ALBUS-KEEFE & ASSOCIATES, INC
GEOTECHNICAL CONSULTANTS

August 24, 2017
J.N.: 2641.00

Mr. Steve Armanino
The Olson Company
3010 Old Ranch Parkway, Suite 100
Seal Beach, California 90740

Subject: **Geotechnical Due Diligence Evaluation, Proposed Residential Development, Van Buren Street and Orangethorpe Avenue, Placentia, California.**

Dear Mr. Armanino,

Albus-Keefe & Associates, Inc. is pleased to present to you our geotechnical due-diligence report for the proposed residential development at the subject site. This report presents the results of our aerial photo and literature review, subsurface exploration, laboratory testing, and engineering analyses. Conclusions relevant to the feasibility of the proposed site development are also presented herein based on the findings of our work.

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

Sincerely,

ALBUS-KEEFE & ASSOCIATES, INC.

Paul Kim
Associate Engineer

TABLE OF CONTENTS

REPORT

1.0 INTRODUCTION 1
1.1 PURPOSE AND SCOPE 1
1.2 SITE LOCATION AND DESCRIPTION 1
1.3 PROPOSED DEVELOPMENT 2
2.0 INVESTIGATION 2
2.1 RESEARCH 2
2.2 SUBSURFACE EXPLORATION 4
2.3 LABORATORY TESTING 4
3.0 SUBSURFACE CONDITIONS 4
3.1 SOIL CONDITIONS 4
3.2 GROUNDWATER 5
3.3 FAULTING 5
4.0 ANALYSES 6
4.1 SEISMICITY 6
4.2 SETTLEMENT 6
5.0 CONCLUSIONS 6
5.1 FEASIBILITY OF PROPOSED DEVELOPMENT 6
5.2 GEOLOGIC HAZARDS 7
5.2.1 Ground Rupture 7
5.2.2 Ground Shaking 7
5.2.3 Liquefaction 7
5.3 STATIC SETTLEMENT 7
5.4 EXCAVATION AND MATERIAL CHARACTERISTICS 8
5.5 SHRINGKAGE AND BULKAGE 9
5.6 SOIL EXPANSION 9
5.7 FOUNDATIONS 9
5.8 CONCRETE MIX DESIGN 9
5.9 PERCOLATION CHARACTERISTICS 9
6.0 LIMITATIONS 10
REFERENCES 11

FIGURES AND PLATES

Figure 1 - Site Location Map
Plate 1 – Geotechnical Map
Plate 2 – Dry Well Design

APPENDICES

APPENDIX A - Exploratory Logs
Boring Logs - Plates A-1 through A-8

APPENDIX B - Laboratory Test Program
Table B - Summary of Laboratory Test Results
Plate B-1 – Grain-Size Distribution Plots
Plate B-2 – Direct Shear Plot

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

The purpose of our work was to evaluate the feasibility of proposed site development in order to assist you in your land acquisition evaluation and due-diligence review. The scope of our work for this investigation was focused primarily on the geotechnical issues that we expect to have significant fiscal impacts on future site development. *While this report is comprehensive for the intended purpose, it is not intended for final design purposes. As such, additional geotechnical studies may be warranted based on our review of future rough grading plans and foundation plans.* The scope of our geotechnical due-diligence work included the following:

- Review of published geologic and seismic data for the site and surrounding area
- Review of historical aerial photographs of the site and nearby vicinity
- Exploratory drilling and soil sampling
- Laboratory testing of selected soil samples
- Engineering analyses of data obtained from exploration and laboratory testing
- Evaluation of site seismicity, liquefaction potential, settlement potential
- Preparation of this report

1.2 SITE LOCATION AND DESCRIPTION

The site consists of several parcels of land located at the southwest corner of the Orangethorpe Avenue and Van Buren Street in the city of Placentia, California. Descriptions of the site location and its improvements have been prepared below for each property. The location of the site and its relationship to the surrounding areas are shown on Figure 1, Site Location Map.

The site consists of 5.8 acres of land and is currently occupied by a commercial facility operating as an auto salvage wrecking yard. The facility includes multiple rows of salvage vehicles within the interior portions of the property and several shop buildings along the eastern areas of the property. The western-most corner of the site is vacant with moderate to heavy vegetation. The site is comprised of 3 parcels of land as follows: APN: 346-164-25, APN: 346-164-26 and APN: 364-164-22. The site is bounded to the north and northwest by railroad tracks. The site is bounded to the east by single-family residences and Van Buren Street. The site is bounded to the south by ± 6 feet deep storm drain channel that flows to the west.

Topography within the site is relatively flat with an elevation of approximately 239 to 247 feet above mean sea level (MSL), based on Google Earth. Drainage is generally directed to the south and west. Vegetation consists of large-size trees located along the property line. Some smaller trees are present locally within the interior portions of the site.

1.3 PROPOSED DEVELOPMENT

We understand the site will be developed for residential use. Associated interior driveways, perimeter/retaining walls, underground utilities, and a storm water infiltration system are also anticipated.

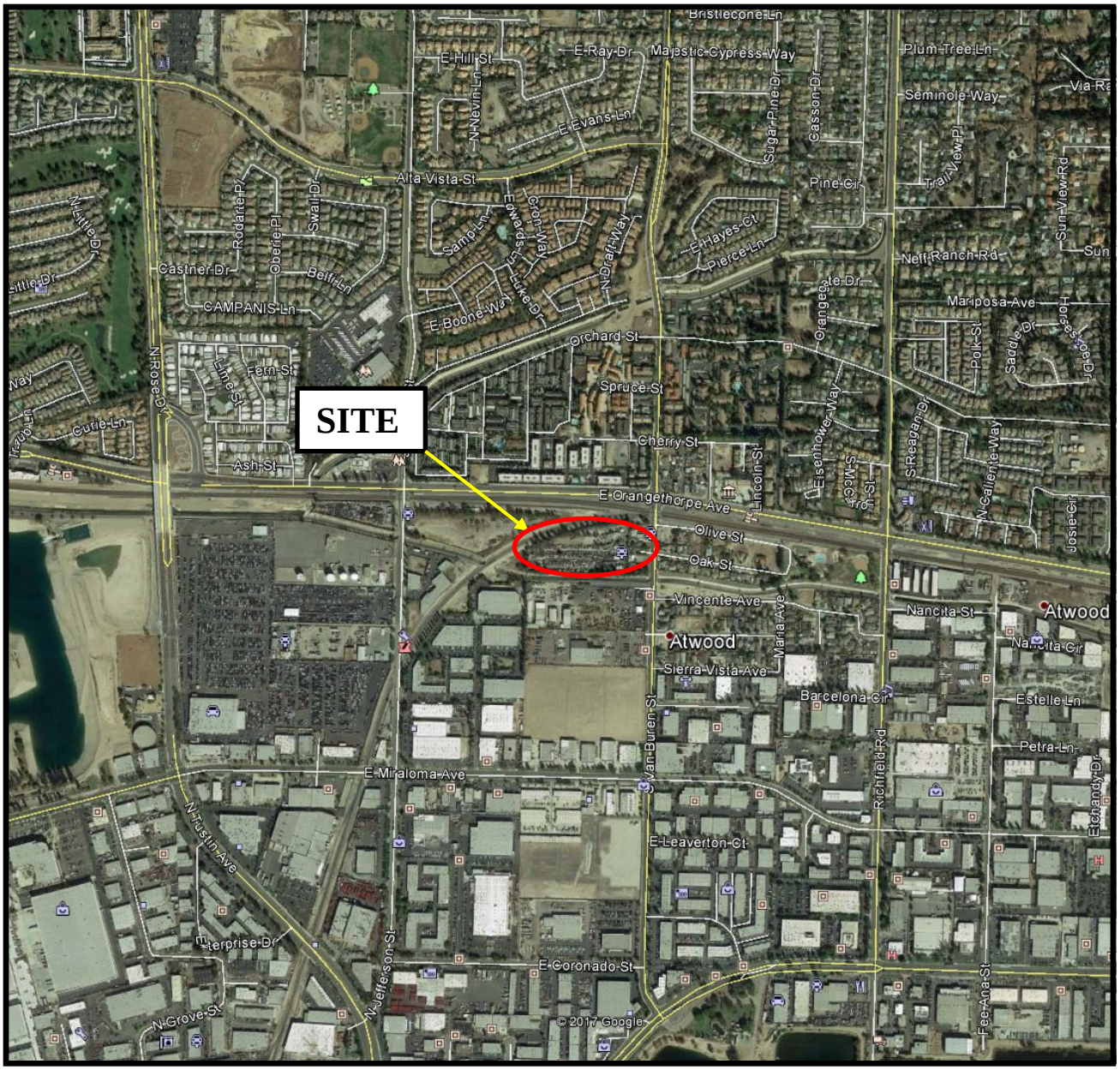
No grading or structural plans were available in preparing of this report. However, we anticipate that minor rough grading of the site will be required to achieve future surface configurations and we expect the proposed residential dwellings will be of wood-frame construction with concrete slabs on grade yielding relatively light foundation loads.

2.0 INVESTIGATION

2.1 RESEARCH

We have reviewed the referenced geologic publications and maps (see references). Data from these sources were utilized to develop some of the findings and conclusions presented herein. We have also reviewed internet sources and our in-house aerial photographs.

Based on our review, the site appears to have been utilized for oil and gas production since at least 1946. Our review of 1946 aerial photos indicates that two possible oil wells existed adjacent the railroad easement along the north-central perimeter of the site, one possible oil well existed within the central interior of the site, and one oil well and a single-family residence existed at the northeast corner of the site. In addition, a small tank farm appears to have existed adjacent the southeasterly boundary of the site. By 1963, other residential structures are present along the eastern boundary of the site and only the northeastern oil well is visible. The tank farm along the southeasterly boundary of the site is no longer visible, however, 2 above-ground tanks are visible adjacent the railroad easement at the northwest boundary. In 1972, rows of vehicles are present on the site and the storm drain channel exists along the southern boundary of the site. During this time, vegetation can be seen on site along the west corner and east side of the site. By 1980, the site appears much like the current site conditions; however, more rows of vehicles and associated parts are present within the site.



© 2016 Google

SITE LOCATION MAP

N

The Olson Company
Proposed Residential Development
Orangethorpe and Van Buren
Placentia, California

NOT TO SCALE

FIGURE 1

2.2 SUBSURFACE EXPLORATION

Subsurface exploration for this investigation was conducted on August 9, 2017. Our exploration consisted of drilling four (4) exploratory borings to depths of about 21.5 to 51.5 feet below the existing ground surface utilizing a truck-mounted, hollow-stem-auger drill rig. An engineer from Albus-Keefe & Associates, Inc. logged the exploratory excavations. Visual and tactile identifications were made of the materials encountered, and their descriptions are presented in the Exploration Logs in Appendix A. The approximate locations of the exploratory excavations completed by this firm are shown on the enclosed Geotechnical Map, Plate 1. The locations of the borings are depicted on Plate 1.

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

Upon completion of drilling, two additional borings (P-1 and P-2) were drilled adjacent to boring B-1 and 2-inch-diameter casings were installed for percolation testing. Details and results of percolation testing can be reported under separate cover; however, a brief discussion of our test results and recommended BMP system are summarized in **Section 5.9**.

2.3 LABORATORY TESTING

Selected samples of representative earth materials from the borings excavated at the site were tested in the laboratory. Tests consisted of in-situ moisture content and density, maximum dry density and optimum moisture content, expansion index, soluble sulfate, direct shear and grain-size analysis. Descriptions of laboratory test criteria and a summary of the test results are presented in Appendix B and on the boring logs in Appendix A.

3.0 SUBSURFACE CONDITIONS

3.1 SOIL CONDITIONS

Soil materials encountered on site generally consisted of alluvial deposits to the maximum depth explored (51.5 feet). Artificial fill ranging in thickness from 3 to 5.5 feet was observed scattered throughout the site (observed in B-1 and B-4). The near surface alluvium typically consisted of coarse-grained material consisting primarily of sand and silty sand. This material was typically dry and loose to medium dense. At greater depths, the alluvium consisted of interlayers of sand, silty sand

and silt. Additional artificial fills associated with underground utilities, abandoned oil and gas facilities and previous site developments are likely present beneath portions of the site.

A more detailed description of the interpreted soil profile at each of the boring locations, based upon the borehole cuttings and soil samples, are presented in Appendix A. The stratigraphic descriptions in the logs represent the predominant materials encountered and relatively thin, often discontinuous layers of different material may occur within the major divisions.

3.2 GROUNDWATER

Groundwater was not encountered during this firm's subsurface exploration to a maximum depth of 51.5 feet below the existing ground surface. A review of the CDMG Seismic Hazard Zone Report 011 indicates that historical high groundwater level for the general site area is approximately 18 feet or more below the existing ground surface.

We performed research of well records from the State of California, Department of Water Resources. We identified seven groundwater wells located within about three-quarters of a mile of the site that have groundwater data extending back to 1968. One well is located northwest of the project, one well is located to the east, four are located southeast, and one is located south of the project.

The data from the nearby wells suggest that groundwater levels have varied by about 40 feet over the last 50 years. On the basis of this data, we conclude current and future groundwater levels are likely to remain below a depth of 80 feet in the project vicinity.

3.3 FAULTING

Based on our review of the referenced publications and seismic data, no seismic faults are known to project through or immediately adjacent the site and the site does not lie within an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. Table 3.1 presents a summary of known seismic faults within 10 miles of the site based on the 2008 USGS National Seismic Hazard Maps.

TABLE 3.1
Summary of Faults

Name	Dist. (miles)	Slip Rate (mm/yr.)	Preferred Dip (degrees)	Slip Sense	Rupture Top (km)	Fault Length (km)
Puente Hills (Coyote Hills)	3.40	0.7	27	Thrust	2.8	17
Elsinore; W	3.86	2.5	75	Strike slip	0	46
Elsinore; W+GI	3.86	n/a	81	Strike slip	0	83
Elsinore; W+GI+T	3.86	n/a	84	Strike slip	0	124
Elsinore; W+GI+T+J	3.86	n/a	84	Strike slip	0	199
Elsinore; W+GI+T+J+CM	3.86	n/a	84	Strike slip	0	241

4.0 ANALYSES

4.1 SEISMICITY

We have performed probabilistic seismic analyses utilizing the web-based U.S. Seismic Design Maps web application by the U.S. Geological Survey (USGS), we obtain a PGA of 0.65 in accordance with Figure 22-7 of ASCE 7-10. The F_{PGA} factor for site class D is 1.0. Therefore, the PGA_M = 1.0 x 0.65 = 0.65g. The mean event associated with a probability of exceedance equal to 2% over 50 years to have a moment magnitude of 6.69 and the mean distance to the seismic source of 7.0 miles.

4.2 SETTLEMENT

Based on the anticipated foundation loads and provided all undocumented artificial fill materials and the upper 1 to 2 feet of alluvial soils are removed and replaced as engineered compacted fill, the total and differential static settlements are not anticipated to exceed 1 inch and ½-inch over 30 feet, respectively, for the proposed residential structures.

5.0 CONCLUSIONS

5.1 FEASIBILITY OF PROPOSED DEVELOPMENT

From a geotechnical point of view, the proposed site development is considered feasible provided the conclusions presented in this report are incorporated into the design and construction of the project. Furthermore, it is also our opinion that the proposed development will not adversely impact the stability of adjoining properties. Key issues that could have significant fiscal impacts on the geotechnical aspects of the proposed site development are discussed in the following sections of this report.

5.2 GEOLOGIC HAZARDS

5.2.1 Ground Rupture

No active faults are known to project through the site nor does the site lie within the boundaries of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo Earthquake Fault Zoning Act. The closest known active fault is the Whittier fault located about 3.5 miles from the site. Therefore, potential for ground rupture due to an earthquake beneath the site is considered very low.

5.2.2 Ground Shaking

The site is situated in a seismically active area that has historically been affected by generally moderate to occasionally high levels of ground motion. The site lies in relative close proximity to several seismically active faults; therefore, during the life of the proposed structures, the property will probably experience similar moderate to occasionally high ground shaking from these fault zones, as well as some background shaking from other seismically active areas of the Southern California region. Potential ground accelerations have been estimated for the site and are presented in Section 4.1 of this report. Design and construction in accordance with the current California Building Code (CBC) requirements is anticipated to address the issues related to potential ground shaking at the site.

5.2.3 Liquefaction

Engineering research of soil liquefaction potential (Youd, et al., 2001) indicates that generally three basic factors must exist concurrently in order for liquefaction to occur. These factors include:

- A source of ground shaking, such as an earthquake, capable of generating soil mass distortions.
- A relatively loose silty and/or sandy soil.
- A relative shallow groundwater table (within approximately 50 feet below ground surface) or completely saturated soil conditions that will allow positive pore pressure generation.

The liquefaction susceptibility of the onsite subsurface soils was evaluated by analyzing the potential concurrent occurrence of the above-mentioned three basic factors. The liquefaction evaluation for the site was completed under the guidance of Special Publication 117A: Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG, 2008).

As mentioned earlier, groundwater levels within the past 50 years in the vicinity of the site are at least 80 feet below the existing ground surface. Therefore, the potential for liquefaction and subsequently lateral spread to occur beneath the site is considered to be low.

5.3 STATIC SETTLEMENT

As summarize in **Section 4.2**, based on anticipated foundation loads and provided all undocumented artificial fill materials and the existing upper 1 to 2 feet of alluvial soils are removed and replaced as engineered compacted fill, total and differential static settlement under the weight of anticipated residential structures are anticipated to be less than 1inch and 1/2 inch over 30 feet, respectively. These values are considered within tolerable limits of proposed structures and site improvements.

5.4 EXCAVATION AND MATERIAL CHARACTERISTICS

The existing artificial fill (generally 3 to 5.5 feet in thickness) and upper 1 to 2 feet of existing soils are considered unsuitable for support of proposed engineered fill and site improvements. These materials should be removed from below future building sites, retaining walls, screen walls, pavement, and any other "structural" areas, and replaced as engineered compacted fill. The actual depth of removal should be determined by the geotechnical consultant during grading.

Removals should extend laterally beyond the limits of the proposed structure no less than 5 feet or distance equal to the depth of removal (i.e. 1:1 projection) if the removals are greater than 5 feet. Certain portions of the site are bounded on several sides by existing improvements. As such, future grading along the margins of the site will need to be performed in such a manner as to not adversely impact adjacent existing improvements. Where removals for residential structures are limited by existing improvements or property lines, special grading techniques such as slot cutting, shoring or other acceptable design criteria may be required. Under such conditions, specific recommendations should be provided by this firm during review of final grading plan.

Off-site improvements exist near the property lines. The presence of the existing offsite improvements may limit removals of unsuitable materials adjacent the property lines. Therefore, construction of perimeter site walls may require deepened footings and/or additional reinforcement and additional control joints, where removals are restricted by property boundaries.

Temporary construction slopes and trench excavations can likely be cut vertically up to a height of 4 feet within the onsite materials provided that no surcharging of the excavations is present. Temporary excavations greater than 4 feet in height will likely require side laybacks to 1:1 (H:V) or flatter to mitigate the potential for sloughing.

Demolition of the existing site improvements will generate concrete and asphaltic concrete debris. Significant portions of concrete and asphaltic concrete debris can likely be reduced in size to less than 4 inches and incorporated within fill soils during earthwork operations.

Onsite sewage disposal systems, clarifiers and other underground improvements associated with the previous site use may be present beneath the site. As an option, further site exploration may be warranted to identify significant underground structures, such as abandoned oil wells excavations, pipelines and other associated underground utilities prior to future rough grading operations. If encountered during future rough grading, these improvements will require proper abandonment or removal.

Subsurface soils are anticipated to be relatively easy to excavate with conventional heavy earthmoving equipment. Removal and recompaction of the site materials will result in some swelling. Design of site grading will require consideration of this loss when evaluating earthwork balance issues.

Following removals, the exposed grade should first be scarified to a depth of 6 inches; moisture conditioned to at least 100 percent of the optimum moisture content, and then compacted to at least 90 percent of the laboratory determined maximum dry density.

5.5 SHRINGKAGE AND BULKAGE

Volumetric changes in earth quantities will occur when excavated onsite soil materials are replaced as properly compacted fill. We estimate the existing surficial soils will shrink approximately 10 to 20 percent within the upper 5 feet. Subsidence of removal bottoms is anticipated to be negligible. The estimates of shrinkage and bulkage are intended as an aid for project engineers in determining earthwork quantities. However, these estimates should be used with some caution since they are not absolute values. Contingencies should be made for balancing earthwork quantities based on actual swelling and bulkage that occurs during the grading process.

5.6 SOIL EXPANSION

Based on laboratory test results and the USCS visual manual classification, the near-surface soils within the site are generally anticipated to be non-expansive or possess Very Low expansion potentials. Additional testing for soil expansion will be required subsequent to rough grading and prior to construction of foundations and other concrete work to confirm these conditions.

5.7 FOUNDATIONS

Considering the very low/negligible expansion potential of site soils, conventional shallow foundations may be used to support habitable structures and miscellaneous structures at the site.

5.8 CONCRETE MIX DESIGN

Laboratory testing of onsite soil indicates **Negligible** soluble sulfate content. Concrete designed to follow the procedures provided in ACI 318, Section 4.3, Table 4.3.1 for negligible sulfate exposure are anticipated to be adequate for mitigation of sulfate attack on concrete. Upon completion of rough grading, an evaluation of as-graded conditions and further laboratory testing will be required for the site to confirm or modify the conclusions provided in this section.

5.9 PERCOLATION CHARACTERISTICS

Based on the subsurface exploration and percolation testing at the site, the use of dry wells is considered feasible. Preliminary analyses indicate that dry wells could likely provide a peak measured infiltration flow of approximately 0.64 cfs and empty within 48 hours. A typical dry well design model is included on Plate 2. The site is underlain by interbedded layers of sand, and fine-grained soils. The presence of fine-grained interbeds will tend to diminish the effectiveness of infiltration, even by dry wells. Further percolation testing may be necessary based on review of preliminary WQMP design plans.

6.0 LIMITATIONS

This report is based on the proposed development and geotechnical data as described herein. The materials encountered on the project site, described in other literature, and utilized in our laboratory testing for this investigation are believed representative of the total project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soil materials can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the grading and construction phases of the project are essential to confirming the basis of this report.

This report summarizes several geotechnical topics that should be beneficial for project planning and budgetary evaluations. *The information presented herein is intended only for a preliminary feasibility evaluation and* ***is not*** *intended to satisfy the requirements of a site specific and detailed geotechnical investigation required for further planning and permitting.*

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

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

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

Respectfully submitted,

ALBUS-KEEFE & ASSOCIATES, INC.

Andrew "AJ" Atry
Project Engineer

REGISTERED PROFESSIONAL ENGINEER
ANDREW J. ATRY
C 84728
CIVIL
STATE OF CALIFORNIA

Paul Hyun Jin Kim
Associate Engineer
P.E. 77214

REGISTERED PROFESSIONAL ENGINEER
HYUN JIN KIM
C 77214
EXP. 06/30/19
CIVIL
STATE OF CALIFORNIA

REFERENCES

Publications

Abrahamson, N.A., and W.J. Silva, "Summary of the Abrahamson & Silva NGA Ground-Motion Relations", Earthquake Spectra, Vol.24, No.1, 2008.

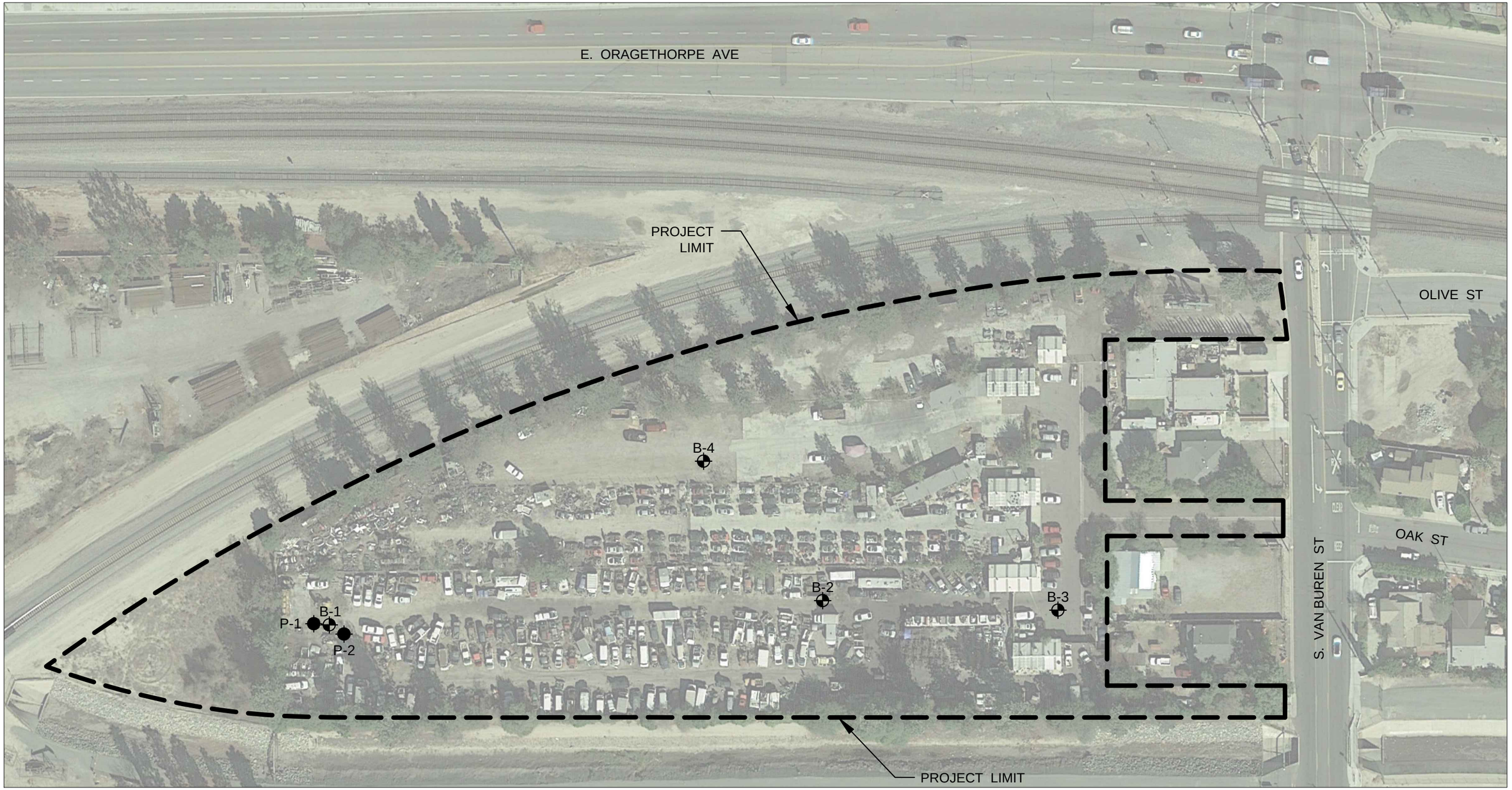
Campbell, K.W., and Y. Bozorgnia, "NGA Ground Motion Model for the Geometric Mean Horizontal Component of PGA, PGV, PGD, and 5% Damped Linear Elastic Response Spectra for Periods Ranging from 0.01 to 10s", Earthquake Spectra, Vol.24, No.1, 2008.

California Geologic Survey, Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California, 2008.

CDMG, "Seismic Hazard Zone Report for the Orange 7.5-Minute Quadrangles, Los Angeles County, California," Seismic Hazard Zone Report 011, 1997.

Southern California Earthquake Center (SCEC), University of Southern California, "Recommended Procedures for Implementation of DMG Special Publication 117 Guidelines for Analyzing and Mitigating Liquefaction Hazards in California", March 1999.

Youd, T.L., Idriss, I.M., Andrus, R.D., Arango, I., Castro, G., Christian, J., Dobry, R., Finn, W.D.L., Harder, L.F., Hynes, M.E., Ishihara, K., Koester, J.P., Liao, S.S.C., Marcuson, W.F., Martin, G.R., Mitchell, J.K., Moriwaki, Y., Power, M.S., Robertson, P.K., Seed, R.B., and Stokoe, K.H., "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils", Journal of Geotechnical and Geoenvironmental Engineering, October, 2001.



0 40 80 160

APPROX. SCALE : 1" = 80'

EXPLANATION

(Locations Approximate)

- Exploratory Boring
- Percolation Well

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

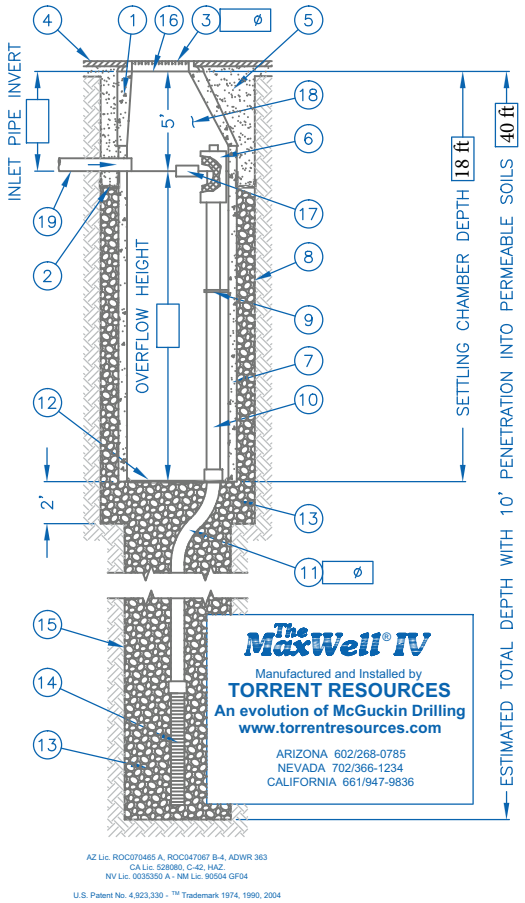
GEOTECHNICAL MAP

Job No.: 2641.00	Date: 08/24/17	Plate: 1

MAXWELL® IV DRAINAGE SYSTEM DETAIL AND SPECIFICATIONS

ITEM NUMBERS

1. **Manhole Cone** - Modified Flat Bottom.
2. **Moisture Membrane** - 6 Mil. Plastic. Applies only when native material is used for backfill. Place membrane securely against eccentric cone and hole sidewall.
3. **Bolted Ring & Grate** - Diameter as shown. Clean cast iron with wording **"Storm Water Only"** in raised letters. **Bolted in 2 locations** and secured to cone with mortar. Rim elevation ±0.02' of plans.
4. **Graded Basin or Paving** (by Others).
5. **Compacted Base Material** - 1-Sack Slurry except in landscaped installtions with no pipe connections.
6. **PureFlo® Debris Shield** - Rolled 16 ga. steel X 24" length with vented anti-siphon and Internal .265" Max. SWO flattened expanded steel screen X 12" length. **Fusion bonded epoxy coated.**
7. **Pre-cast Liner** - 4000 PSI concrete 48" ID. X 54" OD. **Center in hole** and align sections **to maximize bearing surface.**
8. **Min. 6' Ø Drilled Shaft.**
9. **Support Bracket** - Formed 12 Ga. steel. **Fusion bonded epoxy coated.**
10. **Overflow Pipe** - Sch. 40 PVC mated to drainage pipe at base seal.
11. **Drainage Pipe** - ADS highway grade with TRI-A coupler. **Suspend pipe** during backfill operations to prevent buckling or breakage. Diameter as noted.
12. **Base Seal** - Geotextile or concrete slurry.
13. **Rock** - Washed, sized between 3/8" and 1-1/2" to **best complement soil conditions.**
14. **FloFast® Drainage Screen** - Sch. 40 PVC 0.120" slotted well screen with 32 slots per row/ft.Diameter varies 120" overall length with TRI-B coupler.
15. **Min. 4' Ø Shaft** - Drilled to **maintain permeability** of drainage soils.
16. **Fabric Seal** - U.V. resistant geotextile - **to be removed by customer** at project completion.
17. **Absorbent** – Hydrophobic Petrochemical Sponge. Min. to 128 oz. capacity.
18. **Freeboard Depth** Varies with inlet pipe elevation. Increase settling chamber depth as needed to maintain all inlet pipe elevations above overflow pipe inlet.
19. **Optional Inlet Pipe** (Maximum 4", by Others). Extend moisture membrane and compacted base material or 1 sack slurry backfill below pipe invert.



AZ Lic. ROC070465 A, ROC047067 B-4, ADWR 363
CA Lic. 528080, C-42, HAZ.
NV Lic. 0035350 A - NM Lic. 90504 GF04

U.S. Patent No. 4,923,330 - ™ Trademark 1974, 1990, 2004

The referenced drawing and specifications are available on CAD either through our office or web site. This detail is copyrighted (2004) but may be used as is in construction plans without further release. For information on product application, individual project specifications or site evaluation, contact our Design Staff for no-charge assistance in any phase of your planning.

CALCULATING MAXWELL IV REQUIREMENTS

The type of property, soil permeability, rainfall intensity and local drainage ordinances determine the number and design of MaxWell Systems. For general applications draining retained stormwater, use one standard **MaxWell IV** per the instructions below for up to 3 acres of landscaped contributory area, and up to 1 acre of paved surface. For larger paved surfaces, subdivision drainage, nuisance water drainage, connecting pipes larger than 4" Ø from catch basins or underground storage, or other demanding applications, refer to our **MaxWell® Plus** System. For industrial drainage, including gasoline service stations, our **Envibro® System** may be recommended. For additional considerations, please refer to **"Design Suggestions For Retention And Drainage Systems"** or consult our Design Staff.

COMPLETING THE MAXWELL IV DRAWING

To apply the **MaxWell IV** drawing to your specific project, simply fill in the blue boxes per instructions below. For assistance, please consult our Design Staff.

40 feet ESTIMATED TOTAL DEPTH

The Estimated Total Depth is the approximate depth required to achieve 10 continuous feet of penetration into permeable soils. Torrent utilizes specialized **"crowd"** equipped drill rigs to penetrate difficult, cemented soils and to reach permeable materials at depths up to **180 feet.** Our extensive database of drilling logs and soils information is available for use as a reference. Please contact our Design Staff for site-specific information on your project.

18 feet SETTLING CHAMBER DEPTH

On MaxWell IV Systems of over 30 feet overall depth and up to 0.25cfs design rate, the **standard** Settling Chamber Depth is **18 feet .** For systems exposed to greater contributory area than noted above, extreme service conditions, or that require higher design rates, chamber depths up to 25 feet are recommended.

' OVERFLOW HEIGHT

The Overflow Height and Settling Chamber Depth determine the effectiveness of the settling process. The higher the overflow pipe, the deeper the chamber, the greater the settling capacity. For normal drainage applications, an overflow height of **13 feet** is used with the standard settling chamber depth of **18 feet**. Sites with higher design rates than noted above, heavy debris loading or unusual service conditions require greater settling capacities

"Ø DRAINAGE PIPE

This dimension also applies to the **PureFlo®** Debris Shield, the **FloFast®** Drainage Screen, and fittings. The size selected is based upon system design rates, soil conditions, and the need for adequate venting. Choices are 6", 8", or 12" diameter. Refer to "Design Suggestions for Retention and Drainage Systems" for recommendations on which size best matches your application.

"Ø BOLTED RING & GRATE

Standard models are quality cast iron and available to fit 24" Ø or 30" Ø manhole openings. All units are bolted in two locations with wording "Storm Water Only" in raised letters. For other surface treatments, please refer to "Design Suggestions for Retention and Drainage Systems."

"Ø INLET PIPE INVERT

Pipes up to 4" in diameter from catch basins, underground storage, etc. may be connected into the settling chamber. Inverts deeper than 5 feet will require additional settling chamber depth to maintain effective overflow height.

TORRENT RESOURCES INCORPORATED
1509 East Elwood Street, Phoenix Arizona 85040~1391
phone 602~268~0785 fax 602~268~0820
Nevada 702~366~1234
AZ Lic. ROC070465 A, ROC047067 B-4; ADWR 363
CA Lic. 528080 A, C-42, HAZ ~ NV Lic. 0035350 A ~ NM Lic. 90504 GF04

TORRENT RESOURCES (CA) INCORPORATED
phone 661~947~9836
CA Lic. 886759 A, C-42
www.TorrentResources.com
An evolution of McGuckin Drilling

The watermark for drainage solutions.®

TORRENT® RESOURCES

APPENDIX A

EXPLORATORY LOGS

EXPLORATION LOG

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

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

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-1
Address: , Placentia, CA 92870		Elevation: 239.5
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) Silty Sand (SM): Brown, dry, medium dense, fine to medium grained sand		23	■	■	3.8		Max EI SO4 DS
		ALLUVIUM (Qal) Sand (SP): Light brown, dry, medium dense, fine to coarse grained sand, trace fine gravel and silt, friable		20	■	■	1.5		
5				26	■		0.8		200
10				15	■		14.2		
		Silt (ML): Light brown, dry, stiff, fine grained sand, caliche stringers, trace pores and mica, slight iron oxide stains, rootlets present							
15		Sand (SP): light brown to reddish brown, dry, medium dense, fine to medium grained sand, trace silt and fine gravel		17	⧗				
		Silty Sand (SM): Medium brown, dry, medium dense, fine to medium grained sand, trace mica and clay		17	⧗		9.9		
20		Sandy Silt (ML): Medium brown, dry, stiff, fine grained sand, trace mica and clay, iron oxide stringers							

Albus-Keefe & Associates, Inc.

Plate A-2

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-1
Address: , Placentia, CA 92870		Elevation: 239.5
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
				10			18.3		SA Hydro
30		@ 30 ft, Very stiff		20			19.7		200
		Silty Sand (SM): Brown, dry, medium dense, fine grained sand, trace mica							
35		Sand with Silt (SP-SM): Light brown, dry, dense, fine to medium grained sand, trace fine gravel and silt		31					SA
40		@ 40 ft, fine to coarse grained sand, increased fine gravel		29					
		@ 42.5 ft, Gravel encountered							
45		@ 45 ft, Grayish brown, very dense, increased fines, cobbles present		52					200

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-1
Address: , Placentia, CA 92870		Elevation: 239.5
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				51					
		End of boring at 51.5 feet. No groundwater encountered. Installed percolation well (P-1 and P-2) adjacent to boring. Backfilled with soil cuttings upon completion of test.							

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-2
Address: , Placentia, CA 92870		Elevation: 241.6
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ALLUVIUM (Qal)							
		Sand (SP): Light brown, dry, loose, fine to coarse grained sand, trace fine gravel and silt		11	■	■	1.7		200
		@ 4 ft, nodules of cemented silty sand, no gravel		8	■	■	2.2		
5		@ 6 ft, medium dense, fine grained sand		15	■		3.3		
10		@ 10 ft, fine to coarse grained sand, few coarse gravel, trace mica		17	■		1.5	109	
		Silt (ML): Brown, moist, stiff, few fine grained sand in shoe							
		@ 12.5 ft, Gravel encountered							
15		Silty Sand (SM): Brown, dry, loose, fine grained sand, trace clay and mica		7	⧗				
		Sand (SP): Brown, dry, medium dense, fine grained sand, trace silt							
20				20	⧗				
		End of boring at 21.5 feet. No groundwater encountered. Backfilled with soil cuttings.							

Albus-Keefe & Associates, Inc.

Plate A-5

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-3
Address: , Placentia, CA 92870		Elevation: 242.4
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Asphalt Concrete (AC): 6 inches							
		ALLUVIUM (Qal)							
		Sand (SP): Brown, dry, fine to coarse grained sand, trace silt and mica		8			2.9		
				11			2.5		200
5									
		@ 6 ft, fine to medium grained sand		15			3.5		
10				19			1.4	95.7	
		Silty Sand (SM): Brown, dry, fine grained sand							
15				19					
		Sand (SP): Brown, dry, fine grained sand, trace silt							
20				6					
		Sandy Silt (ML): Brown, dry, fine grained sand, trace clay							
		End of boring at 21.5 feet. No groundwater encountered. Backfilled with soil cuttings. Patched with asphalt cold patch.							

EXPLORATION LOG

Project: Placentia (Van Buren & Orangethorpe)		Location: B-4
Address: , Placentia, CA 92870		Elevation: 242.1
Job Number: 2641.00	Client: The Olson Company	Date: 8/9/2017
Drill Method: Hollow-Stem Auger	Driving Weight: 140 lbs / 30 in	Logged By: MP

Depth (feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (Af) / Possible Backfill Silt (ML): Brown, dry, medium stiff, trace fine sand							
				8			4.8		
		@ 3.7 ft, Light gray, medium stiff, fine to coarse grained sand, Possbile Shading Material		10			2.9		
5		**ALLUVIUM (Qal)** Silty Sand (SM): Light gray, dry, medium dense, fine to coarse grained sand, few coarse gravel		13			1.2		
10		@ 10 ft, Abundant fine to coarse gravel		28			0.8		
		Sandy Silt / Silty Sand (ML/SM): Brown, dry, very stiff / medium dense, fine grained sand							
		Silty Sand (SM): Light gray, dry, dense, fine to coarse grained sand							
15				25					
		Silt (ML): Light brown, dry, very stiff, few fine grained sand							
20				15					
		End of boring at 21.5 feet. No groundwater encountered. Backfilled with cuttings.							

Albus-Keefe & Associates, Inc.

Plate A-8

APPENDIX B

LABORATORY TEST PROGRAM

LABORATORY TESTING PROGRAM

Soil Classification

Soils encountered within the exploratory borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (Test Method ASTM D 2488). The samples were re-examined in the laboratory and classifications reviewed and then revised where appropriate. The assigned group symbols are presented in the Boring Logs, Appendix A.

In Situ Moisture and Density

Moisture content and unit dry density of in-place soil materials were determined in representative strata. Test data are summarized in the Boring Logs, Appendix A.

Laboratory Maximum Dry Density

Maximum dry density and optimum moisture content of onsite soils were determined for selected samples in general accordance with Method A of ASTM D 1557. Pertinent test values are given on Table B.

Grain-Size/Hydrometer Analysis

Grain-size/hydrometer analyses were performed on selected samples to verify visual classifications performed in the field. Tests were performed in accordance with ASTM D422. Test results are graphically presented on Plate B-1.

Expansion Potential

An Expansion Index test was performed on a selected sample in accordance with ASTM D 4829. The test result and expansion potential are presented on Table B.

Soluble Sulfate Analysis

Chemical analysis was performed on selected samples to determine soluble sulfate content. These tests were performed in accordance with California Test Method No. 417. The test results are included on Table B.

Direct Shear

The Coulomb shear strength parameters, angle of internal friction and cohesion, were determined for selected bulk samples obtained from our borings. Our laboratory performed these tests in general conformance with Test Method ASTM D 3080. The samples were remolded to 90 percent of maximum dry density and 2 percentage points over optimum. Three specimens were prepared for each test, artificially saturated, and then sheared under varied loads at an appropriate constant rate of strain. Results are graphically presented on Plate B-2.

TABLE B-1
SUMMARY OF LABORATORY TEST RESULTS

Boring No.	Sample Depth (ft)	Soil Description	Test Results	
B-1	0-5	Silty Sand and Sand	Max. Dry Density (pcf):	130.5
			Opt. Moisture Content (%):	8.5
			Expansion Index:	0
			Expansion Potential:	Non-Expansive
			Soluble Sulfate Content (%):	0.004
			Sulfate Exposure:	Negligible

Note: Additional laboratory test results are provided on the boring logs provided in Appendix A.

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

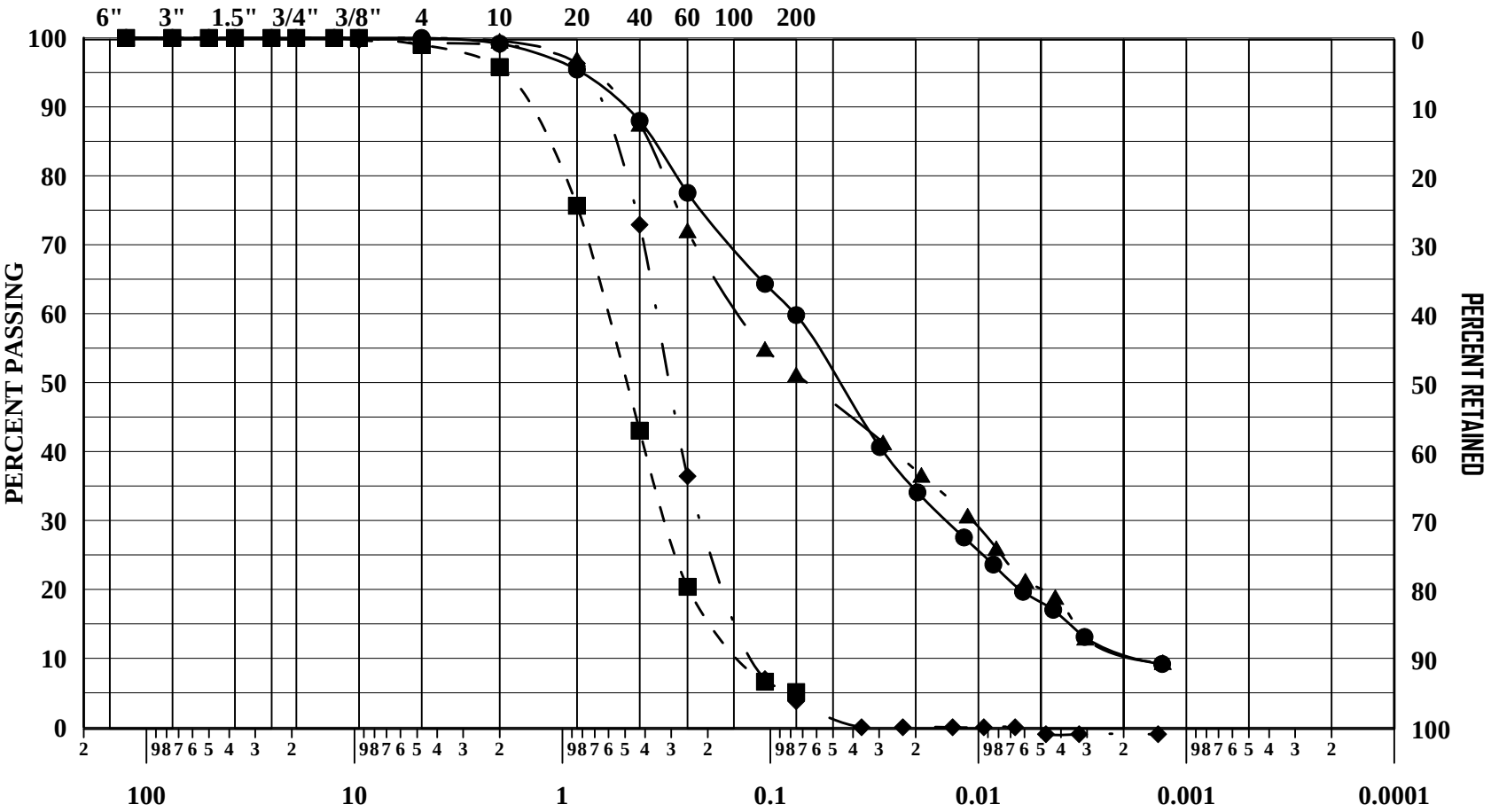
GRAIN SIZE DISTRIBUTION

Job No: 2641.00

Plate No: B-1

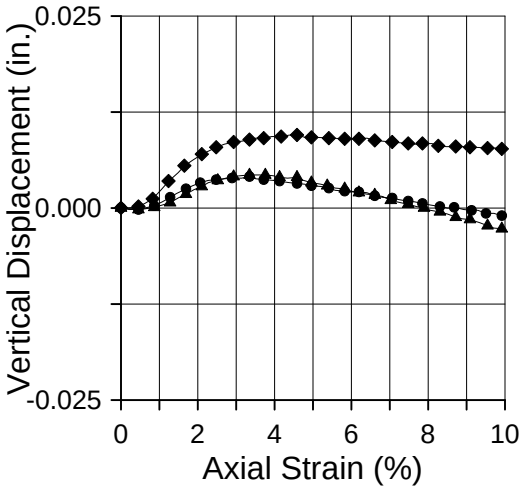
UNIFIED SOIL CLASSIFICATION

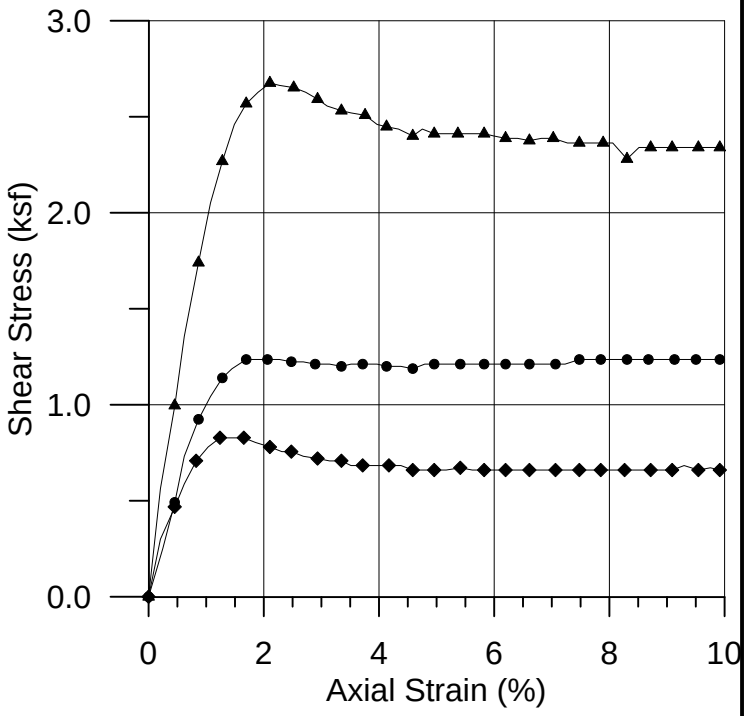
COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

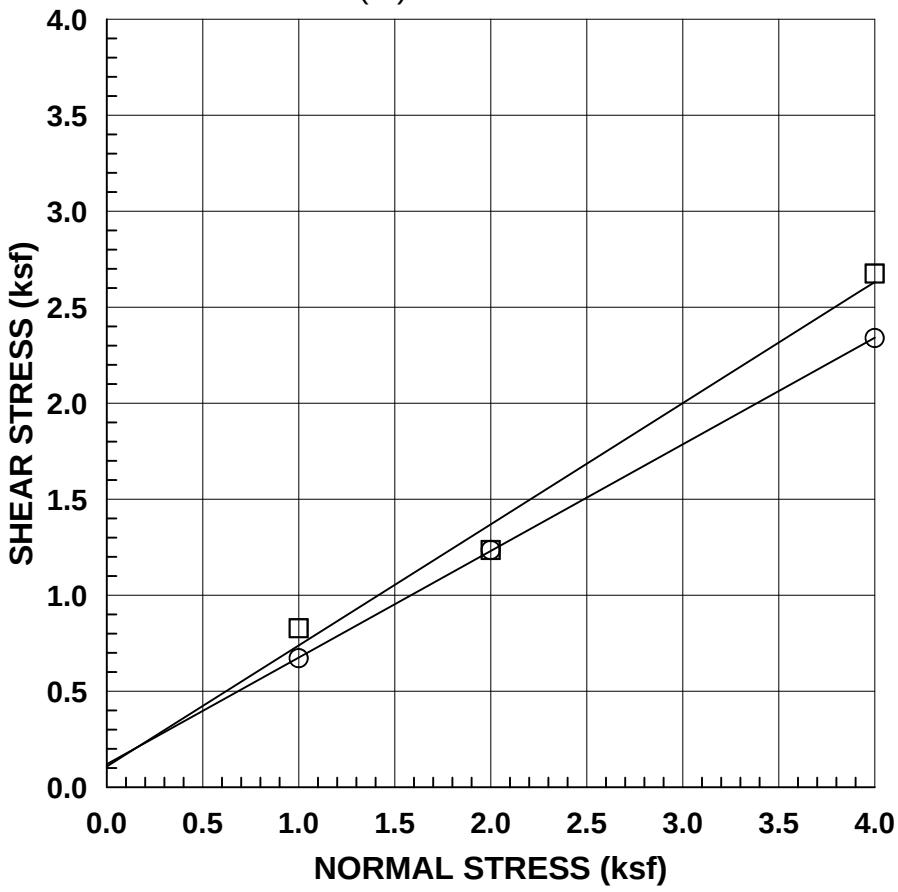


LOCATION	SAMPLE	SYMBOL	LL	PI	CLASSIFICATION
B-1	25 feet				Sandy Silt (ML)
B-1	35 feet				Sand with Silt (SP-SM)
P-1	25 feet				Sandy Silt (ML)
P-2	35 feet				Sand (SP)

Specimen No.	1	2	3
Normal Stress (ksf)	1	2	4
Peak Shear Stress (ksf)	0.828	1.236	2.676
Peak Displacement (in)	0.01	0.004	0.004
Ultimate Shear Stress (ksf)	0.672	1.236	2.34
Ultimate Displacement (in)	0.24	0.25	0.25
Initial Dry Density (pcf)	117.4	117.4	117.4
Initial Moisture Content (%)	8.5	8.5	8.5
Strain Rate (in/min)	0.02		







Strain Legend

◆	1
●	2
▲	4

Strength Legend

□	Peak
○	Ultimate

SAMPLE LOCATION	SAMPLE TYPE	SAMPLE DESCRIPTION
B-1 @ 0-5 feet	SP @ 90% of 130.5 pcf @ 8.5%	Silty Sand (SM)

ALBUS-KEEFE & ASSOCIATES, INC.
GEOTECHNICAL CONSULTANTS

DIRECT SHEAR

Job No: 2641.00

Plate No: B-2