; light olive brown; moist; weakly cemented							
75		16	50/3"	4.5+									
						SILT; ML; hard; light yellowish brown; moist; weakly cemented							
80		17	68	4.5+			88	32					
						End of boring at 81.5 feet. No groundwater encountered during drilling on 11/19/2014 to 41.5-foot depth. Groundwater encontered during drillihg on 3/6/2015 at a depth of 57.5 feet. Grouted boring following completion on 3/6/2015. Bulk Sample Collected: Bag A (0-3')							

LOG OF BOREHOLE (2442.2) 2101.050LOGS.GPJ BLACKBRN.GDT 4/10/15

LOG OF BORING B02

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/19/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						SANDY Lean CLAY; CL; stiff to very stiff; brown; dry							
	X	1	38	4.5+									
						Lean CLAY; CL; hard; brown; dry to moist; weakly to moderately cemented	109	9					
5	X	2	22	2.0		Lean CLAY with SAND; CL; very stiff; brown; moist; weakly cemented							
10	X	3	59	4.5+		SANDY SILT; ML; hard; olive brown; moist; weakly to moderately cemented	118	12	64				
15	X	4	50/6"	4.5+		Becomes mottled brown, olive brown and light gray	108	19					
20	X	5	50/5"	4.5+									
						Becomes brown							
25	X	6	44										
						End of boring at 26.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag B (0-3')							

LOG OF BORING B03

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/19/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 35 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff; brown; dry							
	X	1	32	4.5+		Lean CLAY to Fat CLAY; CL-CH; hard; dark brown; dry-moist; moderately cemented				35	50		
5	X	2	52	4.5+									
						SANDY SILT; ML; hard; brown; moist; weakly to moderately cemented	119	14					
10	X	3	59	4.5+			95	24					
						Lean CLAY; CL; hard; olive brown; moist; weakly to moderately cemented							
15	X	4	50/6"	4.5+						21	38		
20	X	5	50/6"	4.5+		Becomes dark brown, weakly cemented	114	18					
						SANDY SILT; ML; hard; brown; moist; weakly cemented							
25	X	6	44										
						End of boring at 26.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag C (0-3')							

LOG OF BORING B04

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/19/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 35 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry;							
	X	1	68/11"	4.5+		Lean CLAY; CL; hard; dark brown; moist; moderately cemented	109	13					
5	X	2	93/11"	4.5+		SANDY SILT; ML; hard; olive brown; moist; weakly to moderately cemented			64				
10	X	3	61	4.5+									
						End of boring at 11.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag D (0-3')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B05

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		1	21	2		Lean CLAY; CL; stiff to very stiff; brown; dry							
		2	31	3.5 4.5+									
5						Lean CLAY; CL; hard; olive brown; moist; weakly to moderately cemented							
		3	26	4.5+			104	20					
10		4	74	4.5+		SANDY SILT; ML; hard; olive brown; moist; moderately cemented							
						End of boring at 10.5 ft No groundwater encountered Backfilled with native cuttings							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B06

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 6" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 33 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry							
		1	34										
		2	23										
5		3	42	4.5+		CLAYEY SAND; SC; dense; brown; moist; weakly cemented	121	10					
		4	11			SILTY SAND; SM; medium dense; brown; moist							
		5	8						20				
10		6	35			Lean CLAY; CL; hard; olive brown; moist; moderately cemented							

End of boring at 11.5 ft
No groundwater encountered
Backfilled with native cuttings
Infiltration test pipes set to 9.2 ft, pea gravel backfill from depths of 4.5 ft to 9.6 ft
Bulk Sample Collected: Bag R (0.5-1.5')

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B07

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 6" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 33 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry;							
		1	87										
						SANDY Lean CLAY; CL; hard; brown; moist; weakly to moderately cemented	114	14					
		2	34										
5		3	55	4.5+									
		4	35	4.5+									
		5	63	4.5+									
10						End of boring at 10 ft No groundwater encountered Backfilled with native cuttings Infiltration test pipes set to 8.9 ft, pea gravel backfill from depths of 3.9 ft to 9.2 ft							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B08

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 6" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 33 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry to moist;							
		1	50/6"	4.5+		Becomes hard below 2'							
		2	50/6"	4.5+									
5						SILTY SAND; SM; very dense; olive brown; moist; moderately cemented							
		3	63	4.5+			114	9	39				
		4	29	4.5+		SANDY lean CLAY; CL; hard; olive brown; moist; moderately cemented							
						End of boring at 8 ft No groundwater encountered Backfilled with native cuttings Infiltration test pipes set to 7.5 ft, pea gravel backfill from depths of 3.0 ft to 7.7 ft							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B09

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 8" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 32 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
	Bulk	Bag E			CL	Lean CLAY; CL; (stiff to very stiff); brown; dry to moist							
	Bulk	Bag F			CL	Becomes (hard) below 3'							
5						End of boring at 5 ft No groundwater encountered Backfilled with native cuttings Bulk Samples Collected: Bag E (0-2'), Bag F (2-5')							

LOG OF BORING B10

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 8" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 35 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		Bag G				Lean CLAY; CL; (stiff to very stiff); brown; dry to moist							
		Bag H				Becomes (hard) below 3'							
5						End of boring at 5 ft No groundwater encountered Backfilled with native cuttings Bulk Samples Collected: Bag G (0-2'), Bag H (2-4')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B11

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 8" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 36 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		Bag I				Lean CLAY; CL; (stiff to very stiff); brown; dry to moist							
		Bag J				Becomes (hard) below 3'							
5						End of boring at 5 ft No groundwater encountered Backfilled with native cuttings Bulk Samples Collected: Bag I (0-2'), Bag J (2-4')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B12

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 8" Hollow Stem Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 36 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		Bag K				Lean CLAY; (very stiff to hard); brown; dry to moist							
		Bag L				Becomes (hard), moderately cemented below 3 ft							
5						End of boring at 5 ft No groundwater encountered Backfilled with native cuttings Bulk Samples Collected: Bag K (0-2'), Bag L (2-4')							

LOG OF BORING B13

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 35 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		1	28			Lean CLAY; CL; stiff to very stiff; brown; dry							
		2	68	4.5+			94	5					
						Lean CLAY; CL; hard; brown; dry; weakly to moderately cemented Becomes moist							
5		3	90	4.5+									
						SANDY SILT; ML; hard; olive brown; moist; moderately cemented							
10		4	80	4.5+									
						End of boring at 10.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag M (0-1')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B14

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FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		1	16	4.5+		Lean CLAY; CL; stiff to very stiff; olive brown; dry;	94	5					
		2	41	4.5+									
						Lean CLAY; CL; hard; dusky yellow brown; dry to moist; moderately cemented							
5		3	70	4.5+		SANDY Lean CLAY; CL; hard; olive brown; moist; moderately cemented	118	11					
						Lean CLAY; CL; hard; olive brown; moist; moderately cemented							
10		4	63	4.5+									

End of boring at 10.5 ft
No groundwater encountered
Backfilled with native cuttings
Bulk Sample Collected: Bag N (0-2')

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B15

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; stiff to very stiff; brown; dry;							
		1	50/6"	4.5+			86	10					
						Lean CLAY; CL; hard; dusky yellow brown; dry to moist; moderately cemented							
5		2	40	4.5+		CLAYEY SAND; SC; dense; brown; moist; weakly cemented							
						Lean CLAY; CL; hard; brown to olive brown; moist; weakly to moderately cemented							
10		3	63	4.5+									
						End of boring at 10.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag O (0-2')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B16

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 34 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
		1	19	4.5+		Lean CLAY; CL; stiff to very stiff; brown; dry	100	7					
		2	48	4.5+									
5		3	76/11"	4.5+		Lean CLAY; CL; hard; brown to dusky yellow brown; moist; moderately cemented	119	10					
10		4	71	4.5+									
						End of boring at 10.5 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag P (0-1')							

LOG OF BOREHOLE 2101.050LOGS.GPJ BLACKBRN.GDT 12/17/14

LOG OF BORING B17

FILE NO.: 2101.x 050
PROJECT: Elk Grove Aquatic Facility
LOCATION: Elk Grove, California
CLIENT: Willdan Engineering

DRILLING DATE: 11/20/14
DRILLING METHOD: 4" Solid Auger
HAMMER TYPE: Automatic Safety Hammer
LOGGED BY: RCP CHECKED BY: DJM

ELEVATION: 33 ft.
WATER DEPTH:
DATE OF READING:
TIME OF READING:

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FIELD							LABORATORY						
DEPTH (FEET)	SAMPLE	SAMPLE NO.	BLOWS/PRESS.	POCKET PEN (TSF)	GRAPHIC LOG	DESCRIPTION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	% <200 SIEVE	PLASTICITY INDEX	LIQUID LIMIT	UNCONFINED COMPRESSION (tsf)	R-VALUE
						Lean CLAY; CL; (stiff to very stiff); brown; dry							
	X	1	46	4.5+		Lean CLAY; CL; hard; brown to dusky yellow brown; moist; moderately cemented	116	16					
5	X	2	47	4.5+		CLAYEY SAND; SC; very dense; brown; moist	113	12					
						Lean CLAY; CL; hard; dusky yellow brown; dry; moderately cemented							
	X	3	50/5"	4.5+									
						End of boring at 9.9 ft No groundwater encountered Backfilled with native cuttings Bulk Sample Collected: Bag Q (0-2')							

□□IFIED SOIL CLASSIFICATIO□ (ASTM D 2487)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GRAPHIC SYMBOL	GROUP SYMBOL	SOIL GROUP NAMES
COARSE-GRAINED SOILS □50□ RETAI□ED O□ □O. 200 SIEVE	GRAVELS □50□ OF COARSE FRACTIO□ RETAI□ED O□ □O. 4 SIEVE	CLEA□ GRAVELS □5□ FI□ES	Cu □4 A□D 1 □Cc □3		GW	WELL-GRADED GRAVEL
			Cu □4 A□D/OR 1 □Cc □3		GP	POORL□-GRADED GRAVEL
		GRAVELS WITH FI□ES □12□ FI□ES	FI□ES CLASSIF□ AS ML OR MH		GM	SILT□ GRAVEL
			FI□ES CLASSIF□ AS CL OR CH		GC	CLA□E□ GRAVEL
	SANDS □50□ OF COARSE FRACTIO□ RETAI□ED O□ □O. 4 SIEVE	CLEA□ SA□DS □5□ FI□ES	Cu □6 A□D 1 □Cc □3		SW	WELL-GRADED SA□D
			Cu □6 A□D/OR 1 □Cc □3		SP	POORL□-GRADED SA□D
		SA□DS WITH FI□ES □12□ FI□ES	FI□ES CLASSIF□ AS ML OR MH		SM	SILT□ SA□D
			FI□ES CLASSIF□ AS CL OR CH		SC	CLA□E□ SA□D
FINE-GRAINED SOILS □50□ PASSI□G □O. 200 SIEVE	SILTS AND CLAYS LI□□ID LIMIT □50	I□ORGA□IC	PI>7 AND PLOTS ON OR ABOVE "A" LINE		CL	LEA□ CLA□
			PI>4 AND PLOTS BELOW "A" LINE		ML	SILT
		ORGA□IC	LL (oven dried)□0.75/LL (not dried)		OL	ORGA□IC CLA□ OR SILT
	SILTS AND CLAYS LI□□ID LIMIT □50	I□ORGA□IC	PI PLOTS O□ OR ABOVE "A" LI□E		CH	FAT CLA□
			PI PLOTS BELOW "A" LI□E		MH	ELASTIC SILT
		ORGA□IC	LL (oven dried)□0.75/LL (not dried)		OH	ORGA□IC CLA□ OR SILT
HIGHLY ORGANIC SOILS		PRIMARIL□ ORGA□IC MATTER, DARK COLOR, ORGA□IC ODOR			PT	PEAT

□OTE: Cu□D_{60}/D_{10}

Cc□$(D_{30})^2/ D_{10} x D_{60}$

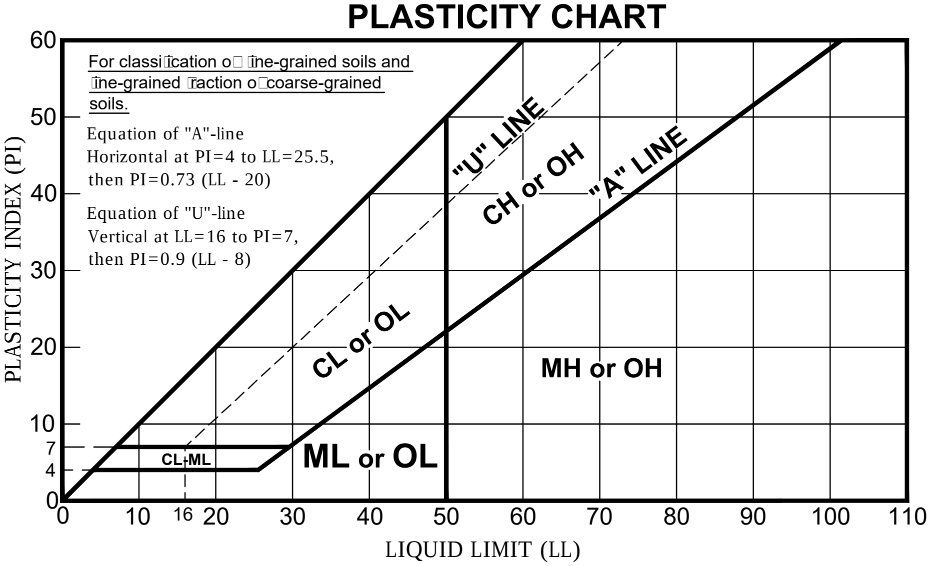
SAMPLE TYPES

- Auger or backhoe cuttings
- Modi□ied Cali□ornia
- Shelb□ tube
- Rock core
- Standard Penetration (SPT)

BLOW COUNT

The number o□blows o□a 140-lb. hammer □alling 30-inches re□uired to drive the sam□ler the last 12-inches o□an 18-inch drive. The notation 50/4 indicates 4-inches o□□enetration achieved in 50 blows.

PLASTICITY CHART



ADDITIONAL TESTS

C - Consolidation
CP - Com□action Curve
CR - Corrosivit□ Testing
C□ - Consolidated □ndrained Triaxial
DS - Direct Shear
EI - Ex□ansion Index
P - Permeabilit□
PA - Partical Si□e Anal□sis
PI - Plasticit□ Index
PP - Pocket Penetrometer
R - R-Value
SE - Sand E□uivalent
SG - S□eci□ic Gravit□
SL - Shrinkage Limit
SW - Swell Potential
TV - Pocket Torvane Shear Test
□C - □ncon□ined Com□ression
□□ - □nconsolidated □ndrained Triaxial

GROUND WATER LEVELS

- Later water level a□ter drilling
- Water level at time o□drilling

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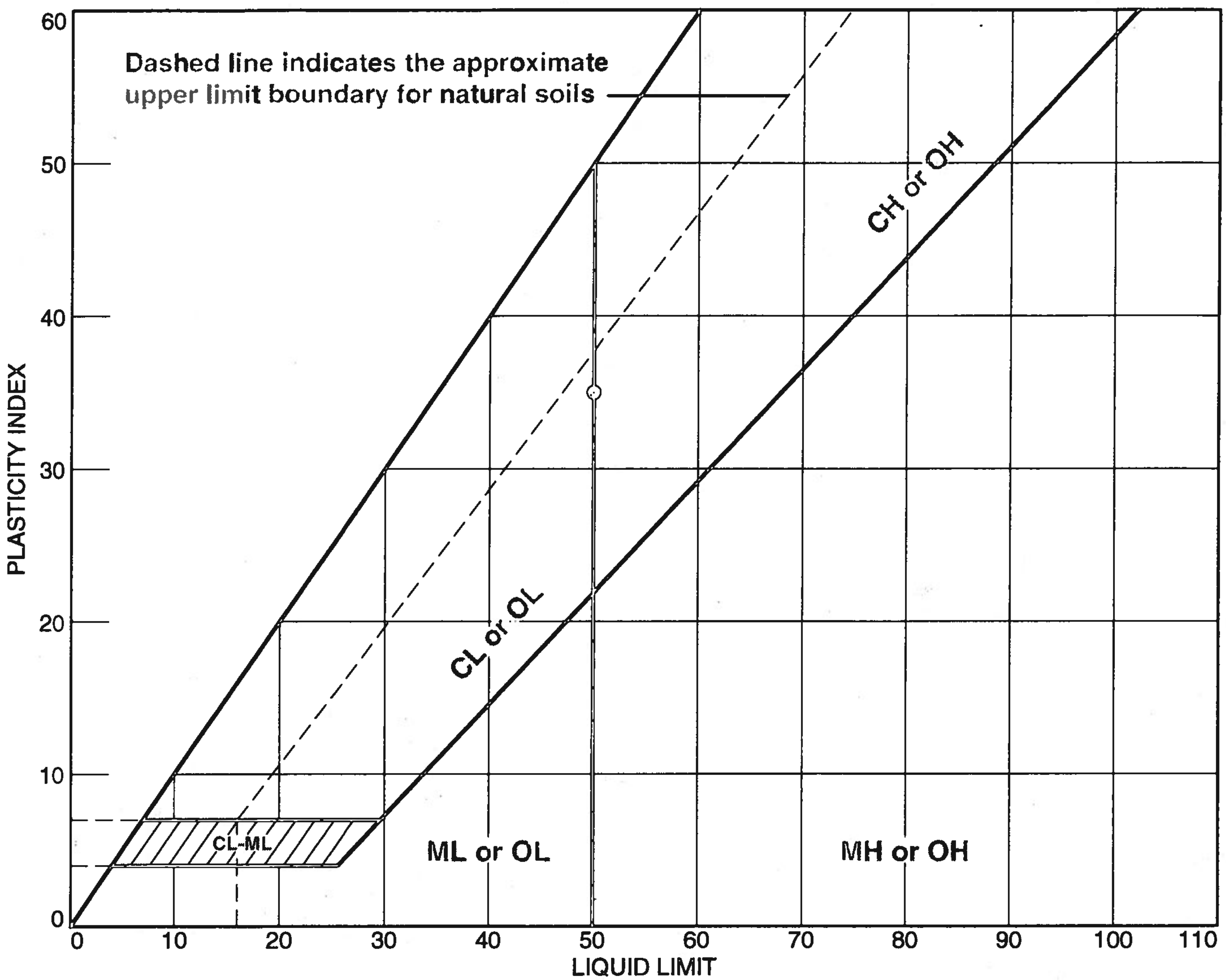
BORING LOG / TEST PIT LEGEND AND SOIL DESCRIPTIONS

GEOTECHNICAL REPORT
Elk Grove Civic Center – Phase 1
Elk Grove, California

APPENDIX B

Laboratory Test Results

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
○	B3	1c	2.0-2.5'		15	50	35	CH

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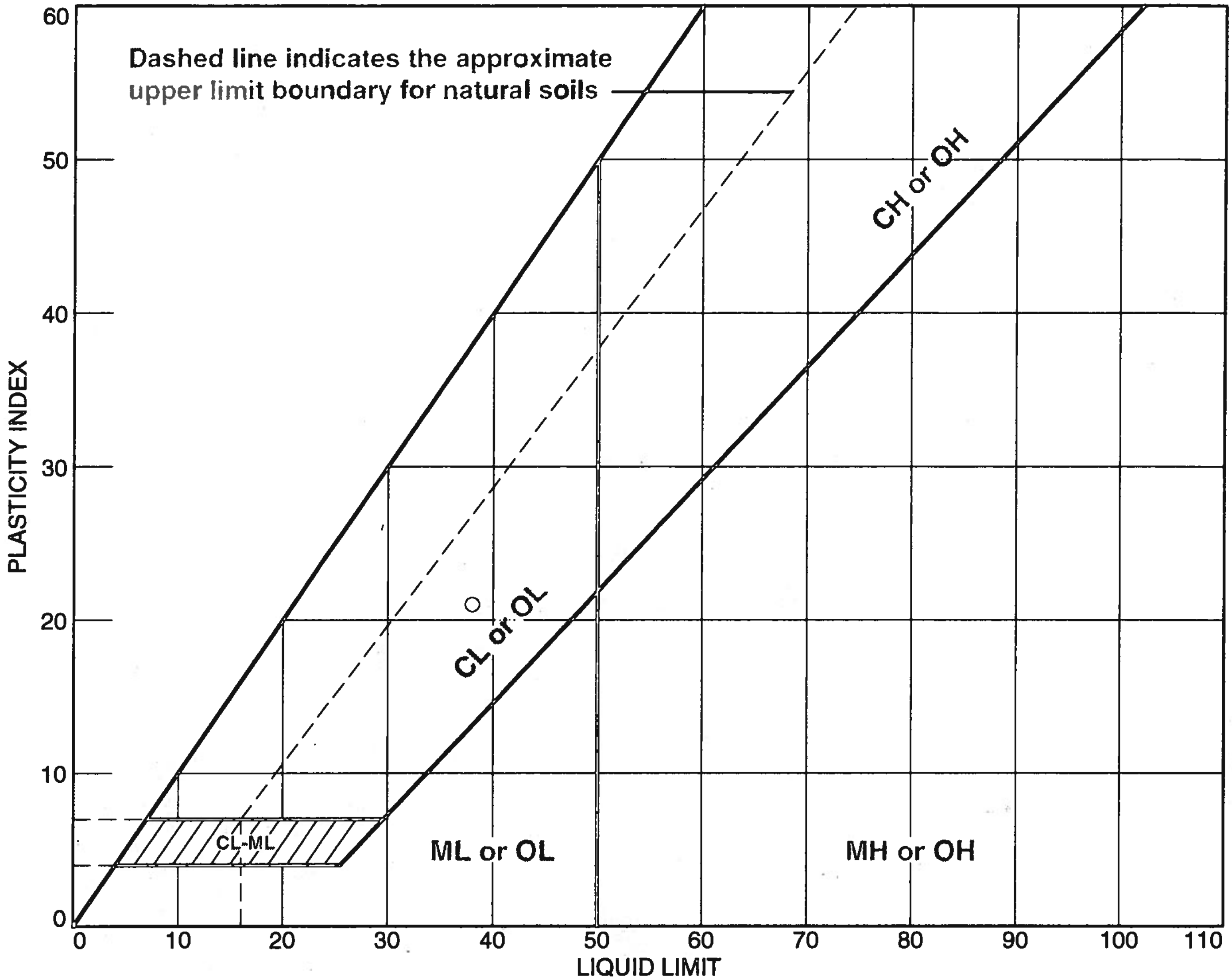
Client: Willdan Engineering
Project: Elk Grove Aquatics Facility

Project No.: 2101.050 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA								
SYMBOL	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
○	B3	4c	15.5-16.0'		17	38	21	CL

Blackburn Consulting W. Sacramento, CA	**Client:** Willdan Engineering **Project:** Elk Grove Aquatics Facility **Project No.:** 2101.050 **Figure**

Project Name: Elk Grove Aquatics Facility
Project No: 2101.05
Sample No: B15 Bag O (0-3')/B17 Bag Q (0-2') Composite
Date: 11/25/14
Technician: BRL/DGF

EXPANSION INDEX TEST
(ASTM D4829)

Test Data Summary	
Retained #4 (%)	0.0
Initial Moisture (%)	10.4
Final Moisture (%)	24.9
Percent Saturation (%)	49.4
Initial Dry Density (pcf)	107.4
Final Dry Density (pcf)	100.0
Expansion Index (uncorrected)	72
Expansion Index (corrected)	72

Project Name: Elk Grove Aquatics Facility
Project No: 2101.05
Sample No: B3 Bag C (0-3')/ B4 Bag D (0-3') Composite
Date: 11/25/14
Technician: BRL/DGF

EXPANSION INDEX TEST
(ASTM D4829)

Test Data Summary	
Retained #4 (%)	0.0
Initial Moisture (%)	9.9
Final Moisture (%)	27.2
Percent Saturation (%)	52.0
Initial Dry Density (pcf)	111.4
Final Dry Density (pcf)	99.7
Expansion Index (uncorrected)	75
Expansion Index (corrected)	77

Project Name: Elk Grove Aquatics Facility
Project No: 2101.05
Sample No: B1 Bag A (0-3')
Date: 11/25/14
Technician: BRL/DGF

EXPANSION INDEX TEST
(ASTM D4829)

Test Data Summary	
Retained #4 (%)	0.0
Initial Moisture (%)	10.1
Final Moisture (%)	24.6
Percent Saturation (%)	51.2
Initial Dry Density (pcf)	110.1
Final Dry Density (pcf)	102.0
Expansion Index (uncorrected)	73
Expansion Index (corrected)	74

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Project Name: Elk Grove Civic Center Phase 1
Project No: 2951.x001
Sample No: B6-16 Bulk A
Depth: 0.0-1.5'
Date: 9/8/2016
Sample Description: Lean CLAY with SAND, yellowish brown

EXPANSION INDEX TEST

(ASTM D4829)

Test Data Summary

Retained #4 (%)	0.0%
Initial Moisture (%)	11.3
Final Moisture (%)	23.6
Percent Saturation (%)	50.5
Initial Dry Density (pcf)	105.0
Final Dry Density (pcf)	98.8
Expansion Index	57

*

TABLE 1 Classification of Potential Expansion of Soils Using *EI*

Expansion Index, *EI*	Potential Expansion
0–20	Very Low
21–50	Low
51–90	Medium
91–130	High
>130	Very High

***ASTM D4829-11 pg.2, table 1**

Project Name:	Elk Grove Civic Center Phase 1
Project No:	2951.x001
Sample No:	B6-16 Bulk B
Depth:	1.5-3.0'
Date:	9/8/2016
Sample Description:	Lean CLAY, yellowish brown

EXPANSION INDEX TEST
(ASTM D4829)

Test Data Summary

Retained #4 (%)	0.0%
Initial Moisture (%)	13.2
Final Moisture (%)	32.3
Percent Saturation (%)	50.4
Initial Dry Density (pcf)	98.7
Final Dry Density (pcf)	88.6
Expansion Index	114

*

TABLE 1 Classification of Potential Expansion of Soils Using *EI*

Expansion Index, *EI*	Potential Expansion
0–20	Very Low
21–50	Low
51–90	Medium
91–130	High
>130	Very High

***ASTM D4829-11 pg.2, table 1**

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Project Name:	Elk Grove Civic Center Phase 1
Project No:	2951.x001
Sample No:	B9-16 Bulk B
Depth:	1.5-3.0'
Date:	9/8/2016
Sample Description:	SANDY lean CLAY, yellowish brown

EXPANSION INDEX TEST

(ASTM D4829)

Test Data Summary

Retained #4 (%)	0.0
Initial Moisture (%)	9.1
Final Moisture (%)	17.8
Percent Saturation (%)	48.1
Initial Dry Density (pcf)	111.6
Final Dry Density (pcf)	109.9
Expansion Index	30

*

TABLE 1 Classification of Potential Expansion of Soils Using *EI*

Expansion Index, *EI*	Potential Expansion
0–20	Very Low
21–50	Low
51–90	Medium
91–130	High
>130	Very High

***ASTM D4829-11 pg.2, table 1**

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Project Name: Elk Grove Civic Center Phase 1
Project No: 2951.x001
Sample No: B10-16 Bulk A
Depth: 0.0-1.5'
Date: 9/8/2016
Sample Description: SANDY lean CLAY, yellowish brown

EXPANSION INDEX TEST
(ASTM D4829)

Test Data Summary

Retained #4 (%)	3.0
Initial Moisture (%)	8.0
Final Moisture (%)	15.4
Percent Saturation (%)	48.2
Initial Dry Density (pcf)	116.3
Final Dry Density (pcf)	115.6
Expansion Index	14

* **TABLE 1 Classification of Potential Expansion of Soils Using *EI***

Expansion Index, *EI*	Potential Expansion
0–20	Very Low
21–50	Low
51–90	Medium
91–130	High
>130	Very High

***ASTM D4829-11 pg.2, table 1**

Project Name:	Elk Grove Civic Center Phase 1
Project No:	2951.x001
Sample No:	B10-16 Bulk B
Depth:	1.5-3.0'
Date:	9/8/2016
Sample Description:	Lean CLAY with SAND, yellowish brown

EXPANSION INDEX TEST

(ASTM D4829)

Test Data Summary

Retained #4 (%)	0.4%
Initial Moisture (%)	11.0
Final Moisture (%)	23.4
Percent Saturation (%)	51.4
Initial Dry Density (pcf)	106.7
Final Dry Density (pcf)	99.7
Expansion Index	87

*

TABLE 1 Classification of Potential Expansion of Soils Using *EI*

Expansion Index, *EI*	Potential Expansion
0–20	Very Low
21–50	Low
51–90	Medium
91–130	High
>130	Very High

***ASTM D4829-11 pg.2, table 1**

SWELL/CONSOLIDATION TEST DATA

Client: Willdan Engineering
Project: Elk Grove Aquatics Facility
Project Number: 2101.050

Sample Data

Source: B13
Sample No.: 3c with water
Elev. or Depth: 6.1-6.2' **Sample Length(in./cm.):**
Location:
Description: Lean CLAY, reddish yellow, moderately cemented
Liquid Limit: **Plasticity Index:**
USCS: CL **AASHTO:** **Figure No.:**
Testing Remarks: ASTM D4546, Method B

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 202.57 g.	**Consolidometer #** = 1	**Wet w+t** = 230.74 g.
Dry w+t = 196.41 g.		**Dry w+t** = 217.04 g.
Tare Wt. = 146.38 g.	**Spec. Gravity** = 2.65	**Tare Wt.** = 146.08 g.
Height = .76 in.	**Height** = .76 in.	
Diameter = 2.00 in.	**Diameter** = 2.00 in.	
Weight = 80.65 g.	**Defl. Table** = Consol #1, 2.0", Wt.Set#A (psf/inches)	
Moisture = 12.3 %	**Ht. Solids** = 0.5264 in.	**Moisture** = 19.3 %
Wet Den. = 128.2 pcf	**Dry Wt.** = 71.81 g.*	**Dry Wt.** = 70.96 g.
Dry Den. = 114.1 pcf	**Void Ratio** = 0.450	**Void Ratio** = 0.478
Ovrbrdn. = 250 psf	**Saturation** = 72.5 %	

*** Initial dry weight used in calculations**

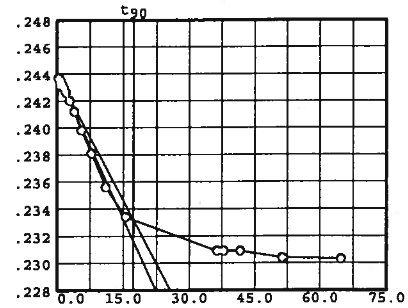
End-of-Load Summary

Pressure (psf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
start	0.24540				0.450	
250	0.23180	0.00150	0.00		0.478	2.0 Swell

C_c = 0.00

Pressure: 250 psf	TEST READINGS	Load No. 1

No.	Clock Time	Dial Reading	No.	Clock Time	Dial Reading
1	11:18:00	0.24540	11	12:18:00	0.23960
2	11:18:06	0.24520	12	13:18:00	0.23710
3	11:18:15	0.24510	13	15:18:00	0.23490
4	11:18:30	0.24500	14	+01 09:18:00	0.23240
5	11:19:00	0.24480	15	+01 11:18:00	0.23240
6	11:20:00	0.24450	16	+01 16:18:00	0.23240
7	11:22:00	0.24410	17	+02 07:18:00	0.23190
8	11:26:00	0.24350	18	+03 09:18:00	0.23180
9	11:33:00	0.24270			
10	11:48:00	0.24130			



Void Ratio = 0.478 **Swell** = 2.0 %
D_0 = 0.24393 D_{90} = 0.23318 D_{100} = 0.23199
C_v **at 299.7 min.** = 0.00 ft.^{2}/day

SWELL/CONSOLIDATION TEST DATA

Client: Willdan Engineering
Project: Elk Grove Aquatics Facility
Project Number: 2101.050

Sample Data

Source: B15
Sample No.: 3c with water
Elev. or Depth: 10.1-10.2' **Sample Length(in./cm.):**
Location:
Description: Lean CLAY, yellowish brown/olive, slightly cemented
Liquid Limit: **Plasticity Index:**
USCS: CL **AASHTO:** **Figure No.:**
Testing Remarks: ASTM D4546, Method B

Test Specimen Data

TOTAL SAMPLE	BEFORE TEST	AFTER TEST
Wet w+t = 188.94 g.	**Consolidometer #** = 2	**Wet w+t** = 226.53 g.
Dry w+t = 182.32 g.		**Dry w+t** = 212.17 g.
Tare Wt. = 145.06 g.	**Spec. Gravity** = 2.65	**Tare Wt.** = 145.96 g.
Height = .75 in.	**Height** = .75 in.	
Diameter = 2.00 in.	**Diameter** = 2.00 in.	
Weight = 78.67 g.	**Defl. Table** = Consol #1, 2.0", Wt.Set#A (psf/inches)	
Moisture = 17.8 %	**Ht. Solids** = 0.4897 in.	**Moisture** = 21.7 %
Wet Den. = 127.5 pcf	**Dry Wt.** = 66.80 g.*	**Dry Wt.** = 66.21 g.
Dry Den. = 108.3 pcf	**Void Ratio** = 0.528	**Void Ratio** = 0.533
Ovrbrdn. = 250 psf	**Saturation** = 89.2 %	

*** Initial dry weight used in calculations**

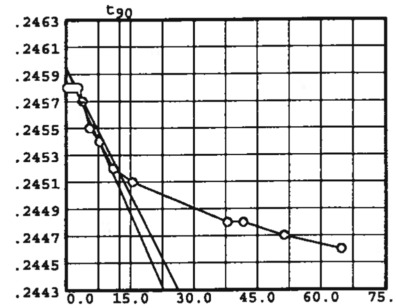
End-of-Load Summary

Pressure (psf)	Final Dial (in.)	Machine Defl. (in.)	C_v (ft.^{2}/day)	C_α	Void Ratio	% Compression /Swell
start	0.24730				0.528	
250	0.24610	0.00150	0.01		0.533	0.4 Swell

C_c = 0.00

Pressure: 250 psf	TEST READINGS	Load No. 1

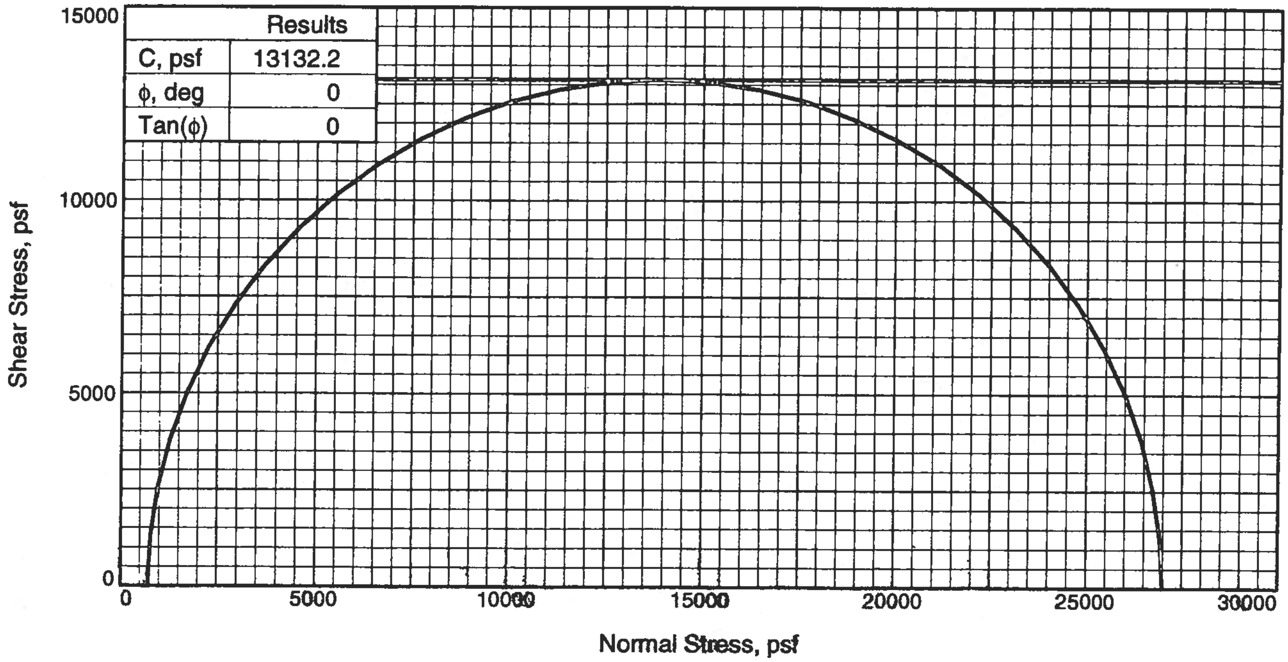
No.	Clock Time	Dial Reading	No.	Clock Time	Dial Reading
1	11:30:00	0.24730	11	12:30:00	0.24690
2	11:30:06	0.24730	12	13:30:00	0.24670
3	11:30:15	0.24730	13	15:30:00	0.24660
4	11:30:30	0.24730	14	+01 11:30:00	0.24630
5	11:31:00	0.24730	15	+01 16:30:00	0.24630
6	11:32:00	0.24730	16	+02 07:30:00	0.24620
7	11:34:00	0.24730	17	+03 09:30:00	0.24610
8	11:38:00	0.24730			
9	11:45:00	0.24720			
10	12:00:00	0.24700			



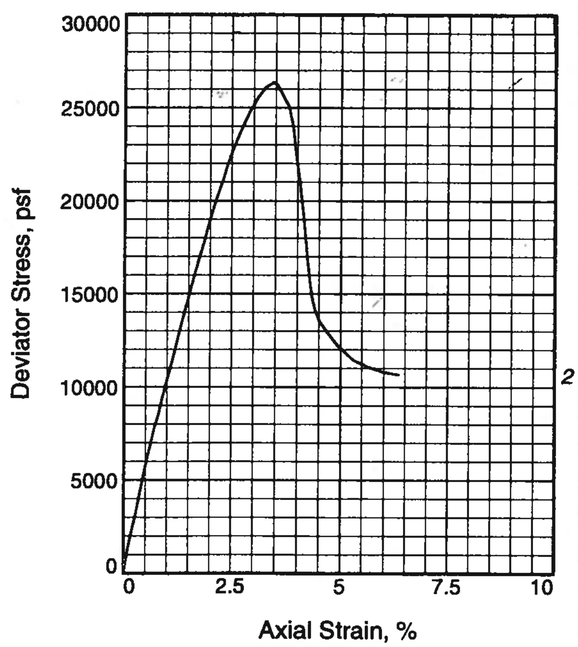
Void Ratio = 0.533 **Swell** = 0.4 %

D_0 = 0.24595 D_{90} = 0.24517 D_{100} = 0.24508

C_v **at 154.6 min.** = 0.01 ft.^{2}/day



Results	
C, psf	13132.2
φ, deg	0
Tan(φ)	0



	Sample No.	2
Initial	Water Content, %	15.3
	Dry Density, pcf	113.0
	Saturation, %	84.3
	Void Ratio	0.4913
	Diameter, in.	2.380
	Height, in.	5.831
At Test	Water Content, %	15.2
	Dry Density, pcf	113.0
	Saturation, %	83.4
	Void Ratio	0.4913
	Diameter, in.	2.380
	Height, in.	5.831
	Strain rate, in./min.	0.058
	Back Pressure, psf	0.0
	Cell Pressure, psf	720.0
	Fail. Stress, psf	26264.5
	Strain, %	3.5
	Ult. Stress, psf	
	Strain, %	
	σ_1 Failure, psf	26984.5
	σ_3 Failure, psf	720.0

Type of Test:
Unconsolidated Undrained

Sample Type: UNIDSTURBED 2.4" CAL MOD

Description: lean CLAY, yellowish brown

Assumed Specific Gravity= 2.70

Remarks: PER ASTM D2850

Figure ________

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B1 **Depth:** 5.5-6.0'

Sample Number: 2c

Proj. No.: 2101.050 **Date Sampled:** 11/21/2014

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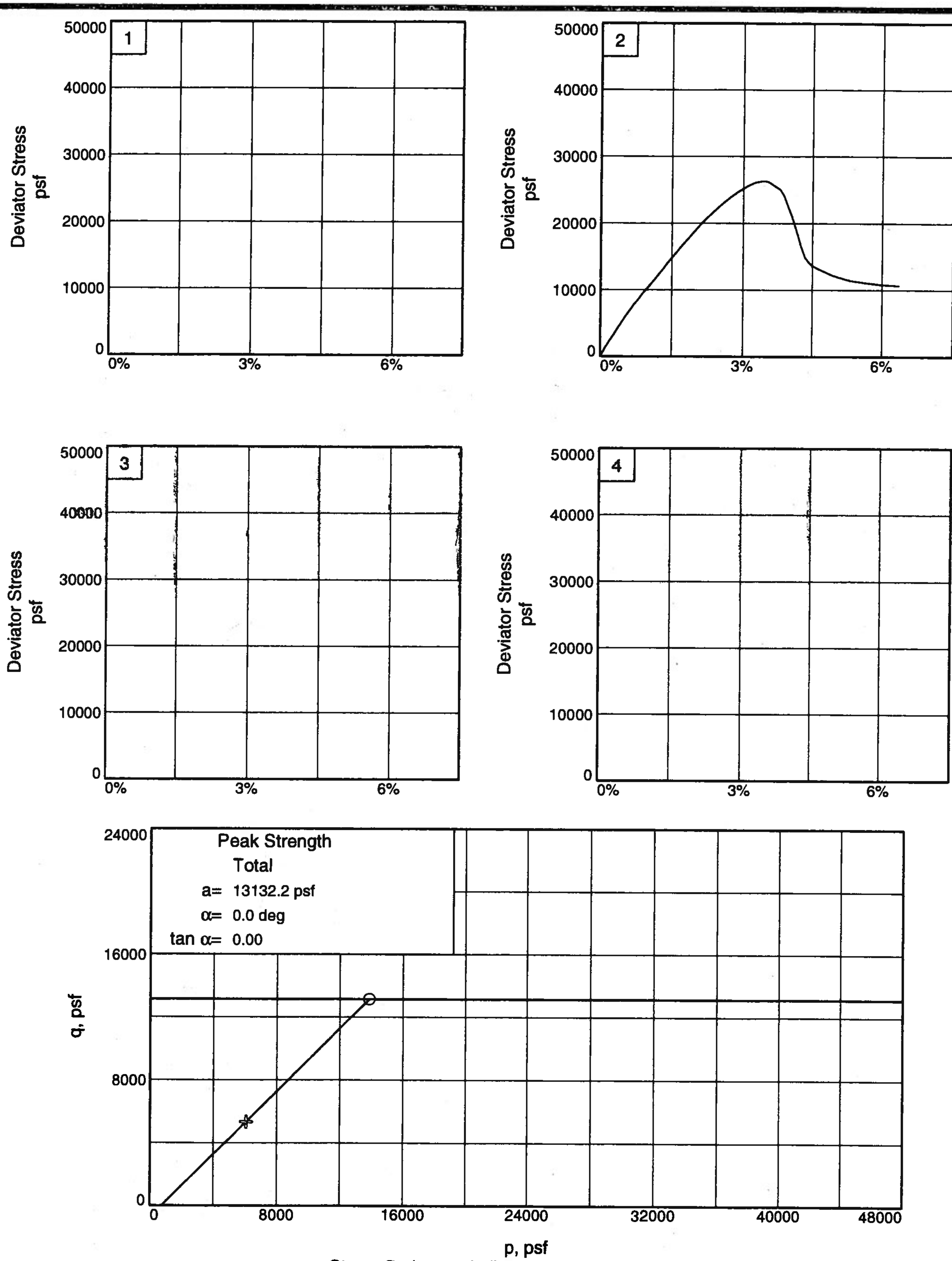

Stress Paths: o indicates peak + indicates end

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B1 **Depth:** 5.5-6.0' **Sample Number:** 2c

Project No.: 2101.050 **Figure** ________

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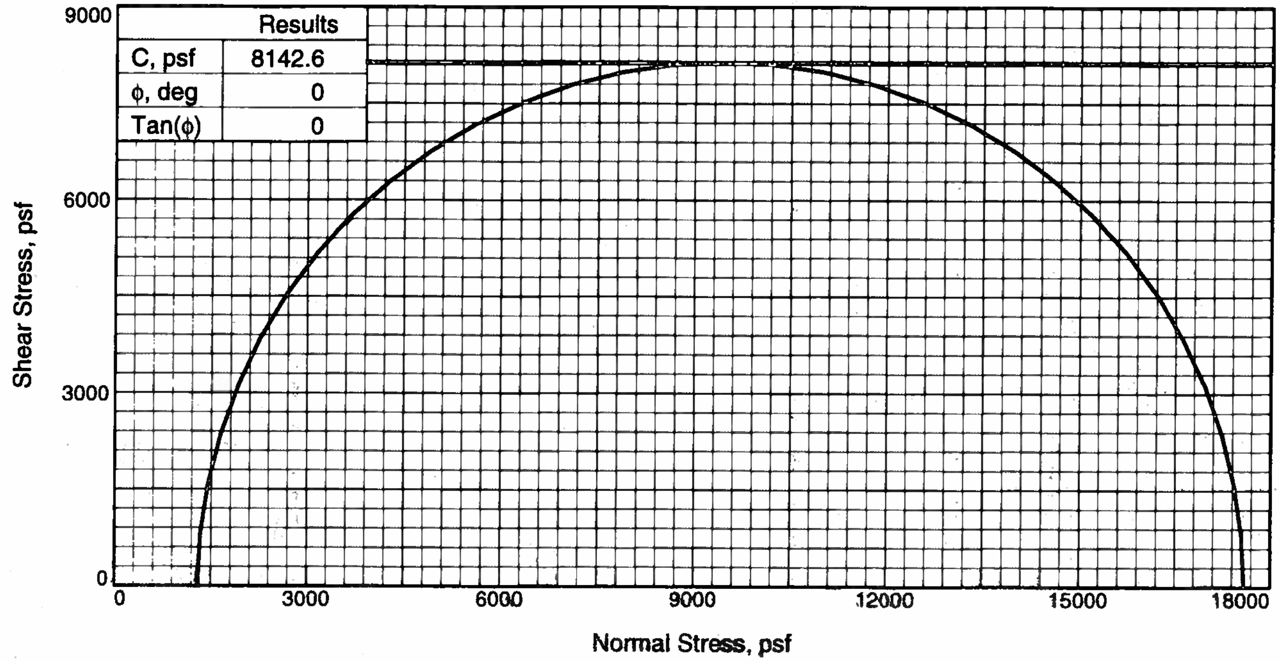

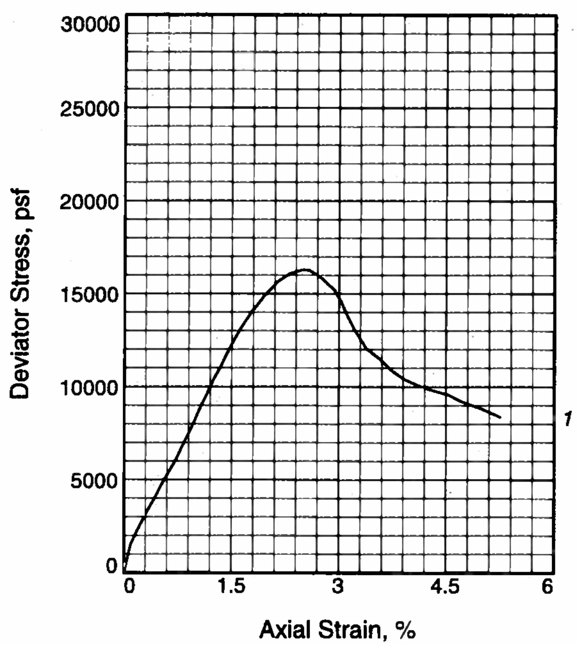

	Sample No.	1
Initial	Water Content, %	17.8
	Dry Density, pcf	109.4
	Saturation, %	88.7
	Void Ratio	0.5405
	Diameter, in.	2.395
	Height, in.	5.781
At Test	Water Content, %	17.8
	Dry Density, pcf	109.4
	Saturation, %	88.7
	Void Ratio	0.5405
	Diameter, in.	2.395
	Height, in.	5.781
	Strain rate, in./min.	0.058
	Back Pressure, psf	0.0
	Cell Pressure, psf	1296.0
	Fail. Stress, psf	16285.2
	Strain, %	2.5
	Ult. Stress, psf	
	Strain, %	
	σ_1 Failure, psf	17581.2
	σ_3 Failure, psf	1296.0

Type of Test:
Unconsolidated Undrained

Sample Type: UNDISTURBED CAL MOD 2.4"

Description: SILT, light yellowish brown

Assumed Specific Gravity= 2.70

Remarks: PER ASTM D2850

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B1 **Depth:** 10.9-11.4'

Sample Number: 3c

Proj. No.: 2101.050 **Date Sampled:** 11/21/2014

TRIAXIAL SHEAR TEST REPORT
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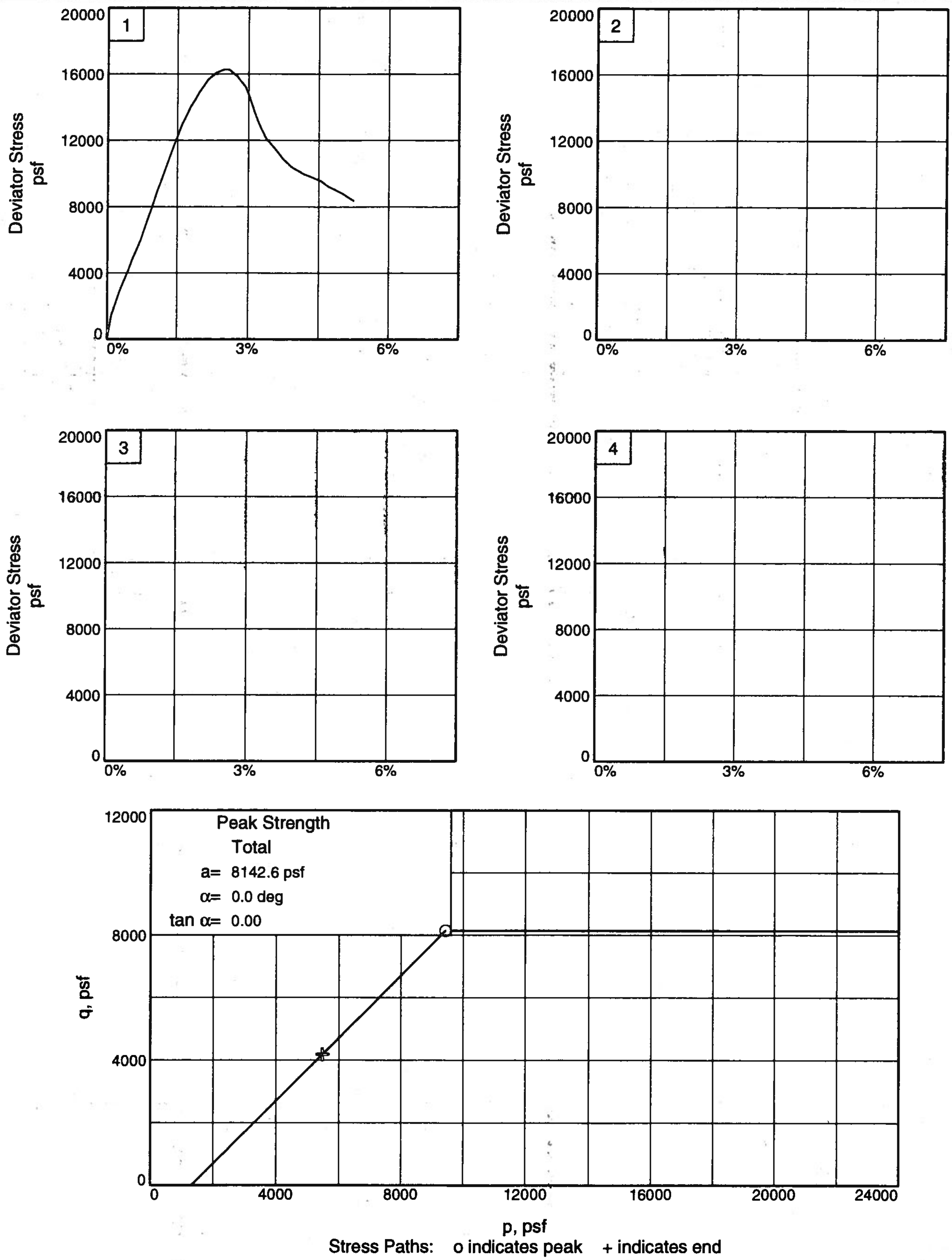
Figure ________



Client: Willdan Engineering
Project: Elk Grove Aquatics Facility
Source of Sample: B1 **Depth:** 10.9-11.4' **Sample Number:** 3c
Project No.: 2101.050 **Figure** ________

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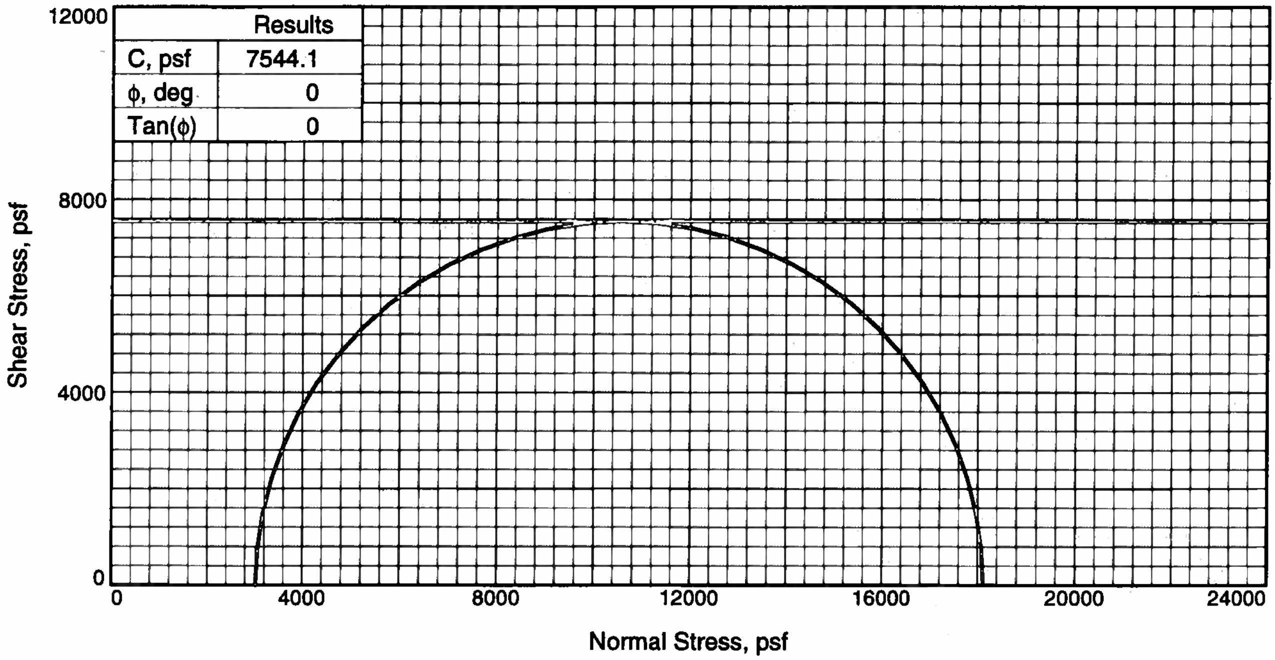

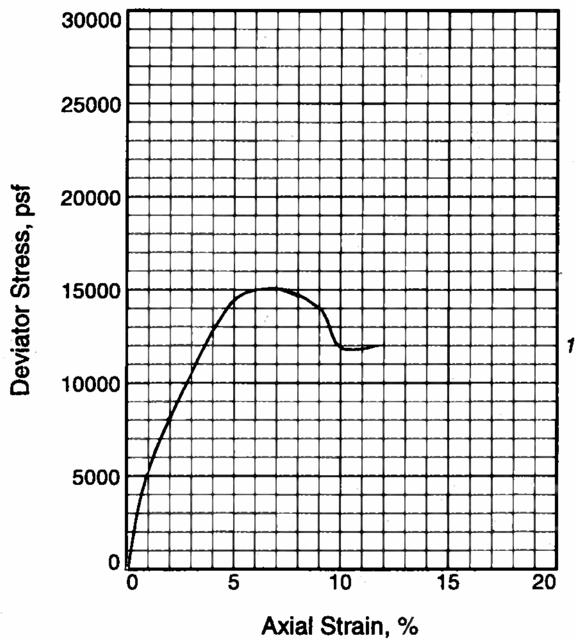

Sample No.		1
Initial	Water Content, %	16.4
	Dry Density, pcf	107.7
	Saturation, %	78.5
	Void Ratio	0.5646
	Diameter, in.	2.381
	Height, in.	5.636
At Test	Water Content, %	16.3
	Dry Density, pcf	107.7
	Saturation, %	78.2
	Void Ratio	0.5646
	Diameter, in.	2.381
	Height, in.	5.636
Strain rate, in./min.		0.056
Back Pressure, psf		0.0
Cell Pressure, psf		3024.0
Fail. Stress, psf		15088.3
Strain, %		6.8
Ult. Stress, psf		
Strain, %		
σ_1 Failure, psf		18112.3
σ_3 Failure, psf		3024.0

Type of Test:
Unconsolidated Undrained

Sample Type: UNDISTURBED CAL MOD 2.4"

Description: SILT with SAND, yellowish brown

Assumed Specific Gravity= 2.70

Remarks: PER ASTM D2850

Figure ________

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B1 **Depth:** 26.0-26.5'

Sample Number: 6c

Proj. No.: 2101.050 **Date Sampled:** 11/21/2014

TRIAXIAL SHEAR TEST REPORT
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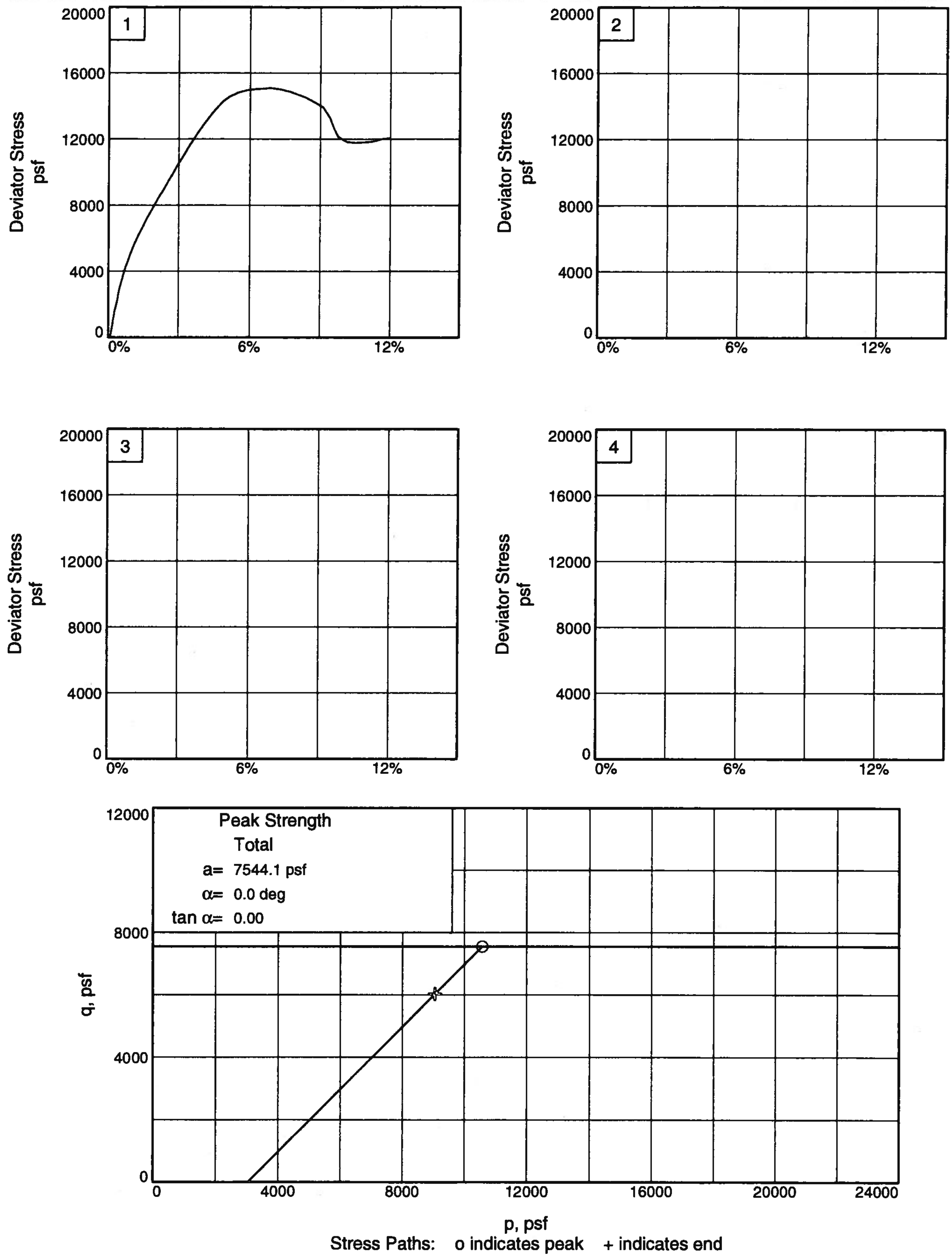
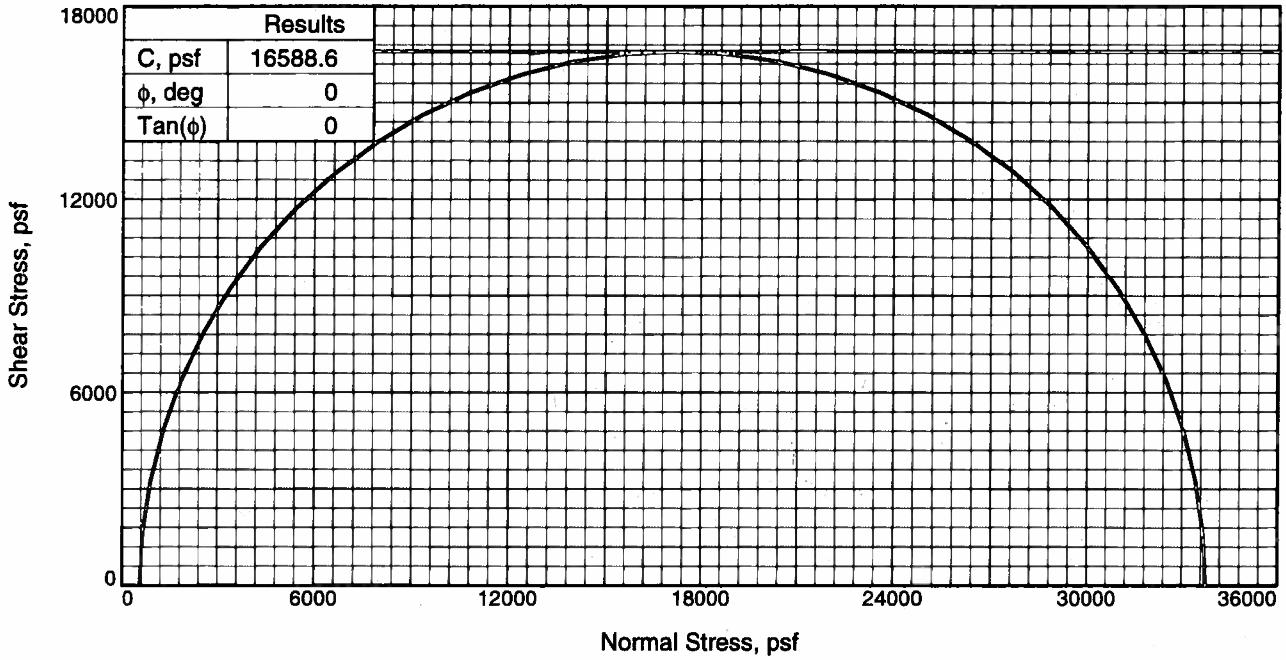
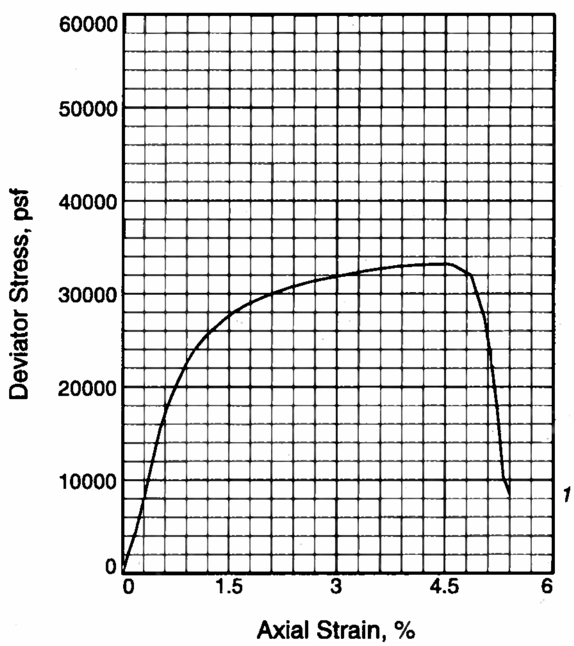


Client: Willdan Engineering
Project: Elk Grove Aquatics Facility
Source of Sample: B1 **Depth:** 26.0-26.5' **Sample Number:** 6c
Project No.: 2101.050 **Figure** ________ Blackburn Consulting





Sample No.		1
Initial	Water Content, %	16.0
	Dry Density, pcf	116.1
	Saturation, %	95.6
	Void Ratio	0.4514
	Diameter, in.	2.390
	Height, in.	5.819
At Test	Water Content, %	16.0
	Dry Density, pcf	116.1
	Saturation, %	95.6
	Void Ratio	0.4514
	Diameter, in.	2.390
	Height, in.	5.819
Strain rate, in./min.		0.058
Back Pressure, psf		0.0
Cell Pressure, psf		576.0
Fail. Stress, psf		33177.3
Strain, %		4.5
Ult. Stress, psf		
Strain, %		
σ_1 Failure, psf		33753.3
σ_3 Failure, psf		576.0

Type of Test:
Unconsolidated Undrained

Sample Type: UNDISTURBED 2.4" CAL MOD

Description: lean CLAY, brown

Assumed Specific Gravity= 2.70

Remarks: PER ASTM D2850

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B17 **Depth:** 3.0-3.5'

Sample Number: 1c

Proj. No.: 2101.050 **Date Sampled:** 11/21/2014

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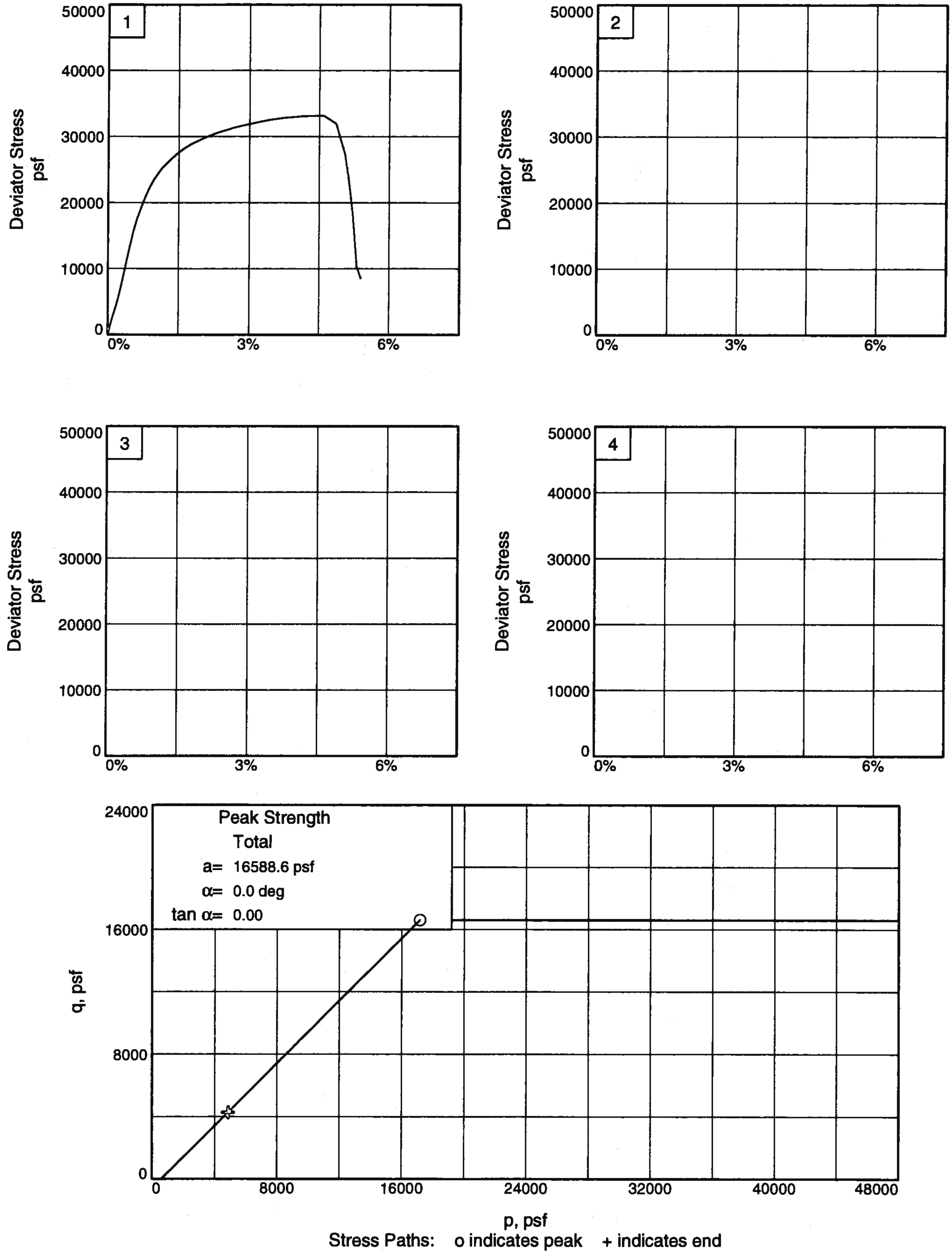
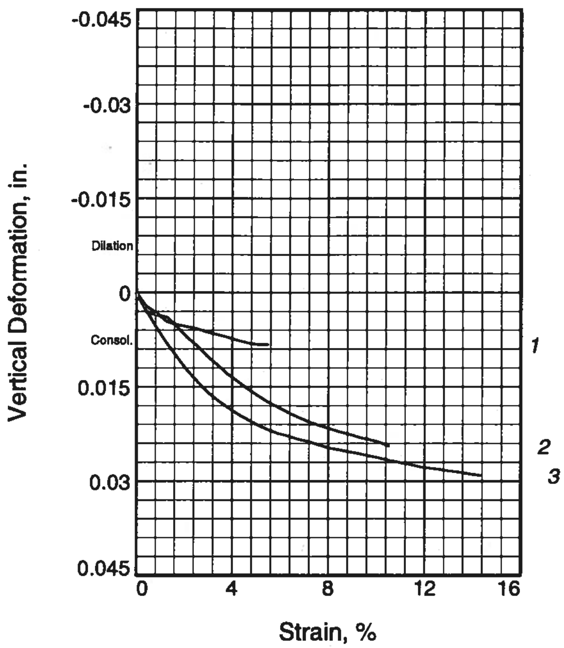
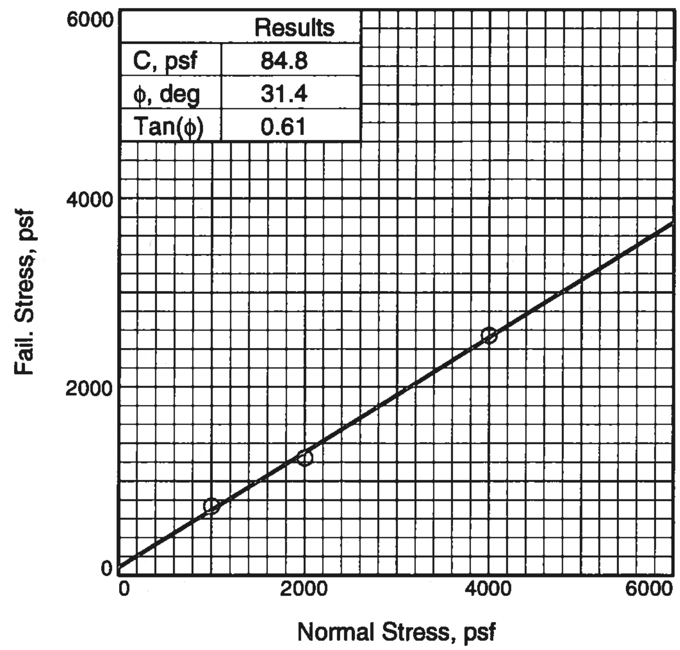
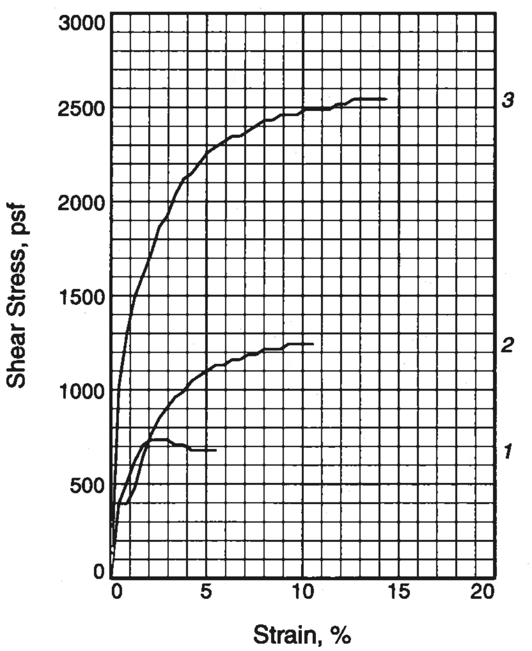
Figure ________



Client: Willdan Engineering
Project: Elk Grove Aquatics Facility
Source of Sample: B17 **Depth:** 3.0-3.5' **Sample Number:** 1c
Project No.: 2101.050 **Figure** ________ Blackburn Consulting







Sample No.		1	2	3
Initial	Water Content, %	8.2	8.7	8.7
	Dry Density, pcf	108.9	109.0	109.6
	Saturation, %	40.3	43.1	43.6
	Void Ratio	0.5473	0.5458	0.5376
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.945	0.945	0.945
At Test	Water Content, %	19.3	18.9	18.6
	Dry Density, pcf	110.8	111.6	112.1
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.5216	0.5100	0.5032
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.929	0.923	0.924
Normal Stress, psf		1000.0	2000.0	4000.0
Fail. Stress, psf		735.3	1244.3	2545.1
Strain, %		2.1	9.3	12.6
Ult. Stress, psf				
Strain, %				
Strain rate, in./min.		0.100	0.100	0.100

Sample Type: UNDISTURBED 2.4" CAL MOD
Description: lean CLAY with SAND, reddish brown

Assumed Specific Gravity= 2.7
Remarks:

Figure ________

Client: Willdan Engineering

Project: Elk Grove Aquatics Facility

Source of Sample: B2 **Depth:** 2.0-2.5'
Sample Number: 1c
Proj. No.: 2101.050 **Date Sampled:** 11/21/2014

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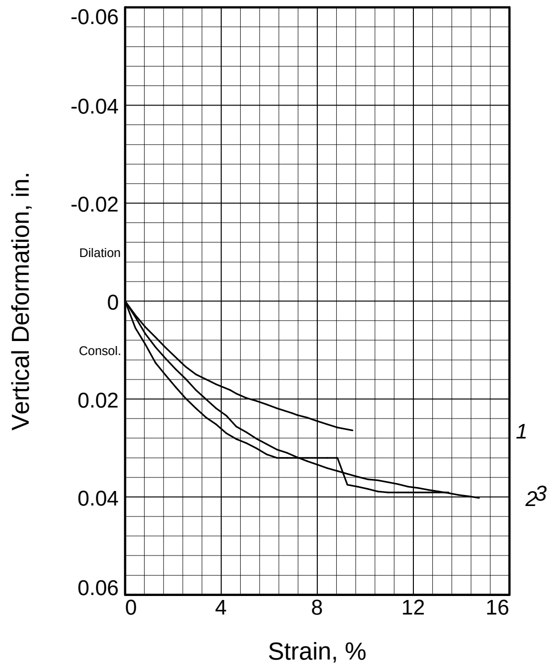
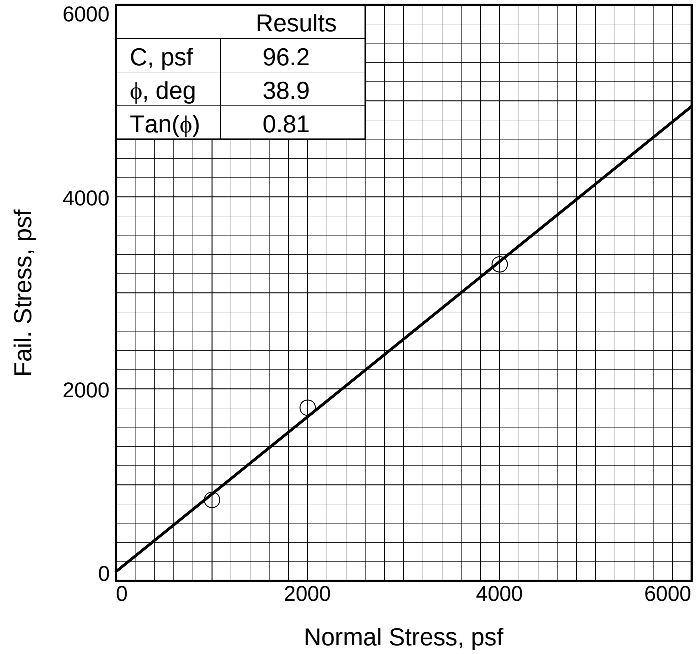
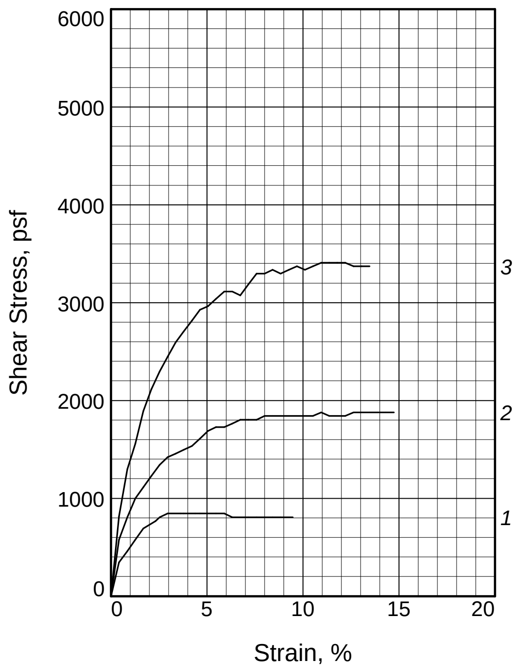
Tested By: BRL







	Sample No.	1	2	3
Initial	Water Content, %	2.9	3.6	4.7
	Dry Density, pcf	101.5	103.0	98.8
	Saturation, %	11.7	15.3	18.1
	Void Ratio	0.6608	0.6371	0.7066
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.945	0.945	0.945
At Test	Water Content, %	22.1	20.2	16.4
	Dry Density, pcf	102.8	108.5	116.7
	Saturation, %	93.2	98.6	100.0
	Void Ratio	0.6400	0.5538	0.4442
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.933	0.897	0.800
	Normal Stress, psf	1000.0	2000.0	4000.0
	Fail. Stress, psf	843.8	1802.7	3297.9
	Strain, %	2.9	6.7	7.6
	Ult. Stress, psf			
	Strain, %			
	Strain rate, in./min.	0.002	0.002	0.002

Sample Type: Undisturbed CalMod
Description: Lean CLAY, reddish brown

Assumed Specific Gravity= 2.7
Remarks:

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B5-16 **Depth:** 1.5-2.0'
Sample Number: 1c
Proj. No.: 2951.X001 **Date Sampled:** 8/17/2016

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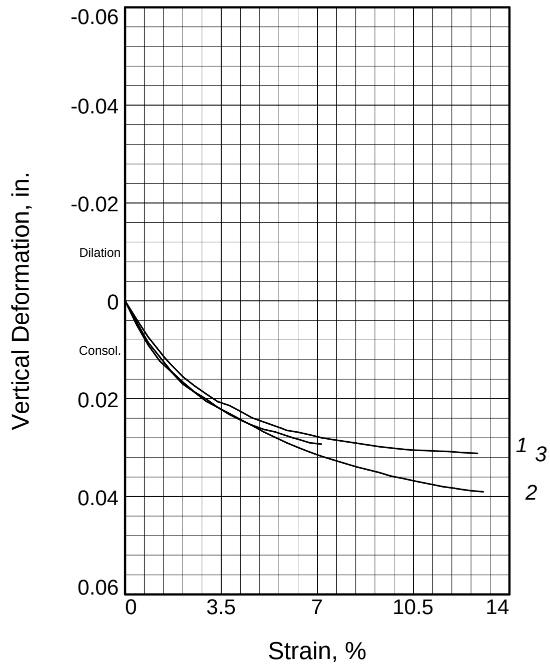

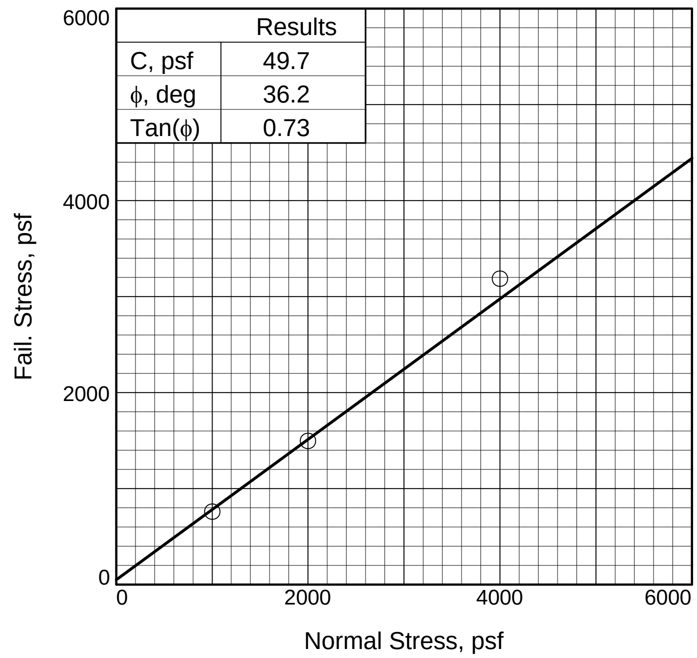

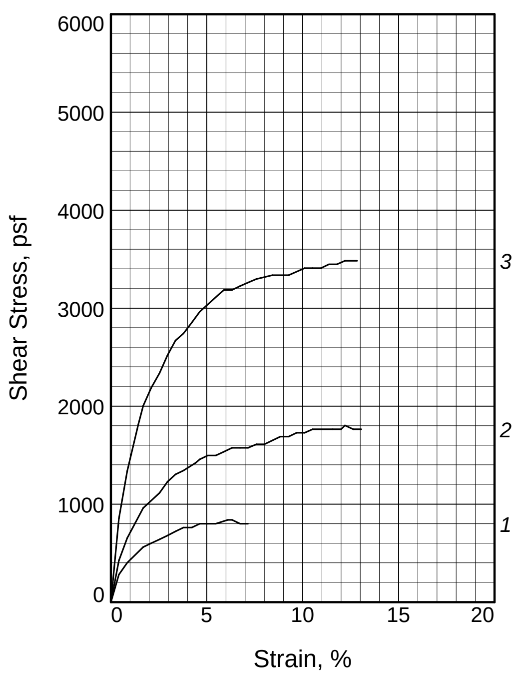

	Sample No.	1	2	3
Initial	Water Content, %	5.7	5.5	6.2
	Dry Density, pcf	101.8	107.1	107.4
	Saturation, %	23.3	25.7	29.1
	Void Ratio	0.6550	0.5735	0.5699
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.945	0.945	0.945
At Test	Water Content, %	18.4	16.0	14.3
	Dry Density, pcf	105.8	113.5	115.6
	Saturation, %	83.8	89.3	84.4
	Void Ratio	0.5935	0.4847	0.4582
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.910	0.892	0.878
	Normal Stress, psf	1000.0	2000.0	4000.0
	Fail. Stress, psf	759.6	1495.9	3186.8
	Strain, %	3.8	5.1	5.9
	Ult. Stress, psf			
	Strain, %			
	Strain rate, in./min.	0.002	0.002	0.002

Sample Type: Undisturbed CalMod
Description: Lean CLAY, dark reddish brown

Assumed Specific Gravity= 2.7
Remarks:

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B9-16 **Depth:** 1.5-2.0'
Sample Number: 1c
Proj. No.: 2951.X001 **Date Sampled:** 8/17/2016

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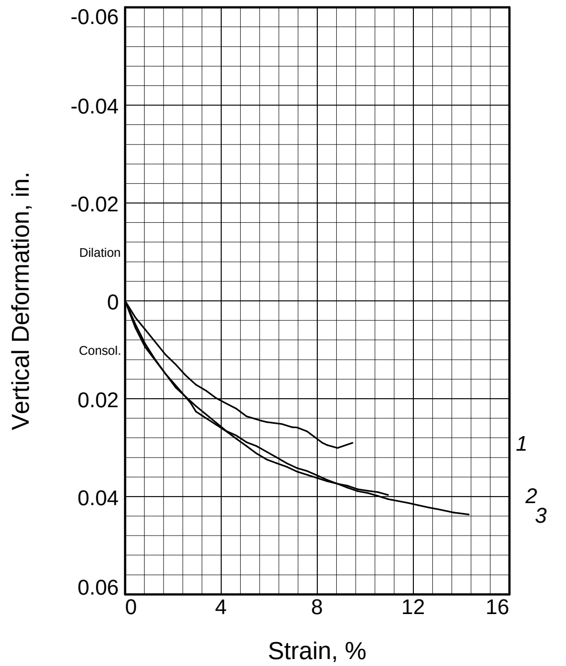

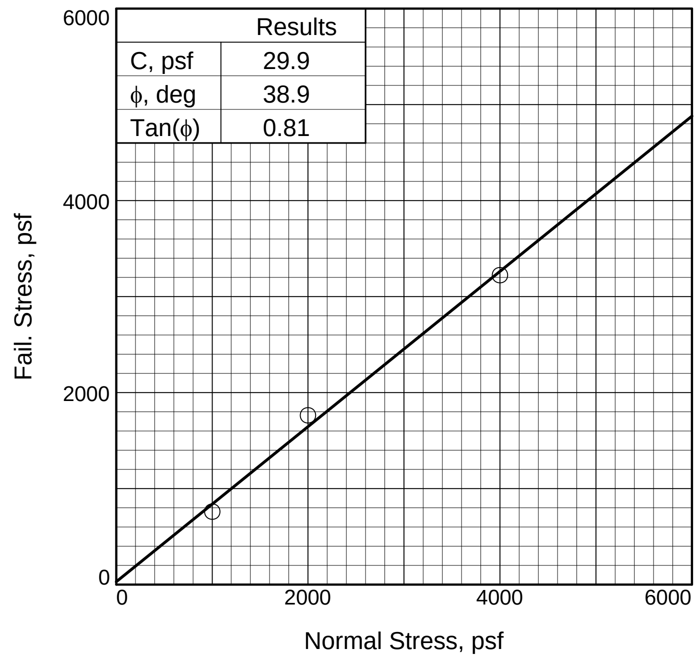

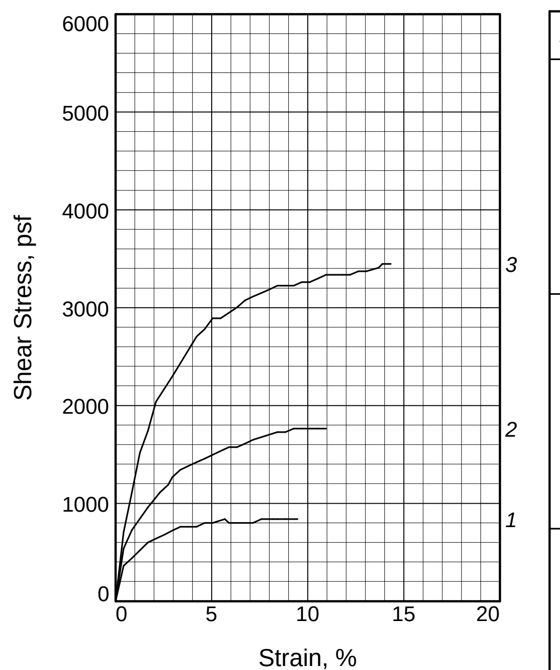

	Sample No.	1	2	3
Initial	Water Content, %	2.0	3.6	5.1
	Dry Density, pcf	103.8	102.5	101.2
	Saturation, %	8.8	15.1	20.6
	Void Ratio	0.6238	0.6437	0.6658
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.945	0.945	0.945
At Test	Water Content, %	18.8	17.3	15.9
	Dry Density, pcf	105.4	109.5	111.2
	Saturation, %	84.5	86.6	83.0
	Void Ratio	0.5998	0.5399	0.5161
	Diameter, in.	2.375	2.375	2.375
	Height, in.	0.931	0.885	0.860
	Normal Stress, psf	1000.0	2000.0	4000.0
	Fail. Stress, psf	759.6	1764.4	3223.8
	Strain, %	3.4	9.3	8.4
	Ult. Stress, psf			
	Strain, %			
	Strain rate, in./min.	0.002	0.002	0.002

Sample Type: Undisturbed CalMod

Description: Lean CLAY with SAND, reddish brown

Assumed Specific Gravity= 2.7

Remarks:

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B10-16 **Depth:** 1.5-2.0'

Sample Number: 1c

Proj. No.: 2951.X001 **Date Sampled:** 8/17/2016

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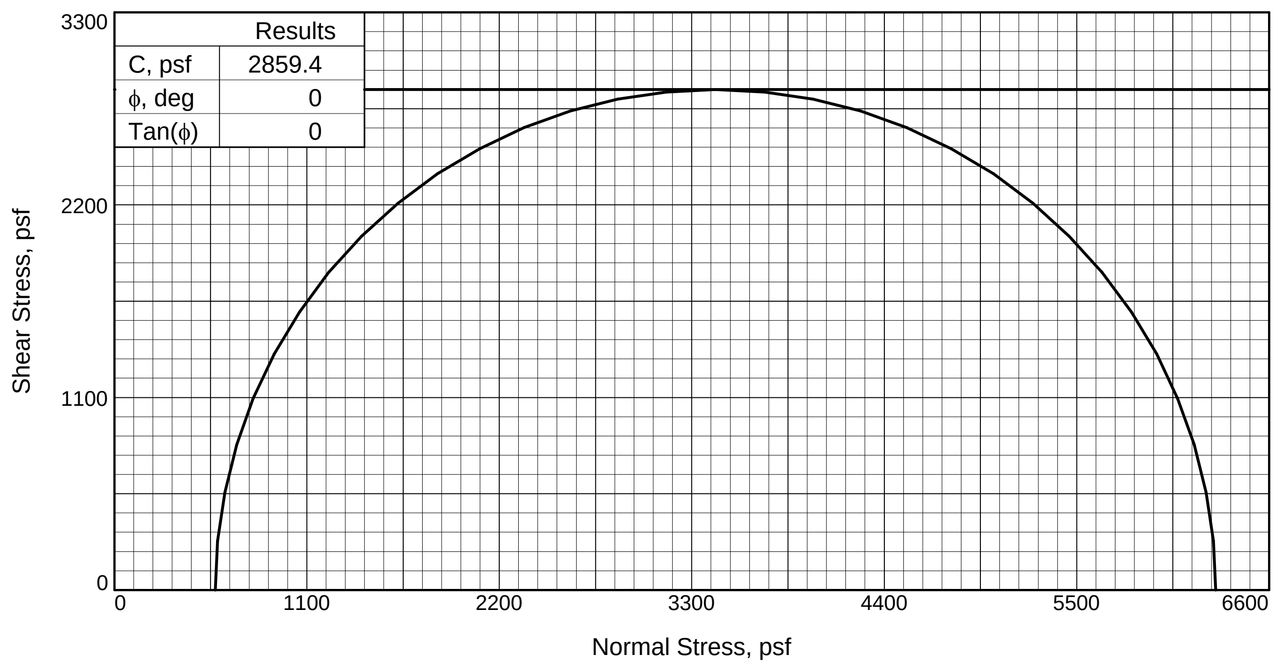

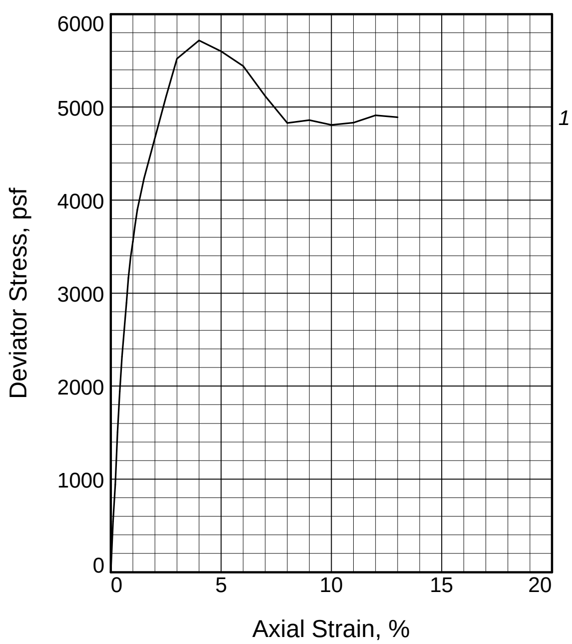

Sample No.		1
Initial	Water Content, %	14.7
	Dry Density, pcf	104.9
	Saturation, %	65.5
	Void Ratio	0.6074
	Diameter, in.	2.401
	Height, in.	4.881
At Test	Water Content, %	12.9
	Dry Density, pcf	104.9
	Saturation, %	57.4
	Void Ratio	0.6074
	Diameter, in.	2.401
	Height, in.	4.881
Strain rate, in./min.		0.025
Back Pressure, psf		0.0
Cell Pressure, psf		576.0
Fail. Stress, psf		5718.7
Strain, %		4.0
Ult. Stress, psf		
Strain, %		
$\pm_1$ Failure, psf		6294.7
$\pm_3$ Failure, psf		576.0

Type of Test:
Unconsolidated Undrained

Sample Type:

Description: SANDY SILT (ML), strong brown, dry, fine SAND, weak cementation

Assumed Specific Gravity= 2.7

Remarks: Strain Rate = .025 inch/minute

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B4-16 **Depth:** 6.0-6.5

Sample Number: 3c

Proj. No.: 2951.X001 **Date Sampled:**

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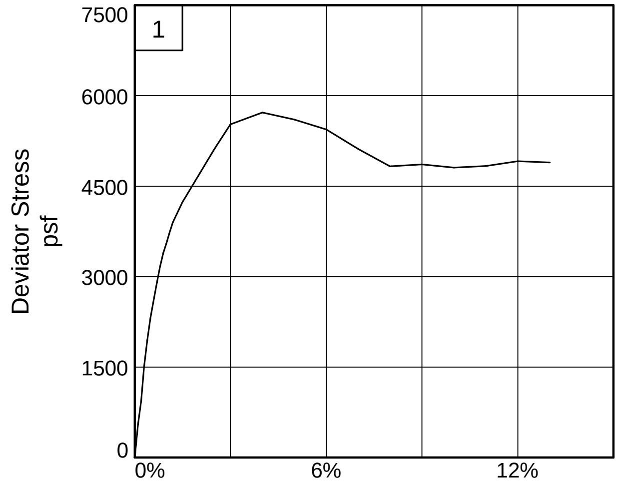

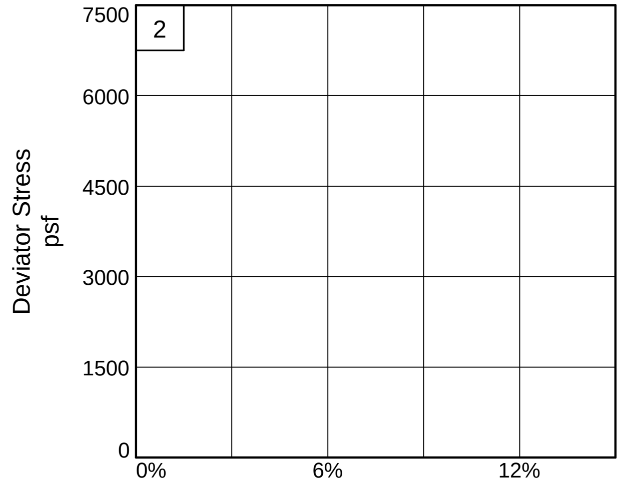

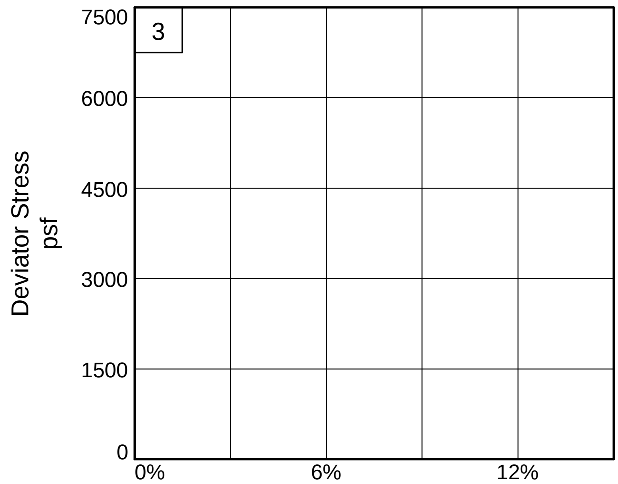

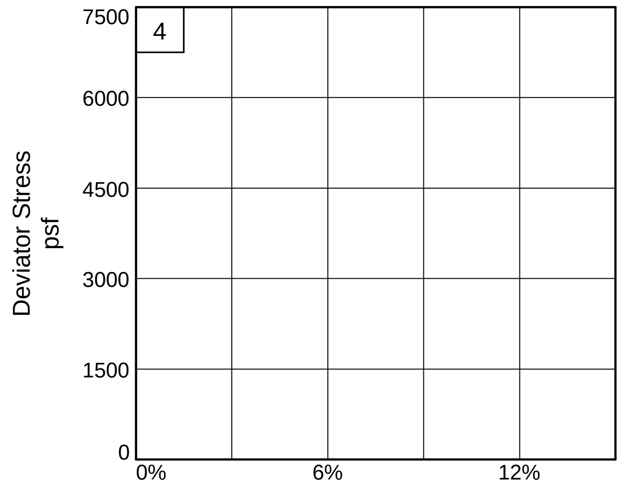

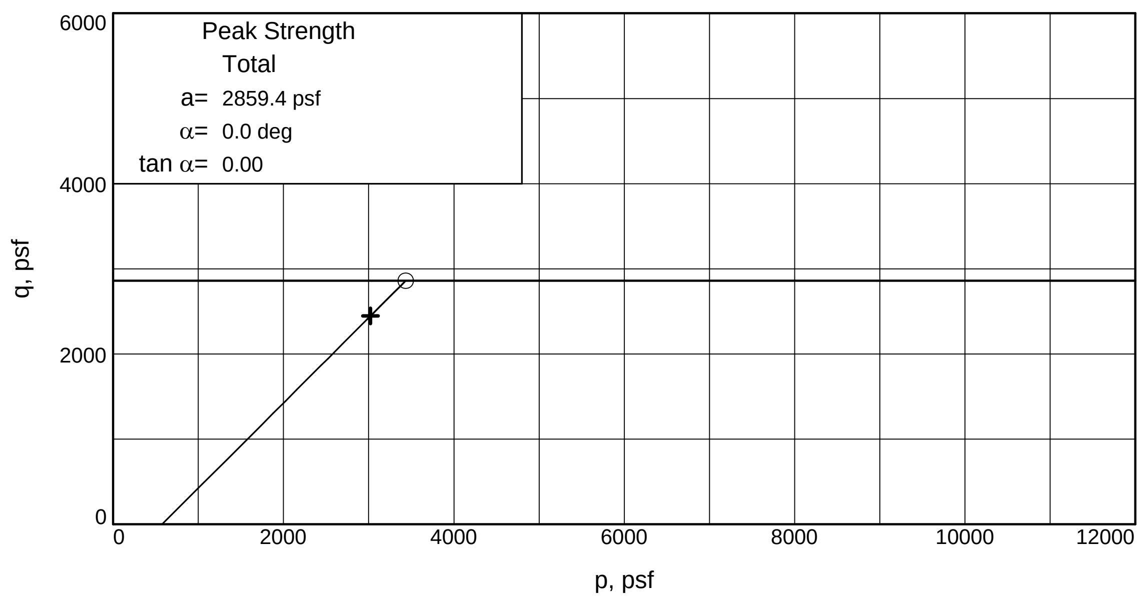

Stress Paths: o indicates peak + indicates end

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B4-16 **Depth:** 6.0-6.5 **Sample Number:** 3c

Project No.: 2951.X001 **Figure** ________

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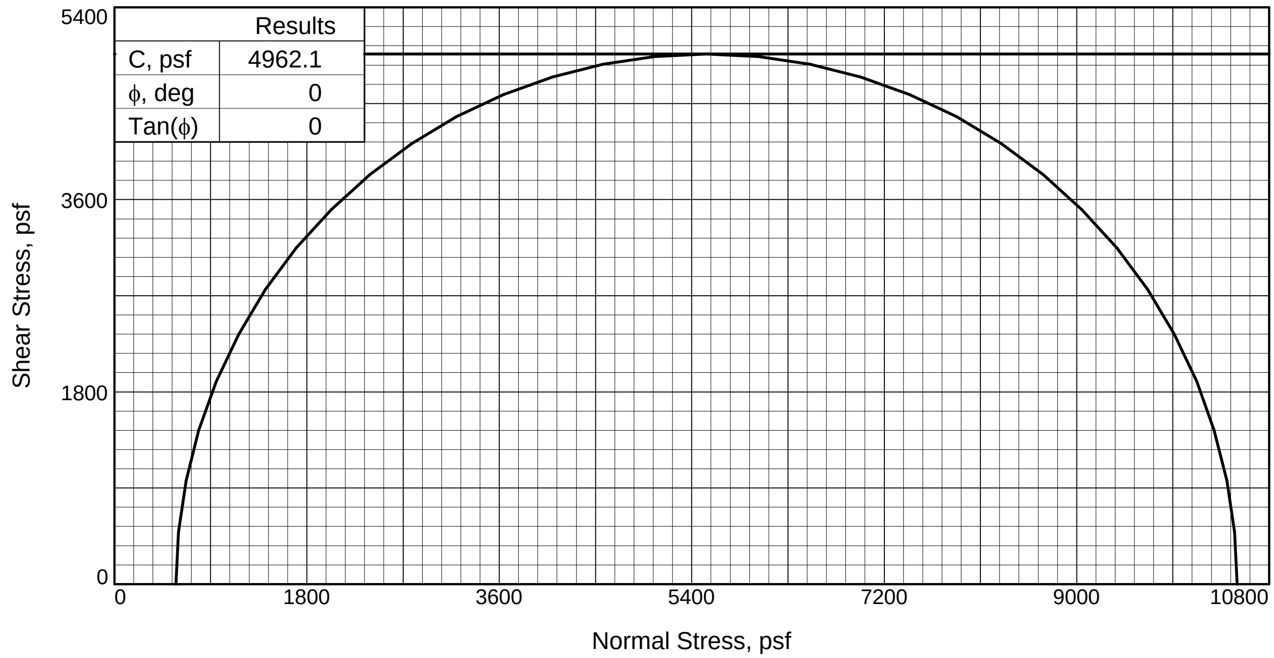
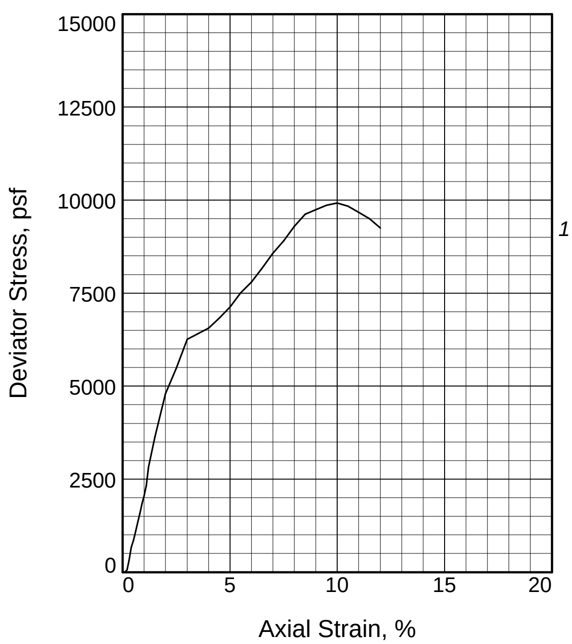


Results	
C, psf	4962.1
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1
Initial	Water Content, %	13.8
	Dry Density, pcf	110.7
	Saturation, %	71.1
	Void Ratio	0.5226
	Diameter, in.	2.402
	Height, in.	4.520
At Test	Water Content, %	13.3
	Dry Density, pcf	110.7
	Saturation, %	68.9
	Void Ratio	0.5226
	Diameter, in.	2.402
	Height, in.	4.520
Strain rate, in./min.		0.050
Back Pressure, psf		0.0
Cell Pressure, psf		576.0
Fail. Stress, psf		9924.3
Strain, %		10.0
Ult. Stress, psf		
Strain, %		
$\pm_1$ Failure, psf		10500.3
$\pm_3$ Failure, psf		576.0

Type of Test:
Unconsolidated Undrained

Sample Type:

Description: Lean CLAY (CL), dark yellowish brown, moist, high to weak cementation

Assumed Specific Gravity= 2.7

Remarks: Sample had stratification between highly cemented clay, dry, and weakly cemented clay, moist.

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B8-16 **Depth:** 5.5'-5.92'

Sample Number: 3c

Proj. No.: 2951.X001 **Date Sampled:**

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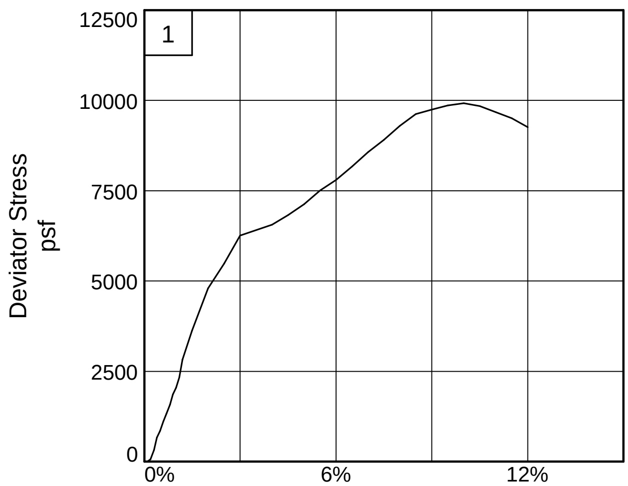

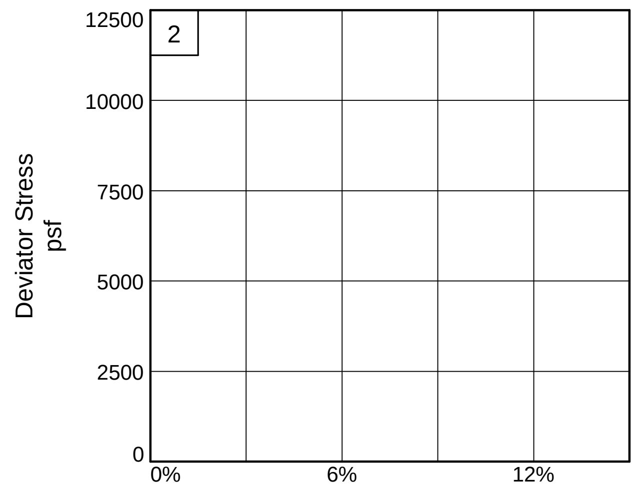

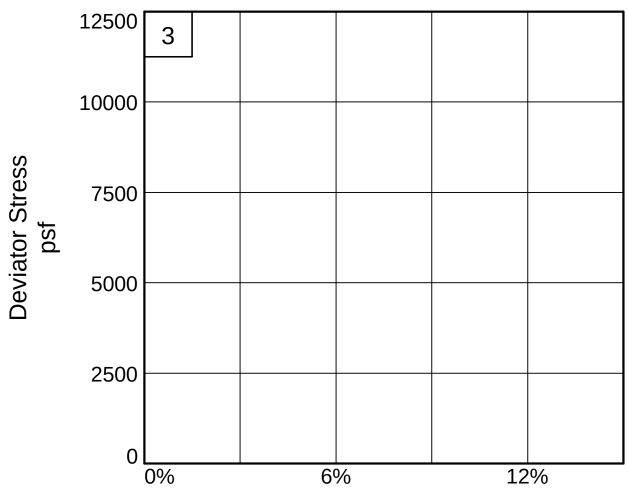

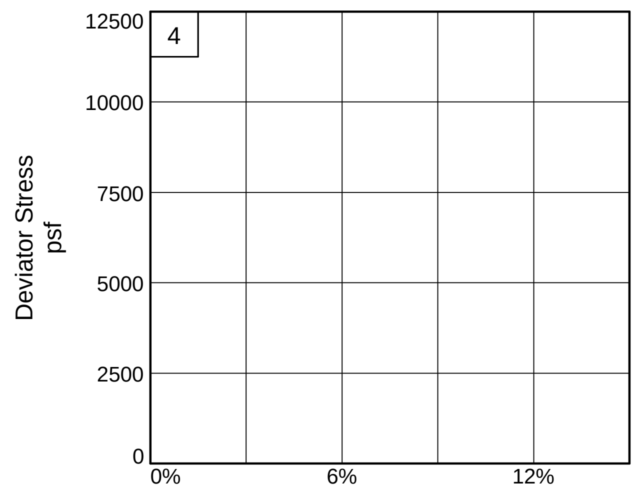

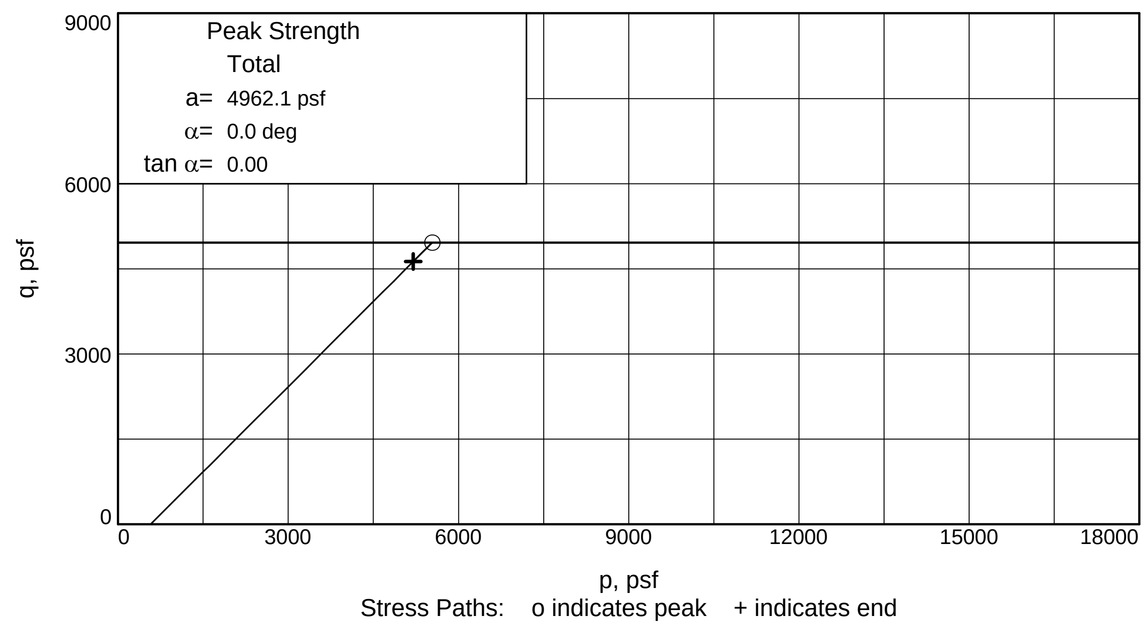

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B8-16 **Depth:** 5.5'-5.92' **Sample Number:** 3c

Project No.: 2951.X001 **Figure** ________

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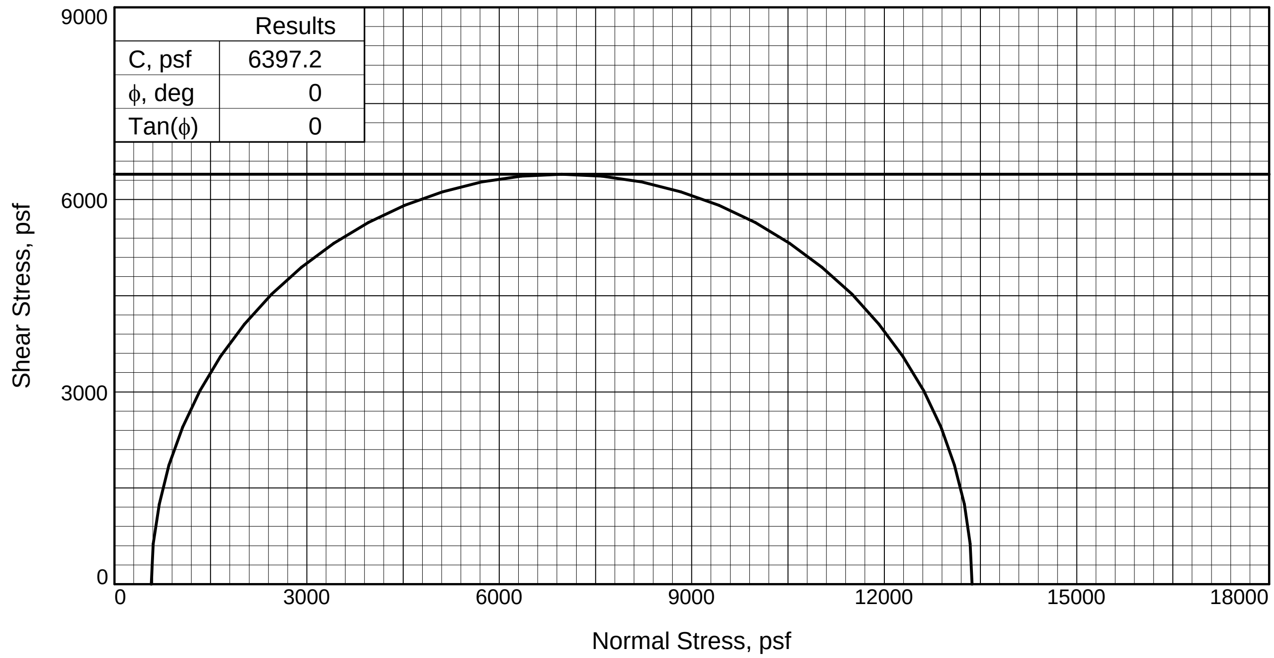

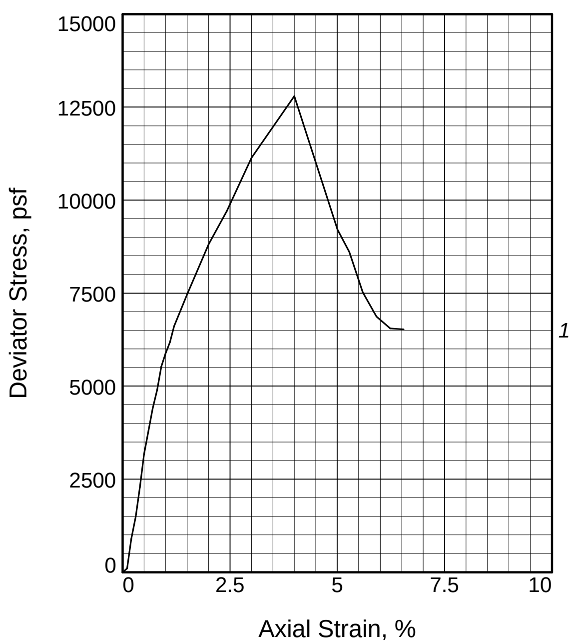

Sample No.		1
Initial	Water Content, %	13.9
	Dry Density, pcf	106.6
	Saturation, %	64.5
	Void Ratio	0.5809
	Diameter, in.	2.398
	Height, in.	4.735
At Test	Water Content, %	13.6
	Dry Density, pcf	106.6
	Saturation, %	63.3
	Void Ratio	0.5809
	Diameter, in.	2.398
	Height, in.	4.735
Strain rate, in./min.		0.050
Back Pressure, psf		0.0
Cell Pressure, psf		576.0
Fail. Stress, psf		12794.5
Strain, %		4.0
Ult. Stress, psf		
Strain, %		
$\pm_1$ Failure, psf		13370.5
$\pm_3$ Failure, psf		576.0

Type of Test:
Unconsolidated Undrained

Sample Type:

Description: Lean CLAY (CL), dark yellowish brown, moist, moderate cementation

Assumed Specific Gravity= 2.70

Remarks:

Figure ________

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B10-16 **Depth:** 6.0'-6.5'

Sample Number: 3c

Proj. No.: 2951.X001 **Date Sampled:**

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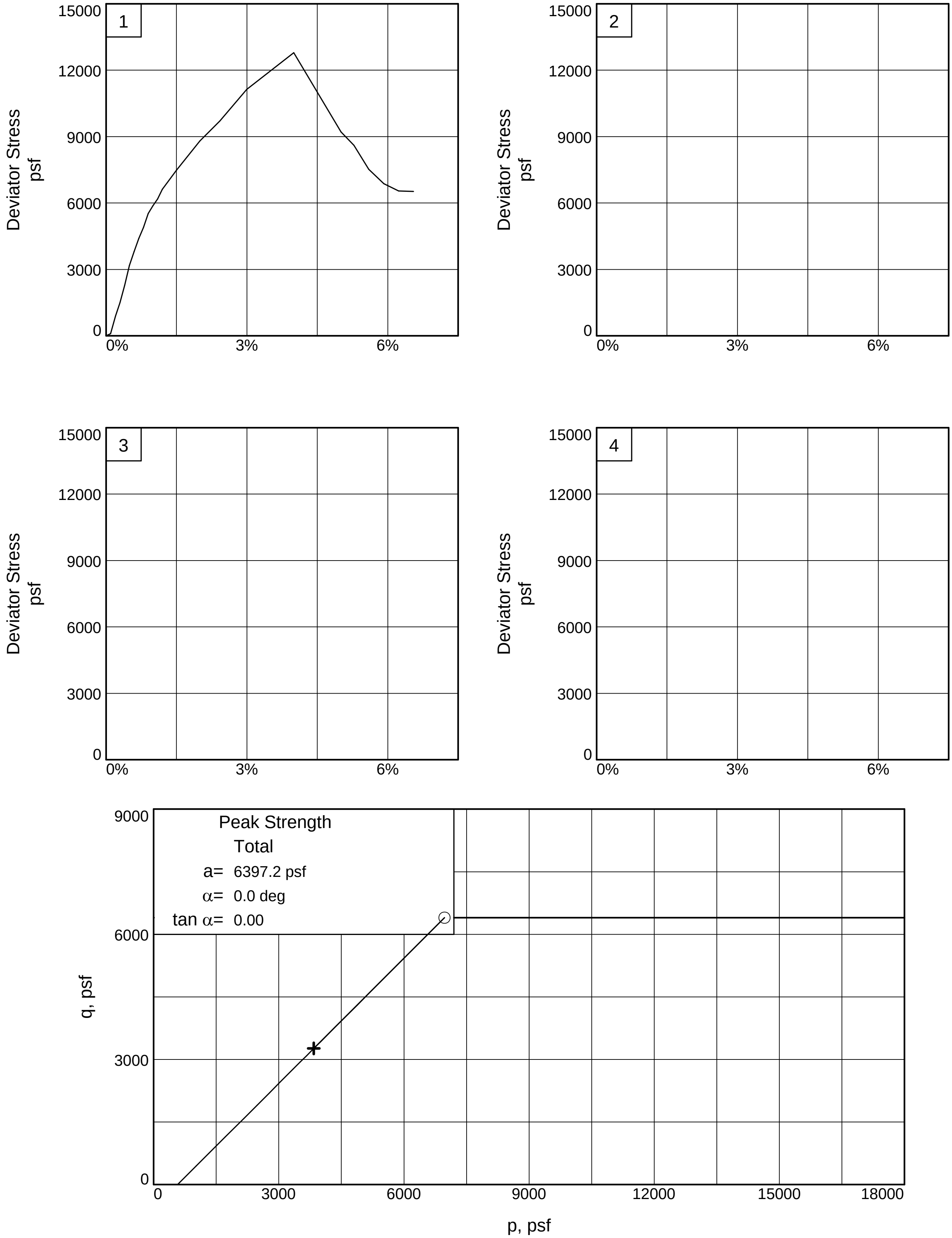

Stress Paths: o indicates peak + indicates end

Client: Willdan Engineering

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B10-16 **Depth:** 6.0'-6.5' **Sample Number:** 3c

Project No.: 2951.X001 **Figure** ________

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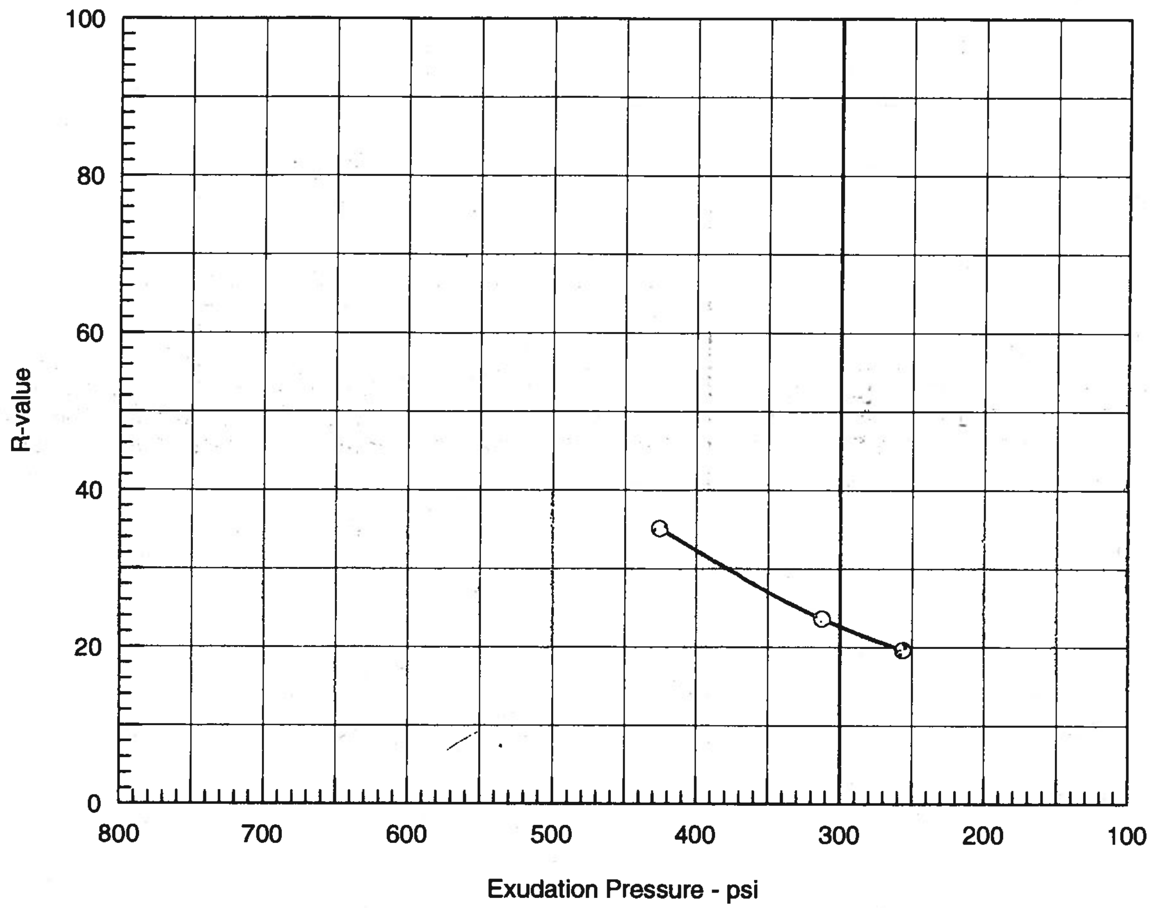
R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	167	115.6	16.8	275	91	2.39	426	38	35
2	115	111.8	18.0	0	110	2.47	313	24	24
3	83	108.8	19.1	0	114	2.53	256	20	20

Test Results	Material Description
R-value at 300 psi exudation pressure = 23	Lean CLAY, reddish brown

Project No.: 2101.050
Project: Elk Grove Aquatics Facility
Source of Sample: B6 **Depth:** .5-1.5'
Sample Number: Bag R
Date: 12/17/2014

Tested by: MDR
Checked by: RBL
Remarks:

R-VALUE TEST REPORT

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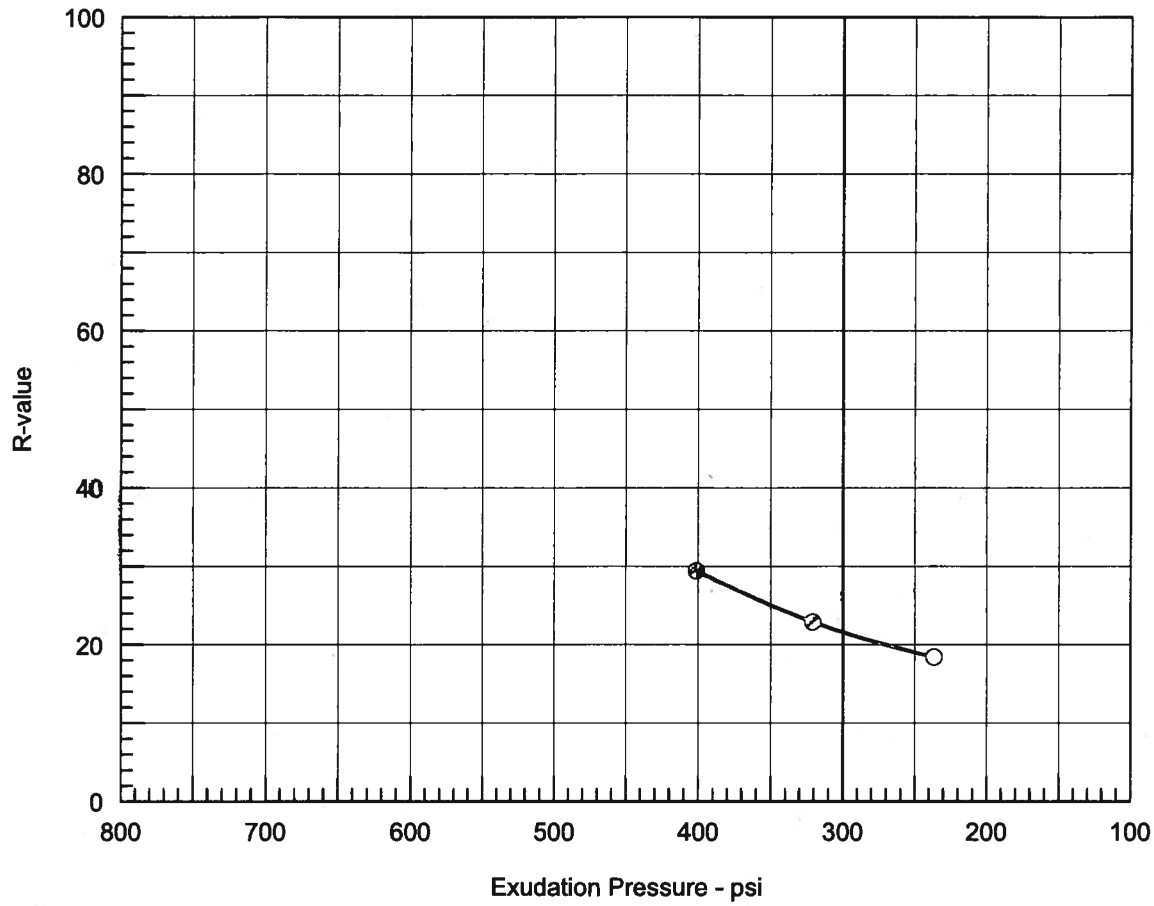
Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	146	109.5	17.7	83	100	2.56	401	28	29
2	115	108.4	18.9	57	107	2.54	321	23	23
3	83	105.7	20.0	13	113	2.53	236	18	18

Test Results	Material Description
R-value at 300 psi exudation pressure = 22	Lean CLAY, reddish brown

Project No.: 2101.050

Project: Elk Grove Aquatics Facility

Source of Sample: B9 **Depth:** 0-2.0'

Sample Number: Bag E

Date: 12/12/2014

Tested by: MDR

Checked by: RBL

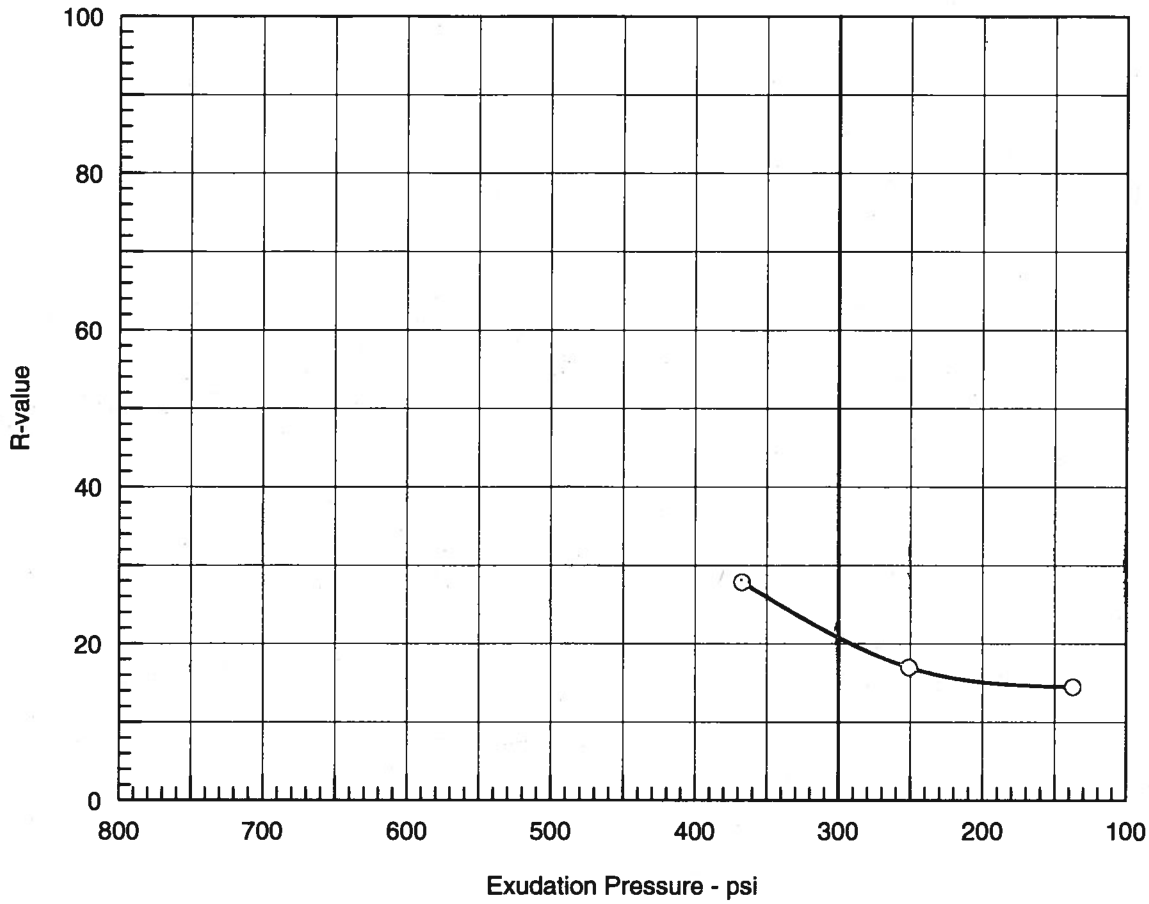
Remarks:

R-VALUE TEST REPORT

Blackburn Consulting

Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	135	121.3	8.3	131	93	2.51	367	28	28
2	83	120.6	9.3	79	110	2.52	251	17	17
3	63	116.0	10.4	74	112	2.50	137	14	14

Test Results	Material Description
R-value at 300 psi exudation pressure = 21	Lean CLAY, dark brown

Project No.: 2101.050
Project: Elk Grove Aquatics Facility
Source of Sample: B10 **Depth:** 0-2.0'
Sample Number: Bag G
Date: 12/17/2014

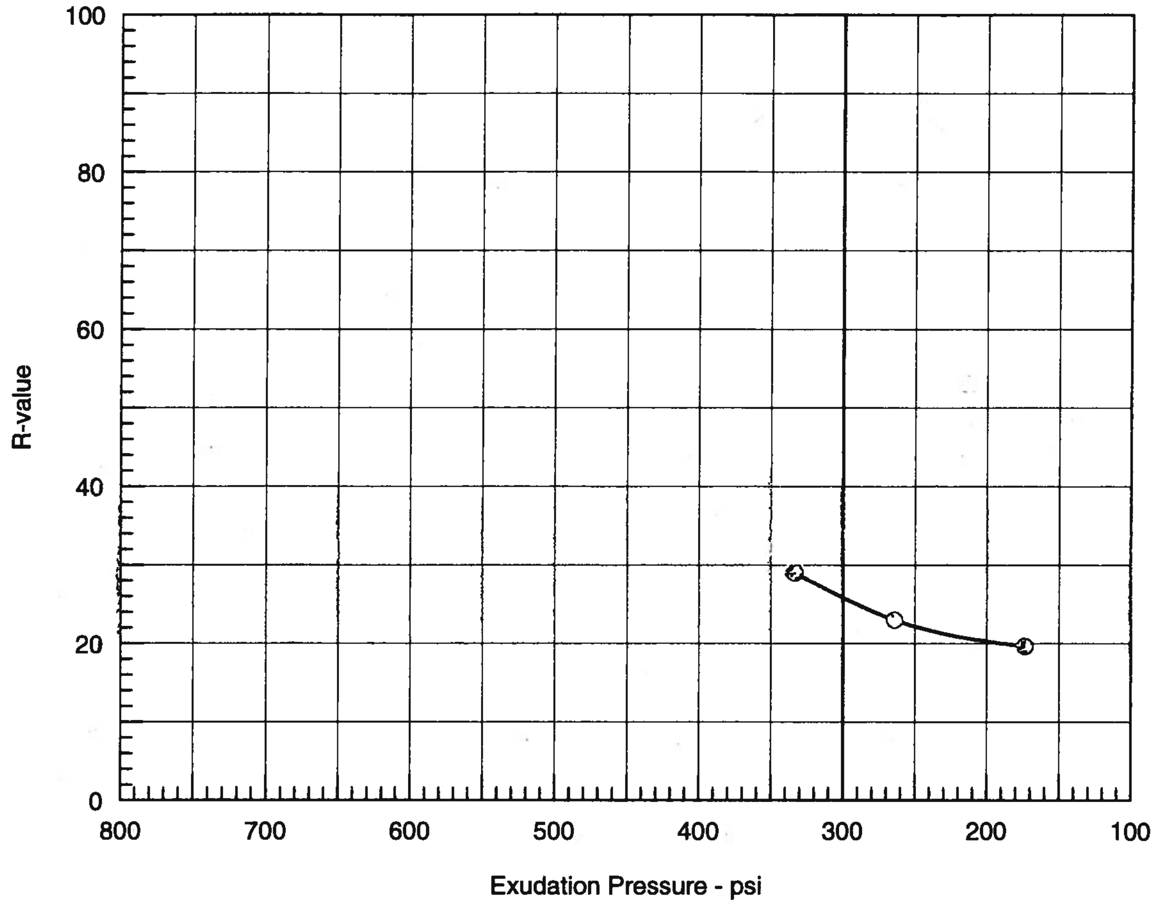
Tested by: MDR
Checked by: RBL
Remarks:

R-VALUE TEST REPORT

Blackburn Consulting

Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	146	117.0	14.1	22	95	2.46	333	29	29
2	83	114.5	15.2	17	100	2.50	264	23	23
3	63	111.8	16.3	0	106	2.55	174	20	20

Test Results	Material Description
R-value at 300 psi exudation pressure = 26	Lean CLAY, dark brown

Project No.: 2101.050
Project: Elk Grove Aquatics Facility
Source of Sample: B12 **Depth:** 2.0-4.0'
Sample Number: Bag L
Date: 12/16/2014

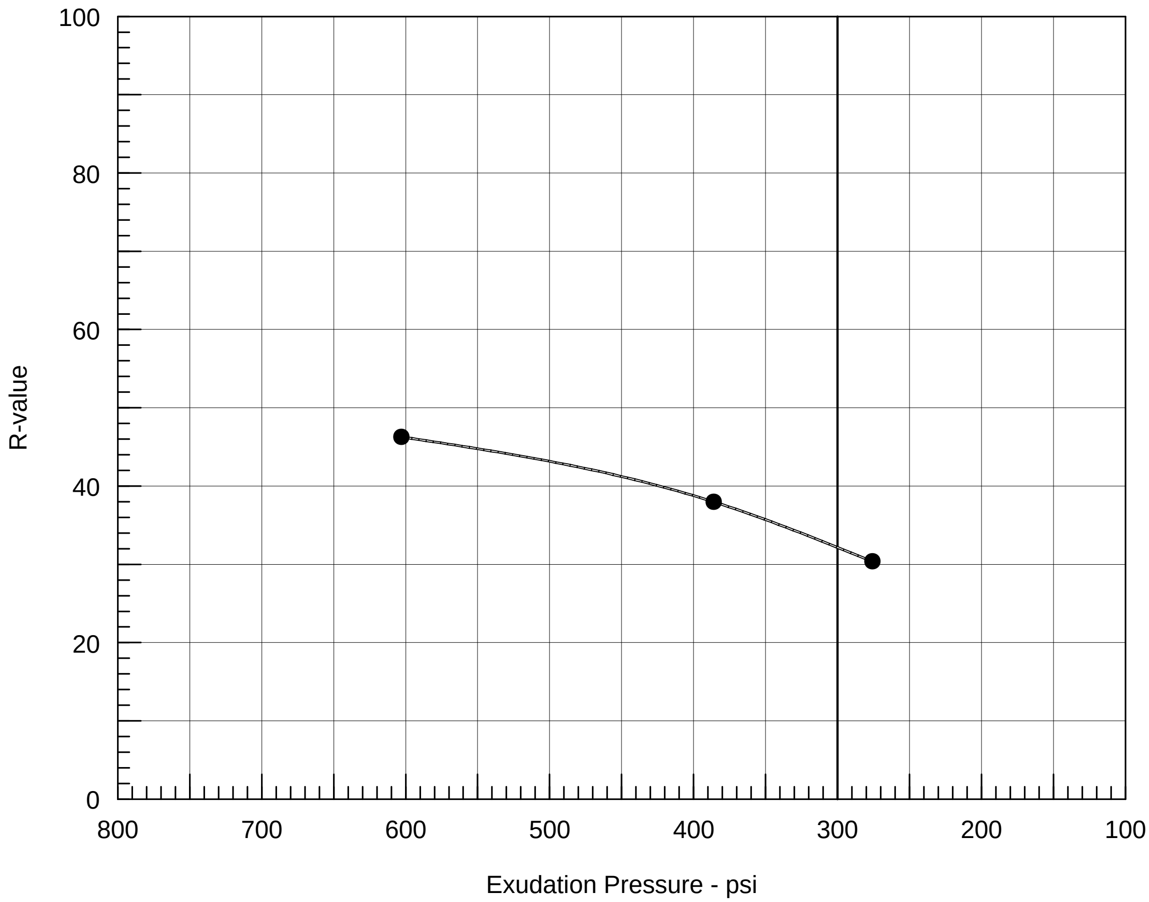
Tested by: MDR
Checked by: RBL
Remarks:

R-VALUE TEST REPORT

Blackburn Consulting

Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	250	113.1	17.1	244	70	2.45	603	46	46
2	198	110.9	18.0	148	85	2.48	386	38	38
3	99	108.8	19.1	87	96	2.54	276	30	30

Test Results	Material Description
R-value at 300 psi exudation pressure = 32	CLAYEY SAND, dark yellowish brown

Project No.: 2951.X001

Project: Elk Grove Civic Center - Phase 1

Source of Sample: B1-16 **Depth:** 1.5-3.0'

Sample Number: Bulk B

Date: 9/26/2016

Tested by: BRL

Checked by: RBL

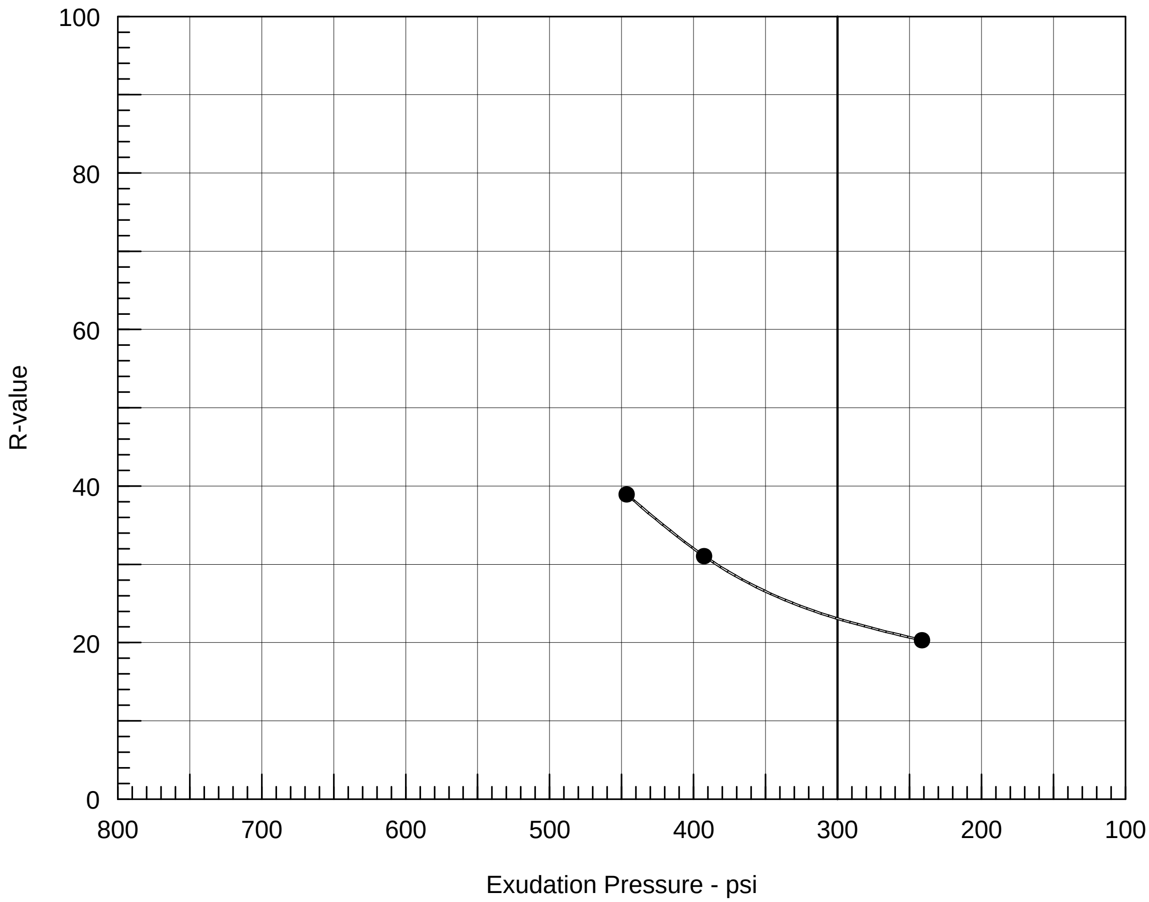
Remarks:
1.2 % retained on #4 sieve

R-VALUE TEST REPORT

Blackburn Consulting

Figure ______

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - Cal Test 301

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psf	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	173	114.1	16.8	450	83	2.43	446	41	39
2	124	111.3	18.2	258	95	2.50	393	31	31
3	99	108.2	19.3	131	113	2.54	241	20	20

Test Results	Material Description
R-value at 300 psi exudation pressure = 23	Lean CLAY, dark brown

Project No.: 2951.X001
Project: Elk Grove Civic Center - Phase 1
Source of Sample: B12-16 **Depth:** 1.5-3.0'
Sample Number: Bulk B
Date: 9/26/2016

Tested by: BRL
Checked by: RBL
Remarks:
1.4% retained on #4 sieve

R-VALUE TEST REPORT

Blackburn Consulting

Figure ______

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/05/2014
Date Submitted 12/01/2014

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2101.050 ELK GROVE Site ID : B1-5B.
Thank you for your business.

* For future reference to this analysis please use SUN # 68405-142099.

EVALUATION FOR SOIL CORROSION

Soil pH	7.38	
Minimum Resistivity	1.37 ohm-cm (x1000)	
Chloride	20.6 ppm	00.00206 %
Sulfate	6.2 ppm	00.00062 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/05/2014
Date Submitted 12/01/2014

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2101.050 ELK GROVE Site ID : B2-2B.
Thank you for your business.

* For future reference to this analysis please use SUN # 68405-142100.

EVALUATION FOR SOIL CORROSION

Soil pH	6.45		
Minimum Resistivity	2.14 ohm-cm (x1000)		
Chloride	16.4 ppm	00.00164	%
Sulfate	14.8 ppm	00.00148	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 12/05/2014
Date Submitted 12/01/2014

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2101.050 ELK GROVE Site ID : B3-1B.
Thank you for your business.

* For future reference to this analysis please use SUN # 68405-142101.

EVALUATION FOR SOIL CORROSION

Soil pH	5.61	
Minimum Resistivity	5.90 ohm-cm (x1000)	
Chloride	9.9 ppm	00.00099 %
Sulfate	1.6 ppm	00.00016 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/02/2016
Date Submitted 08/30/2016

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney RH
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2951.X Site ID : B4-B. (B4-16, Bulk B) DM
Thank you for your business.

* For future reference to this analysis please use SUN # 72719-151849.

EVALUATION FOR SOIL CORROSION

Soil pH	7.64		
Minimum Resistivity	1.55 ohm-cm (x1000)		
Chloride	8.6 ppm	00.00086	%
Sulfate	1.9 ppm	00.00019	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/02/2016
Date Submitted 08/30/2016

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2951.X Site ID : B8-B. (B8-16, Bulk B) DM
Thank you for your business.

* For future reference to this analysis please use SUN # 72719-151850.

EVALUATION FOR SOIL CORROSION

Soil pH	6.69	
Minimum Resistivity	2.95 ohm-cm (x1000)	
Chloride	10.7 ppm	00.00107 %
Sulfate	6.5 ppm	00.00065 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 09/02/2016
Date Submitted 08/30/2016

To: David Morrell
Blackburn Consulting
2491 Boatman Ave
W. Sacramento, CA 95691

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 2951.X Site ID : B11-B. (B11-16, Bulk B) DM
Thank you for your business.

*** For future reference to this analysis please use SUN # 72719-151851.**

EVALUATION FOR SOIL CORROSION

Soil pH	6.81		
Minimum Resistivity	2.73 ohm-cm (x1000)		
Chloride	8.6 ppm	00.00086	%
Sulfate	11.3 ppm	00.00113	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422