REVISED GEOTECHNICAL REPORT UPDATE

GENERAL ATOMICS EL MIRAGE EXPANSION
73 El Mirage Airport Road
Adelanto, CA 92301

Prepared for Steeno Design Studio
Submitted by Merrell Johnson Geotechnical, Inc.
July 18, 2024
Project No. 24031P1

22221 CA-18, Apple Valley, CA 92307
760 240 8000 | www.merrelljohnson.com

July 18, 2024

Steeno Design Studio
11774 Hesperia Road, Suite B1
Hesperia, CA 92345

Re: Geotechnical Report Update | General Atomics El Mirage Expansion | Phase 1.3
73 El Mirage Airport Road, Adelanto, CA 92301 | M.J.G. Project No. 24031P1

Ref: a) Supplemental Geotechnical Investigation, General Atomics Expansion Project, Phases 1.1 and 1.3, El Mirage Airport, San Bernardino County, CA, Prepared for Parkway Construction by Merrell Johnson Companies, Project No. 3514.001.500, November 6, 2018

b) Site Plan, General Atomics Phase 1.3 – Hangar 80, 73 El Mirage Airport Road, Adelanto, CA, Steeno Design Studio, Job No. C24-G10, May 2024

c) Geotechnical Report Update, General Atomics El Mirage Expansion, 73 El Mirage Airport Road, Adelanto, CA, Merrell Johnson Geotechnical, Project No. 24031P1, June 3, 2024

Ladies and Gentlemen:

The referenced Geotechnical Report Update for the subject project has herein been revised on page 4 to include recommendations for the foundation system being used for the modular offices and restroom building.

The Geotechnical Report Update was planned and performed based on the proposed project development illustrated on the Preliminary Composite Utility Plan included with this report in Appendix A, Figure 3.

We appreciate this opportunity to be of service. Should you have questions, please contact our office.

Sincerely,

Brad S. Merrell, P.E., President
Merrell Johnson Geotechnical, Inc.
R.C.E. 49423

Jeff S. Burns, Project Manager
Merrell Johnson Geotechnical, Inc.

CONTENTS

APPENDICES

PROJECT DESCRIPTION

The 153.65-acre General Atomics facility is located at the northerly terminus of El Mirage Airport Road, north of El Mirage Road, San Bernardino County, California. The location of the General Atomics facility is shown on the attached Site Vicinity Map, Google Earth Site Image, and the Site Plan prepared by the Steeno Design Group, dated May 2024.

Proposed construction during the Phase 1.3 expansion will include eight (8) 36' x 60' modular buildings (Buildings A – G) with an accompanying modular restroom, three (3) new launch pads (future canopies), and other ancillary improvements. The new construction is located northeasterly of the existing B-80 Hangar Building.

Merrell Johnson Geotechnical has provided geotechnical and testing/inspection services for numerous improvements to the General Atomics facility. To prepare the Geotechnical Report Update for the currently proposed expansion, MJG reviewed select geotechnical reports, prepared by MJG, that provide soil data obtained from the same proximity as the currently proposed work. On May 15, 2024, MJG excavated one additional exploratory pit in the vicinity of the new work to test the soil conditions and four percolation test pits needed to design the proposed restroom building's onsite wastewater treatment system. The percolation testing will be submitted by MJG in a separate report. This report will provide updated geotechnical engineering recommendations based on the current develop plans and applicable Building Code changes.

The previous geotechnical reports reviewed for this update included the following:

a) Supplemental Geotechnical Investigation, General Atomics Expansion Project, Phases 1.1 and 1.3, El Mirage Airport, San Bernardino County, CA, Prepared for Parkway Construction by Merrell Johnson Companies, Project No. 3514.001.500, November 6, 2018

b) Geotechnical Investigation, Addendum 1, Proposed General Atomics Expansion Project, El Mirage Airport, Prepared for Epic Engineering by Merrell Johnson Companies, Project No. 3439.001.500, March 17, 2017

c) Geologic Hazards Report, Proposed General Atomics Expansion Project, El Mirage Airport, Prepared for Merrell Johnson Companies by Terra Geosciences, Project No. 172936-1, February 3, 2017

Storm and nuisance water from the new development will be directed to two existing retention basins located immediately north of the planned modular buildings and northwest of the launch pads. The two basins are connected by a culvert that passes underneath the runway that separates the basins.

SCOPE OF WORK

In addition to the four percolation test pits needed for the proposed restroom building's onsite wastewater treatment system, one 10-foot-deep exploratory pit was excavated. For the referenced Geotechnical Investigation, Addendum 1, MJG obtained soil samples from 48 test borings, and an additional 10 test borings were drilled for the referenced Supplemental Geotechnical Investigation. The maximum depth explored was 51.5 feet. The test pit and borings were logged by MJG's field representatives, who also collected soil samples of the materials encountered for examination and laboratory testing. Seven of the 10 test borings drilled for the Supplemental Geotechnical Investigation were drilled near the currently proposed expansion project. A copy of the Supplemental Geotechnical Investigation is included with this report in Appendix D.

The test pit location and the locations of the 7 borings drilled near the current project for the Supplemental Geotechnical Investigation are plotted on the Site Plan, Appendix A. The test pit log is presented in Appendix B. The Supplemental Geotechnical Investigation Report is included with this report in Appendix D; the logs and data obtained from the 7 test borings drilled for this report are included therein.

SUBSURFACE CONDITIONS

Existing concrete slabs-on-grade and electrical equipment are located just east of the proposed line of eight (8) modular buildings. Three existing aircraft canopies are located just east of the proposed three (3) launch pads (future canopies).

Previous grading of the site stripped the original desert vegetation, constructed two retention basins, placed some localized areas of artificial fill (<2 feet), and densified the surficial soils. Based on the shallow soil data obtained from the recently excavated test pits and the deeper soil data obtained from borings drilled for the B-80 Hanger Building project located southeast of the project site, the project site is underlain by medium dense silty sand, sand with silt, and clayey sand. Below this depth, the site is underlain by alternating layers of silty sand, poorly graded sand with silt, and occasional thin layers of fat clay to the maximum depth explored, 51.5 feet. The moisture content tends to increase with depth.

Site Class, Site Coefficient and Seismic Design Category

The soils underlying the site are classified as Site Class D-Default according to the California Building Code (CBC) due to the lack of site-specific subsurface information to a depth of 100 feet. The Design Acceleration Parameters were determined according to Chapter 11 of ASCE 7-16 and are provided in the table below.

TABLE 1: SUMMARY OF SEISMIC DESIGN PARAMETERS

Latitude 34.623676 : Latitude -117.591536

Factor or Coefficient	***Value***
S_S	1.122g
S_1	0.444g
F_a	1.2
F_v	1.5
S_{MS}	1.346g
S_{M1}	N/A
S_{DS}	0.897g
S_{D1}	N/A
T_L	12 Seconds
PGA	0.485
PGA_M	0.582
F_{PGA}	1.2
I_e	1
C_V	1.324
Site Class	D-Default
Risk Category	II

CONCLUSIONS AND RECOMMENDATIONS

The recent site reconnaissance indicates the site conditions have not changed appreciably since the referenced Supplemental Geotechnical Investigation Report was prepared in November of 2018. The Geologic Hazards Report, included in the 2017 Geotechnical Investigation, Addendum 1 is also attached with this report update as Appendix E.

Previous earthwork at the site does not appear to correlate with current development plans. It is anticipated that re-grading the planned development areas will need to be performed for the current development.

No active or potentially active faults are shown to cross the site on the Fault Activity Map of California published by the California Geological Survey. The potential for dynamically induced settlement of the granular soils is also very low. In addition, the soils have a very low potential for expansion due to changes in moisture content. Liquefaction will be discussed following the Groundwater paragraph. Additional information regarding seismicity, as well secondary geologic hazards, is contained in the Geologic Hazards Report, Appendix E.

Recommendations for site preparation and grading contained in MJG's Supplemental Geotechnical Investigation Report (Reference a) remain applicable to the presently proposed development, except for the revised over-excavation recommendations presented in the Shallow Foundation paragraph below.

Groundwater

Review of the California Department of Water Resources website (http://wdl.water.ca.gov/waterdatalibrary/) indicates the nearest water well is located off Bella Vista Drive, east of Sheep Creek Road. This is about 1,900 feet northeast of the proposed disposal field. The well data is listed below:

State Well Number: 06N07W11G001S
Site Code: 346256N1175862W001
Well Surface Elevation: 2852.840
Depth of Historic High Groundwater: 21 ft. (1918)
Elevation of Historic Groundwater Surface: 2831.84
Project Site Elevation: 2860

Based on the above data, the highest historic groundwater level is at least 21 feet below the subject site's existing ground surface.

Liquefaction

Based on the Standard Penetration Tests performed in the borings and considering a groundwater level at a depth of 21 feet, the data indicate that there could be a potential for liquefaction in the some of the unconsolidated alluvial deposits below a depth of about 24 feet. In addition, the fines content (percentage of particles smaller than the No. 200 sieve size) in some soil layers is below the limit generally considered to be resistant to liquefaction and the Liquid Limit and Plasticity Index are low. Consequently, there is a potential for liquefaction in some of the deeper layers of saturated sands in the event of a major earthquake. However, liquefaction of the layers of finer-grained soils is not anticipated, and widespread surface settlement over a large area due to liquefaction is not likely.

Earthwork

Debris, vegetation, and other deleterious materials should be stripped and removed from the site prior to grading work. Organic materials should be disposed of off-site in accordance with the owner's instructions.

Existing fill soils should be excavated from areas to be graded and where structures will be constructed.

Areas to receive fill should be scarified to a depth of 12 inches, brought to within 2 percentage points above or below optimum moisture content, and compacted to a minimum of 90% relative compaction based on the ASTM D1557 laboratory test method. All references to optimum moisture content and relative compaction in this report are based on this test method.

Compacted Fill Material

Fill material should consist of clean soils containing no rocks or other particles with a maximum dimension larger than 6 inches. The on-site soils, less any oversize particles, debris, and organic matter, can be used as fill.

Imported Soils

Imported soils, if needed, should consist of predominantly granular material with an expansion index less than 20 when tested in accordance with ASTM D4829, and should have a minimum R-value of 40. Imported material should be inspected and approved by an MJG's representative prior to being brought to the site.

Compacted Fill Placement

Fill should be placed in 8-inch-thick loose lifts, moisture conditioned to within 2 percentage points above or below optimum moisture content and compacted to a minimum of 90% relative compaction (ASTM D1557).

Access Roadways and Parking Lot Pavement Subgrade Preparation

Following removal of existing artificial fill, the pavement subgrade soils should be over-excavated to a depth of 12 inches and the over-excavation bottom soils scarified to a depth of 8 inches, moistened to near the optimum moisture content, and compacted to a relative compaction of at least 90%. The over-excavation should be filled in maximum 8-inch-thick lifts, each lift moistened to within 2% of the optimum moisture content and compacted to a relative compaction of at least 95% (ASTM D 1557).

Foundation Support (Modular Buildings & Restroom)

The existing soils below and within the locations of the masonry piers and soil anchors should be scarified to a depth of at least 6 inches and compacted to a relative compaction of at least 95 percent (ASTM D1557). The top 12 inches of the existing should be omitted for structural capacity on the soil anchors.

Shallow Foundation and Building Slab-on-Grade Support

The existing soils below the launch pads should be over-excavated to a depth of at least 36 inches below existing grade or 12 inches below the bottoms of the footings and floor slabs-on-grade, whichever depth is greater. The over-excavation should extend at least 5 feet beyond perimeter building lines except where constrained by existing development. The bottom of the over-excavation should be scarified to a depth of at least 6 inches, moistened to within 2 percent of the optimum moisture content and compacted to a relative compaction of at least 95 percent (ASTM D1557).

Fill should be placed in 8-inch-thick loose lifts, moisture conditioned to within 2 percentage points above or below optimum moisture content and compacted to a minimum of 95% relative compaction.

Footings should have bottom levels at a minimum depth of 18” below the lowest adjacent finished grade. A minimum width of 12” is recommended for continuous footings. Isolated footings should be at least 18” wide.

Footings can be designed for an allowable bearing pressure of 3000 pounds per square foot for dead plus long-term live loads. This bearing pressure can be increased by 250 pounds per square foot for each additional foot of depth to a maximum bearing pressure of 5000 pounds per square foot for dead plus long-term live loads. These values can be increased by ⅓ for the total of all loads, including wind or seismic forces.

Total post-construction settlement is estimated to be approximately ¾ inch. Post-construction differential settlements are anticipated to be ½ inch or less between isolated footings, and between the middle and end of a continuous footing.

Footing excavations should be observed by an MJG representative to check bearing materials and cleaning.

Lateral Loading

Resistance to lateral loads will be provided by passive earth pressure against the faces of footings and other structural elements below grade, and by friction along the bases of footings and slabs. Passive earth pressure can be taken as 350 pounds per square foot (psf) per foot of depth. Base friction can be taken as 0.35 times the actual dead load. Base friction and passive earth pressure can be combined without reduction. Retaining structures free to rotate at the top should be designed for an active equivalent fluid pressure of 35 psf per foot of height, plus any additional building or equipment surcharge. MJG should be notified if retaining walls greater than 10 feet in height, restrained walls, or tieback walls are planned so that geotechnical recommendations specific to wall conditions can be developed.

Slab-on-Grade

The subgrade surface below slabs should be moisture conditioned to within 2 percentage points above optimum moisture content and proof-rolled with a smooth-wheeled roller.

Slabs-on-grade should be underlain by a 4” thick blanket of clean, poorly graded, coarse sand or crushed rock. A moisture vapor retarder/barrier should be placed beneath slabs where floor coverings will be installed. Typically, plastic is used as a vapor retarder/barrier. If plastic is used, a minimum 10 mil is recommended. The plastic should comply with ASTM E1745. Plastic installation should comply with ASTM E1643.

Current construction practice typically includes placement of a 2-inch-thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture vapor to the underside of the slab that can increase the time required to reduce moisture vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The floor covering manufacturer should be contacted to determine the volume of moisture vapor allowable, and any treatment needed to reduce moisture vapor emissions to acceptable limits for the particular type of floor covering to be installed.

Reinforcing for slabs-on-grade should consist of at least #3 bars at 12 inches on-center each way placed at mid-height in the slab. Reinforcing should extend down into the footing

Surface Drainage

It is important that water be kept a minimum of 5 feet from structures and slabs. No ponding adjacent to buildings and structures should be allowed. Final surfaces should have a positive 2 percent minimum slope away from structures.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain, weep holes or other drainage facilities. If a basement or underground structure is constructed, a subsurface drainage system is recommended.

Utility Excavations

Excavations should be made in accordance with California Administrative Code, Title 8, Industrial Relations, Chapter 4, Division of Industrial Safety, Subchapter 4, Construction Safety Orders, Article 6. Temporary excavations should be shored or sloped in accordance with Cal OSHA requirements. On-site soils can be considered Type C for purposes of excavation design.

In general, temporary excavations in on-site soils should be sloped no steeper than 1.5:1 for excavations up to 20 feet in depth. Compound excavations with vertical sides in lower portions should be properly shielded to a minimum height of 18 inches above the top of the vertical side, with the upper portion having a maximum slope of 1.5:1. A Registered Professional Engineer should design slopes or benching for excavations greater than 20 feet in depth.

Temporary excavation slopes should be inspected twice daily by the contractor’s competent person before personnel are allowed to enter the excavation. If sloughing, raveling or other evidence for slope instability is noted, corrective measures should be implemented.

Temporary shoring will be required for those excavations where temporary cut slopes as described above are not feasible. Cantilever shoring, and shoring with 1 level of bracing, can be designed to resist an equivalent fluid pressure of 30 psf per foot of depth. For shoring with multiple levels of bracing, a uniform lateral pressure equal to 25H in psf, where H is the height of shoring in feet, should be used. The recommended soil pressure applies to level soil conditions behind the shoring. Where a combination of sloped embankment and shoring is used, the soil pressure will be greater and should be evaluated for actual conditions.

Corrosivity

Laboratory test results indicate that the soils sampled exhibit a resistivity of 290 ohms-cm, which indicates the soils have a corrosion potential with respect to reinforced concrete and

ferrous metals. For this reason, Type II modified, or Type V cement is recommended for use in concrete in contact with the ground. Foundations should be designed with continuous reinforcing steel top and bottom. Reinforcing steel should maintain minimum clearances specified by applicable codes and good construction practice. Appropriate corrosion protection, including consultation with a qualified corrosion engineer, should be implemented anywhere ferrous metal is in contact with the soils.

LIMITATIONS

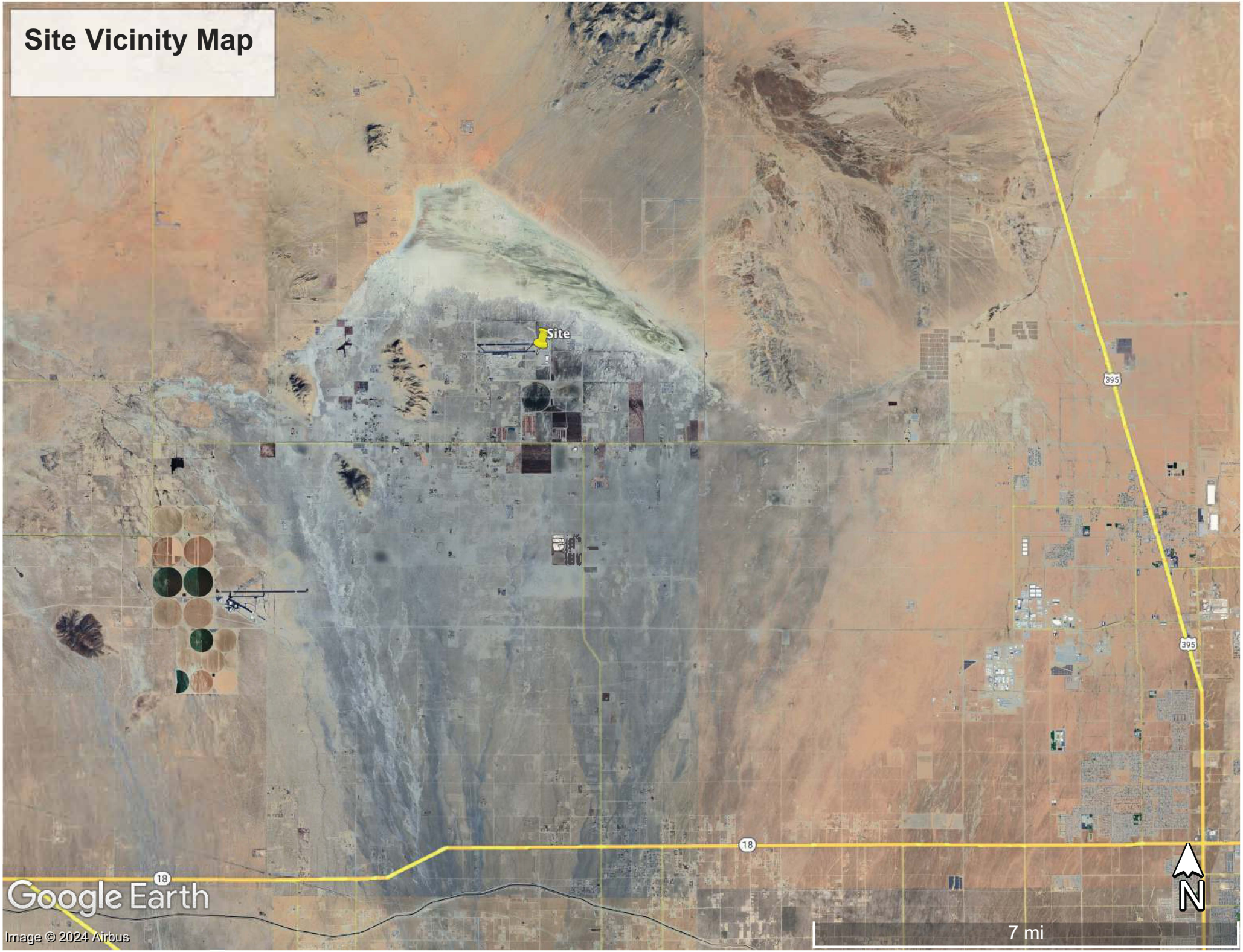
The recommendations in this report are based on results of the field exploration and laboratory test programs, combined with interpolation and extrapolation of subsurface conditions between and beyond boring locations. The nature and extent of variations in these conditions may not become evident until construction. If variations are encountered during construction, MJG should be notified so these variations can be reviewed and the recommendations in this report modified if necessary. If changes in the nature, design or location of the structures are planned, these changes should be reviewed by MJG so that modifications to the recommendations in this report can be made if needed.

Our professional services have been performed using the degree of care and skill ordinarily exercised under similar circumstances by reputable engineering consultants practicing in this or similar localities. No other warranty, express or implied, is made as to the professional advice or data included in this report. This report has not been prepared for use by other parties and may not contain sufficient information for purposes of other parties or other uses.

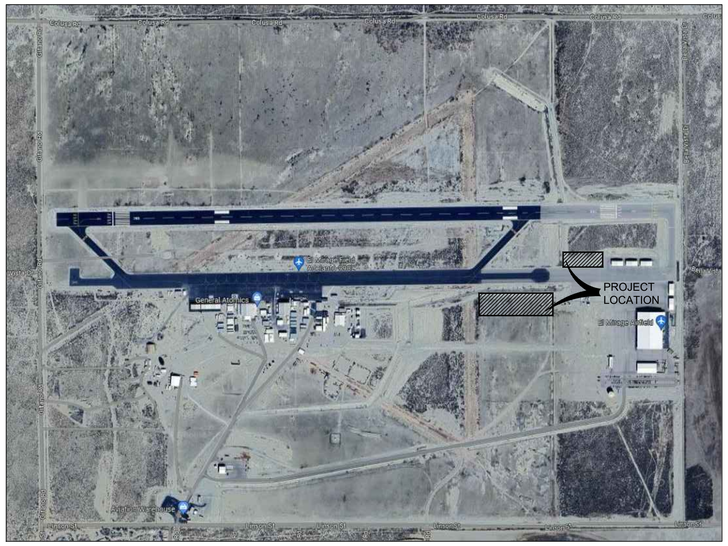
APPENDIX A

Figure 1 – Site Vicinity Map
Figure 2 – Satellite Image of the Project Site
Figure 3 – Site Plan / Boring Plot Plan

Site Vicinity Map

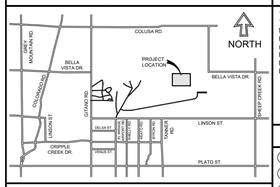



Site
Google Earth
Image © 2024 Airbus
N
500 ft



PROJECT SITE LOCATION
NOT TO SCALE

VICINITY MAP



PROJECT DATA

ZONE:	IN
OCCUPANCY'S:	B / H
CONSTRUCTION TYPE:	V-B
STORIES:	SINGLE
FIRE SPRINKLERS:	NO

APPLICANT / OWNER:
GENERAL ATOMICS
AERONAUTICAL SYSTEMS, INC.
14118 STOWE DR. - BLDG. #A37
POWAY, CA. 92064

ARCHITECT / REPRESENTATIVE:
STEENO DESIGN STUDIO, INC.
ARCHITECT: TOM STEENO
11774 HESPERIA RD. SUITE B-1
PH: 760.244.5001 FX: 760.244.1948

SITE DATA

A.P.N:
0457-041-02& 04

SITE AREA

AREA	SQ. FOOTAGE
GROSS LAND AREA 76.92 + 76.73 =153.65 TOTAL ACRES	6,979,571.68 S.F.
SCOPE OF WORK AREA	77,171 S.F.

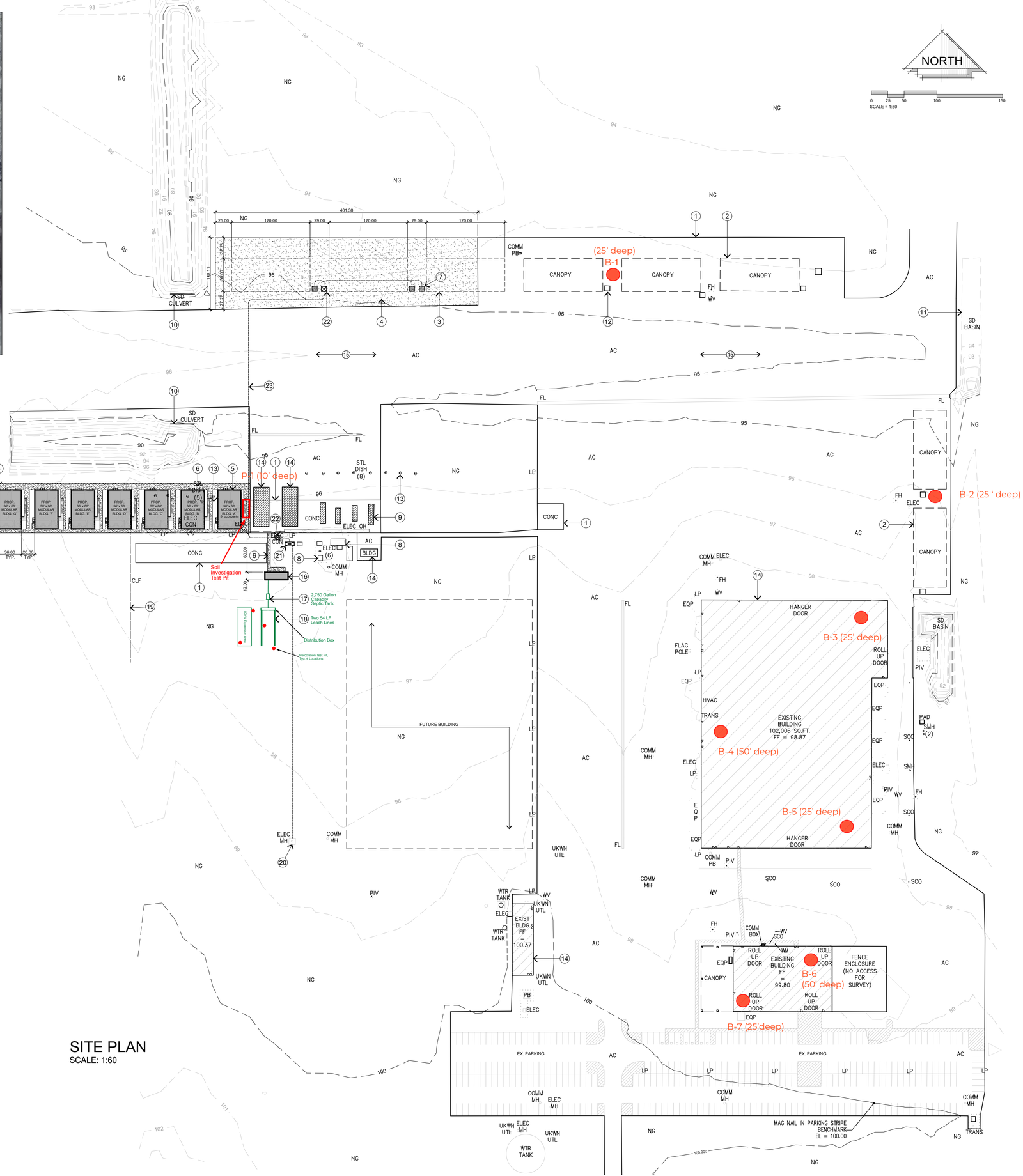
SHEET INDEX

SCOPE OF WORK

TO OBTAIN PERMITS FOR 8 PROPOSED 36' W X 60' L. MODULAR BUILDINGS, TO EXTEND & PROVIDE CONCRETE SIDEWALKS FOR ACCESS TO PROPOSED MODULAR BUILDINGS. TO OBTAIN PERMITS FOR A PROPOSED MODULAR RESTROOM WITH THE REQUIRED SEPTIC SYSTEM. TO OBTAIN PERMITS FOR (3) PROPOSED LANDING PADS TO THE WEST OF THE EXISTING LANDING PADS & TO OBTAIN PERMITS TO ADD A 4,000 AMP ELECTRICAL SERVICE TO PROVIDE POWER TO THE PROPOSED MODULAR BUILDINGS, RESTROOM & LANDING PADS.

KEYED NOTES

1. EXISTING CONCRETE PAD
2. EXISTING LANDING PADS W/ CANOPY
3. PROP. 120' x 50' LANDING PAD W/ FUTURE CANOPIES GENERAL ATOMICS TO SPECIFY REQUIREMENTS TYP. OF 3
4. PROP. 6" NOM. THK. CONC. SLAB
5. PROP. 36' x 60' MODULAR UNIT W/ ADA COMPLIANT. MFGR. TO PROVIDE SET DOWN PLAN W/ CALCS. TO BE SUBMITTED TO BUILDING & SAFETY PRIOR TO INSTALLATION.
6. PROP. 4' WD. CONC. WALKWAY
7. CONTROL SHED
8. EXISTING ELECTRICAL EQUIPMENT
9. EXISTING MODULAR PODS
10. EXISTING HEADWALL DRAINAGE
11. EXISTING RETENTION BASIN
12. EXISTING CONTROL SHED
13. EXISTING SATELLITE DISH
14. EXISTING BUILDING NOT A PART
15. EXISTING AIRPORT RUNWAY
16. PROP. MODULAR BATHROOM BUILDING. MFGR. TO PROVIDE SET DOWN PLAN W/ CALCS. TO BE SUBMITTED TO BUILDING & SAFETY PRIOR TO INSTALLATION.
17. PROP. SEPTIC TANK
18. PROP. LEACH FIELD SEE PERC. TEST
19. EX. CHAIN LINK FENCE TO BE REMOVED AS REQUIRED
20. TIE INTO EDISON POWER
21. PROP. 4000 AMP ELECTRIC SERVICE
22. PROP. ELECTRIC TRANSFORMER
23. PROP. ELECTRIC CONDUIT RUN- TRENCH & REPAIR A/C



SITE PLAN
SCALE: 1:60

STEENO DESIGN STUDIO INC.
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PHONE (760) 244-5001 ◆ FAX (760) 244-1948
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DATE FINISHED
MAY 2024

REVISIONS

PROJECT: PHASE 1.3 - HANGAR 80

GENERAL ATOMICS AERONAUTICAL SYSTEMS, INC.

PROJECT LOCATION:
GENERAL ATOMICS AERONAUTICAL SYSTEMS, INC.
14200 FRONTIER ROAD
ADELANTO, CA. 92301

CONTACT INFO:
GENERAL ATOMICS AERONAUTICAL SYSTEMS, INC.
BRIAN MCTAGGERT
P: (951) 332-6257

JOB NO.
C24-G10

SHEET NAME:
SITE PLAN

PAGE
A-0
OF XX SHEETS

APPENDIX B

Exploratory Pit and Boring Logs

Soil Classification Key

Unified Soil Classification System (USCS) and Particle Size Limits

Project Number:	24031P1
Project Title:	General Atomics El Mirage Expansion
Project Location:	General Atomics, El Mirage, CA
Client:	Steeno Design Studio

Report Date:	06/03/24
Sheet:	1 of 1
Appendix:	B
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Unified Soil Classification System (USCS)

Coarse Grained Soils More Than 50% Is Larger Than No. 200 Sieve	Gravel and Gravelly Soils More Than 50% Retained on No. 4 Sieve	Clean Gravels Little Or No Fines	GW		Well-graded gravels, gravel-sand mixtures, little or no fines
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels w/ Fines Appreciable Amount	GM		Silty gravels, gravel-sand-silt mixtures
			GC		Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More Than 50% Passing No. 4 Sieve	Clean Sand Little Or No Fines	SW		Well-graded sands, gravelly sands, little or no fines
			SP		Poorly-graded sands, gravelly sands, little or no fines
		Sands w/ Fines Appreciable Amount	SM		Silty-sands, sand-silt mixtures
			SC		Clayey sands, sand-clay mixtures
Fine Grained Soils More Than 50% Is Smaller Than No. 200 Sieve	Silts and Clays Liquid Limit Less Than 50		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL		Organic silts and organic silty clays of low placticity
	Silts and Clays Liquid Limit Greater Than 50		MH		Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
	Highly Organic Soils		PT		Peat, humus, swamp soils with high organic contents

Particle Size Limits

Divison	Silt or Clay	Sand			Gravel		Cobbles	Boulders
		Fine	Medium	Coarse	Fine	Coarse		
U.S. Sieve		No. 200	No. 40	No. 10	No. 4	3/4"	3"	12"
Grain (mm)		0.075	0.420	2.00	4.76	19.1	76.2	305

Soils possessing characteristics of two classifications are designated by group symbol combination. Soils may be classified initially using the visual manual procedure prior to laboratory test.

Merrell Johnson

engineering | surveying | testing | inspection

Merrell Engineering Company, Inc. | 22221 US Highway 18, Apple Valley, Ca. 92308 t)760.256.2068 f)760.256.0418 w)www.merrelljohnson.com

Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

Report Date:	06/03/24
Sheet:	1 of 1
Appendix:	B
Permit No:	
Client Project No:	
USA Ticket No:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Project Number:	24031P1
Project Title:	El Mirage Expansion
Project Location:	El Mirage, CA
Client:	Steeno Design Studio

Location No:	B1	**Start Date/Time:**	05/15/24 0830	**End Date/Time:**	05/15/24 0900

Conducted By:	J. Albornoz	**Excavation Type:**	Test Pit	**Elevation:**	2858
Operator:	J. Albornoz	**Dimensions:**	2' x 5'	**Groundwater:**	Not Encountered
Equipment Type:	Excavator	**Advance Assist:**	None	**Recent Weather:**	Clear
Drive Weight (lb)**:**	-	**Field Tests:**	None	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	-	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Dry, Silty Sand	
			4.4	121.3	SM		Tube Sample at 1' - JDA05152401	TD
			6.1	120.7			Tube Sample at 3' - JDA01292403	TD
							Bulk Sample at 0' to 5' - JDA005152403	
5								SA, MD, EI, CR
10							*Test Pit Terminated at Approximately 10'*	
15								
20								
25								

Comments: Some boulder/rock encountered during excavation. Partial caving of pit observed.

(1) =Bulk, =Driven

(2) **DS** =Direct Shear, **EI** =Expansion Index, **SA** =Sieve Analysis, **CR** =Corrosion, **MD** =Max Density, **RV** =R-Value, **AL** =Atterberg Limits, **SE** =Sand Equivalent, **CN** =Consolidation, **TD** =Tube Density

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APPENDIX C

Laboratory Test Results

Particle-Size Analysis of Soil

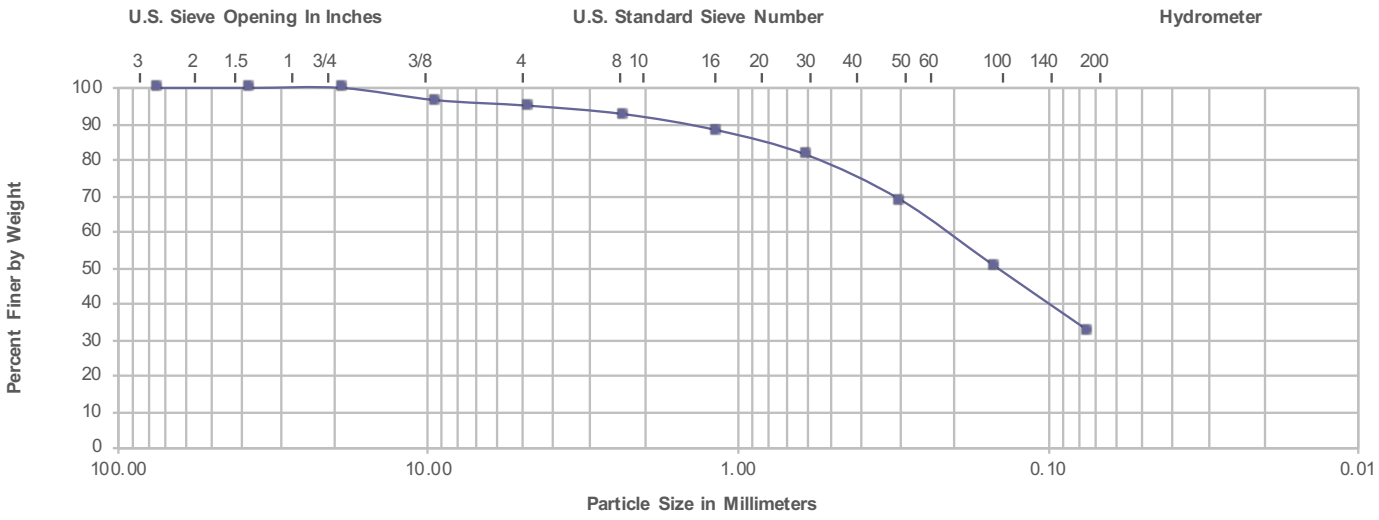
D422, D1140, D2487

Report Date:	06/03/24
Sheet:	1 of 1
Appendix:	C
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Project Number:	24031P1
Project Title:	General Atomics El Mirage Expansion
Project Location:	El Mirage, CA
Client:	Steeno Design

Sample ID: JDA05152403 **Gravel** (%): 4.9% **Sand** (%): 62.2% **Fines** (%): 32.9%

Classification, ASTM D2487: (SM) Silty sand
Sample Origin: Test Pit One at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	SE
NA	NA	3.6%	16.184	0.218	0.000	0.000	ND	ND	ND	ND	ND	ND

Method / Procudure Used:	D422, D1140
Size of Initial Dry Mass (g):	850.8
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2 hr
Type & Amount of Agent:	Defloc. & 1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

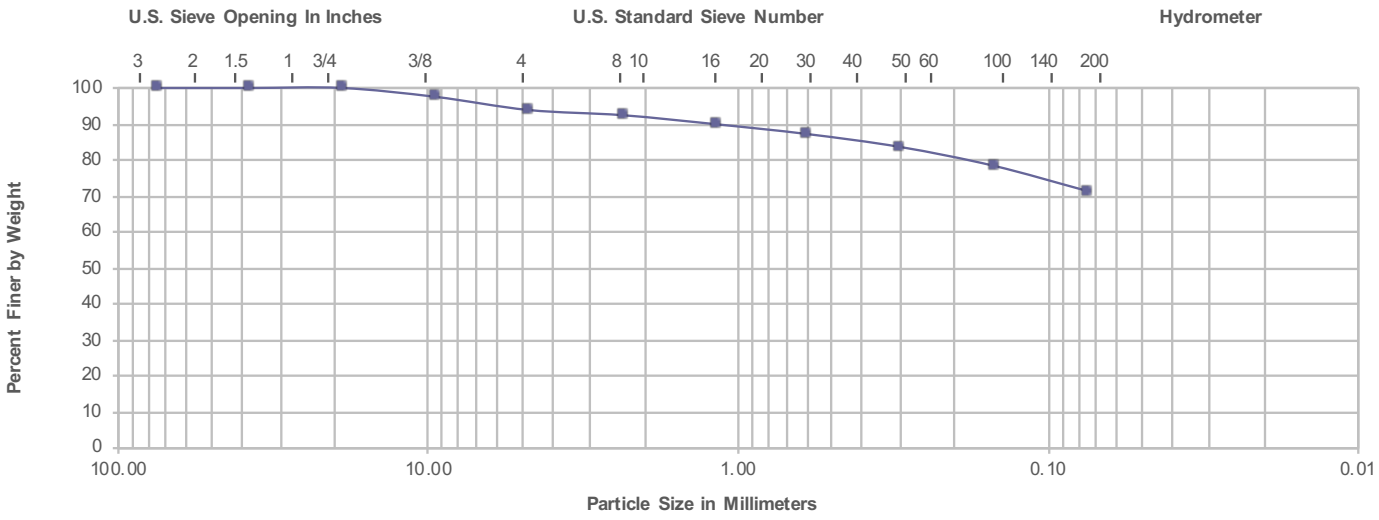
D422, D1140, D2487

Report Date:	06/03/24
Sheet:	1 of 1
Appendix:	C
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Project Number:	24031P1
Project Title:	General Atomics El Mirage Expansion
Project Location:	El Mirage, CA
Client:	Steeno Design

Sample ID: JDA05152404 **Gravel** (%): 6.1% **Sand** (%): 22.5% **Fines** (%): 71.4%

Classification, ASTM D2487: (ML) Silt with sand
Sample Origin: Test Pit Two at 10'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	SE
NA	NA	6.1%	15.123	0.000	0.000	0.000	ND	ND	ND	ND	ND	ND

Method / Procudure Used:	D422, D1140
Size of Initial Dry Mass (g):	485.6
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2 hr
Type & Amount of Agent:	Defloc. & 1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Laboratory Compaction Characteristics

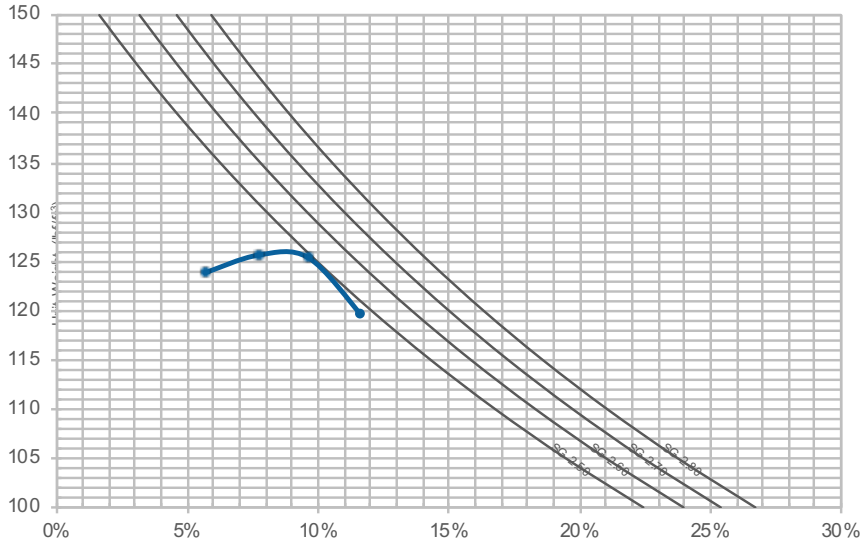
ASTM D1557, D2488

Project Number:	24031P1
Project Title:	General Atomics El Mirage Expansion
Project Location:	El Mirage, CA
Client:	Steeno Design

Report Date:	06/03/24
Sheet:	1 of 1
Attachment:	C
Permit No.:	
Client Project No.:	
Other:	
DSA File No.:	
DSA Application No.:	
DSA LEA No.:	

Sample ID: JDA05152404 **Maximum Dry Unit Weight** (lbf/ft³): 126.0 **Optimum Moisture Content** (%): 8.9

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Test Pit One at 0' to 5'
Laboratory Remarks:



Tested By:	JJB
Received Moisture:	3.7%
Preparation:	Wet
Specific Gravity:	
SG Method:	
Start Weight (lb):	36.5
Retained on 3/4" (lb):	0.4
Retained on 3/8" (lb):	1.2
Retained on No. 4 (lb):	3.1
Retained on 3/4" (%):	1.1%
Retained on 3/8" (%):	3.3%
Retained on No. 4 (%):	8.5%
Oversize Correction:	
Mold Volume Factor:	29.94
Tare Weight (lb):	4.35
Rammer Used:	Mechanical
Method Used:	☐ A ☑ B ☐ C

Weight of Soil and Tare (lb):	8.72	8.87	8.94	8.81
Wet Weight (g):	369.3	307.1	325.1	303.8
Dry Weight (g):	349.5	285.1	296.6	272.2
Moisture Content (%):	5.7%	7.7%	9.6%	11.6%
Dry Unit Weight (lb/ft³):	123.8	125.6	125.4	119.6

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Jeremy Beissner / Laboratory Manager
Name / Title

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Expansion Index

ASTM D4829

Project Number:	24031P1
Project Title:	General Atomics El Mirage Expansion
Project Location:	El Mirage, CA
Client:	Steeno Design

Report Date:	06/03/24
Sheet:	1 *of* 1
Attachment:	C
Permit No.:	
Client Project No.:	
Other:	
DSA File No.:	
DSA Application No.:	
DSA LEA No.:	

Sample ID: JDA05152403 ☐ **General Compliance** ☐ **Non-Compliance** ☐ **Not Specified**

Classification, ASTM D2487:	(SM) Silty sand
Sample Origin:	Test Pit One at 0' to 5'
Laboratory Remarks:	
Tested By:	JJB
Method/Procedure:	ASTM D4829

Expansion Index

Value: 0

Expansion Index	Potention Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
> 130	Very High

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewed By (Signature)

Jeremy Beissner / Laboratory Manager
Name / Title

Corrosion Potential

CT 643, 422, 417, 643

Report Date: 06/03/24
Sheet: 1 of 1
Appendix: C
Permit No:
Client Project No:
Other:
DSA File No:
DSA Application No:
DSA LEA No:

Project Number: 24031P1
Project Title: General Atomics El Mirage Expansion
Project Location: El Mirage, CA
Client: Steeno Design

Sample ID: JDA05152403

Classification, ASTM D2487: (SM) Silty sand
Sample Origin: Test Pit One at 0' to 5'
Laboratory Remarks:

Analysis	Result	Units	Test Method
Minimum Resistivity	290	ohm-cm	CT 643
Chloride Content	635	ppm	CT 422
Sulfate Content	0.265	%	CT 417
pH	7.72	pH units	CT 643

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewd By (Signature)

Jeremy Beissner/ Laboratory Manager
Name / Title

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APPENDIX D

Supplemental Geotechnical Investigation Report

Supplemental Geotechnical Investigation

Proposed General Atomics Expansion Project
Phases 1.1 and 1.3
El Mirage Airport
San Bernardino County, California
Prepared For: Parkway Construction & Architecture
Prepared By: Merrell Johnson Companies

November 6, 2018

Rick Siegfried
Parkway Construction & Architecture
1000 Civic Cir
Lewisville, TX 75067

Re: Supplemental Geotechnical Investigation |
Proposed General Atomics Expansion Project |
Phases 1.1 and 1.3 | El Mirage Airport |
San Bernardino County, California | M.J. Project No. 3514.001.501

Mr. Siegfried:

Merrell Johnson Companies is pleased to provide the enclosed updated findings and recommendations for the proposed General Atomics Expansion Project, Phases 1.1 and 1.3, at El Mirage Airport in San Bernardino, California. The information in the attached report supplements the data in Merrell Johnson Companies' Revised Geotechnical Investigation report dated May 11, 2017.

We trust that the enclosed will be useful in the design and construction of the subject project. Should additional information or interpretation be required, please contact this office. We appreciate the opportunity to be of service and look forward to the successful completion of this project.

Sincerely,
Merrell Johnson Companies

James J. Stone, PE, Geotechnical Engineer
RGE 808 Exp. 12/31/19

Contents

Appendices

Introduction

Merrell Johnson Companies (MJC) is pleased to present this report describing the supplemental geotechnical investigation performed for the proposed General Atomics Expansion Project, Phases 1.1 and 1.3, at El Mirage Airport in San Bernardino County, California. MJC's Revised Geotechnical Investigation report for the project was submitted on May 11, 2017.

The overall project includes runways and taxiways, connecting roads, parking lots, new structures and percolation basins. Phase 1.1 Consists of the Shipping and Receiving Building. Phase 1.3 includes construction of Hanger 80, a Stockroom, and five, 6000-square-foot shade structures.

The general location of the site is shown on the Location Plan in Appendix A.

Proposed Project

The overall General Atomics Expansion Project includes the following:

- 1400 linear feet of runways and taxiways
- 12 structures and associated parking lots. The buildings and parking lots will be constructed in phases. Three phases of construction are currently envisioned.
- A runoff retention basin
- About 1.5 miles of new roads constructed on 2 to 4 feet of fill
- A new hanger enclosing approximately 80,000 square feet.

The currently planned layout of the Shipping and Receiving Building, Phase 1.1, and the locations of Hanger 80 and nearby facilities, Phase 1.3, is shown on the Boring Location Plans in Appendix A.

Scope of Work

Field Exploration

A total of 10 test borings were drilled for the supplemental geotechnical investigation. The borings ranged from a depth of 5 to 51.5 feet below the existing ground surface. The approximate boring locations are shown in Appendix A. The borings were logged by a Merrell Johnson Companies representative, who also collected samples of the materials encountered for examination and laboratory testing.

Bulk samples were collected from drill cuttings. Relatively undisturbed samples were obtained by driving a 2.5-inch inside diameter Modified California sampler with a 140-pound hammer falling 30 inches. Blow counts required to drive the sampler each 6 inches of the total 18-inch drive are noted on the boring logs as “N” Value.

Standard Penetration Tests (SPTs) were performed at selected depths in the borings. The SPTs were performed by driving a 1.4-inch inside diameter sampler a distance of 18 inches with a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler each 6 inches of the 18-inch drive are noted on the boring logs as “N” Value. Uncorrected SPT blow counts for use in further geotechnical analysis were obtained by adding the blow counts for the last 2 increments of the drive and are expressed as “blows/foot.”

The logs of the test borings for the supplemental geotechnical investigation are in Appendix B. Soils are described according to the Unified Soil Classification System explained in Appendix B.

Laboratory Analysis

Selected samples were tested in the Merrell Johnson laboratory to determine pertinent classification and engineering properties. Tests were performed in accordance with

American Society for Testing and Materials (ASTM) procedures. The testing program consisted of the following:

- ASTM D422 Particle-Size Analysis of Soils
- ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index
- ASTM D1557 Laboratory Compaction Characteristics of Soil
- ASTM D3080 Direct Shear Test
- ASTM D2435 One-Dimensional Consolidation

In addition, the soluble sulfate content, resistivity, pH, and chloride ion content were performed on selected samples to provide a basis for assessment of potential soil corrosivity.

Results of the laboratory tests are summarized in Appendix C.

Surface and Subsurface Conditions

In general, the Phase 1.1 and 1.3 areas are underlain by 5 to 15 feet of loose to medium dense, dry to moist, silty and clayey sand and medium stiff sandy silt. The sand and silt at most locations is underlain by moist, medium stiff silt, and moist medium dense silty sand, poorly graded sand with silt, and poorly graded sand with clay extending to a depth of about 25 feet. Below this depth, the site is underlain by alternating layers of silty sand, poorly-graded sand with silt, and occasional thin layers of fat clay to the maximum depth explored, 51.5 feet. The sand is mostly medium dense and moist to saturated. The clay is soft to medium stiff and wet to saturated. The moisture content tends to increase with depth.

Groundwater was encountered as shallow as 24 feet in the test borings drilled in the Phase 1.3 area for this supplemental investigation. Groundwater was not encountered in the borings in the Phase 1.1 area at the time of drilling. However, the finer-grained soils

have low permeability, and groundwater could seep into the borings had they been left open longer.

Reports reviewed for the Geologic Hazards Report as part of the Revised Geotechnical Investigation report indicate historic groundwater levels on the order of 35 to 40 feet below the ground surface. It is anticipated that the permanent groundwater level is below a depth that would influence proposed construction. A groundwater level at a depth of 24 feet was incorporated into the liquefaction analysis described subsequently.

Seismic Design Parameters

Based on the available information gathered for the proposed project, the soils underlying the site are classified as Site Class D according to the 2016 California Building Code (IBC). The Design Acceleration Parameters were determined according to Chapter 11 of ASCE 7-10 and are provided in the table below.

California Building Code – Seismic Parameters

Mapped Spectral Acceleration Parameters	S_S = 1.312	and	S_1 = 0.546
Site Coefficients	F_a = 1.0	and	F_v = 1.5
Adjusted Maximum Considered Earthquake Spectral Response Parameters	S_{MS} = 1.312	and	S_{M1} = 0.819
Design Spectral Acceleration Parameters	S_{DS} = 0.874	and	S_{D1} = 0.546

Available maps indicate that the proposed new buildings are not within a State of California Alquist-Priolo Earthquake Study Zone. No faults are known to traverse the site. Additional information regarding seismicity, as well secondary geologic hazards, is contained in the Geologic Hazards Report.

Liquefaction

Based on the Standard Penetration Tests performed in the borings, and considering a groundwater level at a depth of 24 feet, the data indicate that there could be a potential for liquefaction in the some of the unconsolidated alluvial deposits below a depth of about 24 feet. In addition, the fines content (percentage of particles smaller than the No. 200 sieve size) in some soil layers is below the limit generally considered to be resistant to liquefaction and the Liquid Limit and Plasticity Index are low. Consequently, there is a potential for liquefaction in some of the deeper layers of saturated sands in the event of a major earthquake. However, liquefaction of the layers of finer-grained soils is not anticipated, and widespread surface settlement over a large area due to liquefaction is not likely.

Corrosivity

Laboratory corrosivity tests indicate a high soluble sulfate content in upper layers of on-site soils based on Caltrans Corrosion Guidelines for foundations. Type II modified or Type V cement is recommended for concrete in contact with the ground. In addition, it is recommended that additional sampling and corrosivity testing be performed on soils from proposed foundation and slab-on-grade levels during construction. If a corrosive environment is determined to be present based on this additional testing, a corrosion engineer should be contacted to develop recommendations for appropriate corrosion protection measures.

Conclusions

Based upon our field investigation and test data, combined with our engineering analysis, experience, and judgment, the on-site soils have good strength characteristics and low to moderate compressibility under relatively light to moderately heavy foundation loads. Soils encountered in the borings drilled for the supplemental geotechnical investigation are considered generally consistent with those encountered in

the previous geotechnical investigation.

The existing near surface soils in some areas of the site have been disturbed and are not considered suitable for the support of foundations, floor slabs and pavements. The underlying native soils below these upper soils are generally considered suitable for foundation support following preparation of the upper materials in accordance with the recommendations in this supplemental geotechnical investigation report.

Based on the soil types encountered and the nature of the materials as determined by laboratory testing, the on-site soils at foundation and slab depths have a very low potential for expansion. Further testing may be necessary during construction should other soil types be encountered.

Settlement due to static loading is expected to be slight and will take place as loads are applied. Surface subsidence on the order of 4 to 8 inches may be anticipated locally if liquefaction of isolated deeper layers, below a depth of about 24 feet, should occur. Providing a mat of well compacted soil immediately beneath the structures will minimize the potential for significant differential settlement and assist in mitigating the potential effects of liquefaction on the new facilities. Densification in the dry or moist, medium dense to dense granular soils above the groundwater level is expected to be slight.

The potential for encountering groundwater within the anticipated relatively shallow excavations is slight. Some sloughing or raveling could occur in the near surface cohesionless sands.

Recommendations

Earthwork

Clearing and Grubbing

Debris, vegetation, and other deleterious materials should be stripped and removed

from the site prior to earthwork. Deleterious materials should be disposed of in accordance General Atomics requirements. The site should be cleared of roots, if any, to a depth of 6 inches below foundation and slab subgrade elevations.

Subgrade Preparation in Building Areas

The existing soils should be excavated to a depth of 36 inches below planned footing bottom levels. Excavation should extend at least 5 feet beyond perimeter building lines except where constrained by existing development. The surface exposed by excavation should be scarified to a depth of 8 inches; moisture conditioned to 1 to 2 percentage points above optimum moisture content, and compacted to at least 95% relative compaction. Relative compaction and optimum moisture content should be based on the ASTM D1557 laboratory compaction test method. All references to relative compaction and optimum moisture content in this report are based on this test method.

Fill Materials, Placement and Compaction – Building Areas

Excavated materials can be replaced as compacted fill. Materials from the excavations for retention basins, except for near-surface soils containing roots and organic debris, can be used as compacted fill. Imported material, if used, should consist of predominately granular material free of roots, organic debris, and rocks in excess of 6 inches in maximum dimension. Imported materials should have an Expansion Index of less than 20.

Compacted fill materials should be placed in lifts 8 inches or less in loose thickness, moisture conditioned to 1 to 2 percentage points above optimum moisture content and compacted to at least 95% relative compaction.

Earthwork Quantities

For earthwork estimating purposes, a shrinkage value of 5% can be used when comparing the final 95%-compacted soil volume to the initial in-place volume.

Building Foundation Design

The planned structures can be supported on shallow spread footings with bottom levels in compacted fill. Footings should have bottom levels at a minimum depth of 18 inches below the lowest adjacent finished grade. A minimum width of 18 inches is recommended for continuous footings. Isolated footings should be at least 24 inches wide. Footings can be designed for a maximum allowable bearing pressure of 3000 pounds per square foot (psf) for dead plus long term live loads. This bearing pressure can be increased by 250 psf for each additional foot of depth to a maximum bearing pressure of 5000 psf for dead plus long term live loads. These values can be increased by ⅓ for the total of all loads, including wind or seismic forces.

Total post-construction settlement is estimated to be approximately ¾ inch for spread footings that impose a bearing pressure of 3000 psf with bottom levels in compacted fill. Post-construction differential settlements are anticipated to be ½ inch or less between isolated footings or between the middle and end of a continuous footing.

Slabs on Grade

Slabs-on-grade should be underlain by a 4” thick blanket of clean, poorly graded, coarse sand or crushed rock. A moisture vapor retarder/barrier should be placed beneath slabs where floor coverings will be installed. Typically, plastic is used as a vapor retarder/barrier. If plastic is used, a minimum 10 mil is recommended. The plastic should comply with ASTM E 1745. Plastic installation should comply with ASTM E 1643.

Current construction practice typically includes placement of a 2-inch thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction, and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture vapor to the underside of the slab that can increase the time required to reduce moisture vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The floor-covering

manufacturer should be contacted to determine the volume of moisture vapor allowable and any treatment needed to reduce moisture vapor emissions to acceptable limits for the particular type of floor covering to be installed.

Reinforcing for slabs-on-grade should consist of at least #3 bars at 12 inches on-center each way placed at mid-height in the slab. Reinforcing should extend down into the footings. Concrete construction (i.e. jointing, etc.) should be in conformance with the American Concrete Institute Manual of Concrete Practice Design and Construction Standards.

Lateral Loading

Resistance to lateral loads against the faces of footings and other structural elements below grade will be provided by passive earth pressure and by friction along the bases of footings and slabs. For footings bearing against compacted fill, the passive earth pressure can be taken as 350 psf per foot of depth. Base friction can be taken as 0.35 times the actual dead load. Base friction and passive earth pressure can be combined without reduction.

Retaining structures free to rotate at least 0.01 radian at the top can be designed for an active equivalent fluid pressure of 35 pounds per cubic foot (pcf), plus any additional building or equipment surcharge. Merrell Johnson Companies should be notified if retaining walls greater than 10 feet in height, restrained walls, or tieback walls are planned so that geotechnical recommendations specific to wall conditions can be developed.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain, weep holes or other drainage facilities. If a basement or subterranean structure is constructed a subsurface drainage system is recommended.

Surface Drainage

The final ground surface should slope at a gradient of at least 2% away from structures for a distance of at least 5 feet out from the face of the structure. Positive surface drainage should be provided to prevent ponding near the buildings.

Excavation Procedures

Temporary excavations in on-site soils should be shored or sloped in accordance with Cal OSHA requirements. Soils should be classified as Type C in accordance with Cal OSHA criteria.

Temporary excavations should be sloped no steeper than 1.5 horizontal to 1 vertical for excavations up to 20 feet in depth. A Registered Professional Engineer should design slopes or benching for excavations greater than 20 feet in depth.

Should running sands be encountered during excavation, flattening of cut slope faces, shoring, or other procedures, may be required. During construction, excavation conditions should be evaluated by the contractor's competent person at least once daily before workers are allowed to enter the excavation.

Shoring will be required for those excavations where temporary cut slopes as described above are not feasible. Internally braced or cantilevered shoring can be used. It is recommended that temporary shoring with multiple levels of bracing retaining granular soils be designed considering a uniform lateral earth pressure distribution for the full height of the shoring equal to 25H psf, where H is the height of shoring in feet. Cantilevered shoring, and shoring with 1 level of bracing, should be designed to resist an equivalent fluid pressure of 30 pcf.

The recommended soil pressures apply to level soil conditions behind the shoring. Where a combination of slope embankment and braced shoring is used, the soil pressure will be greater and should be evaluated for actual conditions.

In addition to the above recommended lateral earth pressures, a minimum uniform lateral pressure of 125 psf should be incorporated in the design of the upper 10 feet of shoring when normal traffic is permitted within 10 feet of the wall. The design of temporary shoring should also include the surcharge loads from delivery and construction equipment, as appropriate.

Limitations

The recommendations in this report are based on results of field and laboratory investigations, combined with interpolation and extrapolation of subsurface conditions between and beyond boring locations. The nature and extent of variations in these conditions may not become evident until construction. If variations are encountered during construction, Merrell Johnson Companies should be notified so the variations can be reviewed and the recommendations in this report modified if necessary.

If changes in the nature, design or location of the facilities are planned, the recommendations contained in this report should not be considered valid unless the changes are reviewed by Merrell Johnson Companies so that modifications can be made if needed.

Our professional services have been performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineering consultants practicing in this or similar localities. No other warranty, express or implied, is made as to the professional advice included in this report. This report has not been prepared for use by other parties, and may not contain sufficient information for purposes of other parties or other uses.

REFERENCES

1. California Department of Transportation (Caltrans) Geotechnical Manual, December 2014.

2. Boulanger, R. W. and Idriss, I. M. Liquefaction Susceptibility Criteria for Silts and Clays, ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol. 132, No. 11, November 1, 2006.

3. Youd, T. L., et al, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, ASCE Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001.

4. Federal Highway Administration (FHWA), https://www.fhwa.dot.gov/engineering/geotech/pubs/05037/05b.cfm

5. Merrell Johnson Companies, Revised Geotechnical Investigation, Proposed General Atomics Expansion Project, El Mirage Airport, San Bernardino County, California, dated May 11, 2017 (MJC Project Number 3439.001.100).

Appendix A
Figures

November 6, 2018
Supplemental Geotechnical Investigation | Proposed General Atomics Expansion Project | Phases 1.1 and 1.3 | El Mirage Airport | San Bernardino, CA | MJC Project 3514.001.501
Figure 1 | Site Vicinity

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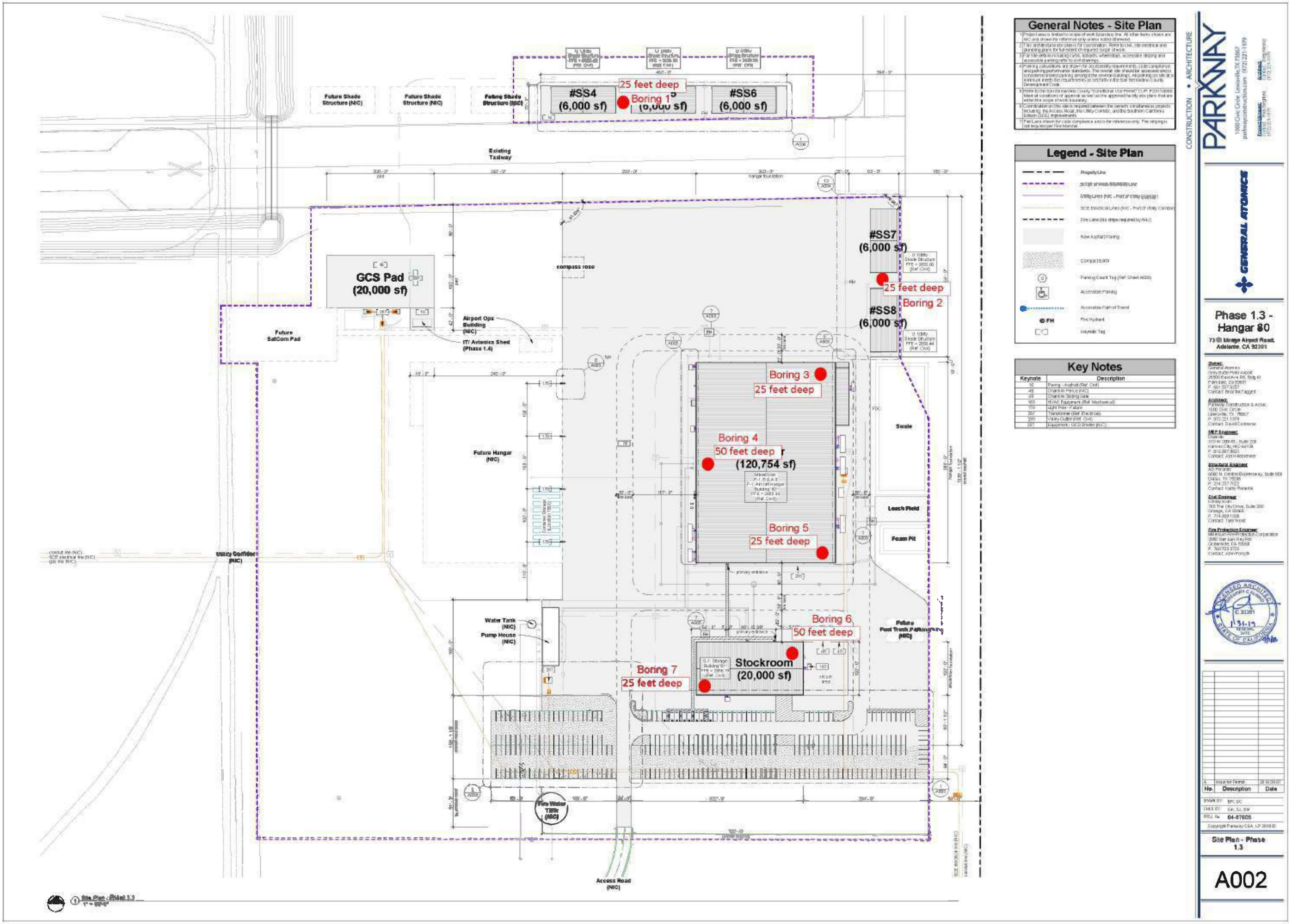

November 6, 2018
Supplemental Geotechnical Investigation | Proposed General Atomics Expansion Project | Phases 1.1 and 1.3 | El Mirage Airport | San Bernardino, CA | MJC Project 3514.001.501
Figure 2 | Boring Location Map - Hangar

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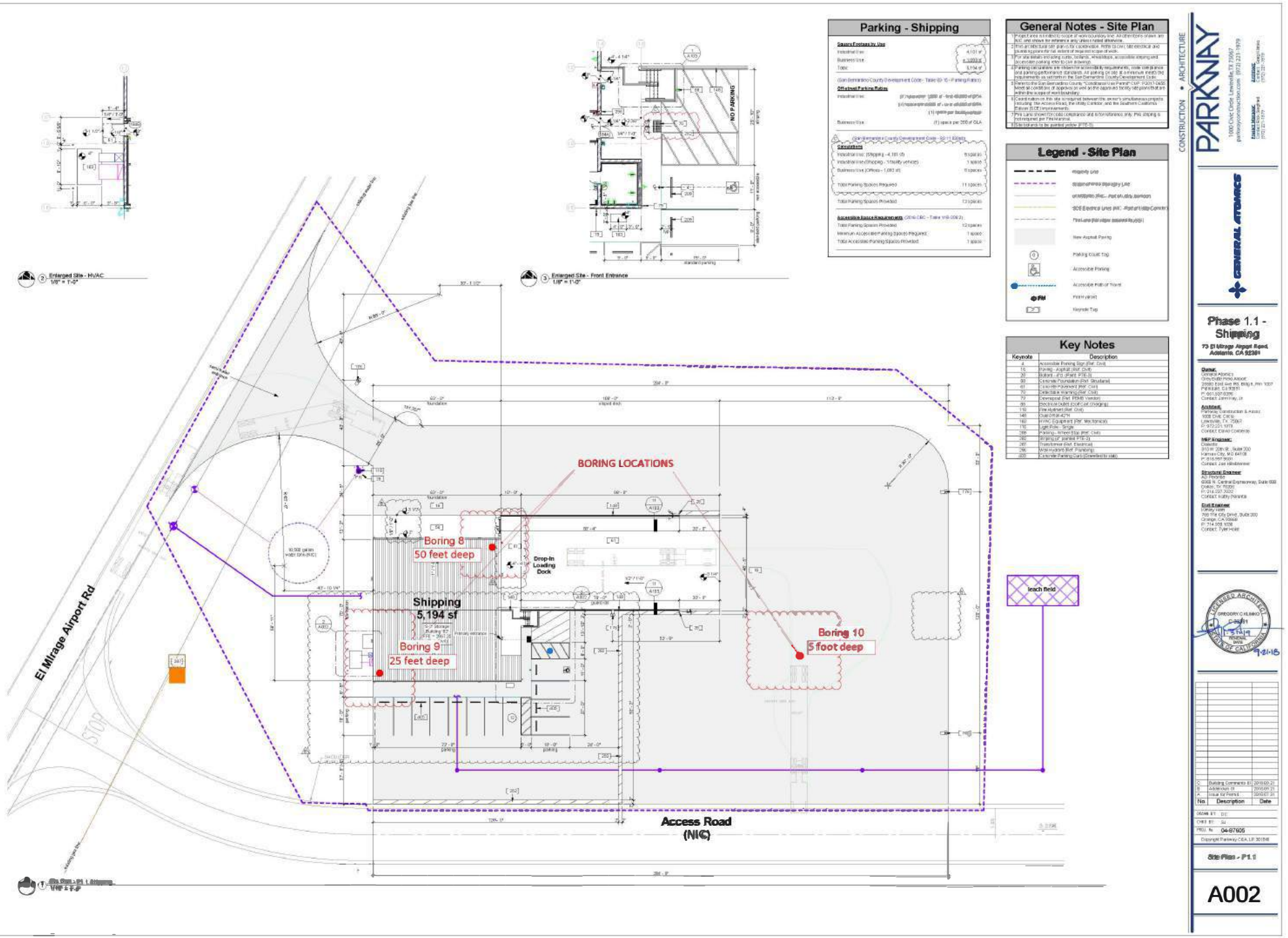

November 6, 2018
Supplemental Geotechnical Investigation | Proposed General Atomics Expansion Project | Phases 1.1 and 1.3 | El Mirage Airport | San Bernardino, CA | MJC Project 3514.001.501
Figure 3 | Boring Location Map - Shipping & Recieving

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Appendix B
Exploratory Logs

Soil Classification Key

Unified Soil Classification System (USCS) and Particle Size Limits

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Report Date:	10/16/18
Sheet:	1 of 1
Appendix:	B
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Unified Soil Classification System (USCS)

Coarse Grained Soils More Than 50% Is Larger Than No. 200 Sieve	Gravel and Gravelly Soils More Than 50% Retained on No. 4 Sieve	Clean Gravels Little Or No Fines	GW		Well-graded gravels, gravel-sand mixtures, little or no fines
			GP		Poorly-graded gravels, gravel-sand mixtures, little or no fines
		Gravels w/ Fines Appreciable Amount	GM		Silty gravels, gravel-sand-silt mixtures
			GC		Clayey gravels, gravel-sand-clay mixtures
	Sand and Sandy Soils More Than 50% Passing No. 4 Sieve	Clean Sand Little Or No Fines	SW		Well-graded sands, gravelly sands, little or no fines
			SP		Poorly-graded sands, gravelly sands, little or no fines
		Sands w/ Fines Appreciable Amount	SM		Silty-sands, sand-silt mixtures
			SC		Clayey sands, sand-clay mixtures
Fine Grained Soils More Than 50% Is Smaller Than No. 200 Sieve	Silts and Clays Liquid Limit Less Than 50		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL		Organic silts and organic silty clays of low placticity
	Silts and Clays Liquid Limit Greater Than 50		MH		Inorganic silts, micaceous or diatomaceous fine sand or silty soils
			CH		Inorganic clays of high plasticity, fat clays
			OH		Organic clays of medium to high plasticity, organic silts
	Highly Organic Soils		PT		Peat, humus, swamp soils with high organic contents

Particle Size Limits

Divison	Silt or Clay	Sand			Gravel		Cobbles	Boulders
		Fine	Medium	Coarse	Fine	Coarse		
U.S. Sieve		No. 200	No. 40	No. 10	No. 4	3/4"	3"	12"
Grain (mm)		0.075	0.420	2.00	4.76	19.1	76.2	305

Soils possessing characteristics of two classifications are designated by group symbol combination. Soils may be classified initially using the visual manual procedure prior to laboratory test.

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Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 1	**Start Date/Time:**	10/16/18 1115	**End Date/Time:**	10/16/18 1155

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2853'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Dry, Medium Dense, Clayey Sand	
1	10, 18		1.4	88.3	SC		Bulk Sample at 0' to 5' - CRG10161801	SA, CR
	24						Tube Sample at 1' - CRG10161802	TD
3	18, 38		4.3	117.3			Tube Sample at 3' - CRG10161803	TD
	36							
5	15, 17		3.9	110.1			Tube Sample at 5' - CRG10161804	TD
	22							
							Light Brown, Dry, Loose, Poorly Graded Sand with Silt	
10	8, 10				SP-SM		SPT Sample at 10' - CRG10161805	SA
	11							
15	6, 8						SPT Sample at 15' - CRG10161806	
	11							
20	5, 7, 8						SPT Sample at 20' - CRG10161807	
							Brown, Moist, Very Loose, Silty Sand	
25	3, 5 ,7				SM		SPT Sample at 25' - CRG10161808	AL
							Drilling terminated at approx. 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 2	**Start Date/Time:**	10/16/18 1200	**End Date/Time:**	10/16/18 1240

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2854'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	24.0'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Dry, Medium Dense, Silty Sand	
1	12, 16		3.3	99.7	SM		Bulk Sample at 0' - 5' - CRG10161809	SA
	25						Tube Sample at 1' - CRG10161810	TD
3	15, 18		2.5	105.4			Tube sample at 3' - CRG10161811	TD
	25							
5	25, 33		3.3	109.3			Tube Sample at 5' - CRG10161812	TD, DS
	38							
					SP-SM		Light Brown, Moist, Medium Dense, Poorly Graded Sand with Silt	
10	6, 7, 8						SPT Sample at 10' - CRG10161813	
15	3, 6, 9						SPT Sample at 15' - CRG10161814	
20	10, 11						SPT Sample at 20' - CRG10161815	
	8							
							Encountered groundwater at 24'	
25	9, 10						SPT Sample at 25' - CRG10161816	
	11						Drilling terminated at approx. 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 3	**Start Date/Time:**	10/16/18 1300	**End Date/Time:**	10/16/18 1310

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2856'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Moist, Medium Dense, Silty Sand	
1	16, 18		6.5	96.0	SM		Bulk Sample at 0' to 5' - CRG10161817	SA
	20						Tube Sample at 1' - CRG10161818	TD
3	11, 13		3.8	104.8			Tube Sample at 3' - CRG10161819	TD
	20							
5	10, 11		3.6	87.0			Tube Sample at 5' - CRG10161820	TD
	17							
							Brown, Moist, Medium Dense, Poorly Graded Sand with Silt	
10	5, 7, 8				SP-SM		SPT Sample at 10' - CRG10161821	
15	6, 10						SPT Sample at 15' - CRG10161822	
	8							
20	7, 8						SPT Sample at 20' - CRG10161823	
	17							
							Dark Brown, Wet, Loose, Silty Sand	
25	3, 5, 5				SM		SPT Sample at 25' - CRG10161824	
							Drilling terminated at approx. 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk, =Driven

(2) **DS** =Direct Shear, **EI** =Expansion Index, **SA** =Sieve Analysis, **CR** =Corrosion, **MD** =Max Density, **RV** =R-Value, **AL** =Atterberg Limits, **SE** =Sand Equivalent, **CN** =Consolidation, **TD** =Tube Density

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 4	**Start Date/Time:**	10/16/18 1400	**End Date/Time:**	10/16/18 1500

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2859'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	38.6'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Moist, Stiff, Sandy Silt	
1	11, 17 21		3.6	80.0	ML		Bulk Sample at 0' - 5' - CRG10161825	SA
							Tube Sample at 1' - CRG10161826	TD
							Brown, Wet, Medium Dense, Silty Sand	
5	12, 18 21		6.5	105.7	SM		Tube Sample at 5' - CRG10161827	TD, CN
10	15, 21 30		3.8	92.3			Tube Sample at 10' - CRG10161828	TD
15	10, 11 16		14.2	104.7			Tube Sample at 15' - CRG10161829	TD
							Dark Grey, Wet, Very Loose, Silty Sand	
20	2, 4, 7						SPT Sample at 20' - CRG10161830	
							Dark Grey, Wet, Loose, Sandy Silt	
25	3, 9, 10				ML		SPT Sample at 25' - CRG10161831	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 4 (Cont.d)	**Start Date/Time:**	10/16/18 1400	**End Date/Time:**	10/16/18 1500

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2859'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	38.6ft
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
30	3, 3, 8				SP-SC		Dark Grey, Wet, Very Loose, Poorly Graded Sand with Clay SPT Sample at 30' - CRG10161832	
							Dark Grey, Wet, Soft, Fat Clay	
35	4, 6, 8				CH		SPT Sample at 35' - CRG10161833	
							Ground water encountered at 38.6'	
40	6, 9, 14						SPT Sample at 40' - CRG10161834	
45	6, 8, 12						SPT Sample at 45' - CRG10161835	
							Dark Grey, Wet, Soft, Fat Clay with Traces of Sand	
50							No Recovery at 50' Drilling Terminated at approx. 51.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 5	**Start Date/Time:**	10/17/18 0936	**End Date/Time:**	10/17/18 1009

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2861'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	24.5'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Brown, Dry, Loose, Silty Sand	
1	6, 12		1.7	103.5	SM		Bulk Sample at 0' to 5' - CRG10171801	SA
	17						Tube Sample at 1' - CRG10171802	TD
3	10, 18		7.1	105.7			Tube Sample at 3' - CRG10171803	TD
	26							
5	12, 19		7.2	115.3			Tube Sample at 5' - CRG10171804	TD
	28							
10	5, 7, 7						SPT Sample at 10' - CRG10171805	SA
					SP-SC		Dark Brown, Moist, Loose, Poorly Graded Sand with Clay	
15	8. 5 10						SPT Sample at 15' - CRG10171806	
20	3, 5, 7						SPT Sample at 20' - CRG10171807	
							Groundwater encountered at 24.5',	
25	3, 3, 1				SM		SPT Sample at 25' - CRG10171808	AL
							Dark Brown, Very Wet, Very Loose, Silty Sand	
							Drilliing Terminated at 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk, =Driven

(2) **DS** =Direct Shear, **EI** =Expansion Index, **SA** =Sieve Analysis, **CR** =Corrosion, **MD** =Max Density, **RV** =R-Value, **AL** =Atterberg Limits, **SE** =Sand Equivalent, **CN** =Consolidation, **TD** =Tube Density

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Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 6	**Start Date/Time:**	10/16/18 1115	**End Date/Time:**	10/16/18 1155

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2861'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	28.3'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Wet, Loose, Silty Sand	
1	6, 8		5.7	86.1	SM		Bulk Sample at 0' t0 5' - CRG10171809	SA
	12						Tube Sample at 1' - CRG10171810	TD
5	6, 11		1.5	85.7			Tube Sample at 5' - CRG10171811	TD, CN
	16							
							Grey, Wet, Medium Dense, Poorly Graded Sand	
10	8, 14		7.2	114.6	SP		Tube Sample at 10' - CRG10171812	TD
	21							
							Dark Brown, Very Wet, Loose, Poorly Graded Sand with Silt	
15	5, 8		21.0	92.7	SP-SM		Tube Sample at 15' - CRG10171813	TD
	10							
20	2, 4, 7						SPT Sample at 20' - CRG10171814	
							Brown, Wet,Very Soft, Sandy Fat Clay	
25	2, 3, 6				CH		SPT Sample at 25' - CRG10171815	SA
							Ground water encountered at 28.3'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 6 (Cont.d)	**Start Date/Time:**	10/17/18 1016	**End Date/Time:**	10/17/18 1117

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2861'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	28.3'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
30	4, 4, 8				SM		SPT Sample at 30' - CRG10171816 Dark Brown, Wet, Loose, Silty Sand	
35	5, 6, 8				SC		SPT Sample at 35' - CRG10171817 Brown, Wet, Loose, Clayey Sand	
40	3, 5, 7						SPT Sample at 40' - CRG10171818	
45	5, 8 11						SPT Sample at 45' - CRG10171819	
50	3, 8, 14						SPT Sample at 50' - CRG10171820 Drilling Terminated at approx. 51.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 7	**Start Date/Time:**	10/17/18 1140	**End Date/Time:**	10/17/18 1202

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2861'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	24.7'
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Brown, Dry, Loose, Poorly Graded Sand with Silt	
1	6, 6, 10		2.8	ND	SP-SM		Bulk Sample at 0' to 5' - CRG10171821	SA
							Tube Sample at 1' - CRG10171822	TD
3	5, 11		9.9	108.3			Tube Sample at 3' - CRG10171823	TD
	15							
5	7, 13		3.5	113.8			Tube Sample at 5' - CRG10171824	TD
	23							
							Light Browm, Moist, Loose, Silty Sand	
10	4, 8, 8				SM		SPT Sample at 10' - CRG10171825	SA
15	3, 6, 8						SPT Sample at 15' - CRG1017126	
20	5, 4, 7						SPT Sample at 20' - CRG10171827	
							Ground water encountered at 24.7'	
25	7, 7, 7				SC		SPT Sample at 26.5' - CRG10171828	
							Dark Brown, Dry, Loose, Clayey Sand	
							Drilling Terminated at approx. 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk, =Driven

(2) **DS** =Direct Shear, **EI** =Expansion Index, **SA** =Sieve Analysis, **CR** =Corrosion, **MD** =Max Density, **RV** =R-Value, **AL** =Atterberg Limits, **SE** =Sand Equivalent, **CN** =Consolidation, **TD** =Tube Density

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Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 8	**Start Date/Time:**	10/17/18 1237	**End Date/Time:**	10/27/2018 1317

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2867'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Wet, Very Dense, Clayey Sand	
1	14, 3 50 (5)		4.0	98.7	SC		Bulk Sample at 0' to 5' - CRG10171829 Tube Sample at 1' - CRG10171830	SA, MD, RV TD
5	11, 10 18		2.0	99.3			Tube Sample at 5' - CRG10171831	TD, CN
10	9, 15 24		11.9	99.3	SP-SM		Light Brown, Wet, Medium Dense, Poorly Graded Sand with Silt Tube Sample at 10' - CRG10171832	TD, DS
15	10, 13 24		12.7	111.0			Tube Sample 15' - CRG10171833	TD
20	6, 8, 11				ML		Light Brown, Wet, Medium Stiff, Sandy Silt SPT Sample at 20 ' - CRG10171834	SA
25	4, 3, 6						SPT Sample at 25 - CRG10171835	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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Location No:	Boring 8 (Cont.d)	**Start Date/Time:**	10/17/18 1237	**End Date/Time:**	10/27/2018 1317

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2867'
Operator:	I. Cervantes	**Dimensions:**	8" x 50'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
30	6, 4, 7				ML		SPT Sample at 30' - CRG10171836 Brown, Moist, Very Soft, Sandy Silt with traces of Sand	
35	3, 4, 8						SPT Sample at 35' - CRG10171837	
40	6, 7, 9						SPT Sample at 40' - CRG10171838	
45	7, 9, 11						SPT Sample at 45' - CRG10171839	
50	3, 6, 7						SPT Sample at 50 ' - CRG10171840 Drilling terminated at approx. 51.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 9	**Start Date/Time:**	10/17/18 1337	**End Date/Time:**	10/17/18 1401

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2868'
Operator:	I. Cervantes	**Dimensions:**	8" x 25'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Moist, Dense, Clayey Sand	
1	24, 35		2.4	101.5	SC		Bulk Sample at 0' to 5' - CRG10171841	SA
	39						Tube Sample at 1' - CRG10171842	TD
3	19, 29		4.7	93.3			Tube Sample at 3' - CRG10171843	TD
	42							
5	15, 23		2.5	100.3			Tube Sample at 5' - CRG10171844	TD, DS
	30							
							Brown, Wet, Loose, Silty Sand	
10	4, 7, 8				SM		SPT Sample at 10' - CRG10171845	SA
							Dark Brown, Wet, Loose, Poorly Graded Sand with Silt	
15	9, 9, 9				SP-SM		SPT Sample at 15' - CRG10171846	
20	7, 10						SPT Sample at 20' - CRG10171847	
	8							
							Brown, Moist, Loose, Silty Sand	
25	9, 15				SM		SPT Sample at 26.5' - CRG10171848	
	15						Drilling Terminated at approx. 26.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk, =Driven

(2) **DS** =Direct Shear, **EI** =Expansion Index, **SA** =Sieve Analysis, **CR** =Corrosion, **MD** =Max Density, **RV** =R-Value, **AL** =Atterberg Limits, **SE** =Sand Equivalent, **CN** =Consolidation, **TD** =Tube Density

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Exploratory Log

ASTM D5434, D1452, D1586, D1587, D2488 (USCS), D3550

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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Location No:	Boring 10	**Start Date/Time:**	10/17/18 1410	**End Date/Time:**	10/17/18 1428

Conducted By:	C. Garrison	**Excavation Type:**	Auger Hole	**Elevation:**	2868'
Operator:	I. Cervantes	**Dimensions:**	8" x 5'	**Groundwater:**	Not Encountered
Equipment Type:	CME-75-HSSA	**Advance Assist:**	None	**Recent Weather:**	Clear/Windy
Drive Weight (lb)**:**	140	**Field Tests:**	D3550	**Sampler Insertion:**	Driven
Drive Drop (in)**:**	30	**Shoring Type:**	None	**Preservation:**	D4220

Depth (ft)	'N' Value	Sample (1)	Moisture (%)	Density (pcf)	Class (USCS)	Graphic	Description / Comments	Lab Tests (2)
0							Light Brown, Moist, Stiff, Sandy Silt	
1	15, 28		2.9	109.2	ML		Bulk Sample at 0' to 5' - CRG10171849	SA
	50 (4)						Tube Sample at 1' - CRG10171850	TD
3	21, 28		4.2	101.4			Tube Sample at 3' - CRG10171851	TD
	50							
5	17, 27		3.8	95.1			Tube Sample at 5' - CRG10171852	TD
	33						Drilling terminated at approx. 6.5'	

Comments: "N" Value based on 2.5 diameter modified California tube sampler (ASTM D3550) or SPT (ASTM D1586) as noted on log. Some boulder/cobble encountered during drilling operations. Partial caving of hole observed.

(1) =Bulk =Driven

(2) **DS** =Direct Shear **EI** =Expansion Index **SA** =Sieve Analysis **CR** =Corrosion **MD** =Max Density **RV** =R-Value **AL** =Atterberg Limits **SE** =Sand Equivalent **CN** =Consolidation **TD** =Tube Density

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Appendix C
Laboratory Testing

Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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Client Project No:	
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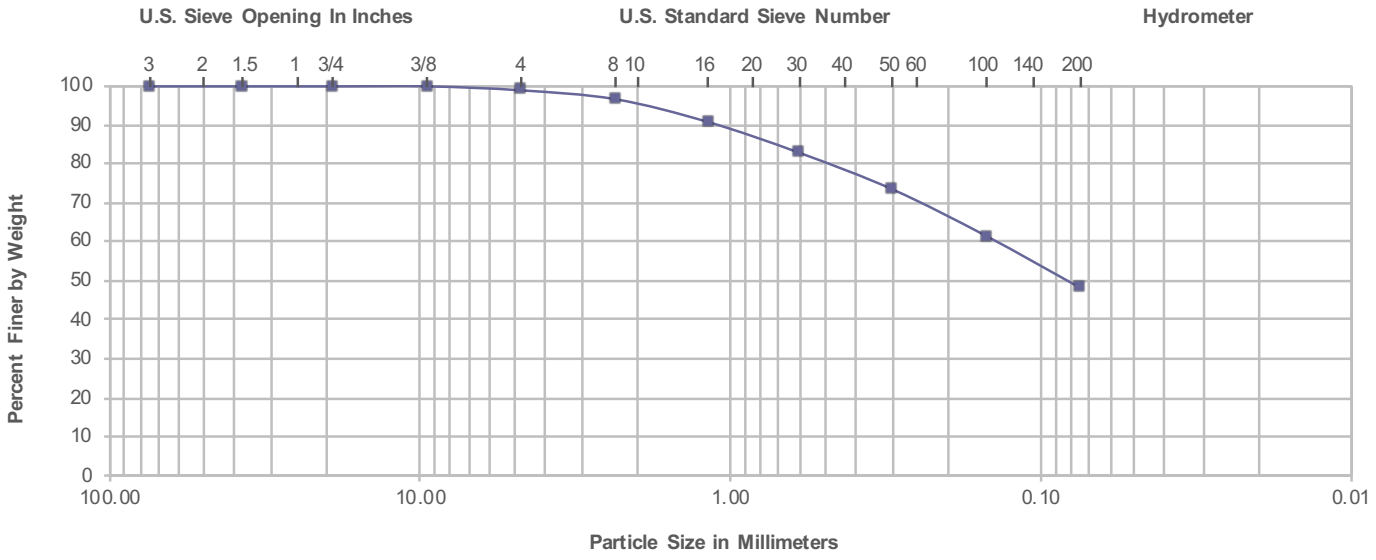
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10161801 **Gravel** (%): 1.0% **Sand** (%): 50.7% **Fines** (%): 48.3%

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring One at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	2.2%	9.500	0.150			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 294.6
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

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Client Project No:	
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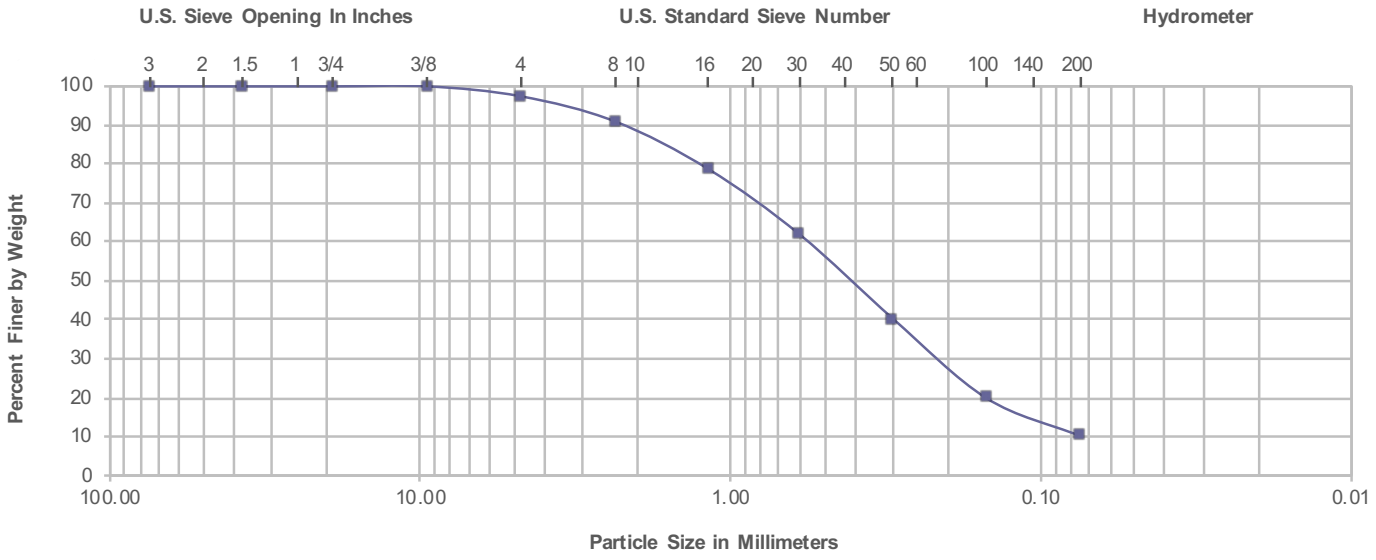
DSA File No:	
DSA Application No:	
DSA LEA No:	

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10161805 **Gravel** (%): 2.6% **Sand** (%): 87.3% **Fines** (%): 10.2%

Classification, ASTM D2488: (SP-SM) Poorly graded sand with silt
Sample Origin: Boring One at 10'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
8	1	0.6%	9.500	0.565	0.220	0.075	ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 301.6
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

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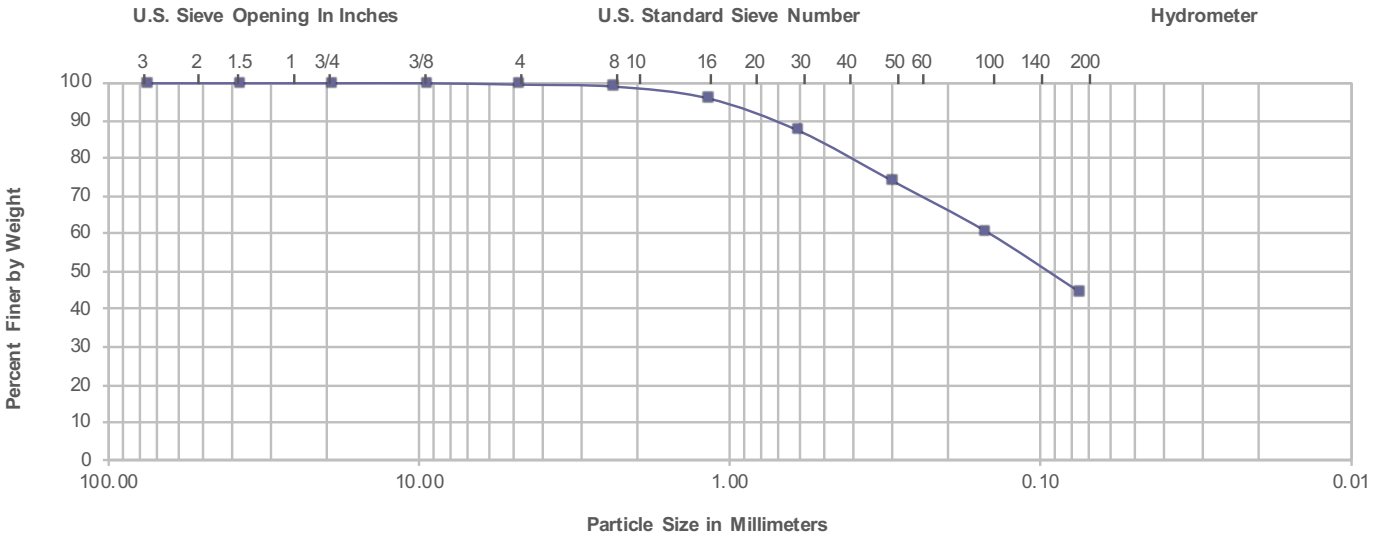
DSA LEA No:	

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10161809 **Gravel** (%): 0.4% **Sand** (%): 55.0% **Fines** (%): 44.6%

Classification, ASTM D2488:	(SM) Silty sand
Sample Origin:	Boring Two at 0' to 5'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	1.7%	4.750	0.167			ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	300.1
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

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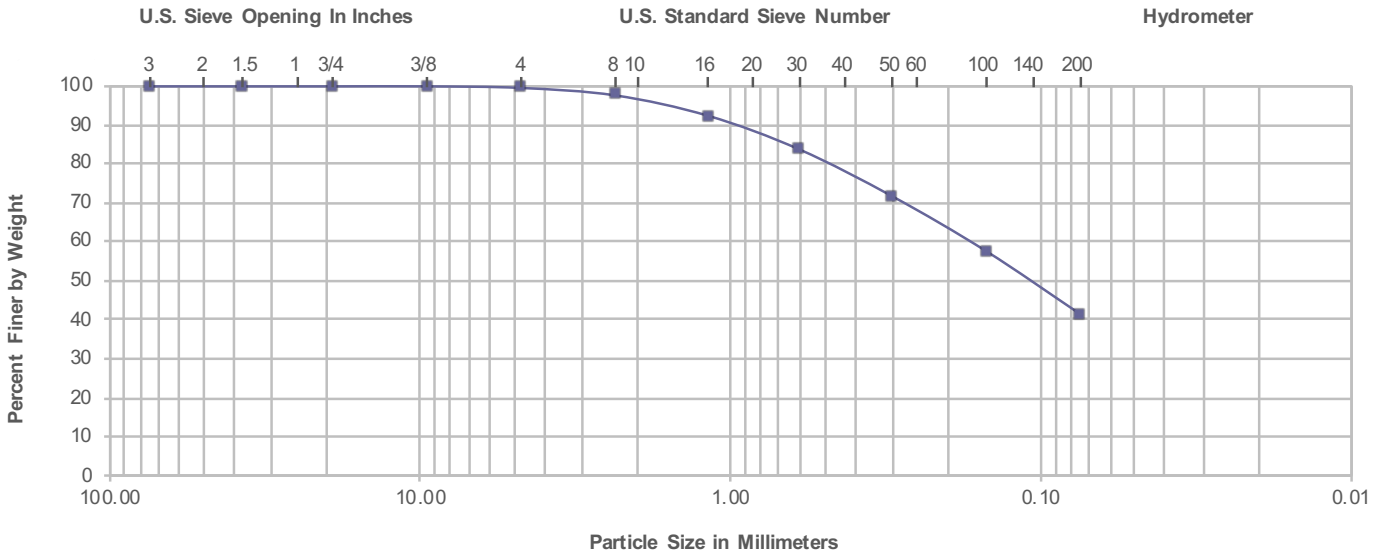
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10161817 **Gravel** (%): 0.4% **Sand** (%): 58.1% **Fines** (%): 41.5%

Classification, ASTM D2488:	(SM) Silty sand
Sample Origin:	Boring Three at 0' to 5'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	2.9%	4.750	0.175			ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	293.6
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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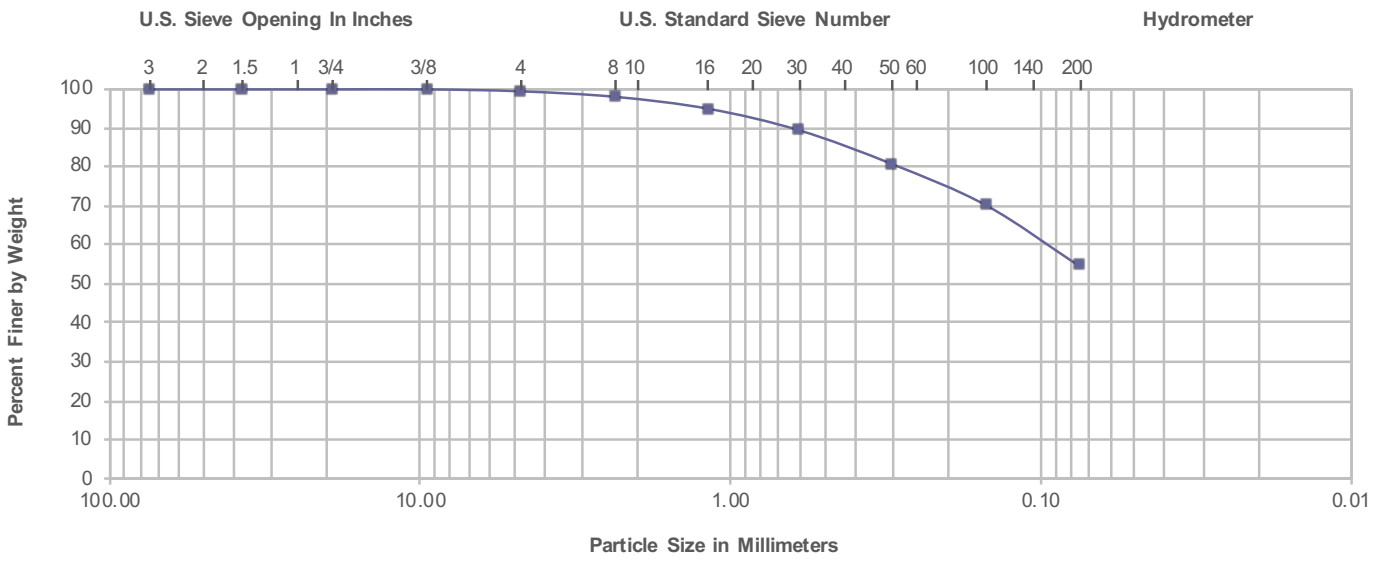
Sample ID: CRG10161825 **Gravel** (%): 0.5% **Sand** (%): 45.0% **Fines** (%): 54.5%

Classification, ASTM D2488: (ML) Sandy silt
Sample Origin: Boring Four at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	2.8%	4.750	0.098			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 296.3
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

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Client:	Parkway Construction

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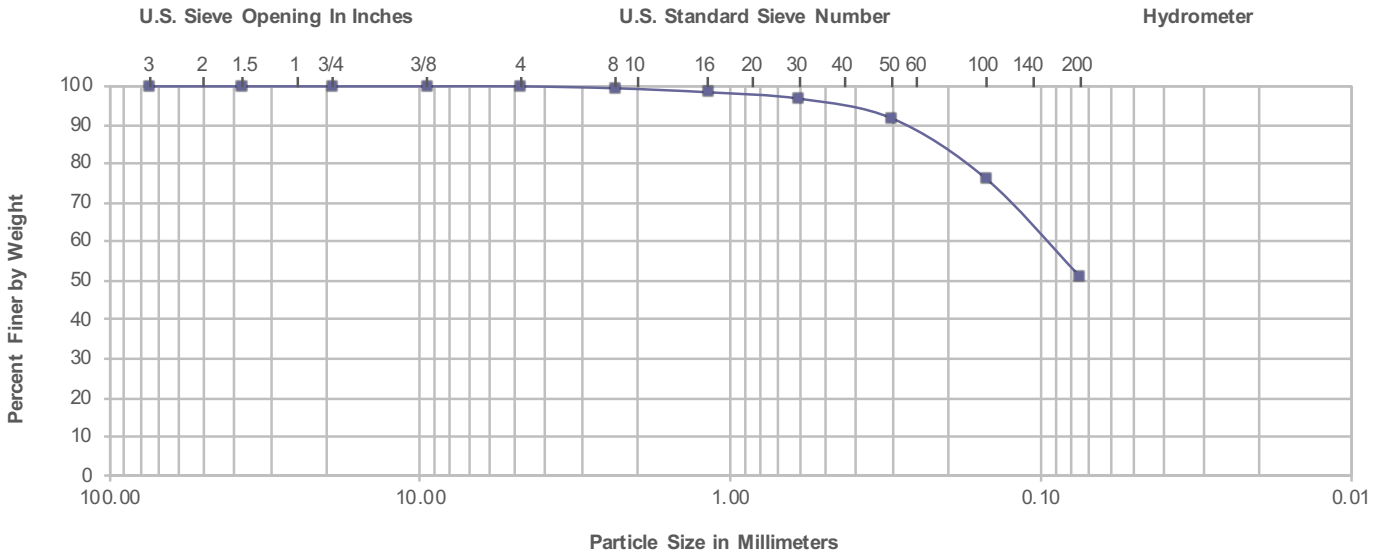
Sample ID: CRG10161831 **Gravel** (%): 0.0% **Sand** (%): 48.9% **Fines** (%): 51.1%

Classification, ASTM D2488: (ML) Sandy silt
Sample Origin: Boring Four at 25'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	24.6%	4.750	0.098			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 241.6
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

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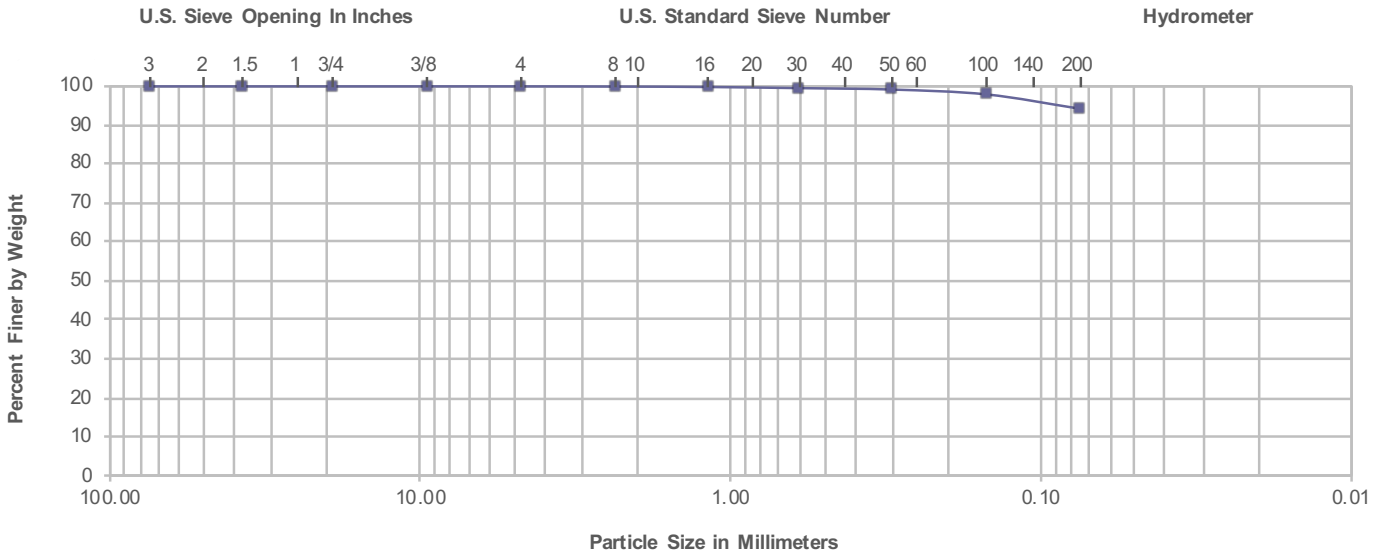
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10161833 **Gravel** (%): 0.0% **Sand** (%): 5.8% **Fines** (%): 94.2%

Classification, ASTM D2488:	(CH) Fat clay
Sample Origin:	Boring Four at 35'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	30.0%	0.600				ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	241.7
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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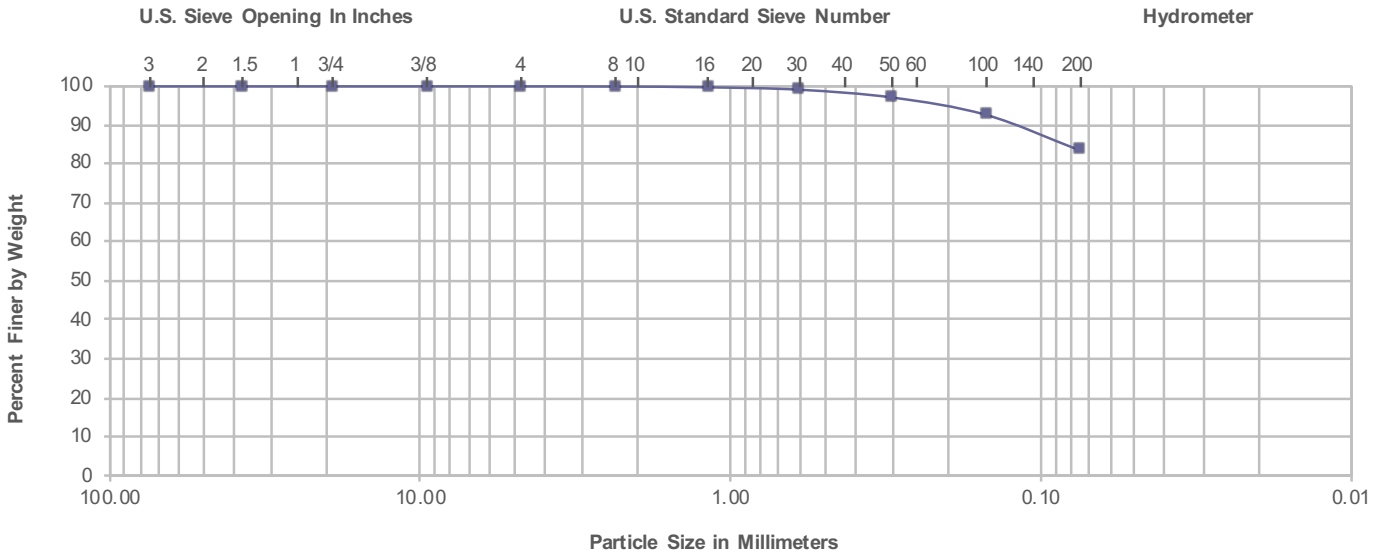
Sample ID: CRG10161834 **Gravel** (%): 0.0% **Sand** (%): 16.5% **Fines** (%): 83.5%

Classification, ASTM D2488: (CH) Fat clay with traces of sand
Sample Origin: Boring Four at 45'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	30.0%	1.180				ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	241.7
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

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Particle-Size Analysis of Soil

D422, D1140, D2487

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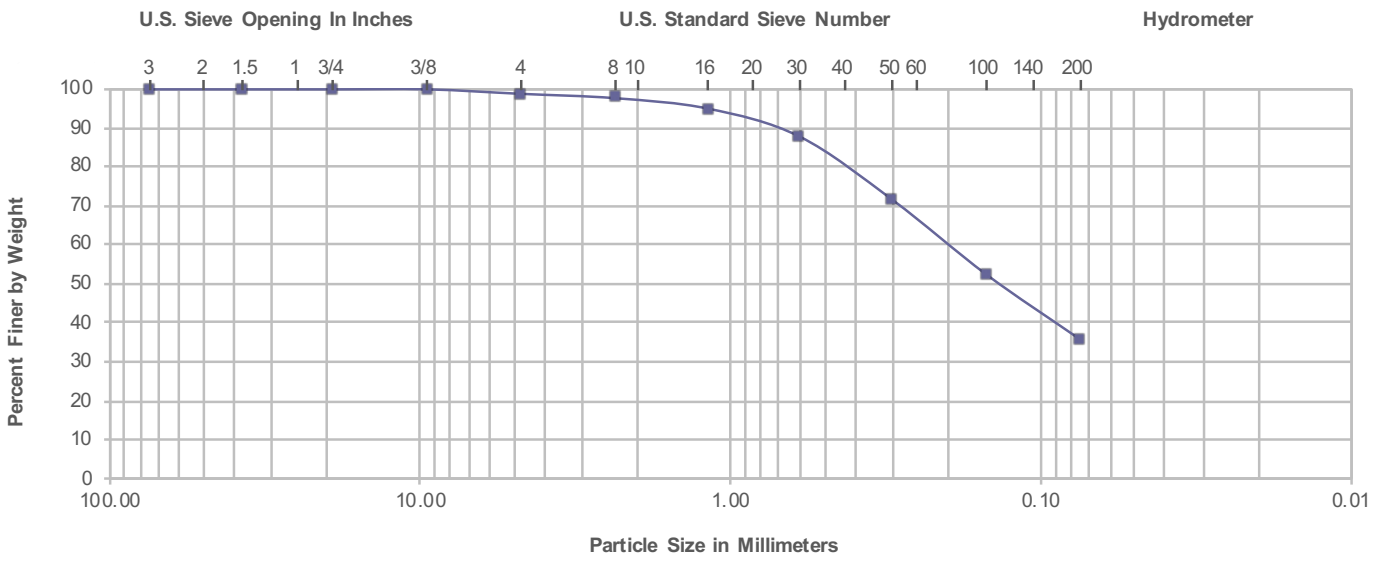
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171801 **Gravel** (%): 1.2% **Sand** (%): 63.1% **Fines** (%): 35.8%

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Five at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	1.7%	9.500	0.200			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 295.5
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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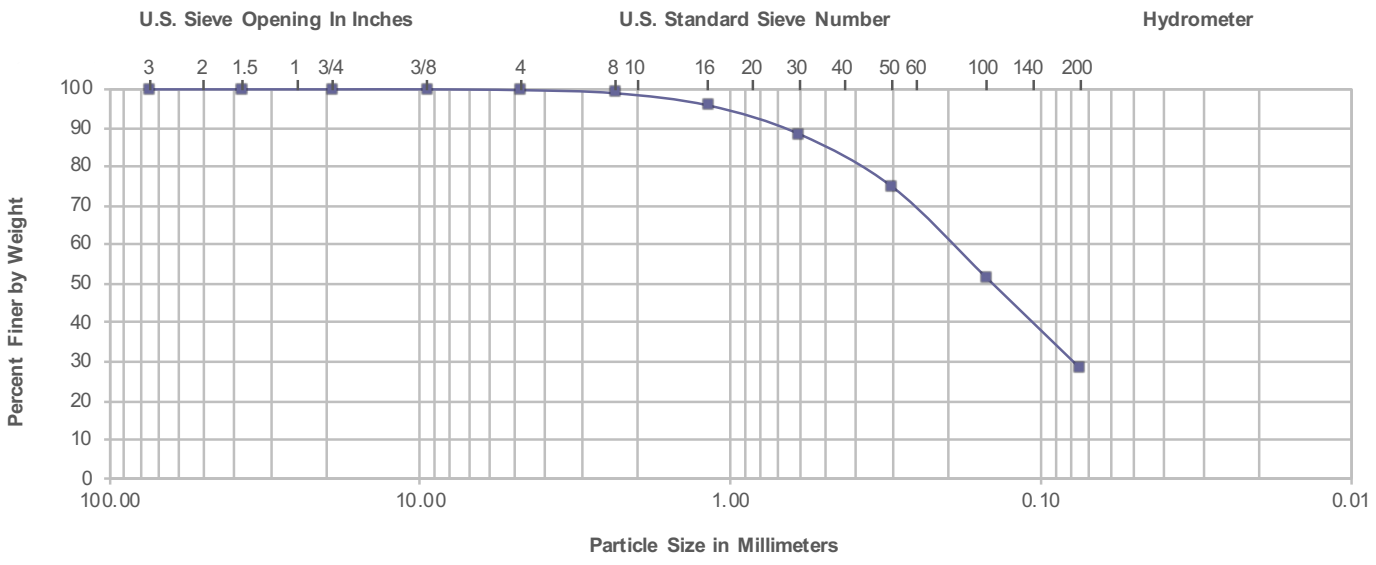
Sample ID: CRG10171805 **Gravel** (%): 0.2% **Sand** (%): 71.4% **Fines** (%): 28.4%

Classification, ASTM D2488: (SM) Sitly sand
Sample Origin: Boring Five at 10'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	4.0%	4.750	0.195	0.080		ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 289.4
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
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Client:	Parkway Construction

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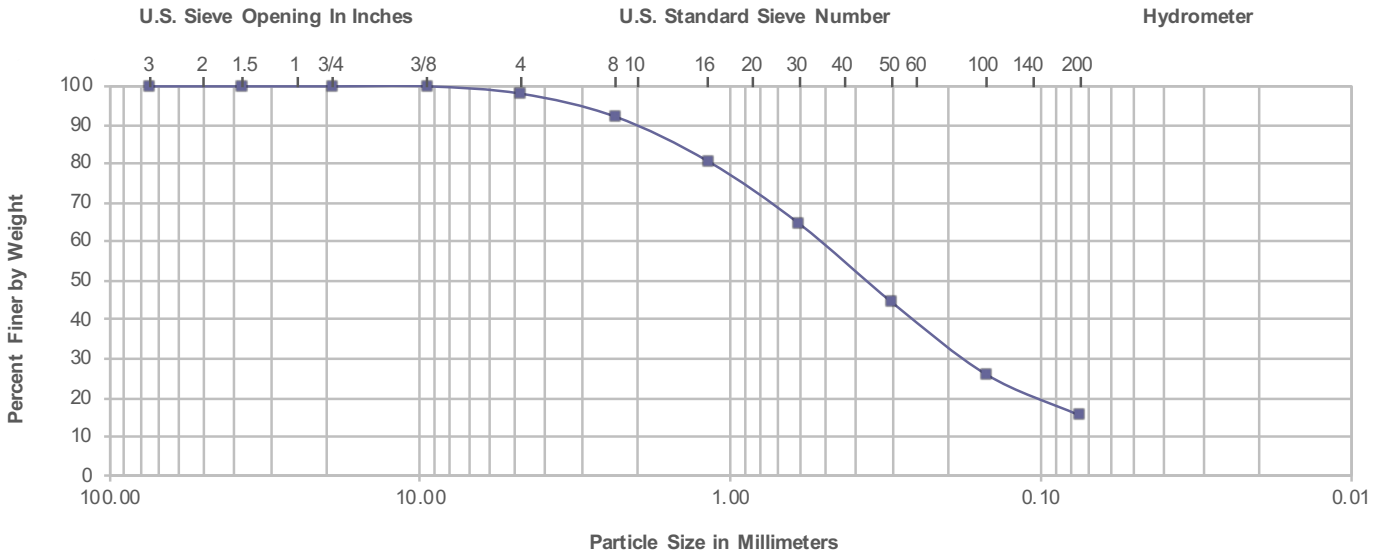
Sample ID: CRG10171809 **Gravel** (%): 1.9% **Sand** (%): 82.7% **Fines** (%): 15.4%

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Six at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	0.6%	9.500	0.515	0.180		ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 308.8
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

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Particle-Size Analysis of Soil

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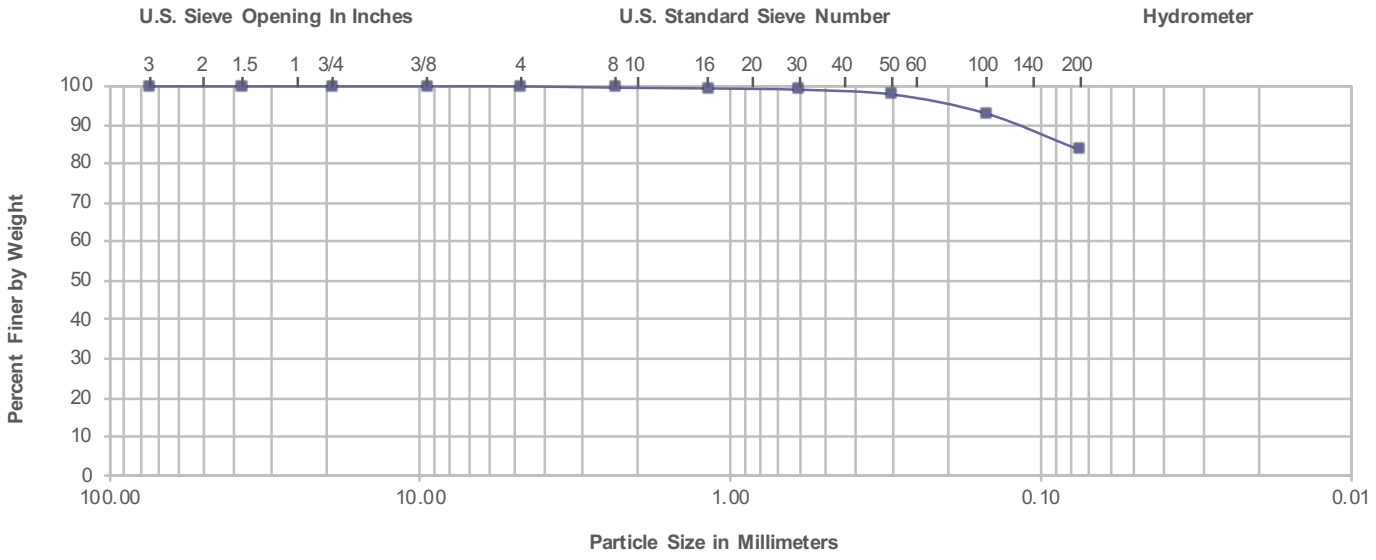
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171815 **Gravel** (%): 0.0% **Sand** (%): 16.4% **Fines** (%): 83.6%

Classification, ASTM D2488:	(CH) Sandy fat clay
Sample Origin:	Boring Six at 25'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	28.9%	1.180				ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	240.9
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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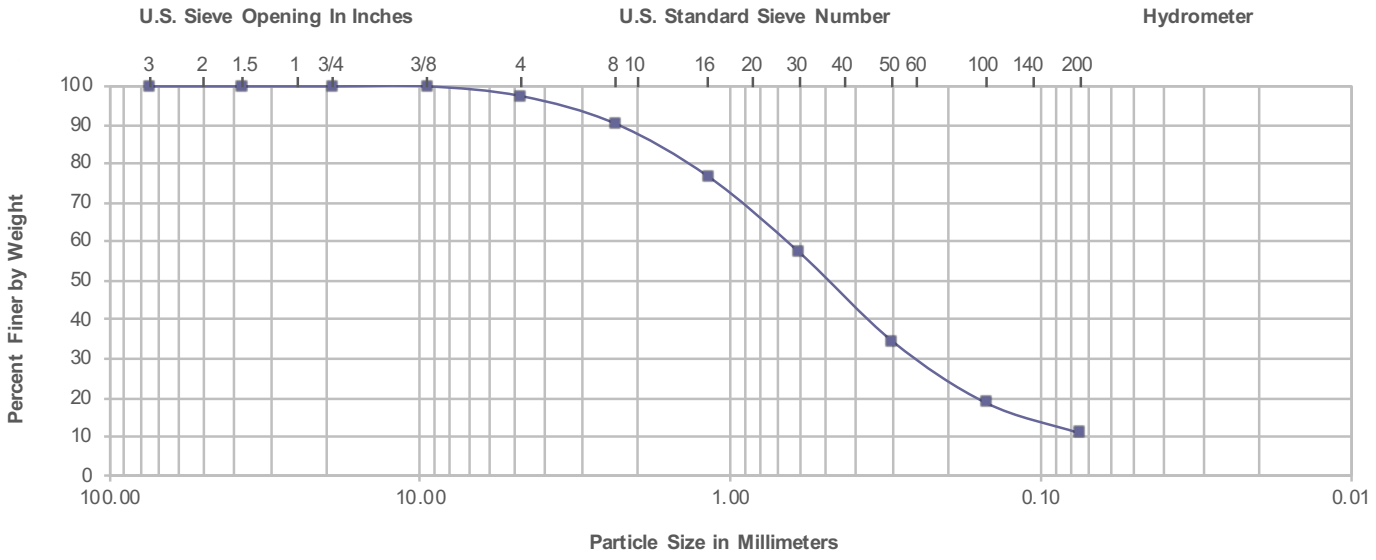
Sample ID: CRG10171821 **Gravel** (%): 2.5% **Sand** (%): 86.7% **Fines** (%): 10.8%

Classification, ASTM D2488: (SP-SM) Poorly graded sand with silt
Sample Origin: Boring Seven at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
9	1	1.2%	9.500	0.685	0.270	0.075	ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	310.1
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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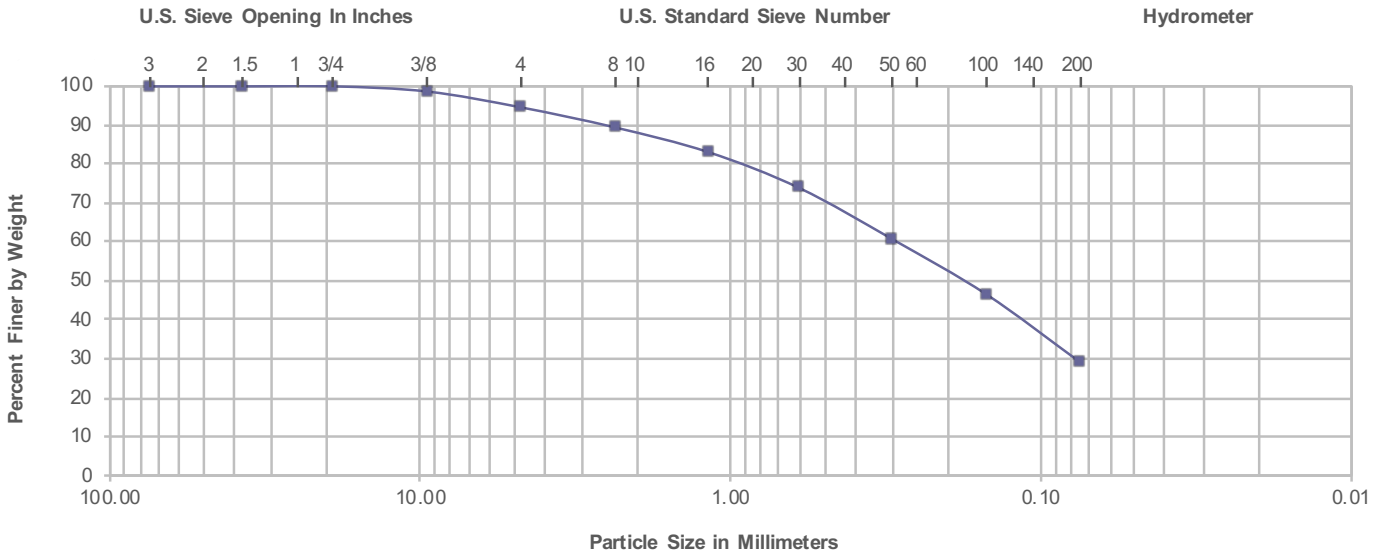
Sample ID: CRG10171825 **Gravel** (%): 5.4% **Sand** (%): 65.5% **Fines** (%): 29.1%

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Seven at 10'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	4.6%	19.000	0.300	0.080		ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 300.3
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

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Particle-Size Analysis of Soil

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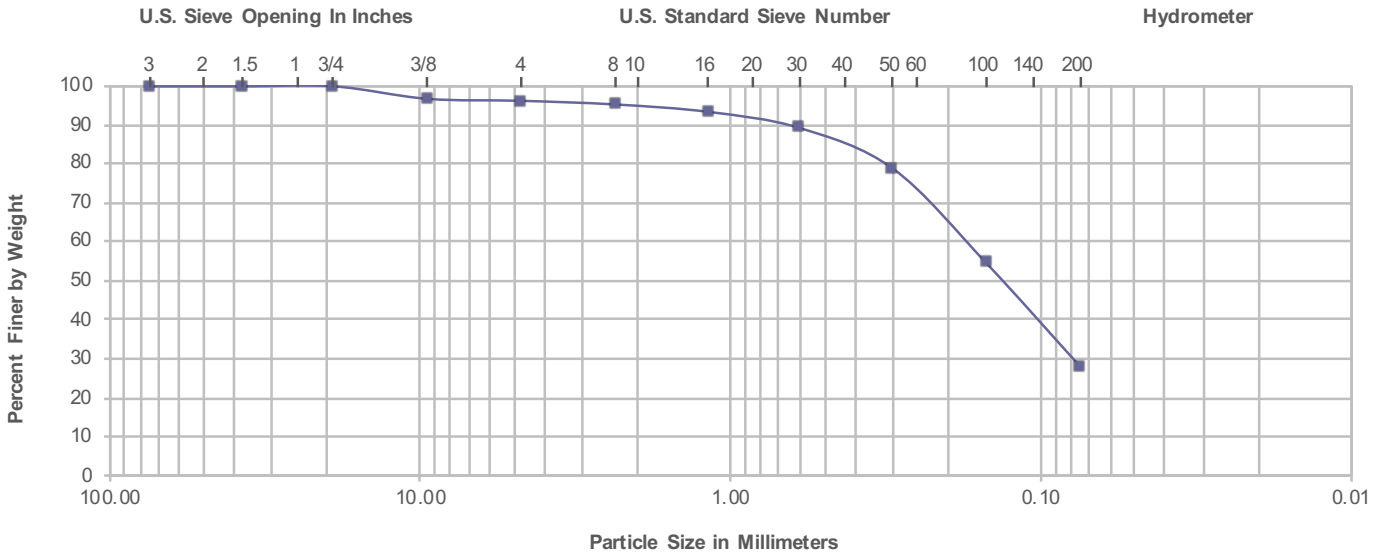
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171828 **Gravel** (%): 3.7% **Sand** (%): 68.2% **Fines** (%): 28.1%

Classification, ASTM D2488:	(SC) Clayey sand
Sample Origin:	Boring Seven at 25'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	22.8%	19.000	0.175	0.080		ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	255.9
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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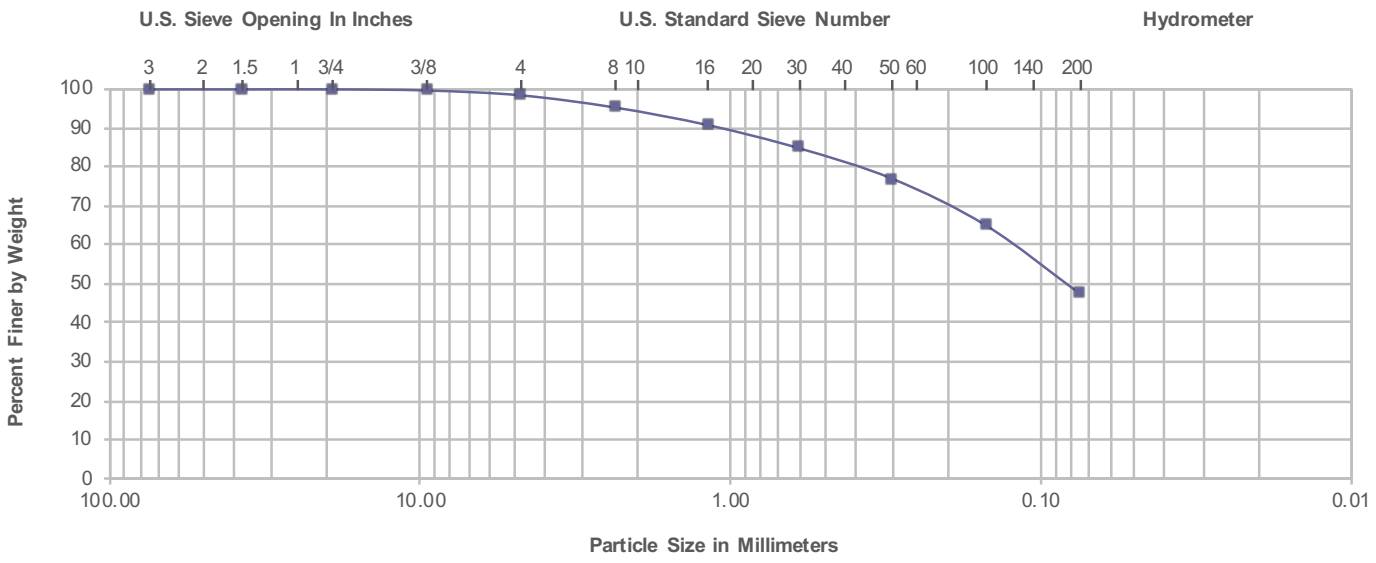
Sample ID: CRG10171829 **Gravel** (%): 1.5% **Sand** (%): 51.0% **Fines** (%): 47.5%

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring Eight at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	1.4%	9.500	1.350			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 305.7
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

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Particle-Size Analysis of Soil

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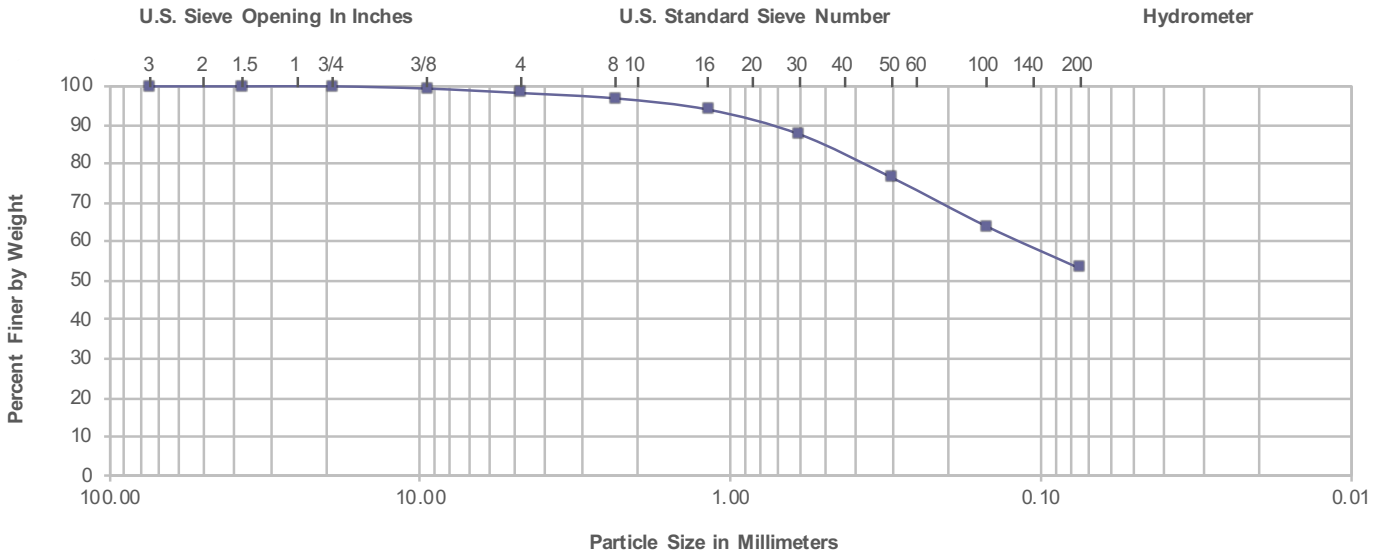
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171834 **Gravel** (%): 1.7% **Sand** (%): 45.1% **Fines** (%): 53.2%

Classification, ASTM D2488:	(ML) Sandy silt
Sample Origin:	Boring Eight at 20'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	13.6%	9.500	0.130			ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	278.6
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

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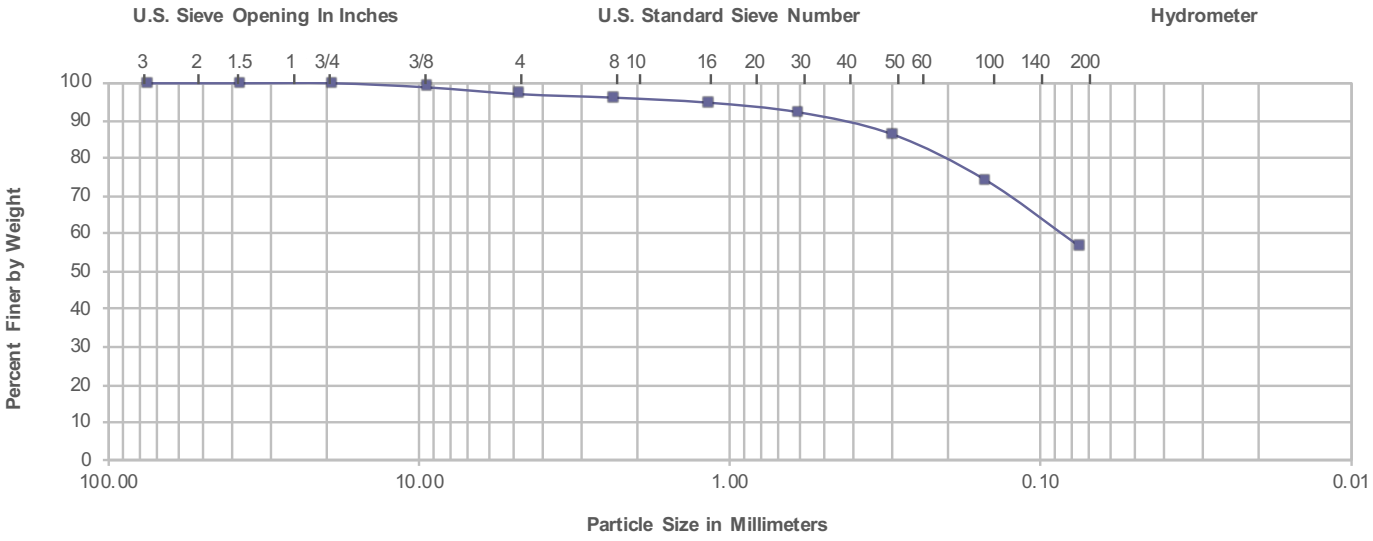
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171835 **Gravel** (%): 2.9% **Sand** (%): 40.4% **Fines** (%): 56.7%

Classification, ASTM D2488:	(ML) Sandy silt
Sample Origin:	Boring Eight at 25'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	17.5%	19.000	0.075			ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	258.7
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

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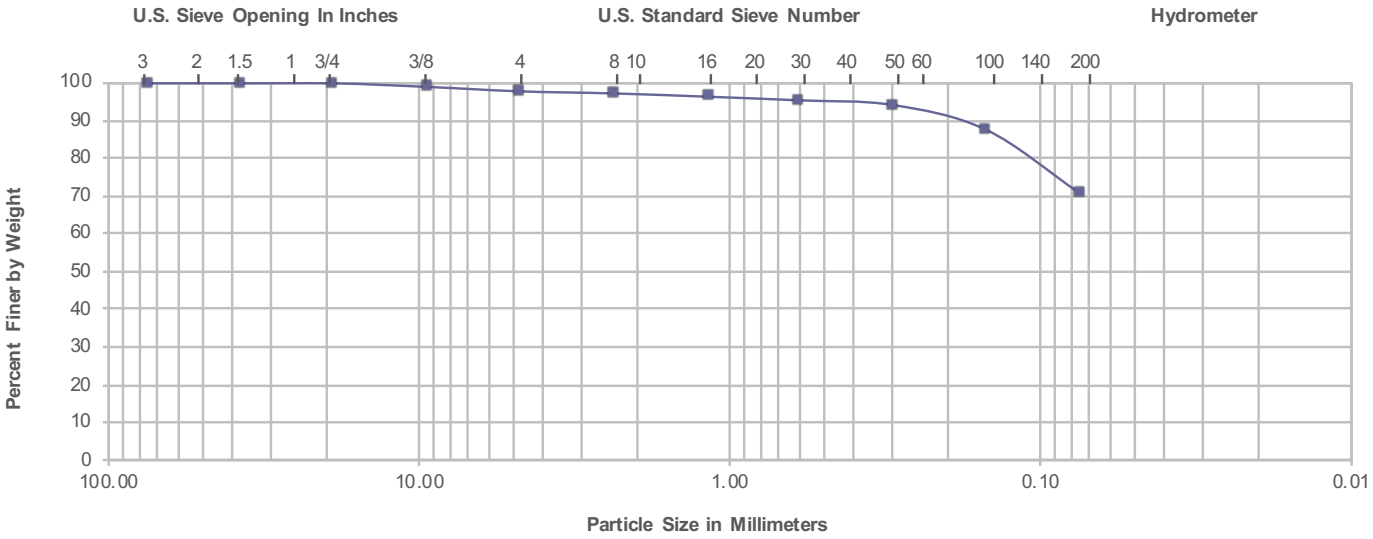
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171836 **Gravel (%):** 2.1% **Sand (%):** 27.0% **Fines (%):** 70.8%

Classification, ASTM D2488:	(ML) Sandy silt with traces of sand
Sample Origin:	Boring Eight at 30'
Laboratory Remarks:	



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	21.4%	19.000				ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	251.8
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

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Particle-Size Analysis of Soil

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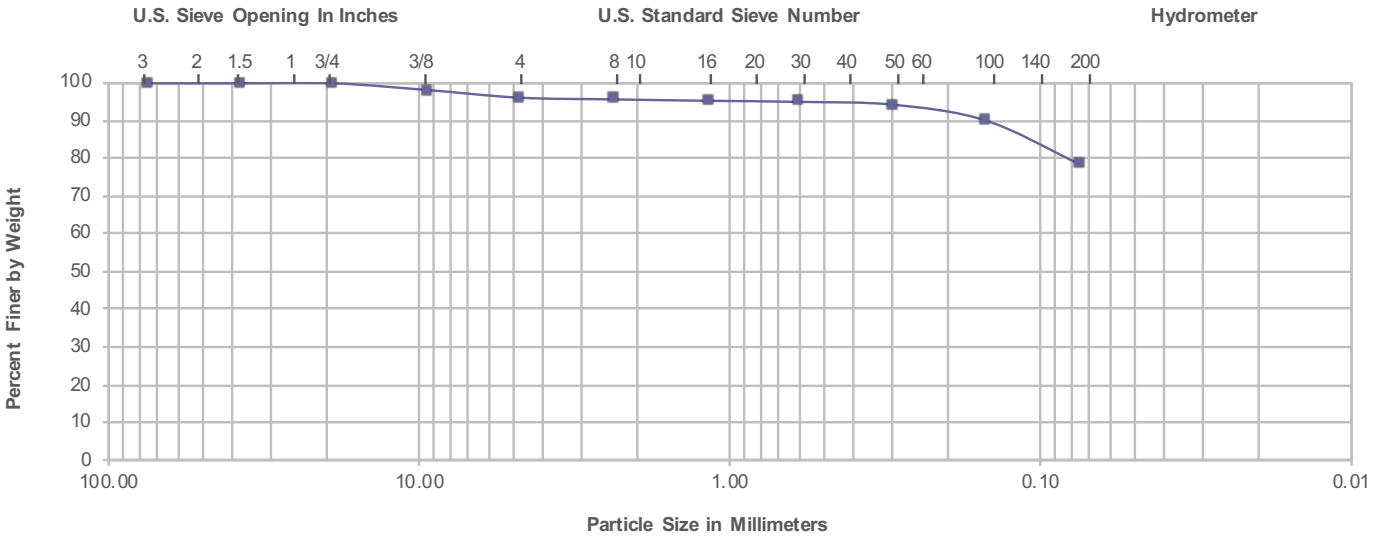
DSA LEA No:	

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171840 **Gravel (%):** 3.8% **Sand (%):** 17.7% **Fines (%):** 78.5%

Classification, ASTM D2488: (ML) Sandy silt with traces of sand
Sample Origin: Boring Eight at 50'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	28.1%	19.000				ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	242.9
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Report Date:	10/17/18
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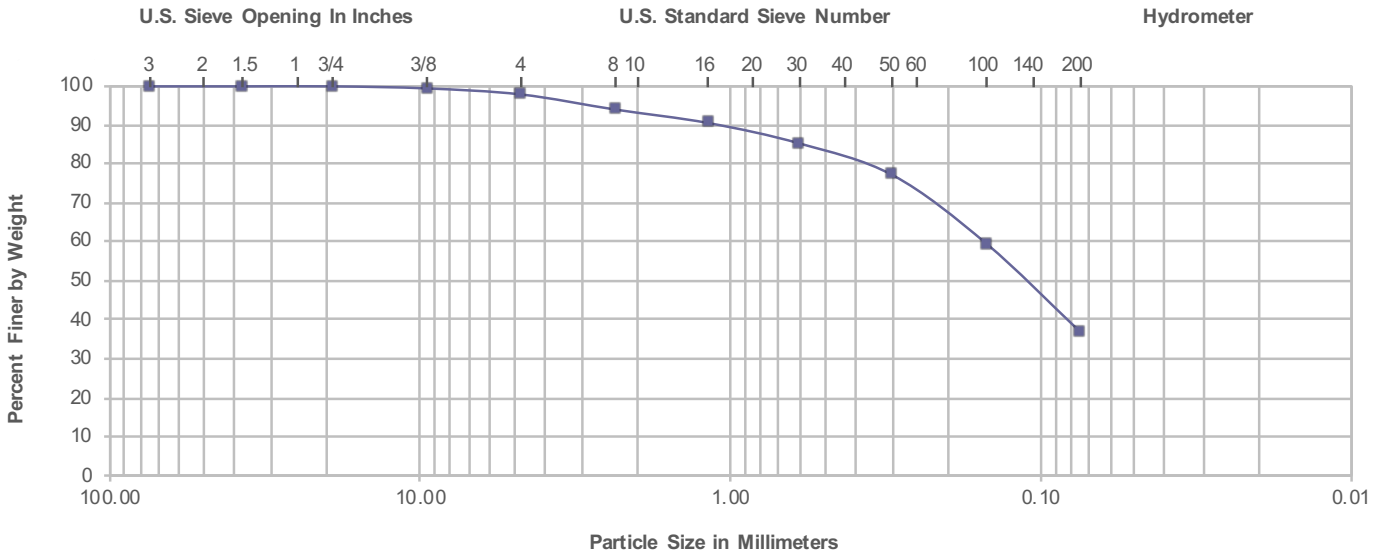
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10171841 **Gravel** (%): 2.1% **Sand** (%): 61.0% **Fines** (%): 37.0%

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring Nine at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	1.6%	9.500	0.165			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 298.9
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Report Date:	10/17/18
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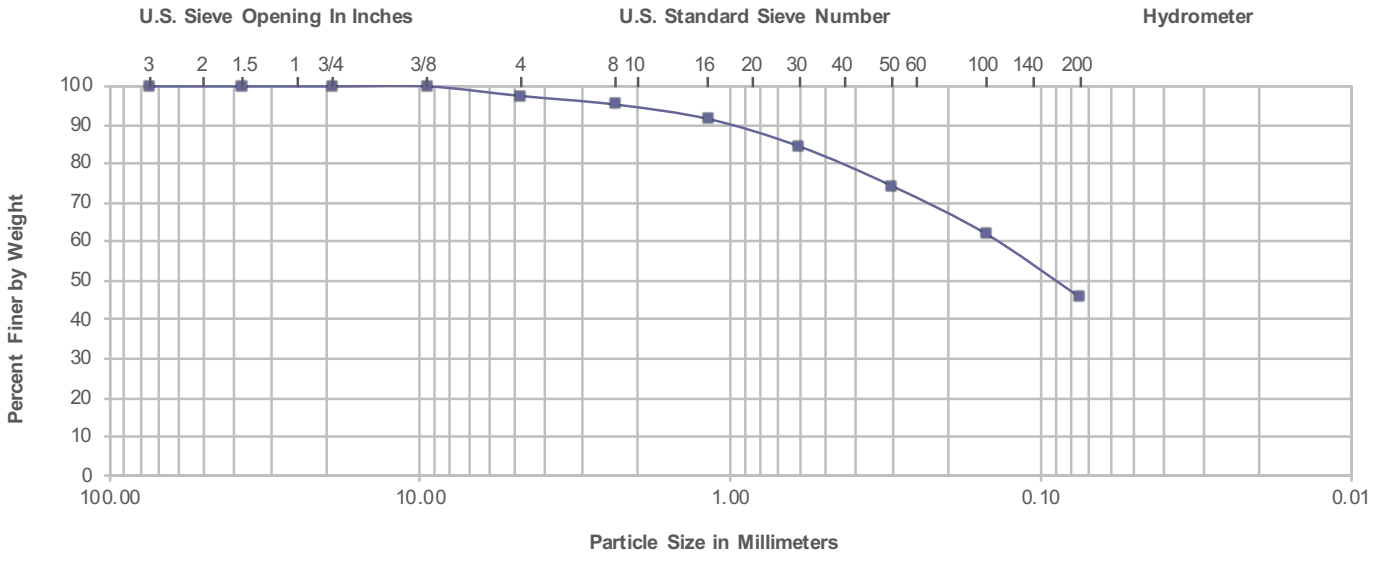
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10171845 **Gravel** (%): 2.5% **Sand** (%): 51.7% **Fines** (%): 45.8%

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Nine at 10'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	8.3%	9.500	1.450			ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 278.6
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
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Particle-Size Analysis of Soil

D422, D1140, D2487

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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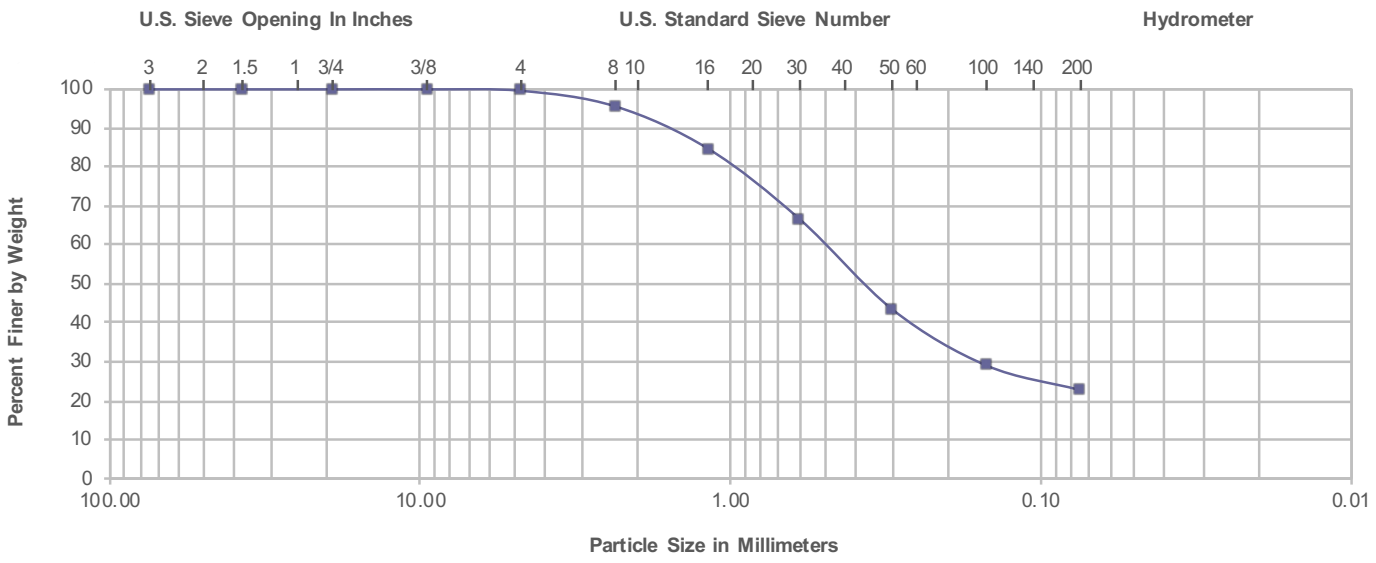
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10171848 **Gravel** (%): 0.4% **Sand** (%): 76.9% **Fines** (%): 22.7%

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Nine at 25'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	6.0%	4.750	0.500	0.155		ND	ND	ND	ND	ND	-

Method / Procudure Used: D422/Proc. A
Size of Initial Dry Mass (g): 300.3
Determination of Dry Mass: D2216
Particles; Shape, Hardness: ND
Dispersion Device/Period: Manual/2.0hr
Type & Amount of Agent: Defloc./1.0
Laboratory Comments:

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
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Particle-Size Analysis of Soil

D422, D1140, D2487

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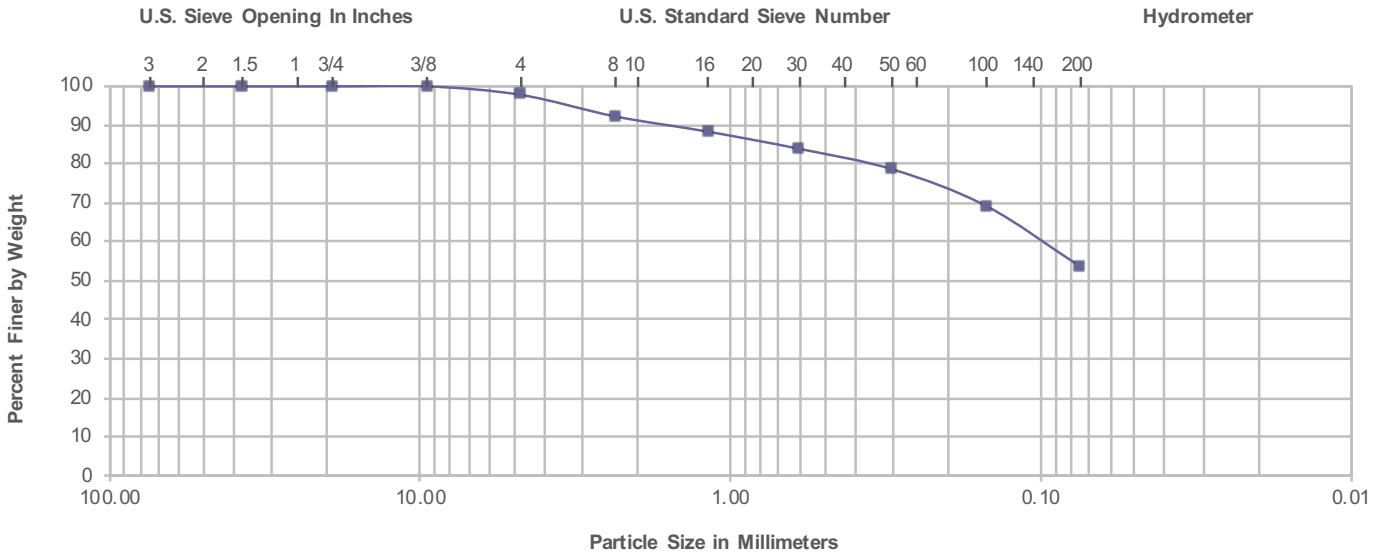
DSA LEA No:	

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171849 **Gravel** (%): 2.2% **Sand** (%): 44.1% **Fines** (%): 53.7%

Classification, ASTM D2488: (ML) Sandy silt
Sample Origin: Boring Ten at 0' to 5'
Laboratory Remarks:



C_u	C_c	Moisture	D_{100}	D_{60}	D_{30}	D_{10}	LL	PL	PI	SG	FM	Other
NA	NA	2.7%					ND	ND	ND	ND	ND	-

Method / Procudure Used:	D422/Proc. A
Size of Initial Dry Mass (g):	301.7
Determination of Dry Mass:	D2216
Particles; Shape, Hardness:	ND
Dispersion Device/Period:	Manual/2.0hr
Type & Amount of Agent:	Defloc./1.0
Laboratory Comments:	

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Laboratory Compaction Characteristics

ASTM D1557, D2488

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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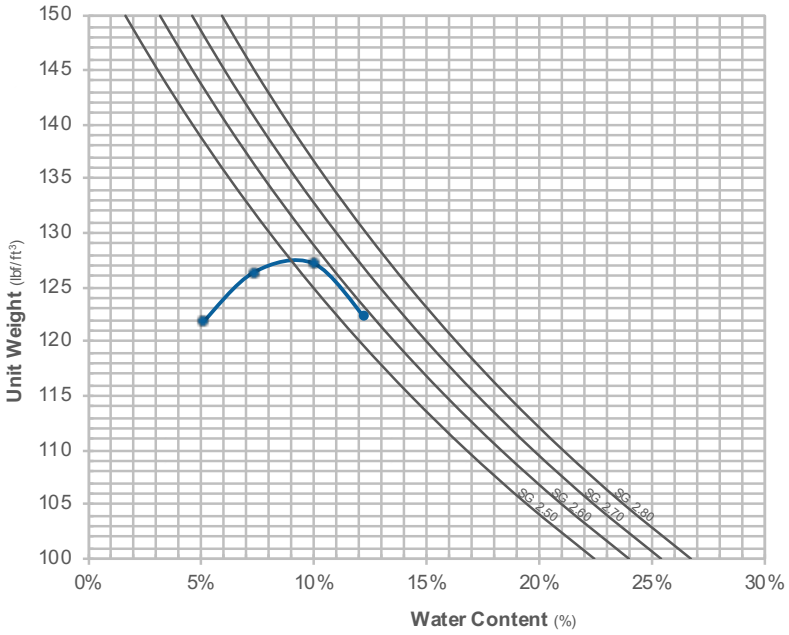
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10161801 **Maximum Dry Unit Weight** (lb/ft³): 127.5 **Optimum Moisture Content** (%): 9.4

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring One at 0' to 5'
Laboratory Remarks:



Tested By:	JDA
Date Tested:	10/19/18
Received Moisture:	2.2%
Preparation:	Wet
Specific Gravity:	ND
Specific Gravity Method:	ND
Start Weight (lb):	35.0
Retained on 3/4" (lb):	0.0
Retained on 3/8" (lb):	0.0
Retained on No. 4 (lb):	0.3
Retained on 3/4" (%):	0.0%
Retained on 3/8" (%):	0.0%
Retained on No. 4 (%):	0.9%
Oversize Correction:	ND
Mold Volume Factor:	30.08
Tare Weight	4.40
Rammer Used:	Mechanical
Method A:	☑
Method B:	☐
Method C:	☐

Weight of Soil and Tare (lb):	8.66	8.91	9.05	8.96
Wet Weight (g):	306.2	308.9	301.4	303.5
Dry Weight (g):	291.3	287.8	274.1	270.4
Moisture Content (%):	5.1%	7.3%	10.0%	12.2%
Dry Unit Weight (lb/ft³):	121.9	126.4	127.2	122.2

The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
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Reviewd By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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Laboratory Compaction Characteristics

ASTM D1557, D2488

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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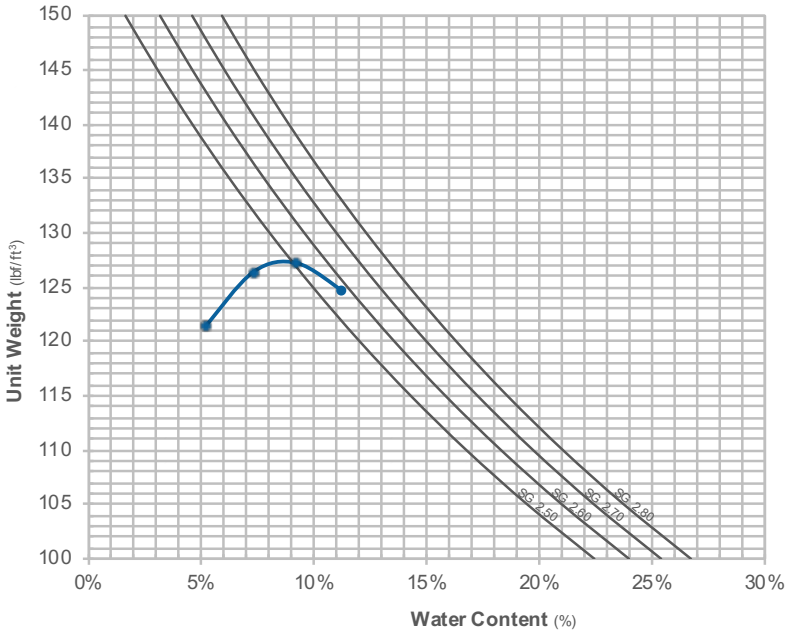
DSA LEA No:	

Sample ID: CRG10171829 **Maximum Dry Unit Weight** (lb/ft³): 127.3 **Optimum Moisture Content** (%): 8.7

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring Eight at 0' to 5'
Laboratory Remarks:



Tested By:	CRO
Date Tested:	10/19/18
Received Moisture:	1.4%
Preparation:	Wet
Specific Gravity:	ND
Specific Gravity Method:	NA
Start Weight (lb):	35.0
Retained on 3/4" (lb):	0.0
Retained on 3/8" (lb):	0.0
Retained on No. 4 (lb):	0.8
Retained on 3/4" (%):	0.0%
Retained on 3/8" (%):	0.0%
Retained on No. 4 (%):	2.3%
Oversize Correction:	ND
Mold Volume Factor:	30.08
Tare Weight	4.40
Rammer Used:	Mechanical
Method A:	☑
Method B:	☐
Method C:	☐

Weight of Soil and Tare (lb):	8.65	8.91	9.02	9.01
Wet Weight (g):	306.5	307.0	300.7	308.6
Dry Weight (g):	291.3	286.1	275.3	277.3
Moisture Content (%):	5.2%	7.3%	9.2%	11.3%
Dry Unit Weight (lb/ft³):	121.5	126.4	127.2	124.6

The Material	☐ Was	☐ Was Not	Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested	☐ Met	☐ Did Not Meet	The requirements of the DSA approved documents.

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Plasticity Index of Soils

ASTM D4318

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DSA LEA No.:	

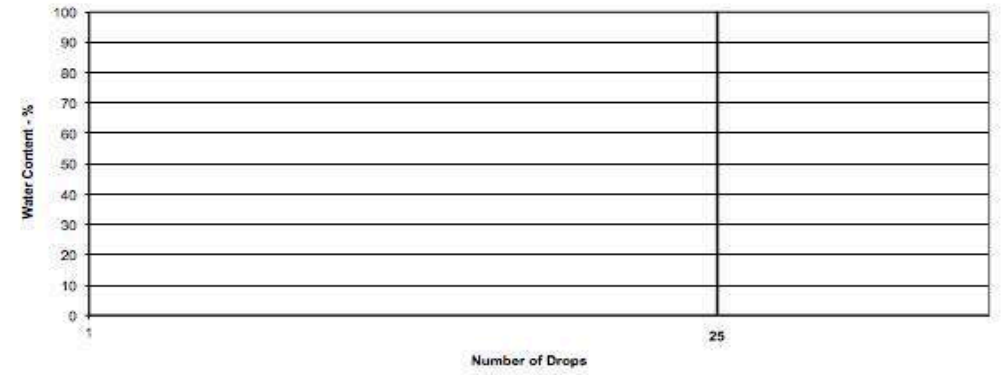
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

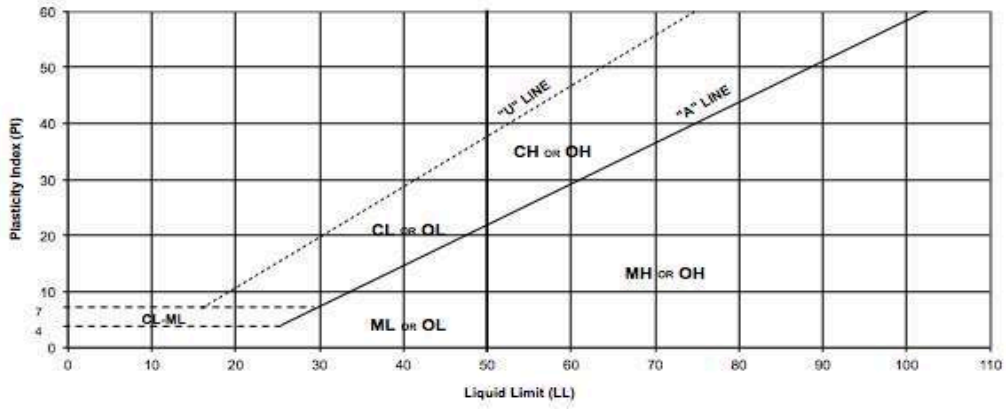
Sample ID: CRG10161808

Desription:	(SM) Silty sand	**Tested By:**	James Albornoz
Sample Origin:	Boring One at 25'	**Method/Equipment Used:**	Multi Point, Manual
Laboratory Remarks:			

Plasticity Index (PI):

Liquid Limit (LL):	-
Plastic Limit (PL):	-
Plasticity Index (LL-PL):	NP





The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Clayton Garrison / Laboratory Manager
Name / Title

Plasticity Index of Soils

ASTM D4318

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DSA LEA No.:	

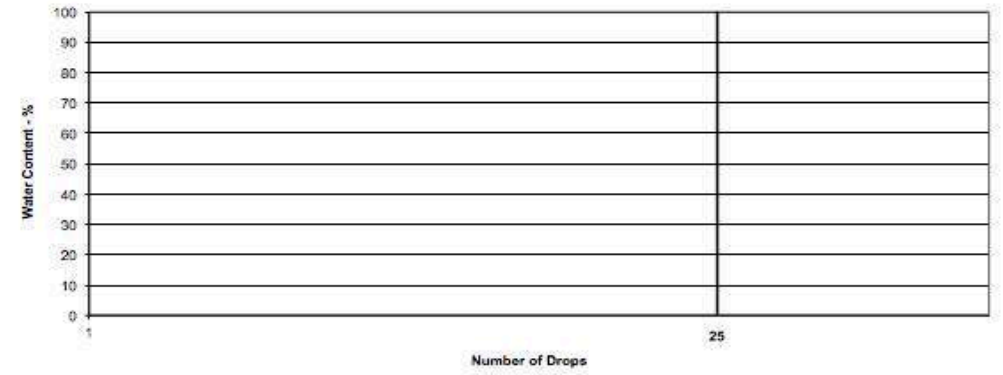
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

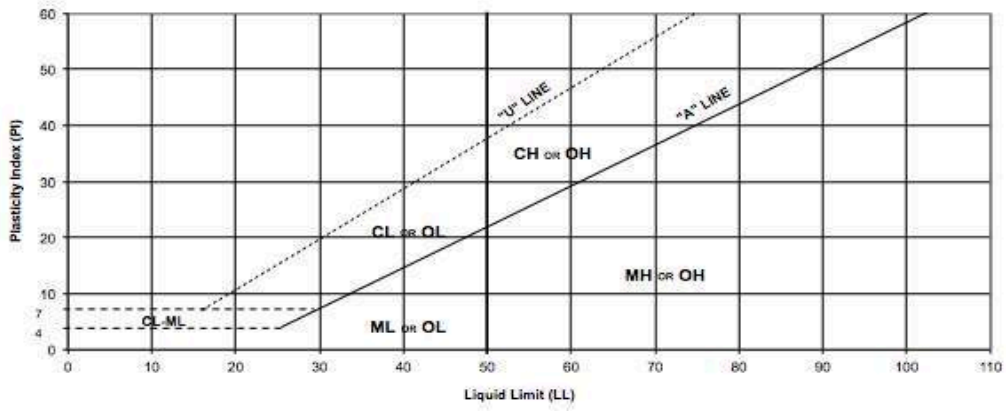
Sample ID: CRG10171808

Desription:	(SM) Silty sand	**Tested By:**	James Albornoz
Sample Origin:	Boring Five at 25'	**Method/Equipment Used:**	Multi Point, Manual
Laboratory Remarks:			

Plasticity Index (PI):

Liquid Limit (LL):	-
Plastic Limit (PL):	-
Plasticity Index (LL-PL):	NP





The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

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Clayton Garrison / Laboratory Manager
Name / Title

R-Value and Expansion Pressure of Compacted Soils

ASTM D2844

Report Date:	10/22/18
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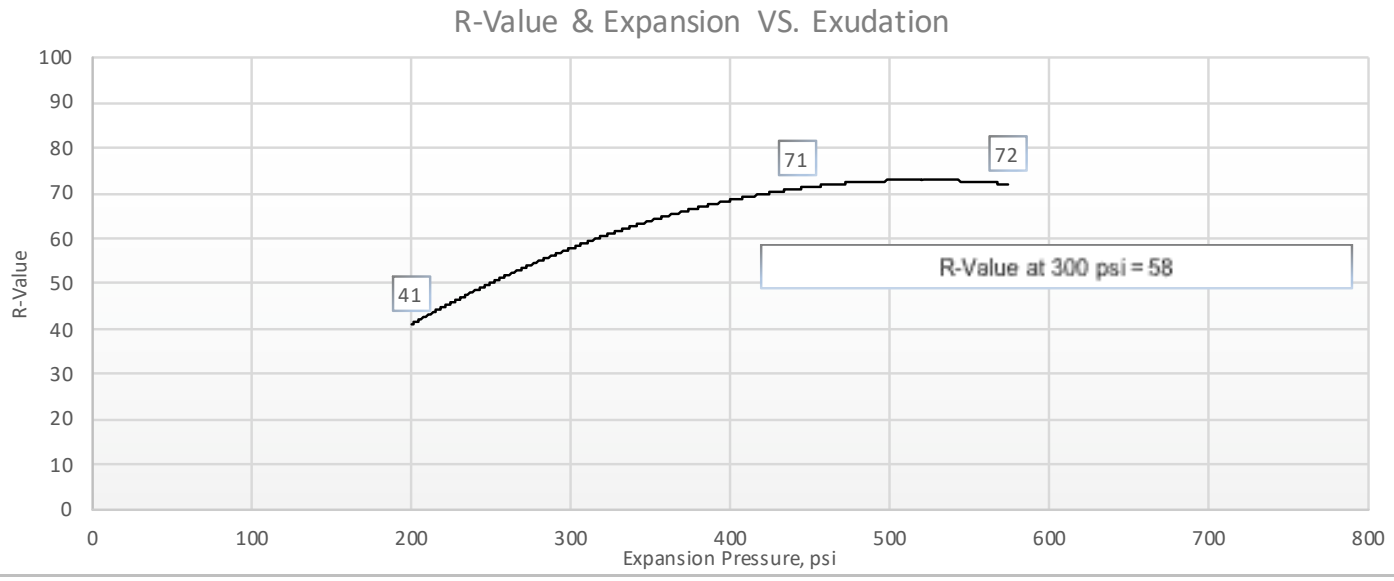
Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10171829 ☐ **General Compliance** ☐ **Non-Compliance** ☑ **Not Specified**

Desription:	(SC) Clayey sand
Sample Origin:	Boring Eight at 0' to 5'
Tested By:	James Albornoz

Briguette Number:	1	2	3
Moisture Content (%):	9.0	9.8	11.4
Dry Density (pcf):	118.4	120.2	117.5
Exudation Pressure (psi):	574	442	200
Expansion Pressure (psf):	0	0	0
R-Value:	72	71	41



The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

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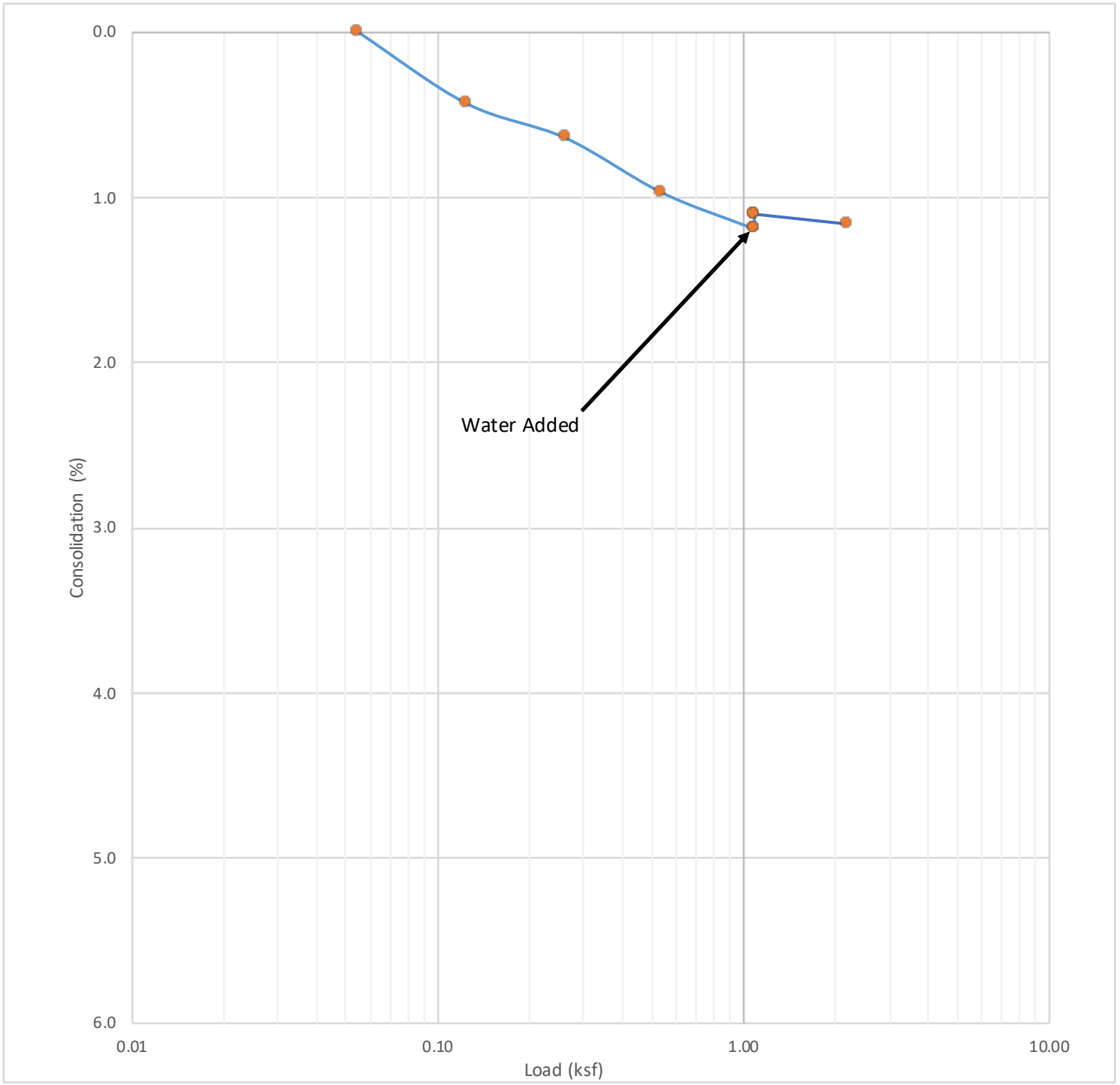
Consolidation Test Results

ASTM D2435



Sample ID:	CRG10171831	γ_d	99.3	pcf
Sample Description:	(SM) Light Brown Silty Sand	Pre-consolidation w_c	2.0	%
Sample Source:	Boring Eight at 5'	Post-consolidation w_c	25.1	%

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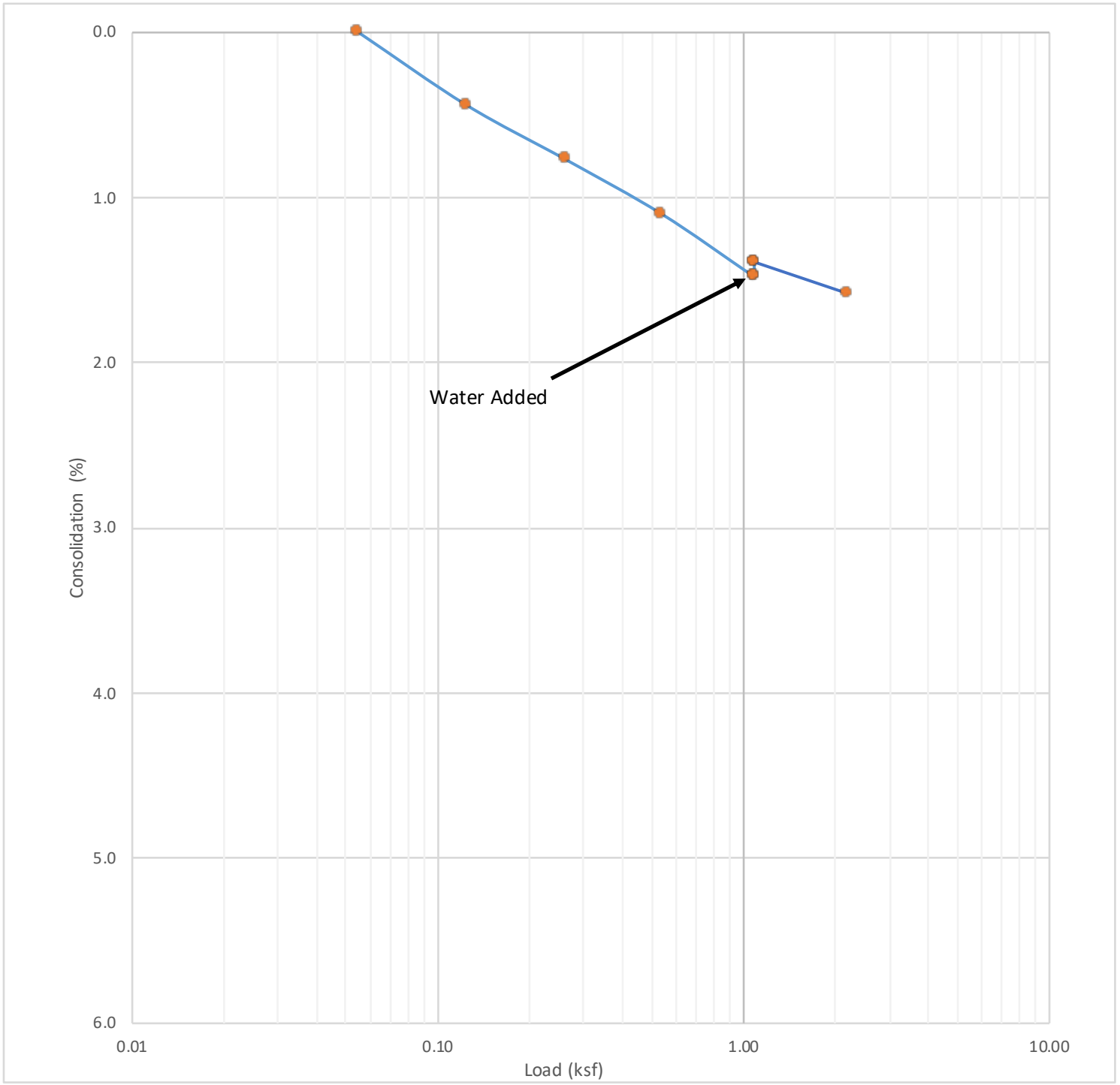
Supplemental Geotechnical Investigation
El Mirage, CA

By:	Clayton Garrison	Date:	10/24/18
Job No:	3514.001.501	Appendix:	C

Consolidation Test Results

ASTM D2435



Sample ID:	CRG10171811	γ_d	85.7	pcf
Sample Description:	(SM) Light Brown Silty Sand	Pre-consolidation w_c	1.5	%
Sample Source:	Boring Six at 5'	Post-consolidation w_c	35.1	%

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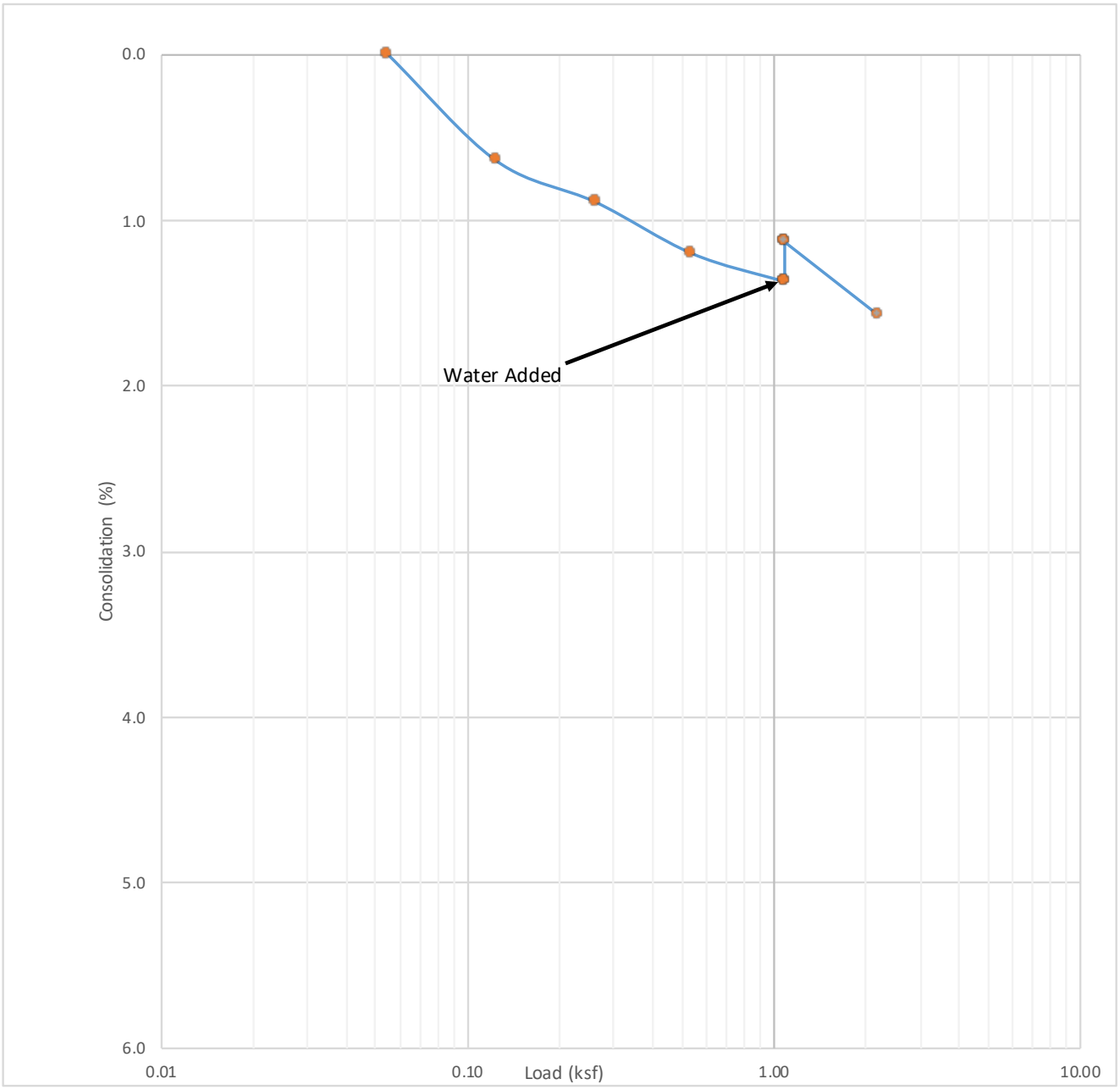
Supplemental Geotechnical Investigation
El Mirage, CA

By:	Clayton Garrison	Date:	10/25/18
Job No:	3514.001.501	Appendix:	C

Consolidation Test Results

ASTM D2435



Sample ID:	CRG10161827		γ_d	105.7 pcf
Sample Description:	(SM) Light Brown Silty Sand		Pre-consolidation w_c	6.5 %
Sample Source:	Boring Four at 5'		Post-consolidation w_c	21.3 %

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Supplemental Geotechnical Investigation
El Mirage, CA

By:	Clayton Garrison	Date:	10/26/18
Job No:	3514.001.501	Appendix:	C

Corrosion Potential

CT 643, 422, 417, 643

Report Date:	10/16/18
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Other:	
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Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Sample ID: CRG10161801

Classification, ASTM D2488:	(SC) Clayey sand
Sample Origin:	Boring One at 0' to 5'
Laboratory Remarks:	

Analysis	Result	Units	Test Method
Saturated Resistivity	324	ohm-cm	CT 643
Chloride	0.002	%	CT 422
Sulfate	0.840	%	CT 417
pH	8.29	pH units	CT 643

The Material	☐ Was	☐ Was Not	Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested	☐ Met	☐ Did Not Meet	The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Clayton Garrison / Laboratory Manager

Name / Title

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Direct Shear Test of Soils

ASTM D3080

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

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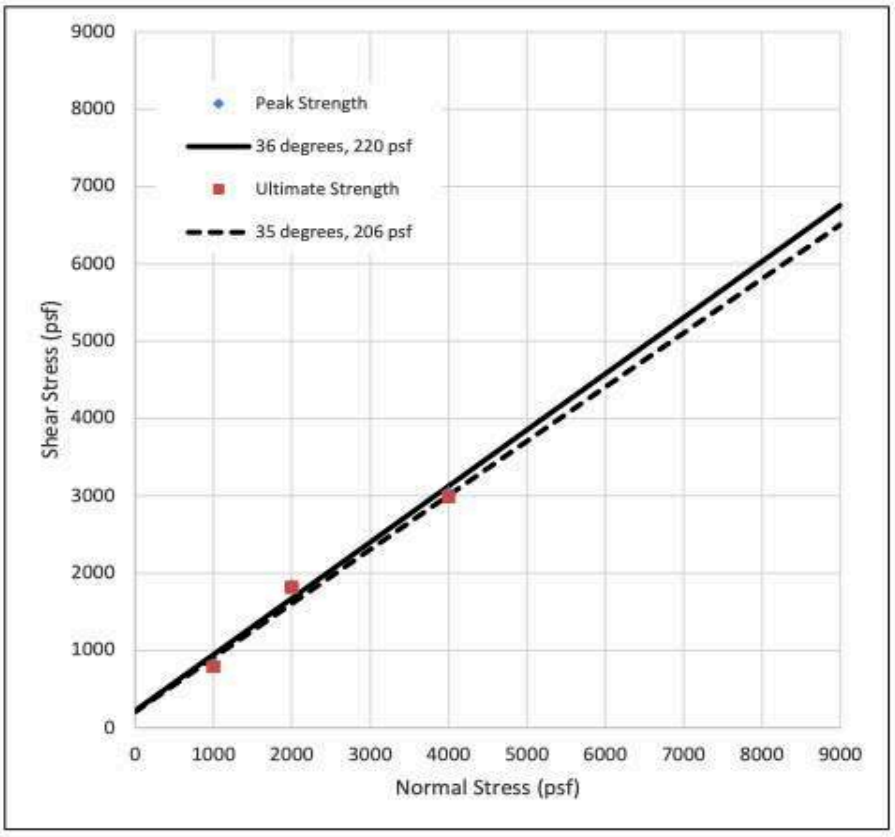
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10161812 **Angle of Internal Friction** (°): 35 (Ultimate) **Cohesion** (psf): 206 (Ultimate)

Classification, ASTM D2488: (SM) Silty sand
Sample Origin: Boring Two at 5'
Laboratory Remarks:



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The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

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Clayton Garrison / Laboratory Manager
Name / Title

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Direct Shear Test of Soils

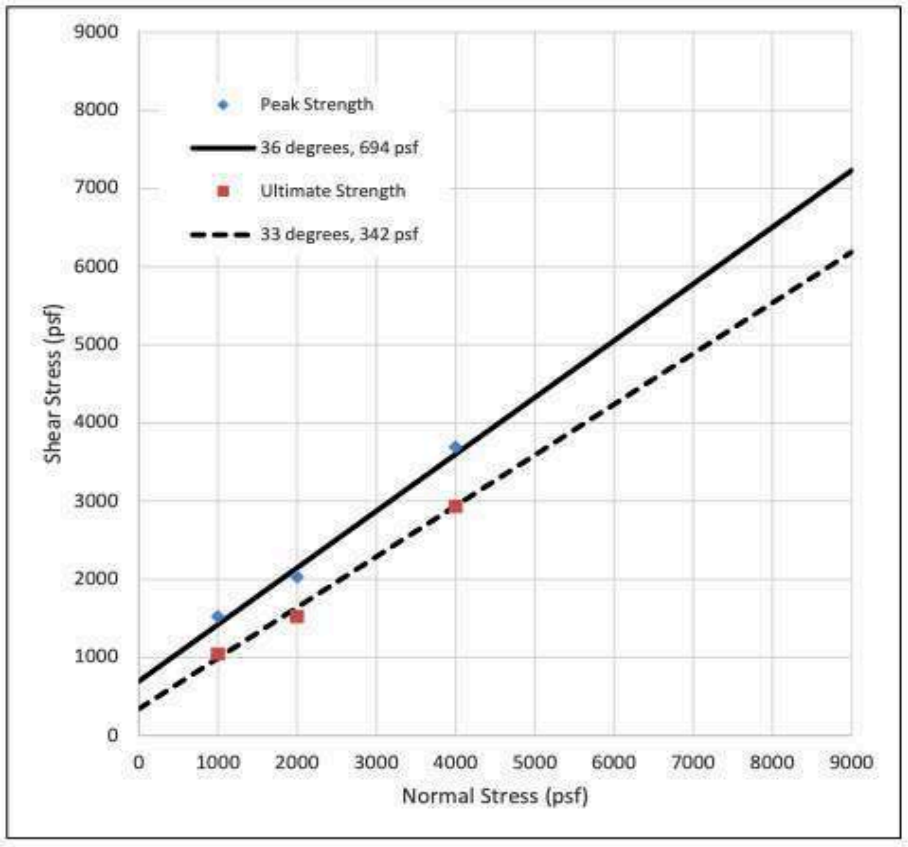
ASTM D3080

Project Number:	3514.001.501
Project Title:	Supplemental Geotechnical Investigation
Project Location:	El Mirage, CA
Client:	Parkway Construction

Report Date:	10/17/18
Sheet:	1 of 1
Appendix:	C
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10171832 **Angle of Internal Friction** (°): 33 (Ultimate) **Cohesion** (psf): 342 (Ultimate)

Classification, ASTM D2488: (SP-SM) Poorly graded sand with silt
Sample Origin: Boring Eight at 10'
Laboratory Remarks:



The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.

cc: Project Architect, Structural Engineer, Project Inspector, DSA Regional Office, School District

Reviewd By (Signature)

Clayton Garrison / Laboratory Manager
Name / Title

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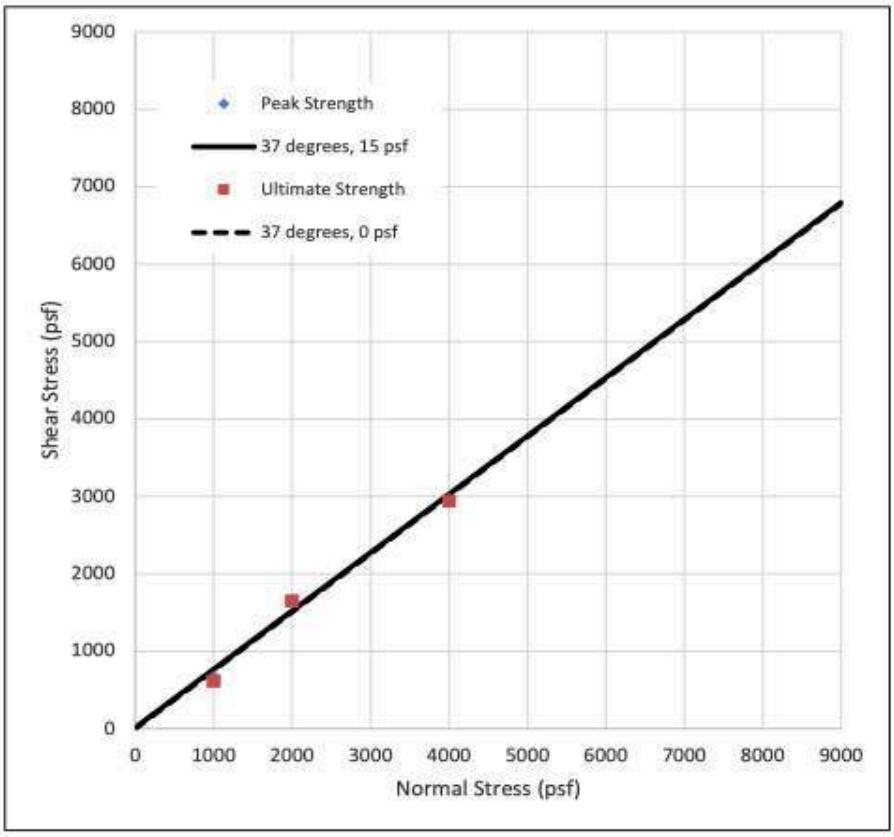
Sheet:	1 of 1
Appendix:	C
Permit No:	
Client Project No:	
Other:	
DSA File No:	
DSA Application No:	
DSA LEA No:	

Sample ID: CRG10171844 **Angle of Internal Friction** (°): 37 (Ultimate) **Cohesion** (psf): 0 (Ultimate)

Classification, ASTM D2488: (SC) Clayey sand
Sample Origin: Boring Nine at 5'
Laboratory Remarks:



The Material ☐ Was ☐ Was Not Sampled & tested in accordance with the reqs. of the DSA approved documents.
The Material Tested ☐ Met ☐ Did Not Meet The requirements of the DSA approved documents.
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Reviewd By (Signature)

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APPENDIX E

Geologic Hazards Report

TERRA GEOSCIENCES

GEOLOGIC HAZARDS REPORT

PROPOSED GENERAL ATOMICS EXPANSION PROJECT

EL MIRAGE AIRPORT, SAN BERNARDINO COUNTY, CALIFORNIA

Project No. 172936-1

February 3, 2017

Prepared for:

Merrell Johnson Companies
128 East Fredricks Street
Barstow, CA 92311

Consulting Engineering Geology & Geophysics

P.O. Box 1090, Loma Linda, CA 92354 • 909 796-4667

Merrell Johnson Companies
128 East Fredricks Street
Barstow, CA 92311

Attention: Mr. Chris Langdon

Regarding: Geologic Hazards Report
Proposed General Atomics Expansion Project
El Mirage Airport, San Bernardino County, California
Merrell Johnson Companies Project No. 3439.001.100

INTRODUCTION

At your request, this firm has prepared a Geologic Hazards Report for the proposed General Atomics Expansion Project, within the El Mirage Airport, San Bernardino County, California, as referenced above. We understand this project will consist of a variety of construction projects to include but not limited to runway/taxiway extensions, road, and a hangar. The purpose for this study was to evaluate the local geologic conditions and seismic hazards, and to develop generalized conclusions and recommendations, if warranted, with respect to the proposed development.

There were no grading plans available for this evaluation and no subsurface exploration was performed by this firm. Only a review of available geologic and geotechnical data in our files was undertaken, along with the provided exploratory boring logs prepared from your subsurface exploration. We understand that this report will be appended into the geotechnical report prepared for the site by Merrell Johnson Companies; therefore, some descriptive sections have been purposely omitted as they are described in detail in your main report. The scope of services provided for this study included the following:

- ***Review of available published and unpublished geologic/seismic data in our files pertinent to the site.***
- ***Field reconnaissance by a State of California Certified Engineering Geologist including review of exploratory borings performed by Merrell Johnson Companies.***
- ***Preparation of this report, presenting our findings, conclusions, and recommendations from a geologic standpoint, with respect to the proposed development.***

Accompanying Map and Appendices

Plate 1 - Regional Geologic Map
Appendix A - Ground Motion Analysis Data
Appendix B - References

GEOLOGIC SETTING

The subject site is located within a natural geomorphic province in southern California known as the Mojave Desert. This province consists of a broad interior region of isolated mountain ranges separated by expanses of desert plains, and is characterized by the numerous interior enclosed drainages and playas. The Mojave Desert is in large, bounded structurally on the southwest by the San Andreas Fault and on the northwest by the Garlock Faults, and is ill-defined along the east where the structural patterns resemble the Basin and Range Province to the north and east. This province exhibits interior drainage, including the Mojave River, which has its source in the San Bernardino Mountains and would extend into Death Valley if there was enough water. The geologic units of this region generally consist of three main divisions being: 1) Crystalline rocks of pre-Tertiary age; 2) sediments and volcanic rocks of Tertiary age; and 3) sediments and basalt flows of Quaternary age. Regionally, the site is located along a large alluvial plain, locally underlain by Quaternary age alluvium and older that has been derived predominantly as outwash from the San Bernardino and San Gabriel Mountains to the south and southwest, respectively. These sediments are believed to be as thick as 500± feet locally (Subsurface Surveys, 1990).

More specifically, the site lies along a distinctive alluvial fan complex referred to as the Sheep Creek fan, which is shown below on Figure 1. This fan is depicted by the dark gray "cone-shape" that emanates from the toe of the San Gabriel Mountains to the south, extending northward to the distal limits that terminates at El Mirage Lake.

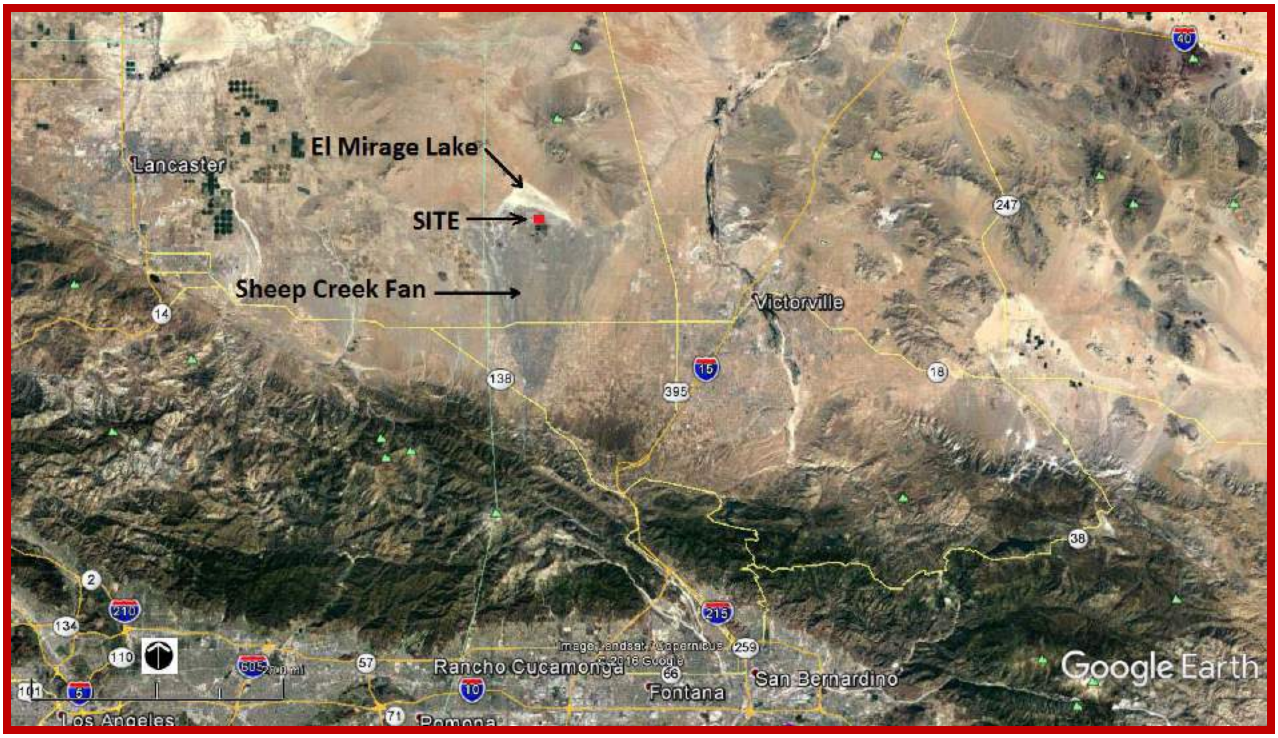


FIGURE 1- Google™ Earth (2014) image showing the "cone-shaped", dark gray Sheep Creek Fan.

This fan is composed largely of detrital material from Pelona Schist, which is a Late Cretaceous-early Tertiary well-foliated, metamorphic rock (predominantly a gray, well-foliated, albite-quartz-muscovite). The source of this fan material originates as debris flows from Sheep, Heath, and Swarthout Creeks farther to the south in the San Gabriel Mountains. The dark gray Pelona Schist debris in the Sheep Creek fan causes the fan to stand out prominently from adjacent fans that are dominated by lighter colored gneissic and granitic material (as depicted on Figure 1).

Locally as mapped by Miller and Bedford (2000) and as shown on the Regional Geologic Map, Plate 1, the subject site is predominantly shown to be mantled by Holocene age eolian and alluvial fan deposits (map symbol Qyef), comprised predominantly of sand-sized particles carried north on the Sheep Creek fan in gullies, then blown eastward into sand sheets with an estimated thickness of 3 to 12± feet. Directly underlying these eolian deposits are Holocene age alluvial sand and eolian deposits (map symbol Qyfe) consisting of gravel, sand, and silt, which forms the main body of Sheep Creek fan.

Subsurface exploratory boring excavations performed by Merrell Johnson Companies (January 2017) indicate the subject construction area to be predominantly underlain by interbedded dry to moist fine- to coarse-grained silty sands, sandy silts, sandy clays, and clayey sands, with minor gravel, that are poorly graded, to a depth of at least 51± feet. These sediments were noted to be in an overall medium-dense to dense condition.

FAULTING

There are at least forty-two major "potentially active/active" (late Quaternary) faults that are within a 100-kilometer (62 mile) radius of the site as generally shown on Figure 2 below (site shown as small black square in middle). Of these, there are no active faults known to traverse the site based on published literature. In addition, the subject site is not located within a State of California “Alquist-Priolo Earthquake Fault Zone” for surface fault rupture hazards (Bryant and Hart, 2007). Figure 3 below (from Miller and Bedford, 2000) has been provided to generally illustrate the subject site with respect to nearby active and inactive faults in the Mojave Desert region. The nearest known zoned active fault is associated with the San Andreas Fault Zone (Mojave Segment), which is located approximately 16¾ miles to the southwest (C.D.M.G., 1974).

The Mojave Segment of the San Andreas Fault is a right-lateral, strike-slip fault, being approximately 103 kilometers in length, with an estimated maximum moment magnitude of M_W 7.2-7.4, and an associated slip-rate of 30.0 ±7.0 mm/year (C.D.M.G., 1996; Cao et al., 2003; and Petersen et al., 2008). However, it should be noted that if all of the individual fault segments of the San Andreas Fault system were to rupture along its entire length, a combined maximum moment magnitude of M_W 8.1 could occur (Petersen et al., 2008).

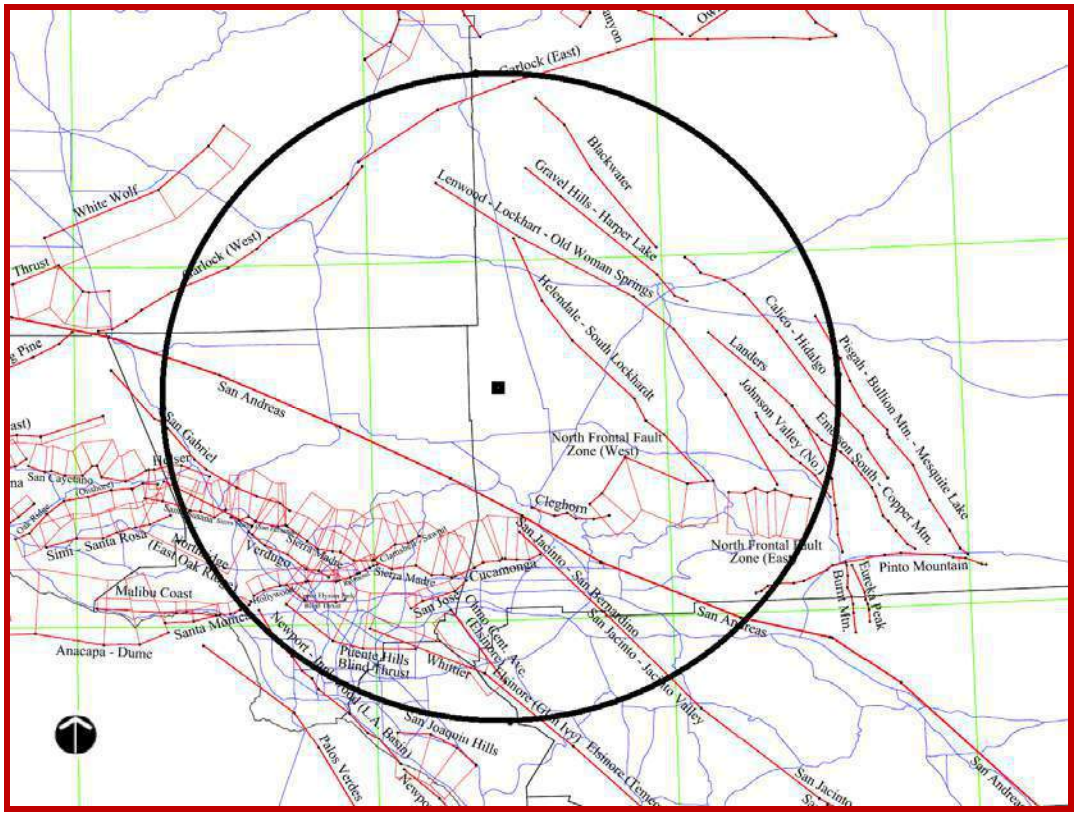


FIGURE 2- Regional Fault Map showing 100 km radius (from CGS 2002 California Fault Model)

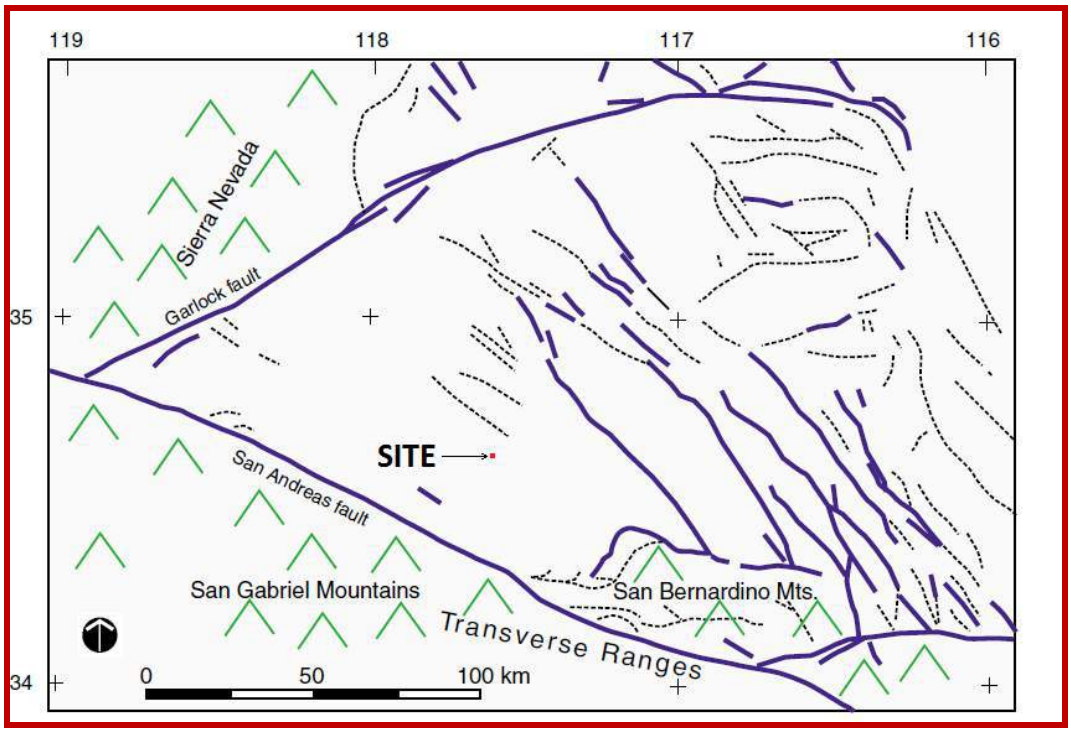


FIGURE 3- Map of active faults (heavy blue lines) and inactive faults (small black dashed lines).

GROUNDWATER

The study area lies within the El Mirage Valley Groundwater Basin, which underlies Swarthout Valley in the San Gabriel Mountains farther to the south and extends northwards beneath El Mirage Valley along the western border of central San Bernardino County. The basin is bounded by nonwater-bearing rocks of the of the Shadow Mountains on the north, Adobe Mountain and Nash Hill on the northwest, and the San Gabriel Mountains on the south. Alluvial drainage divides extending from the San Gabriel Mountains define the western and eastern boundaries of the basin.

The major water-bearing material within the basin is comprised of Quaternary alluvium forms and includes unconsolidated younger alluvial deposits and underlying unconsolidated to semi-consolidated older alluvial deposits. The estimated maximum thickness of the Quaternary alluvium is at least 392 feet (DWR 1980).

Several groundwater reports are available for the region and were used as a guide to determine the historic and recent local groundwater levels and characteristics, which included the following; Lines, 1996; Mendez and Christensen, 1997; Smith, 2000 and 2004; and Stamos and Predmore, 1995. These reports are listed in Appendix A for reference purposes. Based on a review of this data, groundwater is shown to vary between depths of around 35 to 40± feet in the general site vicinity. Subsurface exploration performed by Merrell Johnson Companies (January 2017) encountered groundwater at a depth as shallow as 46 feet locally, which appears reasonable considering the prolonged drought conditions that currently exist in the region.

FLOODING

According to the Federal Emergency Management Agency (2017), the proposed project is shown to be located within a non-printed flood map boundary (Map Panel 06071C5775H, dated August 28, 2008), which by definition is designated as “All area in Zone D.” This zone is further defined as “Areas in which flood hazards are undetermined, but possible.” Additionally, the San Bernardino County Hazards Overlay Map (San Bernardino County, 2010) does not indicate the site to be located within a designated flood hazard area.

CBC SEISMIC SUMMARY

Included for this study was an assessment of the seismic ground motion parameters of the subject site with respect to the most recently adopted 2016 California Building Code (CBC) and ASCE Standard 7-10 as partially summarized and tabulated below, with the calculation data (U.S.G.S. Design Maps, 2013) presented within Appendix A, for reference. Geographically, the subject project construction area is generally located at Longitude -117.5908 and Latitude 34.6221 (WGS 1984 coordinates).

TABLE 1 – SUMMARY OF SEISMIC DESIGN PARAMETERS

Factor or Coefficient	Value
S_S	**1.312g**
S_1	**0.546g**
F_a	**1.0**
F_v	**1.5**
S_{DS}	**0.874g**
S_{D1}	**0.546g**
S_{MS}	**1.312g**
S_{M1}	**0.819g**
T_L	**12 Seconds**
PGA	**0.489g**
Site Soil Classification	**D**

HISTORIC SEISMIC ACTIVITY

A computerized search, based on Southern California historical earthquake catalogs, has been performed using the computer programs EQSEARCH (Blake, 1989-2000) and EPI (Reeder, 1997). The following table and discussion summarizes the historic seismic events (greater than or equal to M4.0) that have been estimated and/or recorded during this time period of 1800 to January 2017, within a 100-kilometer radius of the site.

TABLE 2 - HISTORIC SEISMIC EVENTS; 1800-2017 (100 Kilometer Radius)

Richter Magnitude	No. of Events
4.0 - 4.9	352
5.0 - 5.9	54
6.0 - 6.9	15
7.0 - 7.9	1
8.0+	0

It should be noted that pre-instrumental seismic events (generally before 1932) have been estimated from isoseismal maps (Toppozada, et al., 1981 and 1982). These data have been compiled generally based on the reported intensities throughout the region, thus focusing in on the most likely epicentral location. Instrumentation beyond 1932 has greatly increased the accuracy of locating earthquake epicenters.

A summary of the historic earthquake data is as follows:

- The largest estimated historical earthquake magnitude within a 62 mile radius of the site is a M6.9 event of December 8, 1812 (approximately 18 miles southwest).
- The largest recorded historical earthquake was the M6.7 Big Bear event, located approximately 52 miles to the southeast (June 28, 1992).
- The nearest estimated significant historic earthquake epicenter was approximately 18 miles southwest, being the M6.9 event of December 8, 1812.
- The nearest recorded significant historic earthquake epicenter was approximately 25 miles southeast of the site (September 12, 1970, M5.4).
- The largest ground acceleration estimated to have been experienced at the site was 0.207g which resulted from the M6.9 event of December 8, 1812, which was located approximately 18 miles to the southwest (Blake, 1989-2000), based on the attenuation relationship of Boore et al. (1997).

SECONDARY SEISMIC HAZARDS

Secondary permanent or transient seismic hazards generally associated with severe ground shaking that occurs during an earthquake are ground rupture, liquefaction, seiches or tsunamis, flooding (water storage facility failure), landsliding, ground lurching and lateral spreading, rockfalls, and seismically-induced settlement. These are discussed below.

Ground Rupture:

Ground rupture is generally considered most likely to occur along pre-existing faults. Since there are no faults (active or otherwise) that are known to traverse the site, the potential for ground rupture is considered to be nil.

Liquefaction:

In general, liquefaction is a phenomenon that occurs where there is a loss of strength or stiffness in the soils from repeated disturbances of saturated cohesionless soil that can result in the settlement of buildings, ground failures, or other related hazards. The main factors contributing to this phenomenon are: 1) cohesionless, granular soils having relatively low densities (usually of Holocene age); 2) shallow groundwater (generally less than 50 feet); and 3) moderate-high seismic ground shaking. Due to the presence of relatively high groundwater conditions (encountered locally as shallow as 46 feet) and the groundwater data reviewed (as shallow as 35± feet); unconsolidated alluvial deposits underlying the site at depth, and regional high seismic potentials, there may be a potential for liquefaction to occur at the site.

Seiches/Tsunamis:

Based on the far distance of large, open bodies of water and the elevation of the subject site with respect to sea level, the possibility of seiches and/or tsunamis is considered nil.

Flooding (Water Storage Facility Failure):

Since no water storage facility (i.e. water tank, dam, etc.) is located above the site, the potential for flooding, caused by water storage facility failure, is considered nil. Additionally, the San Bernardino County Hazards Overlay Map (San Bernardino County, 2010) does not indicate the site to be located within a dam inundation hazard area.

Landsliding:

Due to the low-lying relief of the site and vicinity, landsliding due to seismic shaking is considered nil.

Ground Lurching/Lateral Spreading:

Ground lurching is the horizontal movement of soil, sediments, or fill located on relatively steep embankments or scarps as a result of seismic activity, forming irregular ground surface cracks. The potential for lateral spreading or lurching is highest in areas underlain by soft, saturated materials, especially where bordered by steep banks or adjacent hard ground. Due to the flat-lying nature of the site and distance from embankments, the potential for ground lurching and/or lateral spreading is nil.

Rockfalls:

Since no large rock outcrops are present at or adjacent to the site, the possibility of rockfalls during seismic shaking is nil.

Seismically-Induced Settlement:

Seismically-induced settlement generally occurs within areas of loose granular soils. Based on the data provided within the boring logs, the proposed construction area appears to be underlain by generally dense sediments therefore the potential for settlement appears to be low.

CONCLUSIONS AND RECOMMENDATIONS

GENERAL

Based on our review of available pertinent published and unpublished geologic/seismic literature (including the site-specific boring log data), construction of the proposed General Atomics expansion project appears to be feasible from a geologic standpoint, providing that our recommendations are considered during planning and construction. No unusual geologic conditions were observed during our field reconnaissance or literature research.

CONCLUSIONS:

1. Earth Materials

Based on our review of available published data and the provided borings logs, the earth materials underlying the site consist of younger alluvial fan deposits that consist of predominantly interbedded dry to moist, fine- to coarse-grained silty sands, sandy silts, sandy clays, and clayey sands, with minor gravel, that are poorly graded, to a depth of at least 51± feet. These surficial deposits have been derived from the Sheep Creek alluvial fan complex originating from the San Gabriel Mountains to the south and appear to be consistent with regional geologic mapping.

2. Faulting

No active faults are known to traverse the site, based on published literature, and no surficial indications or geomorphic features were observed that are suggestive of faulting. In addition, the subject site is not located within a designated Alquist-Priolo Earthquake Fault Zone for surface fault rupture hazards. The nearest mapped “active” fault (zoned Alquist-Priolo Earthquake Fault) is the San Andreas Fault (Mojave segment) which is located approximately 16¾ miles to the southwest.

3. Seismicity

The primary geologic hazard that exists at the site is that of ground shaking. Ground shaking from earthquakes accounts for nearly all earthquake losses. Many factors determine the severity of ground shaking at a given location, such as size of earthquake, length of fault rupture (if any), depth of hypocenter, type of faulting (dip slip/strike slip), directional attenuation, amplification, earth materials, and others. Due to the location of the subject property with respect to regional faulting and the recorded historical seismic activity in the region, moderate to severe ground shaking could be anticipated during the life of the proposed facilities.

4 Flooding

According to the Federal Emergency Management Agency and San Bernardino County, the proposed development is not located within the boundaries of a designated flood zone.

5. Groundwater

Groundwater was noted to be encountered as shallow as 46 feet locally during the subsurface exploration. Available published data indicates that the depth to groundwater historically has varied locally between 35 and 40± feet within the vicinity of the proposed development.

6. Secondary Seismic Hazards

Other than the potential for liquefaction, there do not appear to be any other permanent or transient secondary seismic hazards that are expected to occur at the subject site.

RECOMMENDATIONS:

1. It is recommended that all structures be designed to at least meet the current California Building Code provisions in the latest CBC edition (2016) and the ASCE Standard 7-10, where applicable, such as outlined in this report. However, it should be noted that the building code is described as a minimum design condition and is often the maximum level to which structures are designed. Structures that are built to minimum code are designed to remain standing after an earthquake in order for occupants to safely evacuate, but then may have to ultimately be demolished (Larson and Slosson, 1992).

   It is the responsibility of both the property owner and project structural engineer to determine the risk factors with respect to using CBC minimum design values for the subject project. The previously-outlined seismic summary data have been provided for use by the project structural engineer, to aid in evaluating design criteria. This data has been compiled from the U.S.G.S. web application "DesignMaps" using the ASCE 7-10 Standard which was derived from 2008 U.S.G.S. hazard data. This information should be carefully reviewed prior to construction.

2. Although the subject site is not shown to be located within a designated flood hazard zone, heavy runoff could be anticipated during peak periods of rainfall, which should be properly evaluated by the project Civil Engineer.

3. Due to the presence of relatively shallow groundwater conditions (i.e. less than 50 feet), the potential for liquefaction should be properly evaluated by the project Geotechnical Engineer. Any appropriate site-specific mitigation measures should be implemented as recommended, if warranted. For evaluation purposes, a high groundwater level of 35 feet (based on published groundwater data) along with an associated peak ground acceleration of 0.489g appears to be appropriate values when evaluating liquefaction potentials.

CLOSURE

Our conclusions and recommendations are based on a field reconnaissance, review of subsurface exploratory boring excavations, and an interpretation of available existing geotechnical and geologic/seismic data. We make no warranty, either express or implied. Should conditions be encountered at a later date or more information becomes available that appear to be different than those indicated in this report, we reserve the right to reevaluate our conclusions and recommendations and provide appropriate mitigation measures, if warranted.

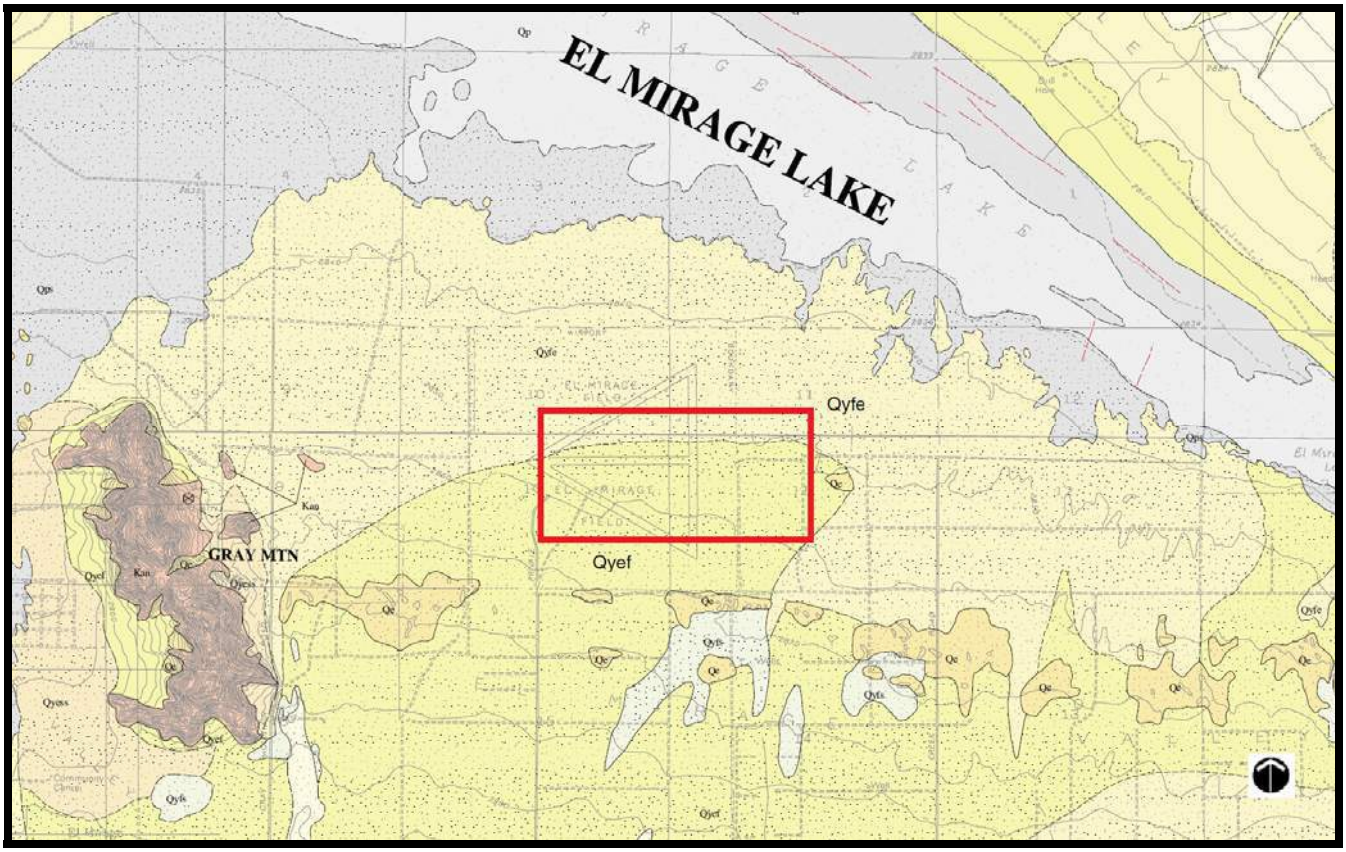
It is assumed that all the conclusions and recommendations outlined in this report are understood and followed. If any portion of this report is not understood, it is the responsibility of the owner, contractor, engineer, and/or governmental agency, etc., to contact this office for further clarification.

This opportunity to be of service is sincerely appreciated. If you should have questions regarding this report or do not understand the limitations of this study or the data and results that are presented, please do not hesitate to contact our office.

Respectfully submitted,
TERRA GEOSCIENCES

Donn C. Schwartzkopf
Certified Engineering Geologist
CEG 1459

REGIONAL GEOLOGIC MAP



BASE MAP: Miller and Bedford (2000), U.S.G.S. Open-File Report 2000-222, Scale 1"=3,800± feet (site outlined in red).

PARTIAL LEGEND

Qyef

YOUNG EOLIAN AND ALLUVIAL FAN DEPOSITS (Holocene)— Eolian sand sheets and mounds with subordinate young alluvium; restricted to southeast part of map area. Composed largely of sand-sized component of granitic sediments carried north on Sheep Creek fan in gullies and then blown eastward into sand sheets. Thickness 1 to 4 m.

Qyfe

YOUNG ALLUVIAL FAN AND EOLIAN DEPOSITS (Holocene)— Alluvium consisting of gravel, sand, and silt, irregularly overlain by subordinate eolian sand in mounds and small sheets. Forms main body of Sheep Creek fan. East of El Mirage Lake, consists of alluvium that represents reworked pale-green eolian sand blown from old playa bed. About 1 to 2 m thick.

GEOLOGIC CONTACT — Dashed where location is uncertain.

FAULT — Dashed where location uncertain, dotted where covered, queried where existence uncertain.

APPENDIX A

GROUND MOTION ANALYSIS DATA

USGS Design Maps Summary Report

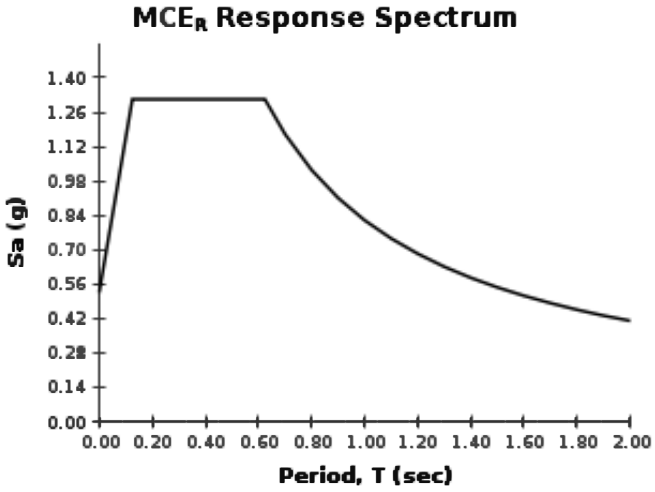
User–Specified Input

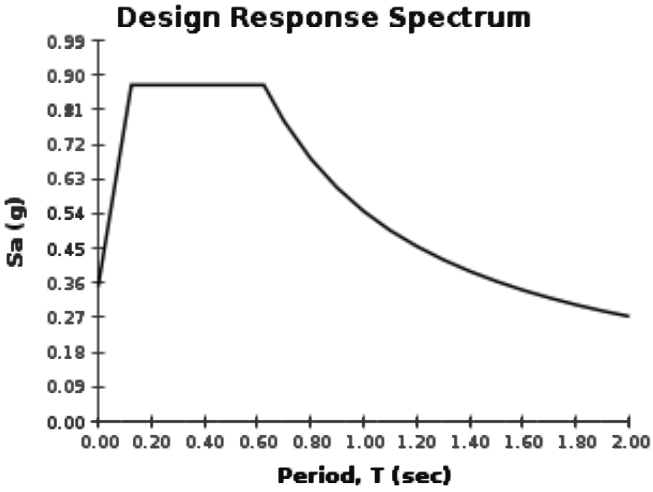
Report Title	El Mirage Project Tue January 24, 2017 00:26:28 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	34.6221°N, 117.5908°W
Site Soil Classification	Site Class D – "Stiff Soil"
Risk Category	I/II/III

USGS–Provided Output

S_S =	1.312 g	S_{MS} =	1.312 g	S_{DS} =	0.874 g
S_1 =	0.546 g	S_{M1} =	0.819 g	S_{D1} =	0.546 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

Design Maps Detailed Report

ASCE 7-10 Standard (34.6221°N, 117.5908°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 1.312$ g

From Figure 22-2 [2] $S_1 = 0.546$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content w ≥ 40%, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = D and S_s = 1.312 g, F_a = 1.000

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.546 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 1.312 = 1.312$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.546 = 0.819$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

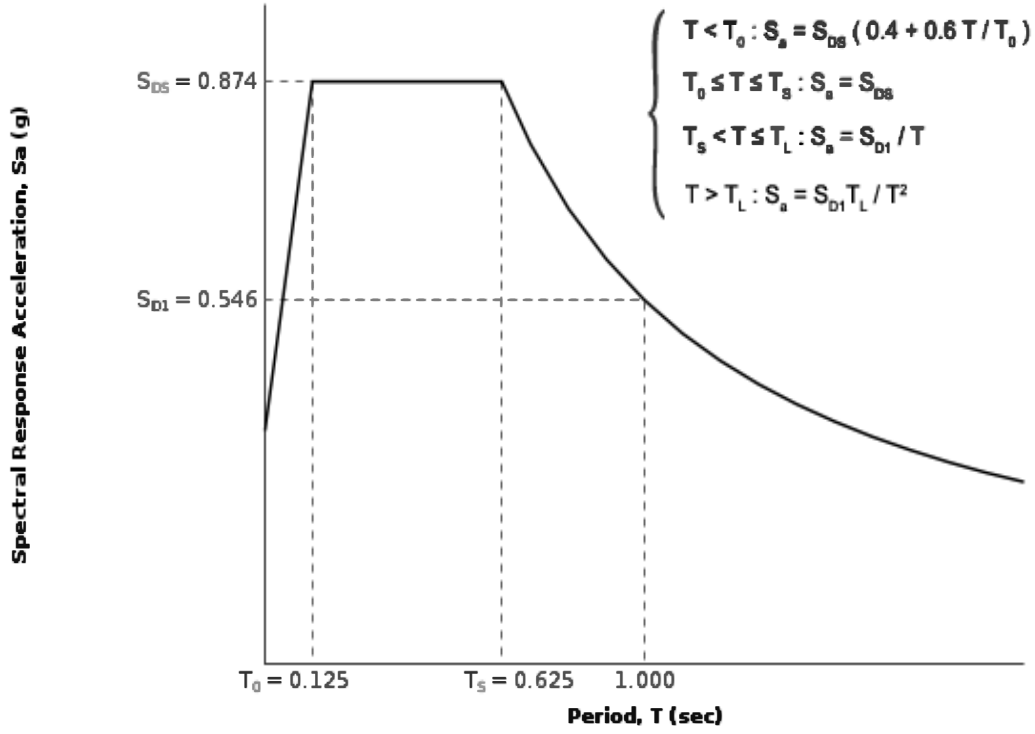
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.312 = 0.874$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.819 = 0.546$ g

Section 11.4.5 — Design Response Spectrum

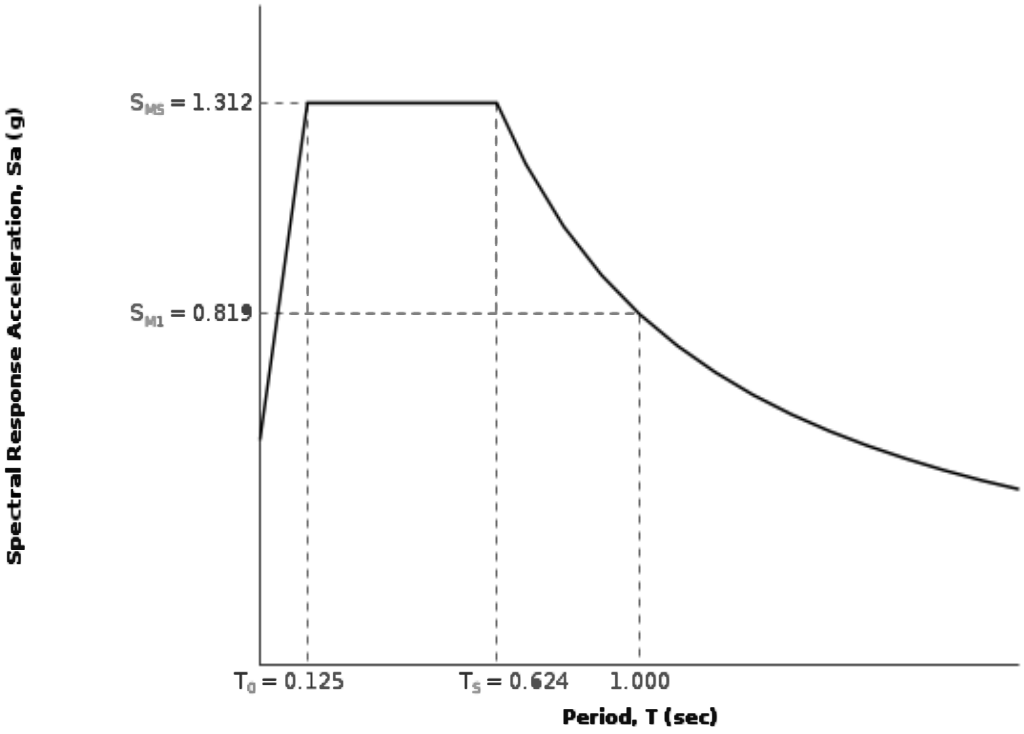
From Figure 22-12 [3] $T_L = 12$ seconds

Figure 11.4–1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.479

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.021 \times 0.479 = 0.489$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.479 g, F_{PGA} = 1.021

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.076

From Figure 22-18 [6] C_{R1} = 1.051

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.874 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.546 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX B

REFERENCES

REFERENCES

American Society of Civil Engineers (ASCE), 2010, Minimum Design Loads for Buildings and other Structures, ASCE Standard 7-10, 650 pp.

Blake, T.F. 1989-2000, EQSEARCH, A computer program for the estimation of peak horizontal acceleration from Southern California Historical Earthquake Catalog, Version 3.00b.

Boore, D.M., Joyner, W.B., and Fumal, T.E., 1997, Equations for Estimating Horizontal Response Spectra and Peak Acceleration from Western North American Earthquakes: A Summary of Recent Work, *in*, Seismological Research Letters, Volume 68, pp. 128-153.

Bryant, W.A. and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California," California Division of Mines & Geology Special Publication 42, Interim Revision 2007.

California Building Standards Commission, 2016, California Building Code (CBC), California Code of Regulations, Title 24, Part 2, Volume 2 pp.

California Department of Water Resources (DWR), 1980, Ground Water Basins in California, DWR Bulletin No. 118, El Mirage Valley Groundwater Basin (updated 2003).

California Division of Mines & Geology (C.D.M.G.), 1986, "Guidelines to Geologic/Seismic Reports," Note No. 42.

California Division of Mines & Geology (C.D.M.G.), 1996, Probabilistic Seismic Hazard Assessment for the State of California, C.D.M.G. Open File Report 96-08.

California Geological Survey (C.G.S.), 2008, Guidelines for Evaluating and Mitigating Seismic Hazards, in California C.D.M.G. Special Publication 117.

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D., and Wills, C.J., 2003, The Revised 2002 California Probabilistic Seismic Hazard Maps, June 2003, California Geological Survey.

Cox, B.F., and Hillhouse, J.W., 2000, Pliocene and Pleistocene Evolution of the Mojave River, Associated Tectonic Development of the Transverse Ranges and Mojave Desert, Based on Borehole Stratigraphy Studies near Victorville, California, U.S.G.S. Open-File Report 00-147.

Dibblee, Thomas W., Jr., 1967, Areal Geology of the Western Mojave Desert, California, U.S. Geological Survey Professional Paper 522.

Dibblee, Thomas W., Jr., 1980, Geologic Structure of the Mojave Desert, *in* Geology and Mineral Wealth of the California Desert, South Coast Geological Society, Dibblee Volume, pp., 69-100.

Google™ Earth, 2014, http://earth.google.com/, Version 7.1.2.2041.

Larson, R., and Slosson, J., 1992, The Role of Seismic Hazard Evaluation in Engineering Reports, *in,* Engineering Geology Practice in Southern California, AEG Special Publication No. 4, pp. 191-194.

Mendez, G.O., and Christensen, A.H., 1997, Regional Water Table (1996) and Water-Level Changes in the Mojave River, the Morongo, and the Fort Irwin Ground-Water Basins, San Bernardino County, California, U.S. Geological Survey Water-Resources Investigations Report 97-4160.

Petersen, M.D. et al., 2008, Documentation for the 2008 Update of the United States National Seismic Hazard Maps, United States Geological Survey Open-File Report 2008-1128.

Reeder, W., 2000, EPI Earthquake Epicenter Computer Program, EPI Software Company.

Smith, G.A., and Pimentel, M.I., 2000, Regional Table (1998) and Ground-Walter-Level Changes in the Mojave River and the Morongo Ground-Water Basins, San Bernardino County, California, U.S.G.S. Water Resources Investigations Report 00-4090.

Smith, G.A., Stamos, C.L. and Predmore, S.K., 2004, Regional Water Table (2002) and Water-Level Changes in the Mojave River and the Morongo Ground-Water Basins, Southwestern Mojave Desert, California, U.S.G.S. Scientific Investigations Report 2004-5081.

Stamos, C.L., and Predmore, S.K., 1995, Data and Water-Table Map of the Mojave River Ground-Water Basin, San Bernardino County, California, November 1992, U.S.G.S. Water-Resources Investigations Report 95-4148.

Subsurface Surveys, Inc., 1990, Inventory of Ground Water Stored in the Mojave River Basins, 46 pp., 5 Maps.

Toppozada, TR. et al., 1981, Preparation of Isoseismal Maps and Summaries of Reported Effects for pre-1900 California Earthquakes, C.D.M.G. OFR 81-11.

Toppozada, T.R., and Parke, D.L., 1982, Areas Damaged by California Earthquakes, 1900 - 1949, C.D.M.G. Open File Report 82-17.

U.S. Department of Agriculture, Soil Conservation Service, 1986, Soil Survey of San Bernardino County, California, Mojave River Area.

United States Geological Survey (U.S.G.S.), 2013, U.S. Seismic “Design Maps” Web Application, Version 3.1.0 (http://geohazards.usgs.gov/designmaps/us/application.php).

MAPS UTILIZED

Bortungno, E.J. and Spittler, T.E., 1986, Geologic Map of the San Bernardino Quadrangle, California Geological Survey Regional Geologic Map No. 3A, scale 1:250,000.

California Division of Mines & Geology, 1974, Valyermo 7.5' Special Studies Zone Quadrangle, Scale 1:24,000.

Dibblee, T.W., Jr., 2008, Geologic Map of the Shadow Mountains and Victorville 15 Minute Quadrangles, San Bernardino and Los Angeles Counties, California, Dibblee Geology Center Map #DF-387, Scale 1:62,500.

Federal Emergency Management Agency (FEMA), 2017, FEMA Flood Map Service Center, Flood Map 06071C 5775 H, dated August 28, 2008, http://msc.fema.gov/portal.

Gutierrez, C., Bryant, W.A., Saucedo, G., and Wills, C., 2010, 2010 Fault Activity Map of California, Scale 1:750,000, California Geological Survey, Geologic Data Map No. 6. Scale 1:750,000.

Jachens, R.C. et al., 1993, Aeromagnetic Map of the Victorville 1:100,000 Quadrangle, California, U.S.G.S. Open-File Report 93-0247.

Jennings, C.W., 1992, Preliminary Fault Activity Map of California, Scale 1:750,000, C.D.M.G. Open File Report 92-03.

Morin, R.L., 1995, Isostatic Gravity Map of the Victorville 1:100,000 scale Quadrangle, California, U.S.G.S. Open-File Report 95-0016.

Miller, D.M. and Bedford, D.R., 2000, Geologic Map Database of the El Mirage Lake Area, San Bernardino and Los Angeles Counties, California, U.S.G.S. Open-File Report 2000-222, scale 1:24,000.

San Bernardino County, 2010, San Bernardino County Land Use Plan, General Plan, Geologic Hazard Overlays, Victorville/San Bernardino Map EHFH-C, dated March 9, 2010, Scale 1:115,200.

Troxel, B.W., and Gunderson, J.N., 1970, Geology of the Shadow Mountains and Northern Part of the Shadow Mountains Southeast Quadrangles, Western San Bernardino County, California, C.D.M.G. Preliminary Report 12, Scale 1:24,000.

Toppozada, T.R. et al., 2000, Epicenters of and Areas Damaged by M≥4 California Earthquakes, Map Sheet 49, Scale 1”=25 Miles.

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