LANDMARK
Geo-Engineers and Geologists

780 N. 4th Street
El Centro, CA 92243
(760) 370-3000
(760) 337-8900 fax

77-948 Wildcat Drive
Palm Desert, CA 92211
(760) 360-0665
(760) 360-0521 fax

June 15, 2023

Mr. Stefan Vogel
Coachella Valley Community Development Group, Inc.
36101 Bob Hope Drive, Suite E5
Rancho Mirage, CA 92270

Subject: APN 670-110-043
Cathedral City, California
LCI Report No.: LP23130

Reference: Geotechnical Report for Living Care Assisted Living, prepared by ***LandMark Consultants, Inc.,*** dated October 12, 2016.

Dear Mr. Vogel:

As requested, ***LandMark Consultants, Inc.,*** is providing an update letter for the referenced geotechnical report located at 30260 Date Palms Drive, Cathedral City, California. The initial field investigation was conducted in September 2016.

Our site visit on June 12, 2023, found that the site conditions were similar as those encountered during the initial site investigation conducted in September 2016. Based on our present field observations and the proposed multi-family residential project, it is our opinion that the findings, recommendations, and conclusions in the referenced geotechnical investigation report are still applicable, except for the seismic parameters and site preparation.

Faulting

The project site is located in the seismically active Coachella Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. We have performed a computer-aided search of known faults or seismic zones that lie within a 44-mile (70 kilometer) radius of the project site (Table 1).

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2000a) indicates that the nearest mapped Earthquake Fault Zone is the San Andreas – San Bernardino (south) fault located approximately 3.7 mile north-east of the project site.

General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone. Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

2022 CBC General Ground Motion Parameters: The California Building Code (CBC) requires that a site-specific ground motion hazard analysis be performed in accordance with ASCE 7-16 Section 11.4.8 (ASCE, 2016) for structures on Site Class D with S_1 greater than or equal to 0.2 and Site Class E sites with S_s greater than or equal to 1.0 (CBC, 2022). **This project site has been classified as Site Class D and has an S1 value of 0.872, which would require a site-specific ground motion hazard analysis**. However, ASCE 7-16 Section 11.4.8 Supplement 3 provides exceptions which permit the use of conservative values of design parameters for certain conditions for Site Class D and E sites in lieu of a site-specific hazard analysis. The exceptions are:

- Site Class D sites: A ground motion hazard analysis is not required where the value of the parameter S_{M1} determined by Equation 11.4-2 is increased by 50% for all applications of S_{M1} in ASCE 7-16. The resulting value of the parameter S_{D1} determined by ASCE 7-16 Equation 11.4-4 shall be used for all applications of S_{D1} in ASCE 7-16.

- Site Class E sites: A ground motion hazard analysis is not required:
  a. Where the equivalent lateral force procedure is used for design and the value of CS is determined by ASCE 7-16 Equation 12.8-2 for all values of T, or
  b. Where (i) the value of Sai is determined by ASCE 7-16 Equation 15.7-10 for all values of Ti and (ii) the value of the parameter is replaced with 1.5 in ASCE 7-16 Equation 15.7-10 and ASCE 7-16 Equation 15.7-11.

Based on our understanding of the proposed development, the seismic design parameters presented in Table 2 were calculated assuming that one of the exceptions listed above applies to the proposed structures at this site. **However, the structural engineer should verify that one of the exceptions is applicable to the proposed structures.** If none of the exceptions apply, our office should be consulted to perform a site-specific ground motion hazard analysis.

The 2022 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The Structural Engineers Association of California (SEAOC) and

Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps Web Application (SEAOC, 2020) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration adjusted for soil site class effects (PGA_M) value to be used for liquefaction and seismic settlement analysis in accordance with 2022 CBC Section 1803A.5.12 ($PGA_M = F_{PGA}$*PGA) is estimated at 0.98g for the project site. ***Design earthquake ground motion parameters are provided in Table 2.***

Site Preparation

Clearing and Grubbing: Any surface improvements, debris or vegetation including grass, brush, and weeds, on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic stripping should be hauled from the site and not used as fill. *Any trash, construction debris, concrete slabs, old pavement, landfill, and buried obstructions such as old foundations, swimming pool and utility lines exposed during rough grading should be traced to the limits of the foreign material by the grading contractor and removed under our supervision. Any excavations resulting from site clearing should be dish-shaped to the lowest depth of disturbance and backfilled under the observation of the geotechnical engineer's representative.*

Building Pad Preparation: The existing surface soil within the proposed house pad areas should be removed to 24 inches below the lowest foundation grades or 48 inches below the existing grade (whichever deeper), extending five feet beyond all exterior wall/column lines (including adjacent concrete areas). The exposed sub-grade should be scarified to a depth of 8 inches, uniformly moisture conditioned to at least 2% over optimum moisture content and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have footings extended to a minimum of 24 inches below grade. The existing soil beneath the structure foundation prepared in the manner described for the house pad except the preparation needed only to extend 18 inches below and beyond the footing.

Sidewalk and Concrete Hardscape Areas: In areas other than the building pad which are to receive concrete slabs, the ground surface should be over-excavated to a depth of 8 to 12 inches, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Street Subgrade Preparation: The native soils in street areas should be removed and recompacted to 12 inches below the design subgrade elevation. Engineered fill in street areas should be uniformly moisture conditioned to at least 2% over optimum moisture, placed in layers not more than 6 to 8 inches in thickness and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density.

The native granular soil is suitable for use as compacted fill and utility trench backfill. The native soil should be placed in maximum 8-inch lifts (loose), uniformly moisture conditioned to at least 2% of optimum moisture content and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Imported fill soil (if needed) should be like onsite soil or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches. The geotechnical engineer should approve imported fill soil sources before hauling material to the site. Imported granular fill should be placed in lifts no greater than 8 inches in loose thickness, uniformly moisture conditioned to at least 2% over optimum moisture content and re-compacted to a minimum of 90% of the maximum density determined in accordance with ASTM D1557 methods.

Closure

We have prepared this report for your exclusive use in accordance with the generally accepted geotechnical engineering practice as it existed within the site area at the time of our study. No warranty is expressed or implied. It should be noted that the submitted plans were not reviewed for conformance with other clients', governmental or consultant requirements.

We recommend that ***Landmark Consultants, Inc.*** be retained to provide tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

Landmark Consultants, Inc. *recommendations for this site are, to a high degree, dependent upon appropriate quality control of subgrade preparation, fill placement, and foundation construction. Accordingly, the findings and professional opinions in this report are contingent upon the opportunity for* ***Landmark Consultants, Inc.*** *to observe grading operations and foundation excavations for the proposed construction.*

If parties other than ***Landmark Consultants, Inc.*** *are engaged to provide observation and testing services during construction, such parties must be notified that they will be required to assume complete responsibility as the geotechnical engineer of record for the geotechnical phase of the project by concurring with the recommendations in this report and/or by providing alternative recommendations.*

Additional information concerning the scope and cost of these services can be obtained from our office. We appreciate the opportunity to be of service. Should you have any questions, please call our office at (760)360-0665.

Sincerely Yours,
LandMark Consultants, Inc.

Greg M. Chandra, P.E., M.ASCE
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
GREG M. CHANDRA
No. C 34432
CIVIL
STATE OF CALIFORNIA

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Garnet Hill *	1.0	1.6			
San Andreas - San Bernardino (South)	3.7	6.0	7.4	103 ± 10	30 ± 7
San Andreas - San Bernardino (North)	5.6	9.0	7.5	103 ± 10	24 ± 6
Eureka Peak	12.0	19.2	6.4	19 ± 2	0.6 ± 0.4
Indio Hills *	12.7	20.3			
Blue Cut *	12.9	20.6			
San Andreas - Coachella	13.3	21.2	7.2	96 ± 10	25 ± 5
Burnt Mtn.	16.0	25.6	6.5	21 ± 2	0.6 ± 0.4
Morongo *	16.3	26.1			
Pinto Mtn.	18.6	29.8	7.2	74 ± 7	2.5 ± 2
San Jacinto - Anza	20.8	33.3	7.2	91 ± 9	12 ± 6
Landers	23.3	37.2	7.3	83 ± 8	0.6 ± 0.4
San Jacinto - Coyote Creek	25.6	41.0	6.8	41 ± 4	4 ± 2
San Jacinto - San Jacinto Valley	27.7	44.3	6.9	43 ± 4	12 ± 6
Johnson Valley (northern)	32.5	52.0	6.7	35 ± 4	0.6 ± 0.4
Pisgah Mtn. - Mesquite Lake	33.0	52.8	7.3	89 ± 9	0.6 ± 0.4
North Frontal Fault Zone - Eastern	33.2	53.2	6.7	27 ± 3	0.5 ± 0.3
S. Emerson - Copper Mtn.	33.6	53.8	7	54 ± 5	0.6 ± 0.4
Lenwood - Lockhart - Old Woman Springs	37.5	60.1	7.5	145 ± 15	0.6 ± 0.4
North Frontal Fault Zone - Western	40.0	63.9	7.2	51 ± 5	1 ± 0.5
Calico-Hidalgo	40.1	64.2	7.3	95 ± 10	0.6 ± 0.4
Helendale - S. Lockhart	44.0	70.3	7.3	97 ± 10	0.6 ± 0.4

* Note: Faults not included in CGS database.

Table 2
2022 California Building Code (CBC) and ASCE 7-16 Seismic Parameters

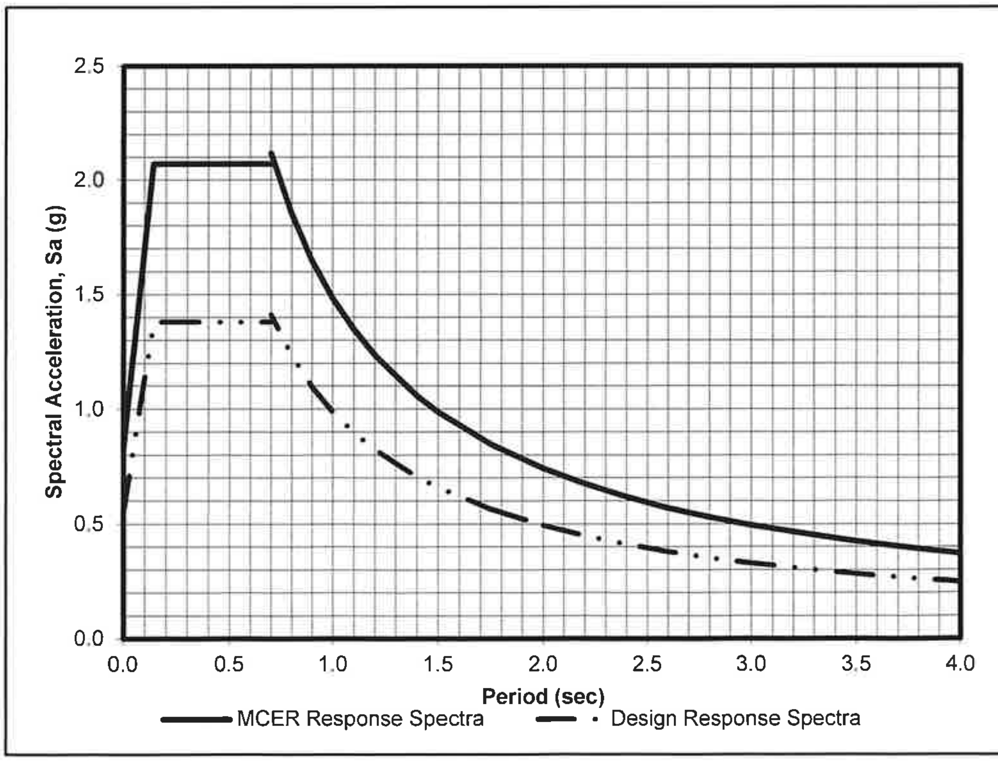
		ASCE 7-16 Reference
Soil Site Class:	**D**	Table 20.3-1
Latitude:	33.8283 N	
Longitude:	-116.4569 W	
Risk Category:	II	
Seismic Design Category:	E	

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_G Short Period Spectral Response	S_s	2.070 g	ASCE Figure 22-1	
Mapped MCE_R 1 second Spectral Response	S_1	0.872 g	ASCE Figure 22-2	
Short Period (0.2 s) Site Coefficient	F_a	1.00	ASCE Table 11.4-1	
Long Period (1.0 s) Site Coefficient	F_v	1.70	ASCE Table 11.4-2	
MCE_G Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.070 g	$= Fa * S_s$	ASCE Equation 11.4-1
MCE_G Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.482 g	$= Fv * S_1$	ASCE Equation 11.4-2

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.380 g	$= 2/3*S_{MS}$	ASCE Equation 11.4-3
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	0.988 g	$= 2/3*S_{M1}$	ASCE Equation 11.4-4
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.896		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.879		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.14 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.72 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.98 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.55	0.83
0.14	1.38	2.07
0.72	1.38	2.07
0.70	1.41	2.12
0.80	1.24	1.85
0.90	1.10	1.65
1.00	0.99	1.48
1.10	0.90	1.35
1.20	0.82	1.24
1.20	0.82	1.24
1.40	0.71	1.06
1.50	0.66	0.99
1.75	0.56	0.85
2.00	0.49	0.74
2.20	0.45	0.67
2.40	0.41	0.62
2.60	0.38	0.57
2.80	0.35	0.53
3.00	0.33	0.49
3.50	0.28	0.42
4.00	0.25	0.37

APPENDIX A

LANDMARK
Geo-Engineers and Geologists
a MBE Company

780 N. 4th Street
El Centro, CA 92243
(760) 370-3000
(760) 337-8900 fax

77-948 Wildcat Drive
Palm Desert, CA 92211
(760) 360-0665
(760) 360-0521 fax

October 12, 2016

Mr. Skip Goodell
Desert Care, LLC
31-190 Calle Cayuga
Cathedral City, CA 92234

Geotechnical Report
Living Care Assisted Living
Cathedral City, California
LCI Report No. LP17122

Dear Mr. Goodell:

This geotechnical report is provided for design and construction of the proposed commercial complex located at 30260 Date Palm Drive in Cathedral City, California. Our geotechnical investigation was conducted in response to your request for our services. The enclosed report describes our soil engineering investigation and presents our professional opinions regarding geotechnical conditions at the site to be considered in the design and construction of the project.

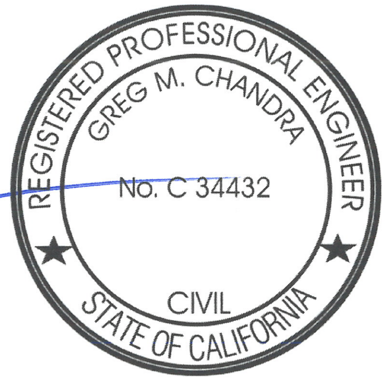
The findings of this study indicate the site is underlain by sands to maximum depth penetrated. The near surface soils at the project site are expected to be non-expansive. The subsurface soils are medium dense to dense in nature. Groundwater was not encountered in the borings during the time of field exploration. Historic groundwater levels ranged from 130 to 170 feet within the past 65 years in the vicinity of the project site.

Elevated sulfate and chloride levels were not encountered in the soil samples tested for this study. The soil is low corrosive to metal. We recommend a minimum of 2,500 psi concrete of Type II Portland Cement with a maximum water/cement ratio of 0.60 (by weight) should be used for concrete placed in contact with native soils of this project.

We did not encounter soil conditions that would preclude implementation of the proposed project provided the professional opinions contained in this report are implemented in the design and construction of this project. Our findings, professional opinions, and application options are related ***only through reading the full report***, and are best evaluated with the active participation of the engineer of record who developed them.

We appreciate the opportunity to provide our findings and professional opinions regarding geotechnical conditions at the site. If you have any questions or comments regarding our findings, please call our office at (760) 360-0665.

Respectfully Submitted,
LandMark Consultants, Inc.



Greg M. Chandra, P.E., M.ASCE
Principal Engineer

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Section 1
INTRODUCTION

1.1 Project Description

This report presents the findings of our geotechnical exploration for the proposed commercial and residential complex located at 30260 Date Palm Drive in the city of Cathedral City, California (See Vicinity Map, Plate A-1). The proposed development will consist of urgent care, senior housing, hotel, restaurant, and administration building on 11 acres of vacant desert land. A site plan for the proposed development was provided by Self Reliance, Inc., dated May 3, 2017.

The structures are planned to consist of continuous wall and column concrete footings, concrete slabs-on-grade and wood-frame construction. Footing loads at exterior bearing walls are estimated at 1 to 10 kips per lineal foot. Column loads are estimated to range from 5 to 80 kips. If structural loads exceed those stated above, we should be notified so we may evaluate their impact on foundation settlement and bearing capacity. Site development will include building pad preparation, underground utilities installation, on-site and off-site street construction, concrete driveway and sidewalk placement.

1.2 Purpose and Scope of Work

The purpose of this geotechnical study was to investigate the upper 51.5 feet of subsurface soil at selected locations within the site for evaluation of physical/engineering properties. From the subsequent field and laboratory data, professional opinions were developed and are provided in this report regarding geotechnical conditions at this site and the effect on design and construction. The scope of our services consisted of the following:

< Field exploration and in-situ testing of the site soils at selected locations and depths.

< Laboratory testing for physical and/or chemical properties of selected samples.

< Review of the available literature and publications pertaining to local geology, faulting, and seismicity.

< Engineering analysis and evaluation of the data collected.

< Preparation of this report presenting our findings and, professional opinions, regarding the geotechnical aspects of project design and construction.

This report addresses the following geotechnical parameters:

- Subsurface soil and groundwater conditions
- Site geology, regional faulting and seismicity, near source factors, and site seismic accelerations
- Liquefaction potential and its mitigation
- Expansive soil and methods of mitigation
- Aggressive soil conditions to metals and concrete

Professional opinions with regard to the above parameters are presented for the following:

- Site grading and earthwork
- Building pad and foundation subgrade preparation
- Allowable soil bearing pressures and expected settlements
- Concrete slabs-on-grade
- Lateral earth pressures
- Excavation conditions and buried utility installations
- Mitigation of the potential effects of salt concentrations in native soil to concrete mixes and steel reinforcement
- Seismic design parameters
- Preliminary Pavement structural sections

Our scope of work for this report did not include an evaluation of the site for the presence of environmentally hazardous materials or conditions.

1.3 Authorization

Ms. Geri Doodell of Desert Care, LLC provided authorization by written agreement to proceed with our work on August 15, 2017. We conducted our work according to our written proposal dated August 11, 2017.

Section 2
METHODS OF INVESTIGATION

2.1 Field Exploration

Subsurface exploration was performed on August 31, 2017 using 2R Drilling of Ontario California to advance five (5) borings to depths of 21.5 to 51.5 feet below existing ground surface. The borings were advanced with a truck-mounted, CME 75 drill rig using 8-inch diameter, hollow-stem, continuous-flight augers. The approximate boring locations were established in the field and plotted on the site map by sighting to discernable site features. The boring locations are shown on the Site and Exploration Plan (Plate A-2).

Additional subsurface exploration was performed on September 14, 2017 by using a backhoe to excavate six (6) test pits to an approximate depth of 15 feet below the existing ground surface. The test pit locations are shown on the Site and Exploration Plan (Plate A-2). Bulk samples driven into undisturbed soil were obtained at selected depths in the test pits. A nuclear densometer (ASTM D6938) was used to evaluate in-situ densities and natural moisture content at selected depths in the upper 5 feet of the backhoe pits. The test pits were located by taped or paced measurements and should be considered approximate.

After logging and sampling the soil, the exploratory boring and test pits were backfilled with the excavated material. The backfill was loosely placed and was not compacted to the requirements specified for engineered fill. The backhoe pits shall be located during rough grading of the site to properly re-compact the backfill.

Our senior engineer maintained logs of the borings and test pits during exploration. The logs were edited in final form after a review of retrieved samples and the field and laboratory data. The boring and test pit logs are presented on Plates B-1 through B-11 in Appendix B. Soils encountered have been classified according to the Unified Soil Classification System. A key to the boring and test pit logs is presented on Plate B-12. The stratification lines shown on the subsurface logs represent the approximate boundaries between the various strata. However, the transition from one stratum to another may be gradual over some range of depth.

2.2 Laboratory Testing

Laboratory tests were conducted on selected bulk and relatively undisturbed soil samples to aid in classification and evaluation of selected engineering properties of the site soils. The tests were conducted in general conformance to the procedures of the American Society for Testing and Materials (ASTM) or other standardized methods as referenced below. The laboratory testing program consisted of the following tests:

- Particle Size Analyses (ASTM D422) – used for soil classification and liquefaction evaluation.
- Collapse Potential (ASTM D5333) – used for hydro-consolidation potential evaluation.
- Unit Dry Densities (ASTM D2937) – used for insitu soil parameters
- Moisture Contents (ASTM D2216) – used for insitu soil parameters
- Moisture-Density Relationship (ASTM D1557) – used for soil compaction determinations.
- Chemical Analyses (soluble sulfates & chlorides, pH, and resistivity) (Caltrans Methods) – used for concrete mix evaluations and corrosion protection requirements.

The laboratory test results are presented on the subsurface logs and on Plates C-1 through C-7 in Appendix C.

Engineering parameters of soil strength, compressibility and relative density utilized for developing design criteria provided within this report were either extrapolated from correlations with the data obtained from the field and laboratory testing program.

Section 3
DISCUSSION

3.1 Site Conditions

The project site is rectangular shaped in plain view, is relatively flat-lying and consists of approximately 11 acres of vacant land. The site is bounded by Rosemount Road to the south and Date Palm Drive to the west, residential homes to the east, and the Northgate Community Church to the north. Adjacent properties are flat-lying and are approximately at the same elevation with this site.

The project site lies at an elevation of approximately 360 to 370 feet above mean sea level (MSL) in the Coachella Valley region of the California low desert. Annual rainfall in this arid region is less than 4 inches per year with four months of average summertime temperatures above 100 ^{o}F. Winter temperatures are mild, seldom reaching freezing.

3.2 Geologic Setting

The project site is located in the Coachella Valley portion of the Salton Trough physiographic province. The Salton Trough is a geologic structural depression resulting from large scale regional faulting. The trough is bounded on the northeast by the San Andreas Fault and Chocolate Mountains and the southwest by the Peninsular Range and faults of the San Jacinto Fault Zone. The Salton Trough represents the northward extension of the Gulf of California, containing both marine and non-marine sediments since the Miocene Epoch. Tectonic activity that formed the trough continues at a high rate as evidenced by deformed young sedimentary deposits and high levels of seismicity. Figure 1 shows the location of the site in relation to regional faults and physiographic features.

The surrounding regional geology includes the Peninsular Ranges (Santa Rosa and San Jacinto Mountains) to the south and west, the Salton Basin to the southeast, and the Transverse Ranges (Little San Bernardino and Orocopia Mountains) to the north and east. Hundreds of feet to several thousand feet of Quaternary fluvial, lacustrine, and aeolian soil deposits underlie the Coachella Valley.

The southeastern part of the Coachella Valley lies below sea level. In the geologic past, the ancient Lake Cahuilla submerged the area. Calcareous tufa deposits may be observed along the ancient shoreline as high as elevation 45 to 50 feet MSL along the Santa Rosa Mountains from La Quinta southward. Lacustrine (lake bed) deposits comprise the subsurface soils over much of the eastern Coachella Valley with alluvial outwash along the flanks of the valley.

3.3 Faulting

The project site is located in the seismically active Coachella Valley of southern California with numerous mapped faults of the San Andreas Fault System traversing the region. We have performed a computer-aided search of known faults or seismic zones that lie within a 62-mile (100 kilometer) radius of the project site (Table 1).

A fault map illustrating known active faults relative to the site is presented on Figure 1, *Regional Fault Map*. Figure 2 shows the project site in relation to local faults. The criterion for fault classification adopted by the California Geological Survey defines Earthquake Fault Zones along active or potentially active faults. An active fault is one that has ruptured during Holocene time (roughly within the last 11,000 years). A fault that has ruptured during the last 1.8 million years (Quaternary time), but has not been proven by direct evidence to have not moved within Holocene time is considered to be potentially active. A fault that has not moved during Quaternary time is considered to be inactive.

Review of the current Alquist-Priolo Earthquake Fault Zone maps (CGS, 2000a) indicates that the nearest mapped Earthquake Fault Zone is the San Andreas Fault located approximately 3.7 miles northeast of the project site.

3.4 General Ground Motion Analysis

The project site is considered likely to be subjected to moderate to strong ground motion from earthquakes in the region. Ground motions are dependent primarily on the earthquake magnitude and distance to the seismogenic (rupture) zone.

Table 1
Summary of Characteristics of Closest Known Active Faults

Fault Name	Approximate Distance (miles)	Approximate Distance (km)	Maximum Moment Magnitude (Mw)	Fault Length (km)	Slip Rate (mm/yr)
Garnet Hill *	1.0	1.6			
San Andreas - San Bernardino (South)	3.7	6.0	7.4	103 ± 10	30 ± 7
San Andreas - San Bernardino (North)	5.6	9.0	7.5	103 ± 10	24 ± 6
Eureka Peak	12.0	19.2	6.4	19 ± 2	0.6 ± 0.4
Indio Hills *	12.7	20.3			
Blue Cut *	12.9	20.6			
San Andreas - Coachella	13.3	21.2	7.2	96 ± 10	25 ± 5
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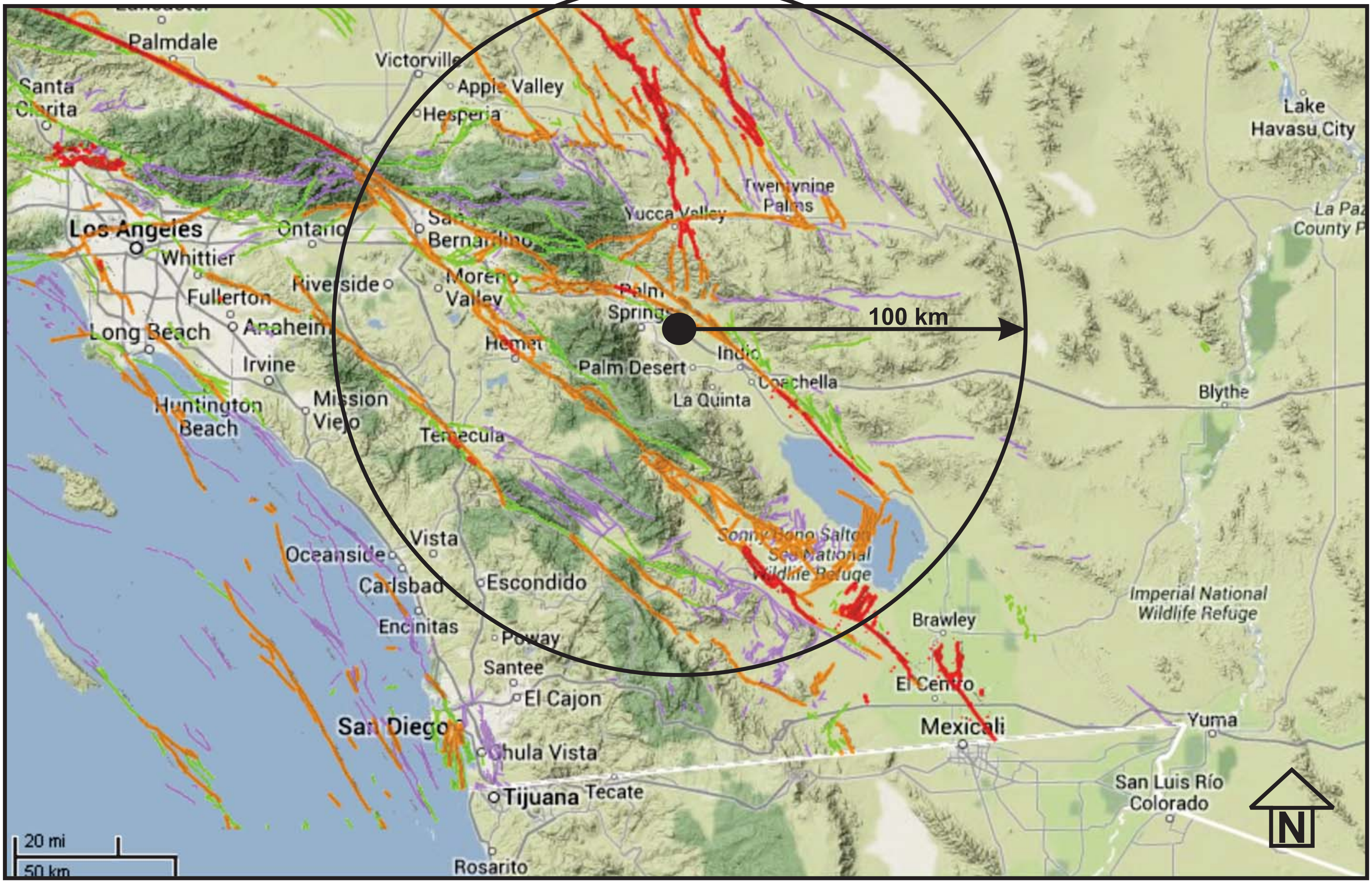
Morongo *	16.3	26.1			
Pinto Mtn.	18.6	29.8	7.2	74 ± 7	2.5 ± 2
San Jacinto - Anza	20.8	33.3	7.2	91 ± 9	12 ± 6
Landers	23.3	37.2	7.3	83 ± 8	0.6 ± 0.4
San Jacinto - Coyote Creek	25.6	41.0	6.8	41 ± 4	4 ± 2
San Jacinto - San Jacinto Valley	27.7	44.3	6.9	43 ± 4	12 ± 6
Johnson Valley (northern)	32.5	52.0	6.7	35 ± 4	0.6 ± 0.4
Pisgah Mtn. - Mesquite Lake	33.0	52.8	7.3	89 ± 9	0.6 ± 0.4
North Frontal Fault Zone - Eastern	33.2	53.2	6.7	27 ± 3	0.5 ± 0.3
S. Emerson - Copper Mtn.	33.6	53.8	7	54 ± 5	0.6 ± 0.4
Lenwood - Lockhart - Old Woman Springs	37.5	60.1	7.5	145 ± 15	0.6 ± 0.4
North Frontal Fault Zone - Western	40.0	63.9	7.2	51 ± 5	1 ± 0.5
Calico-Hidalgo	40.1	64.2	7.3	95 ± 10	0.6 ± 0.4
Helendale - S. Lockhart	44.0	70.3	7.3	97 ± 10	0.6 ± 0.4

* Note: Faults not included in CGS database.



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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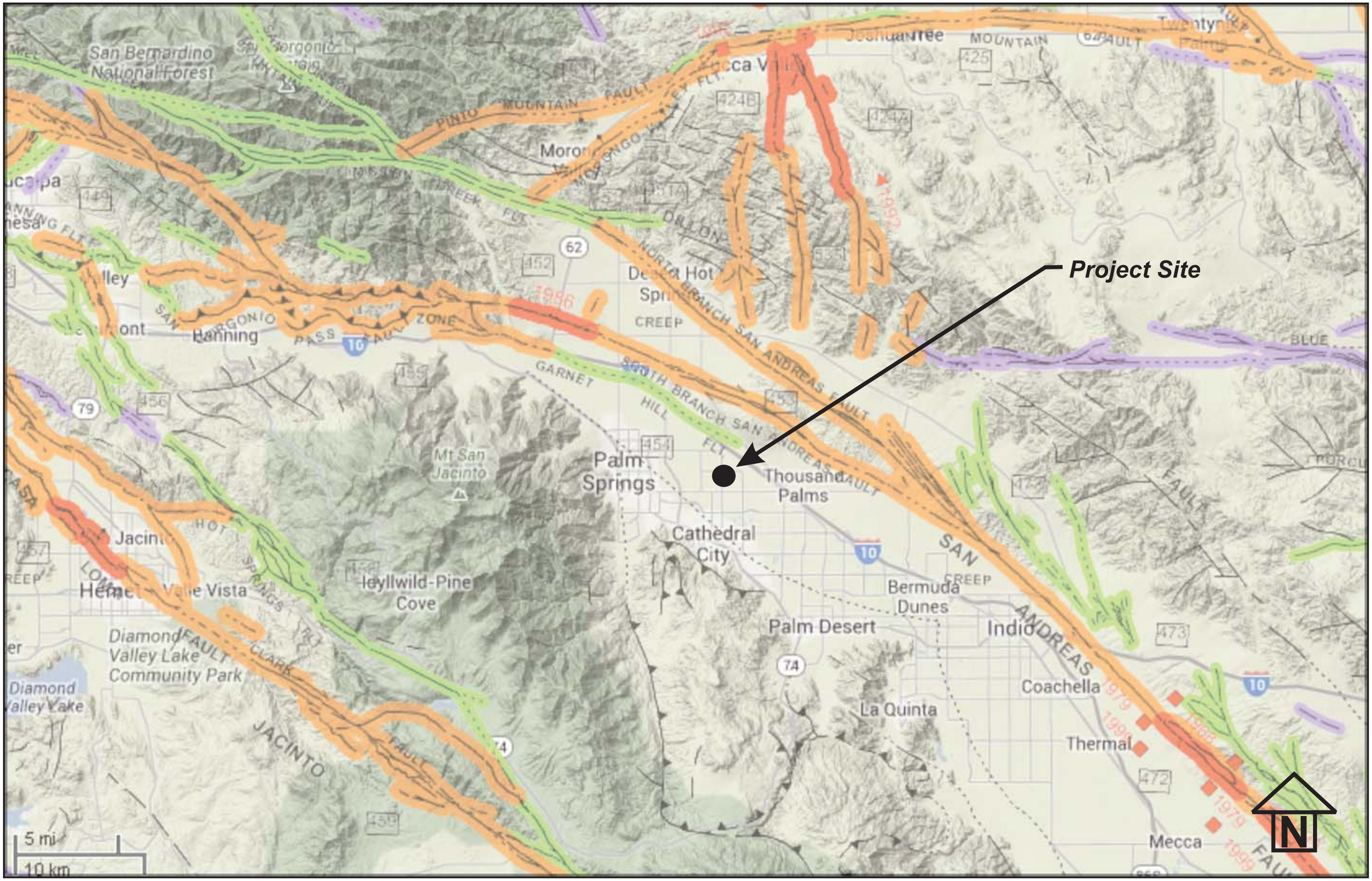
Regional Fault Map

Figure 1



Source: California Geological Survey 2010 Fault Activity Map of California
http://www.quake.ca.gov/gmaps/FAM/faultactivitymap.html#

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Map of Local Faults

Figure 2

EXPLANATION

Fault traces on land are indicated by solid lines where well located, by dashed lines where approximately located or inferred, and by dotted lines where concealed by younger rocks or by lakes or bays. Fault traces are queried where continuation or existence is uncertain. Concealed faults in the Great Valley are based on maps of selected subsurface horizons, so locations shown are approximate and may indicate structural trend only. All offshore faults based on seismic reflection profile records are shown as solid lines where well defined, dashed where inferred, queried where uncertain.

FAULT CLASSIFICATION COLOR CODE
(Indicating Recency of Movement)

Fault along which historic (last 200 years) displacement has occurred and is associated with one or more of the following:

(a) a recorded earthquake with surface rupture. (Also included are some well-defined surface breaks caused by ground shaking during earthquakes, e.g. extensive ground breakage, not on the White Wolf fault, caused by the Arvin-Tehachapi earthquake of 1952). The date of the associated earthquake is indicated. Where repeated surface ruptures on the same fault have occurred, only the date of the latest movement may be indicated, especially if earlier reports are not well documented as to location of ground breaks.

(b) fault creep slippage - slow ground displacement usually without accompanying earthquakes.

(c) displaced survey lines.

A triangle to the right or left of the date indicates termination point of observed surface displacement. Solid red triangle indicates known location of rupture termination point. Open black triangle indicates uncertain or estimated location of rupture termination point.

Date bracketed by triangles indicates local fault break.

No triangle by date indicates an intermediate point along fault break.

Fault that exhibits fault creep slippage. Hachures indicate linear extent of fault creep. Annotation (creep with leader) indicates representative locations where fault creep has been observed and recorded.

Square on fault indicates where fault creep slippage has occured that has been triggered by an earthquake on some other fault. Date of causative earthquake indicated. Squares to right and left of date indicate terminal points between which triggered creep slippage has occurred (creep either continuous or intermittent between these end points).

Holocene fault displacement (during past 11,700 years) without historic record. Geomorphic evidence for Holocene faulting includes sag ponds, scarps showing little erosion, or the following features in Holocene age deposits: offset stream courses, linear scarps, shutter ridges, and triangular faceted spurs. Recency of faulting offshore is based on the interpreted age of the youngest strata displaced by faulting.

Late Quaternary fault displacement (during past 700,000 years). Geomorphic evidence similar to that described for Holocene faults except features are less distinct. Faulting may be younger, but lack of younger overlying deposits precludes more accurate age classification.

Quaternary fault (age undifferentiated). Most faults of this category show evidence of displacement sometime during the past 1.6 million years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age. Unnumbered Quaternary faults were based on Fault Map of California, 1975. See Bulletin 201, Appendix D for source data.

Pre-Quaternary fault (older that 1.6 million years) or fault without recognized Quaternary displacement. Some faults are shown in this category because the source of mapping used was of reconnaissnce nature, or was not done with the object of dating fault displacements. Faults in this category are not necessarily inactive.

ADDITIONAL FAULT SYMBOLS

Bar and ball on downthrown side (relative or apparent).

Arrows along fault indicate relative or apparent direction of lateral movement.

Arrow on fault indicates direction of dip.

Low angle fault (barbs on upper plate). Fault surface generally dips less than 45° but locally may have been subsequently steepened. On offshore faults, barbs simply indicate a reverse fault regardless of steepness of dip.

OTHER SYMBOLS

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Numbers refer to annotations listed in the appendices of the accompanying report. Annotations include fault name, age of fault displacement, and pertinent references including Earthquake Fault Zone maps where a fault has been zoned by the Alquist-Priolo Earthquake Fault Zoning Act. This Act requires the State Geologist to delineate zones to encompass faults with Holocene displacement.

Structural discontinuity (offshore) separating differing Neogene structural domains. May indicate discontinuities between basement rocks.

Brawley Seismic Zone, a linear zone of seismicity locally up to 10 km wide associated with the releasing step between the Imperial and San Andreas faults.

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
Quaternary	Late Quaternary	Holocene	11,700		? ? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
Quaternary	Late Quaternary	Pleistocene	700,000		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
Quaternary	Early Quaternary	Pleistocene	1,600,000*		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			4.5 billion (Age of Earth)			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.

Acceleration magnitudes also are dependent upon attenuation by rock and soil deposits, direction of rupture and type of fault; therefore, ground motions may vary considerably in the same general area.

CBC General Ground Motion Parameters: The 2016 CBC general ground motion parameters are based on the Risk-Targeted Maximum Considered Earthquake (MCE_R). The U.S. Geological Survey "U.S. Seismic Design Maps Web Application" (USGS, 2017) was used to obtain the site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. The site soils have been classified as Site Class D (stiff soil profile). Design spectral response acceleration parameters are defined as the earthquake ground motions that are two-thirds (2/3) of the corresponding MCE_R ground motions. Design earthquake ground motion parameters are provided in Table 2. A Risk Category II was determined using Table 1604.5 and the Seismic Design Category is E since S_1 is greater than 0.75.

The Maximum Considered Earthquake Geometric Mean (MCE_G) peak ground acceleration (PGA_M) value was determined from the "U.S. Seismic Design Maps Web Application" (USGS, 2017) for liquefaction and seismic settlement analysis in accordance with 2016 CBC Section 1803.5.12 and CGS Note 48 ($PGA_M = F_{PGA}*PGA$). A PGA_M value of 0.85g is used for liquefaction settlement analysis.

3.5 Seismic and Other Hazards

► **Groundshaking.** The primary seismic hazard at the project site is the potential for strong groundshaking during earthquakes along the San Andreas Fault. A further discussion of groundshaking follows in Section 3.4.

► **Surface Rupture.** The project site does not lie within a State of California, Alquist-Priolo Earthquake Fault Zone. Surface fault rupture is considered to be unlikely at the project site because of the well-delineated fault lines through the Coachella Valley as shown on USGS and CDMG maps. However, because of the high tectonic activity and deep alluvium of the region, we cannot preclude the potential for surface rupture on undiscovered or new faults that may underlie the site.

► **Liquefaction.** Liquefaction is unlikely to be a potential hazard at the site, since the groundwater is believed to be deeper than 50 feet (the maximum depth that liquefaction is known to occur).

Table 2
2016 California Building Code (CBC) and ASCE 7-10 Seismic Parameters

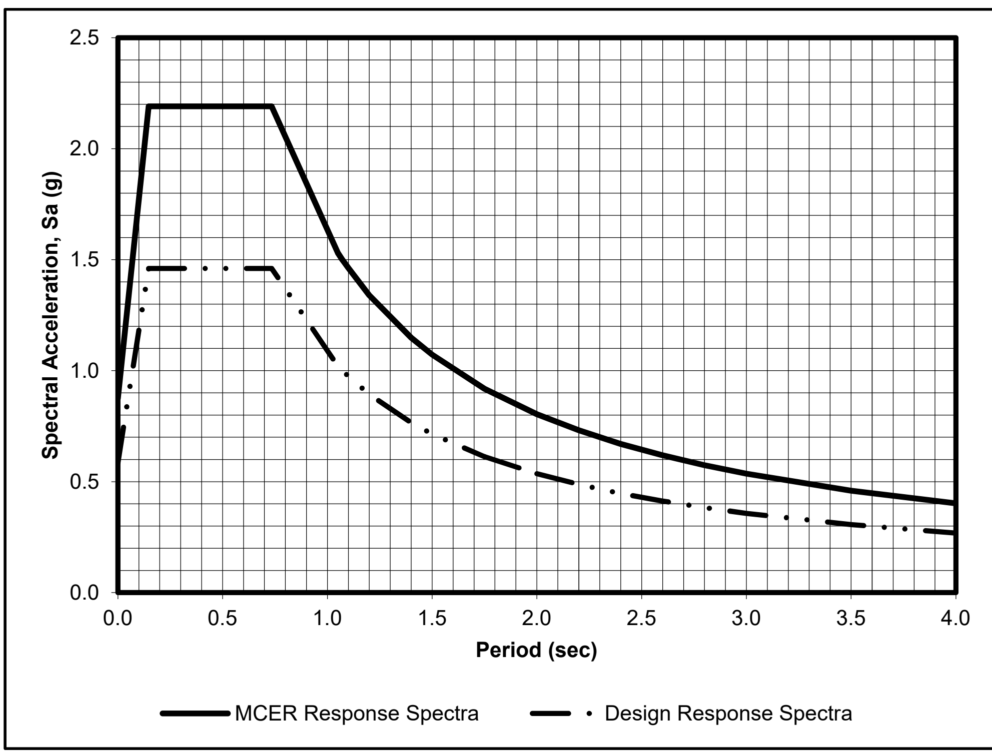
			CBC Reference
Soil Site Class:	**D**		Table 20.3-1
Latitude:	33.8283	N	
Longitude:	-116.4569	W	
Risk Category:	II		
Seismic Design Category:	E		

Maximum Considered Earthquake (MCE) Ground Motion

Mapped MCE_R Short Period Spectral Response	S_s	2.191 g	Figure 1613.3.1(1)	
Mapped MCE_R 1 second Spectral Response	S_1	1.072 g	Figure 1613.3.1(2)	
Short Period (0.2 s) Site Coefficient	F_a	1.00	Table 1613.3.3(1)	
Long Period (1.0 s) Site Coefficient	F_v	1.50	Table 1613.3.3(2)	
MCE_R Spectral Response Acceleration Parameter (0.2 s)	S_{MS}	2.191 g	$= F_a * S_s$	Equation 16-37
MCE_R Spectral Response Acceleration Parameter (1.0 s)	S_{M1}	1.608 g	$= F_v * S_1$	Equation 16-38

Design Earthquake Ground Motion

Design Spectral Response Acceleration Parameter (0.2 s)	S_{DS}	1.461 g	$= 2/3*S_{MS}$	Equation 16-39
Design Spectral Response Acceleration Parameter (1.0 s)	S_{D1}	1.072 g	$= 2/3*S_{M1}$	Equation 16-40
Risk Coefficient at Short Periods (less than 0.2 s)	C_{RS}	0.963		ASCE Figure 22-17
Risk Coefficient at Long Periods (greater than 1.0 s)	C_{R1}	0.914		ASCE Figure 22-18
	T_L	8.00 sec		ASCE Figure 22-12
	T_O	0.15 sec	$=0.2*S_{D1}/S_{DS}$	
	T_S	0.73 sec	$=S_{D1}/S_{DS}$	
Peak Ground Acceleration	PGA_M	0.85 g		ASCE Equation 11.8-1



Period T (sec)	Sa (g)	MCE_R Sa (g)
0.00	0.58	0.88
0.15	1.46	2.19
0.73	1.46	2.19
1.05	1.02	1.53
1.06	1.01	1.52
1.07	1.00	1.50
1.08	0.99	1.49
1.10	0.97	1.46
1.20	0.89	1.34
1.20	0.89	1.34
1.40	0.77	1.15
1.50	0.71	1.07
1.75	0.61	0.92
2.00	0.54	0.80
2.20	0.49	0.73
2.40	0.45	0.67
2.60	0.41	0.62
2.80	0.38	0.57
3.00	0.36	0.54
3.50	0.31	0.46
4.00	0.27	0.40

Other Potential Geologic Hazards.

► **Landsliding.** The hazard of landsliding is unlikely due to the regional planar topography. No ancient landslides are shown on geologic maps of the region and no indications of landslides were observed during our site investigation.

► **Volcanic hazards.** The site is not located in proximity to any known volcanically active area and the risk of volcanic hazards is considered very low.

► **Tsunamis, sieches, and flooding.** The site does not lie near any large bodies of water, so the threat of tsunami, sieches, or other seismically-induced flooding is unlikely. The project site is located within a Federal Emergency Management Agency (FEMA) Other Flood Areas Zone X (as shown on Plate A-6).

► **Expansive soil.** The near surface soils at the project site consist of sands which are non-expansive in nature.

3.6 Subsurface Soil

Subsurface soils encountered during the field exploration conducted on August 31 and September 14, 2017 consist of medium dense to dense sands to maximum depth penetrated. The near surface soils are non-expansive in nature. The subsurface logs (Plates B-1 through B-11) depict the stratigraphic relationships of the various soil types.

3.7 Groundwater

Groundwater was not encountered in the test pits during the time of exploration. According to Coachella Valley Water District (CVWD) readings of groundwater levels from nearby wells, groundwater is located at a depth of approximately 230 feet below the ground surface in the vicinity of the project site.

There is uncertainty in the accuracy of short-term water level measurements, particularly in fine-grained soil. Groundwater levels may fluctuate with precipitation, irrigation of adjacent properties, drainage, and site grading. The groundwater level noted should not be interpreted to represent an accurate or permanent condition.

Based on the general topography, groundwater flow directions are estimated to be toward the southeast within the subject site area. Flow directions may also vary locally in the vicinity of the site.

Historic groundwater records in the vicinity of the project site indicate that groundwater has fluctuated between 130 to 170 feet below the ground surface over the last 65 years according to the Coachella Valley Water District and to a report "Coachella Valley Investigation" conducted by the Department of Water Resources, published July 1964.

3.8 Hydro-consolidation

In arid climatic regions, granular soils have a potential to collapse upon wetting. This collapse (hydro-consolidation) phenomena is the result of the lubrication of soluble cements (carbonates) in the soil matrix causing the soil to densify from its loose configuration during deposition.

Collapse potential tests (Plates C-7) performed on a remolded sample from the site indicated a slight risk of collapse upon saturation. Therefore, development of building foundation is not required to include provisions for mitigating the hydro-consolidation caused by soil saturation from landscape irrigation or broken utility lines.

3.9 Regional Subsidence

The project is located in the Coachella Valley which has experienced up to 12 inches of regional subsidence between 1996 and 2005 (USGS, 2007). The risk of regional subsidence at the project site is considered low.

Section 4
DESIGN CRITERIA

4.1 Site Preparation

Pre-grade Meeting: Prior to site preparation, a meeting should be held at the site with as a minimum, the owner's representative, grading contractor and geotechnical engineer in attendance.

Clearing and Grubbing: All surface improvements, debris and/or vegetation including grass, trees, and weeds on the site at the time of construction should be removed from the construction area. Root balls should be completely excavated. Organic stripping should be hauled from the site and not used as fill. ***Any trash, construction debris, concrete slabs, old pavement, and buried obstructions such as old foundations and utility lines exposed during rough grading should be traced to the limits of the foreign materials and removed***. Any excavations resulting from site clearing and grubbing should be dish-shaped to the lowest depth of disturbance and backfilled with engineered fill.

Building Pad Preparation: The existing surface soil within the building pad areas should be removed to 24 inches below the lowest foundation grade or 48 inches below the original grade (whichever is deeper), extending five feet beyond all exterior wall/column lines (including adjacent concreted areas). The exposed sub-grade should be scarified to a depth of 8 inches, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density

The on-site soils are suitable for use as compacted fill and utility trench backfill. Imported fill soil (if required) should similar to onsite soil or non-expansive, granular soil meeting the USCS classifications of SM, SP-SM, or SW-SM with a maximum rock size of 3 inches. ***The geotechnical engineer should approve imported fill soil sources before hauling material to the site***. Native, stock pile and imported materials should be placed in lifts no greater than 8 inches in loose thickness, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

In areas other than the building pad which are to receive concrete slabs and asphalt concrete pavement, the ground surface should be over-excavated to a depth of 12 inches, uniformly moisture conditioned to at least 2% over optimum moisture, and re-compacted to at least 90% of ASTM D1557 maximum density.

Trench Backfill: On-site soil free of debris, vegetation, and other deleterious matter may be suitable for use as utility trench backfill. Backfill within roadways should be placed in layers not more that 6 inches in thickness, uniformly moisture conditioned to at least 2% over optimum moisture and mechanically compacted to a minimum of 90% of the ASTM D1557 maximum dry density except for the top 12 inches of the trench which shall be compacted to at least 95%. Native backfill should only be placed and compacted after encapsulating buried pipes with suitable bedding and pipe envelope material.

Pipe envelope/bedding should either be clean sand (Sand Equivalent SE>30) or crushed rock when encountering groundwater. A geotextile filter fabric (Mirafi 140N or equivalent) should be used to encapsulate the crushed rock to reduce the potential for in-washing of fines into the gravel void space. Precautions should be taken in the compaction of the backfill to avoid damage to the pipes and structures.

Moisture Control and Drainage: The moisture condition of the building pad should be maintained during trenching and utility installation until concrete is placed or should be rewetted before initiating delayed construction. If soil drying is noted, a 2 to 3 inches depth of water may be used in the bottom of footings to restore footing subgrade moisture and reduce potential edge lift.

Adequate site drainage is essential to future performance of the project. Infiltration of excess irrigation water and stormwaters can adversely affect the performance of the subsurface soil at the site. Positive drainage should be maintained away from all structures (5% for 5 feet minimum across unpaved areas) to prevent ponding and subsequent saturation of the native soil. Gutters and downspouts may be considered as a means to convey water away from foundations. If landscape irrigation is allowed next to the building, drip irrigation systems or lined planter boxes should be used. The subgrade soil should be maintained in a moist, but not saturated state, and not allowed to dry out. Drainage should be maintained without ponding.

Observation and Density Testing: All site preparation and fill placement should be continuously observed and tested by a representative of a qualified geotechnical engineering firm. Full-time observation services during the excavation and scarification process is necessary to detect un-desirable materials or conditions and soft areas that may be encountered in the construction area. The geotechnical firm that provides observation and testing during construction shall assume the responsibility of "***geotechnical engineer of record***" and, as such, shall perform additional tests and investigation as necessary to satisfy themselves as to the site conditions and the recommendations for site development.

Auxiliary Structures Foundation Preparation: Auxiliary structures such as free standing or retaining walls should have the existing soil beneath the structure foundation prepared in the manner recommended for the building pad except the preparation needed only to extend 18 inches below and beyond the footing.

4.2 Foundations and Settlements

Shallow column footings and continuous wall footings are suitable to support the structures provided they are founded on a layer of properly prepared and compacted soil as described in Section 4.1. The foundations may be designed using an allowable soil bearing pressure of 1,800 psf. The allowable soil pressure may be increased by 20% for each foot of embedment depth in excess of 18 inches and by one-third for short term loads induced by winds or seismic events. The maximum allowable soil pressure at increased embedment depths shall not exceed 2,800 psf.

All exterior and interior foundations should be embedded a minimum of 18 inches below the building support pad or lowest adjacent final grade, whichever is deeper. Continuous wall footings should have a minimum width of 12 inches. Column footings should have a minimum width of 24 inches and should not be structurally isolated. ***Recommended concrete reinforcement and sizing for all footings should be provided by the structural engineer.***

Resistance to horizontal loads will be developed by passive earth pressure on the sides of footings and frictional resistance developed along the bases of footings and concrete slabs. Passive resistance to lateral earth pressure may be calculated using an equivalent fluid pressure of 300 pcf to resist lateral loadings.

The top one foot of embedment should not be considered in computing passive resistance unless the adjacent area is confined by a slab or pavement. An allowable friction coefficient of 0.4 may also be used at the base of the footings to resist lateral loading.

Foundation movement under the estimated static (non-seismic) loadings and static site conditions are estimated to not exceed ¾ inch with differential movement of about two-thirds of total movement for the loading assumptions stated above when the subgrade preparation guidelines given above are followed.

4.3 Slabs-On-Grade

Concrete slabs and flatwork should be a minimum of 4 inches thick. Concrete slabs and flatworks should be determined by the design engineer. Concrete floor slabs may either be monolithically placed with the foundation or dowelled after footing placement. The concrete slabs may be placed on granular subgrade that has been compacted at least 90% relative compaction (ASTM D1557).

American Concrete Institute (ACI) guidelines (ACI 302.1R-04 Chapter 3, Section 3.2.3) provide recommendations regarding the use of moisture barriers beneath concrete slabs. The concrete floor slabs should be underlain by a 10-mil polyethylene vapor retarder that works as a capillary break to reduce moisture migration into the slab section. All laps and seams should be overlapped 6-inches or as recommended by the manufacturer. The vapor retarder should be protected from puncture. The joints and penetrations should be sealed with the manufacturer's recommended adhesive, pressure-sensitive tape, or both. The vapor retarder should extend a minimum of 12 inches into the footing excavations. The vapor retarder should be covered by 4 inches of clean sand (Sand Equivalent SE>30) unless placed on 2.5 feet of granular fill, in which case, the vapor retarder may lie directly on the granular fill with 2 inches of clean sand cover.

Placing sand over the vapor retarder may increase moisture transmission through the slab, because it provides a reservoir for bleed water from the concrete to collect. The sand placed over the vapor retarder may also move and mound prior to concrete placement, resulting in an irregular slab thickness.

For areas with moisture sensitive flooring materials, ACI recommends that concrete slabs be placed without a sand cover directly over the vapor retarder, provided that the concrete mix uses a low-water cement ratio and concrete curing methods are employed to compensate for release of bleed water through the top of the slab. The vapor retarder should have a minimum thickness of 15-mil (Stego-Wrap or equivalent).

Control joints should be provided in all concrete slabs-on-grade at a maximum spacing (in feet) of 2 to 3 times the slab thickness (in inches) as recommended by American Concrete Institute (ACI) guidelines. All joints should form approximately square patterns to reduce randomly oriented contraction cracks. Contraction joints in the slabs should be tooled at the time of the pour or sawcut (¼ of slab depth) within 6 to 8 hours of concrete placement. Construction (cold) joints in foundations and area flatwork should either be thickened butt-joints with dowels or a thickened keyed-joint designed to resist vertical deflection at the joint. All joints in flatwork should be sealed to prevent moisture, vermin, or foreign material intrusion. Precautions should be taken to prevent curling of slabs in this arid desert region (refer to ACI guidelines).

All independent concrete flatworks should be underlain by 12 inches of moisture conditioned and compacted soils. All flatwork should be jointed in square patterns and at irregularities in shape at a maximum spacing of 10 feet or the least width of the sidewalk.

4.4 Concrete Mixes and Corrosivity

Selected chemical analyses for corrosivity were conducted on bulk samples of the near surface soil from the project site (Plate C-5). The native soils tested were shown to have low levels of sulfate and chloride ion concentrations. Resistivity determinations on the soil indicate low potential for metal loss because of electrochemical corrosion processes.

A minimum of 2,500 psi concrete of Type II Portland Cement with a maximum water/cement ratio of 0.60 (by weight) should be used for concrete placed in contact with native soil on this project (sitework including streets, sidewalks, driveways, patios, and foundations).

A minimum concrete cover of three (3) inches is recommended around steel reinforcing or embedded components (anchor bolts, hold-downs, etc.) exposed to native soil or landscape water (to 18 inches above grade). The concrete should also be thoroughly vibrated during placement.

Landmark does not practice corrosion engineering. We recommend that a qualified corrosion engineer evaluate the corrosion potential on metal construction materials and concrete at the site.

4.5 Excavations

All trench excavations should conform to CalOSHA requirements for Type C soil. The contractor is solely responsible for the safety of workers entering trenches. Temporary excavations with depths of 4 feet or less may be cut nearly vertical for short duration. Temporary slopes should be no steeper than 1.5:1 (horizontal: vertical). Sandy soil slopes should be kept moist, but not saturated, to reduce the potential of raveling or sloughing.

Trench excavations deeper than 4 feet will require shoring or slope inclinations in conformance to CAL/OSHA regulations for Type C soil. Surcharge loads of stockpiled soil or construction materials should be set back from the top of the slope a minimum distance equal to the height of the slope. All permanent slopes should not be steeper than 3:1 to reduce wind and rain erosion. Protected slopes with ground cover may be as steep as 2:1. However, maintenance with motorized equipment may not be possible at this inclination.

4.6 Lateral Earth Pressures

Earth retaining structures, such as retaining walls, should be designed to resist the soil pressure imposed by the retained soil mass. Walls with granular drained backfill may be designed for an assumed static earth pressure equivalent to that exerted by a fluid weighing 35 pcf for unrestrained (active) conditions (able to rotate 0.1% of wall height), and 50 pcf for restrained (at-rest) conditions. These values should be verified at the actual wall locations during construction.

4.7 Seismic Design

This site is located in the seismically active southern California area and the site structures are subject to strong ground shaking due to potential fault movements along the San Andreas fault. Engineered design and earthquake-resistant construction are the common solutions to increase safety and development of seismic areas. Designs should comply with the latest edition of the CBC for Site Class D using the seismic coefficients given in Section 3.4 of this report.

4.8 Permanent Slopes

Cut and Fill slopes should be constructed generally no steeper than 3 (H):1(V) to permit easy landscape maintenance and provide erosional stability form wind or rain while unprotected without landscape cover. Slope with a 2(H):1(V) gradient are permitted provided, it is recognized that such slopes are more prone to erosion and so not permit landscape maintenance by motorized riding equipment, and require landscape cover to retard erosion.

4.9 Pavements

Pavements should be designed according to CALTRANS or other acceptable methods. Traffic indices were not provided by the project engineer or owner; therefore, we have provided structural sections for several traffic indices for comparative evaluation. The public agency or design engineer should decide the appropriate traffic index for the site. Maintenance of proper drainage is necessary to prolong the service life of the pavements.

Based on the current State of California CALTRANS method, an estimated R-value of 60 for the subgrade soil and assumed traffic indices, the following table provides our estimates for asphaltic concrete (AC) pavement sections.

RECOMMENDED PAVEMENTS SECTIONS

R-Value of Subgrade Soil - 60 (estimated) Design Method - CALTRANS 2012

Traffic Index (assumed)	Flexible Pavements	
	Asphaltic Concrete Thickness (in.)	Aggregate Base Thickness (in.)
5.0	3.0	4.0
6.0	3.5	4.0
7.0	4.5	4.0
8.0	5.0	5.5

Notes:

1) Asphaltic concrete shall be Caltrans, Type B, ¾ inch maximum medium grading, (½ inch for parking areas) compacted to a minimum of 95% of the 50-blow Marshall density (ASTM D1559).
2) Aggregate base shall conform to Caltrans Class 2 (¾ in. maximum), compacted to a minimum of 95% of ASTM D1557 maximum dry density.
3) Place pavements on 8 inches of moisture conditioned (at least 2% of over optimum) native soil compacted to a minimum of 90% of the maximum dry density determined by ASTM D1557, or the governing agency requirements.

Final recommended pavement sections may need to be based on sampling and R-Value testing during grading operations when actual subgrade soils will be exposed.

Section 5
LIMITATIONS AND ADDITIONAL SERVICES

5.1 Limitations

The findings and professional opinions within this report are based on current information regarding the proposed commercial complex, located at 30260 Date Palm Drive in the city of Cathedral City, California. The conclusions and professional opinions of this report are invalid if:

- Proposed building(s) location and size are changed from those shown in this report
- Structural loads change from those stated or the structures are relocated.
- The Additional Services section of this report is not followed.
- This report is used for adjacent or other property.
- Changes of grade or groundwater occur between the issuance of this report and construction other than those anticipated in this report.
- Any other change that materially alters the project from that proposed at the time this report was prepared.

Findings and professional opinions in this report are based on selected points of field exploration, geologic literature, laboratory testing, and our understanding of the proposed project. Our analysis of data and professional opinions presented herein are based on the assumption that soil conditions do not vary significantly from those found at specific exploratory locations. Variations in soil conditions can exist between and beyond the exploration points or groundwater elevations may change. If detected, these conditions may require additional studies, consultation, and possible design revisions.

This report contains information that may be useful in the preparation of contract specifications. However, the report is not worded is such a manner that we recommend its use as a construction specification document without proper modification. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

This report was prepared according to the generally accepted *geotechnical engineering standards of practice* that existed in Riverside County at the time the report was prepared. No express or implied warranties are made in connection with our services.

This report should be considered invalid for periods after two years from the report date without a review of the validity of the findings and professional opinions by our firm, because of potential changes in the Geotechnical Engineering Standards of Practice.

The client has responsibility to see that all parties to the project including, designer, contractor, and subcontractor are made aware of this entire report. The use of information contained in this report for bidding purposes should be done at the contractor's option and risk.

5.2 Additional Services

We recommend that a qualified geotechnical consultant be retained to provide the tests and observations services during construction. *The geotechnical engineering firm providing such tests and observations shall become the geotechnical engineer of record and assume responsibility for the project.*

The professional opinions presented in this report are based on the assumption that:

< Consultation during development of design and construction documents to check that the geotechnical professional opinions are appropriate for the proposed project and that the geotechnical professional opinions are properly interpreted and incorporated into the documents.

< ***LandMark Consultants, Inc.*** will have the opportunity to review and comment on the plans and specifications for the project prior to the issuance of such for bidding.

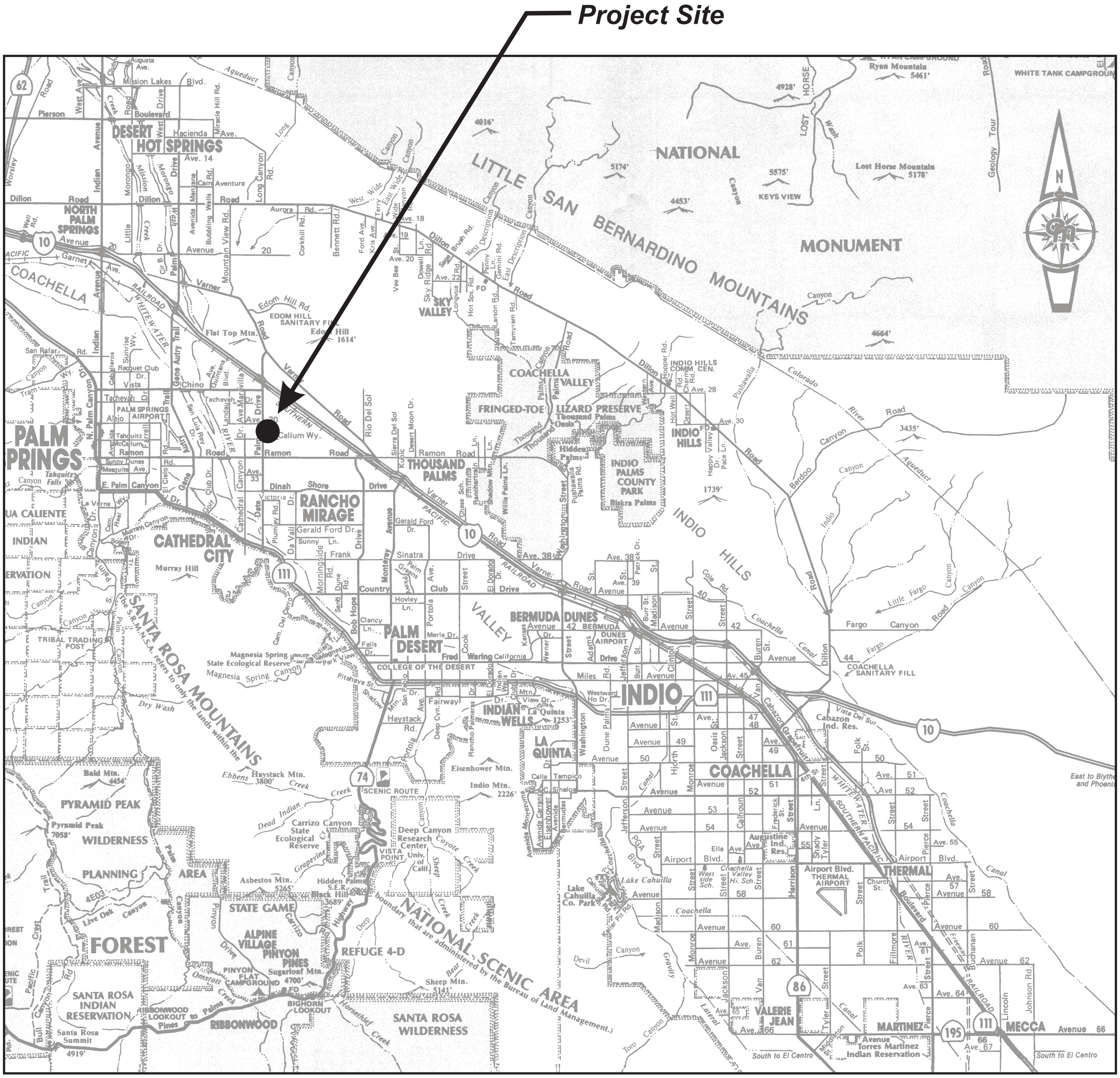
< Continuous observation, inspection, and testing by the geotechnical consultant of record during site clearing, grading, excavation, placement of fills, building pad and subgrade preparation, and backfilling of utility trenches.

< Observation of foundation excavations and reinforcing steel before concrete placement.

< Other consultation as necessary during design and construction.

We emphasize our review of the project plans and specifications to check for compatibility with our professional opinions and conclusions. Additional information concerning the scope and cost of these services can be obtained from our office.

APPENDIX A

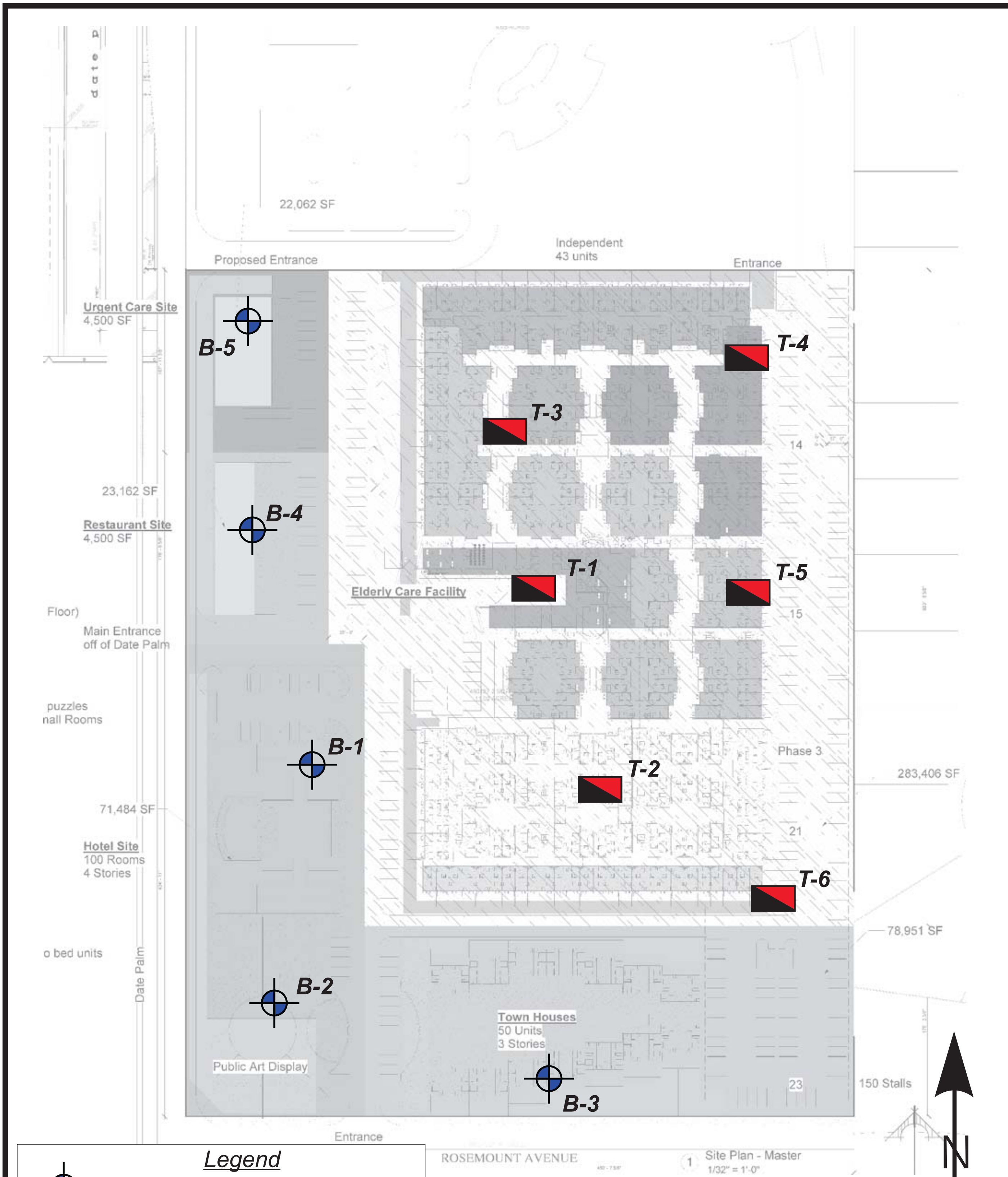


LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

Vicinity Map

Plate A-1



Legend

Approximate Boring Location

Approximate Test Pit Location

LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

Site and Exploration Plan

Plate
A-2

Map Scale: 1:4,060 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 150, 300, 600, 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

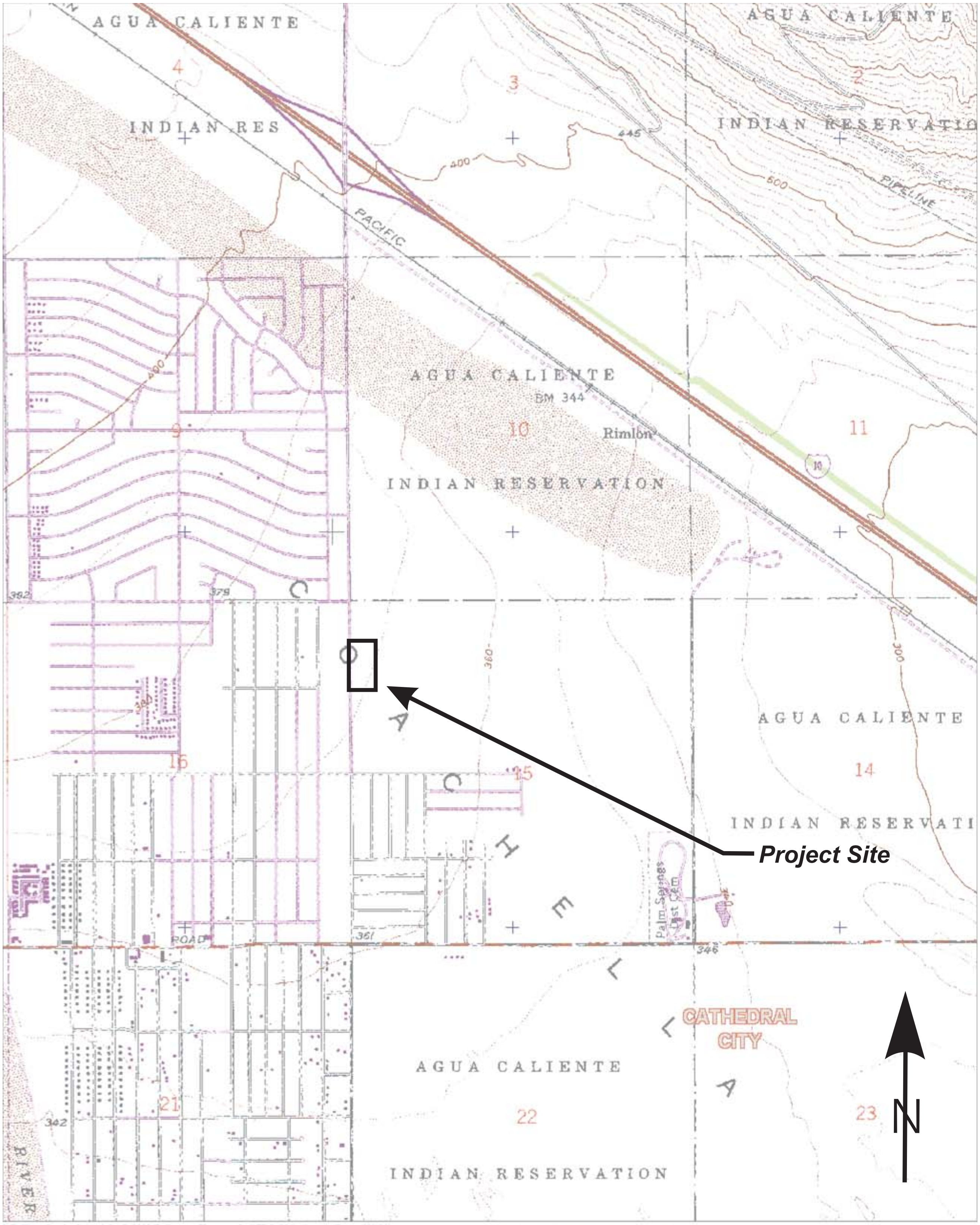
LANDMARK
Geo-Engineers and Geologists
Project No.: LP17122

USDA Soil Conservation
Soil Service Map

Plate
A-3

Map Unit Legend

Riverside County, Coachella Valley Area, California (CA680)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
MaB	Myoma fine sand, 0 to 5 percent slopes	88.6	100.0%
Totals for Area of Interest		**88.6**	**100.0%**

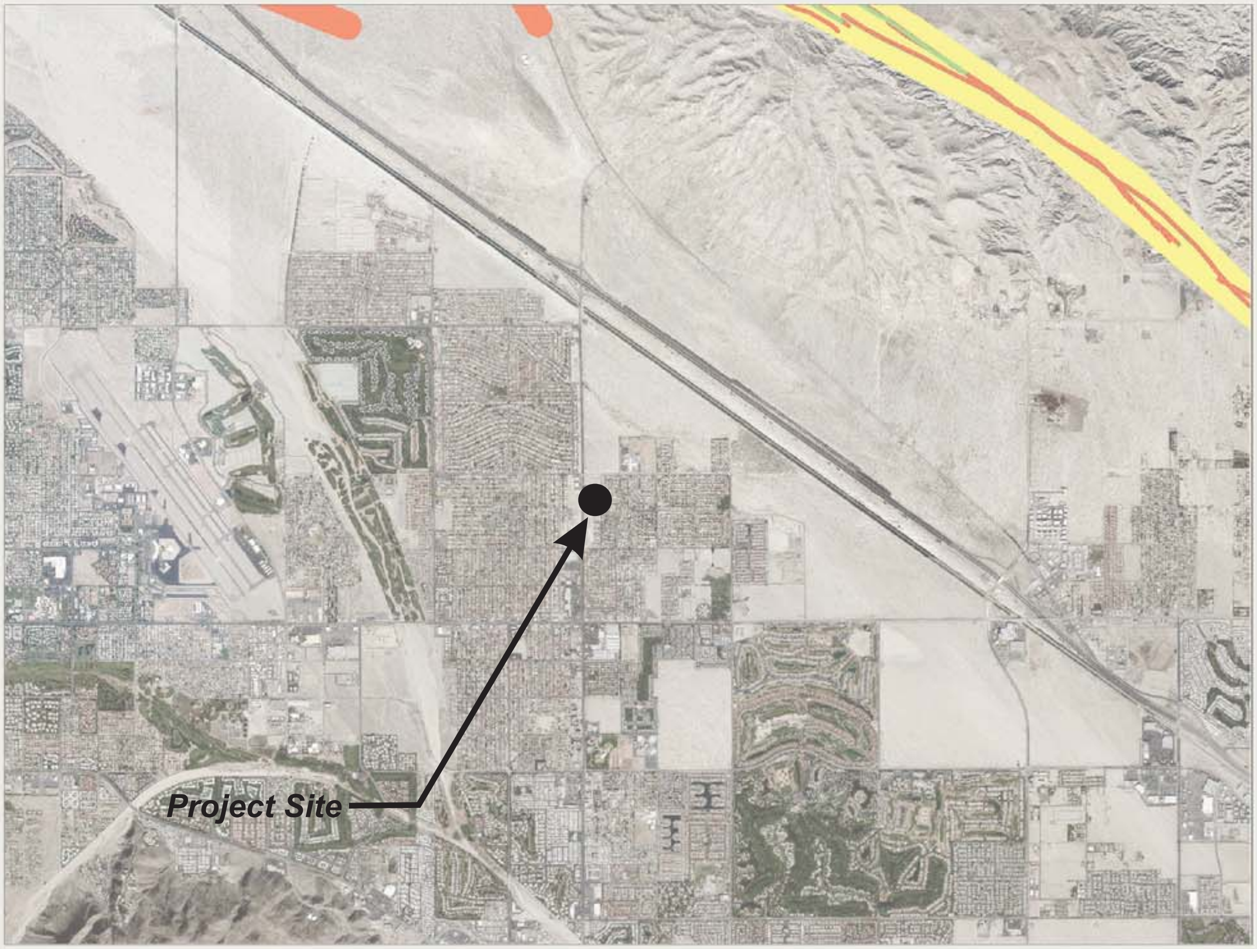


3-D TopoQuads Copyright © 1999 DeLorme Yarmouth, ME 04096 Source Data: USGS

700 ft Scale: 1 : 24,000 Detail: 13-1 Datum: WGS84

LANDMARK Geo-Engineers and Geologists Project No.: LP17122	Topographic Map	Plate A-4

Fault Map



Legend

Faults

- <all other values>
- ALQUIST-PRIOLO
- RIVERSIDE COUNTY

Fault Zones

- <all other values>
- COUNTY FAULT ZONE
- ELSINORE FAULT ZONE
- SAN ANDREAS FAULT ZONE
- SAN JACINTO FAULT ZONE

Notes

RCIT

0 6,788 13,576 Feet

REPORT PRINTED ON... 9/27/2017 10:48:38 AM

LANDMARK
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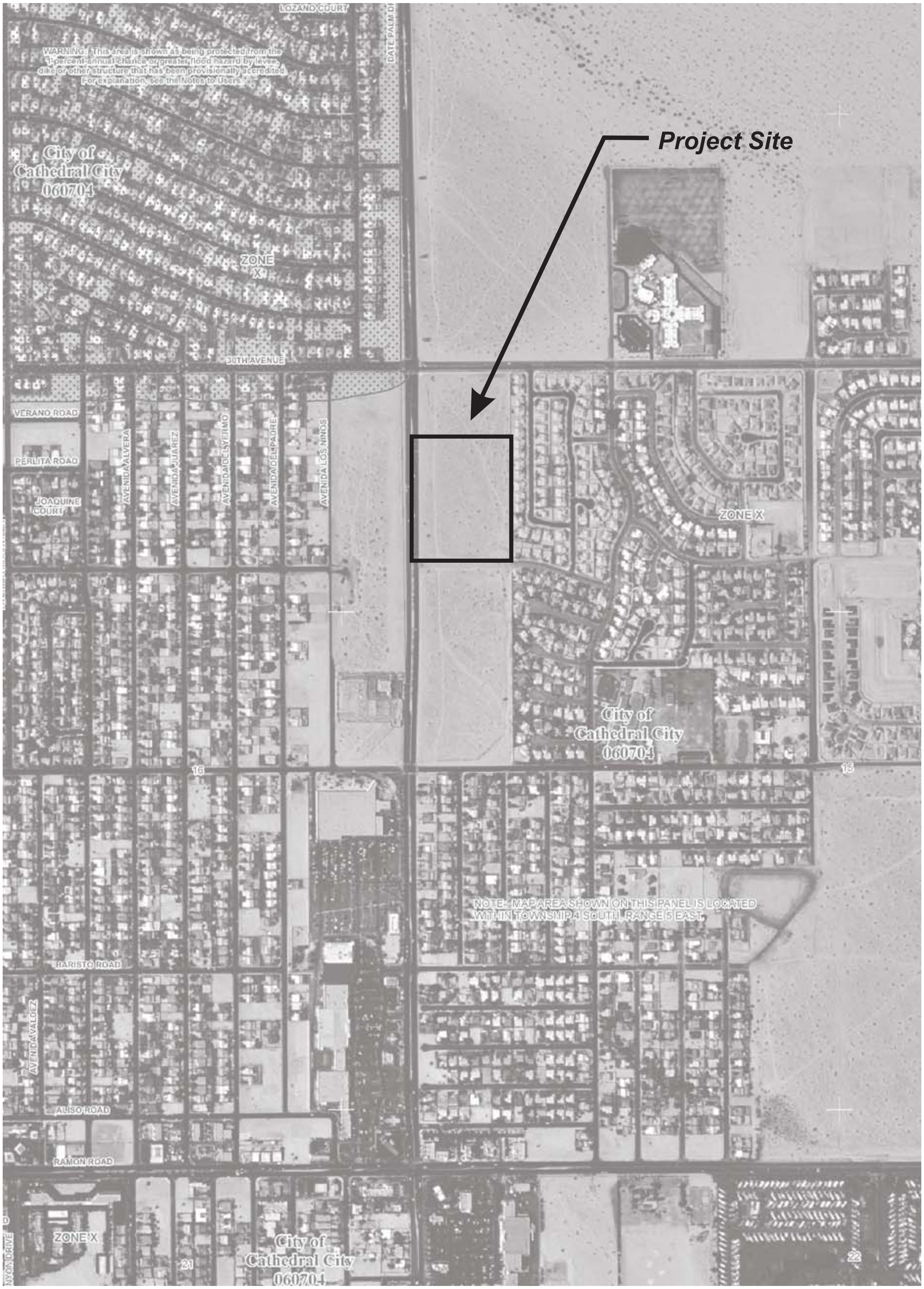
Project No.: LP17122

Riverside County
Geographic Information System (GIS)
Fault Map

Plate
A-5



LANDMARK Geo-Engineers and Geologists Project No.: LP17122	FEMA Flood Zones	Plate A-6

LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - - -(23)	Transect line
87°07'45", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
2476000mN	1000-meter Universal Transverse Mercator grid values, zone 11N
600000 FT	5000-foot grid ticks: California State Plane coordinate system, zone VI (FIPSZONE 0406), Lambert Conformal Conic projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
●M1.5	River Mile

APPENDIX B

LOG OF BORING No. B-1

SHEET 1 OF 1

DEPTH	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–38			SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense			Passing #200 = 7.1%
5	21			107.3	1.9	
10	18				0.3	Passing #200 = 9.2%
15	27			115.0	1.0	
20	19				0.6	
22.5						Passing #200 = 7.2%
25	30				0.3	
30	18				1.4	Passing #200 = 8.1%
35	31				1.4	
40	41		SILTY SAND (SM): Grayish brown, dry, fine grained, very dense		3.0	Passing #200 = 18.1%
45	50/6"		SAND (SP-SM): Grayish brown, dry, fine grained, very dense, some gravel		0.6	Passing #200 = 5.6%
50	44					

Total Depth = 51.5'
Groundwater not encountered at time of drilling
Backfilled with excavated soil

DATE DRILLED: 8/31/17
TOTAL DEPTH: 51.5 Feet
DEPTH TO WATER: NA
LOGGED BY: G. Chandra
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: Approximately 370'
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-1

LOG OF BORING No. B-2

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–5					SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense			
5			24			107.8	0.6	Passing #200 = 10.3%
10			12				1.7	
15			42			106.0	8.5	
20			33		SILTY SAND (SM): Grayish brown, dry, fine grained, dense		0.9	Passing #200 = 15.5%
25			26		SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense			
30								
35								
40								
45								
50								
55					Total Depth = 26.5' Groundwater not encountered at time of drilling Backfilled with excavated soil			
60								

FIELD / LABORATORY

DATE DRILLED: 8/31/17	TOTAL DEPTH: 26.5 Feet	DEPTH TO WATER: NA
LOGGED BY: G. Chandra	TYPE OF BIT: Hollow Stem Auger	DIAMETER: 8 in.
SURFACE ELEVATION: Approximately 370'	HAMMER WT.: 140 lbs.	DROP: 30 in.

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

LOG OF BORING No. B-3

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained, medium dense			
5			22			96.5	1.5	
10			9		SILTY SAND (SM): Grayish brown, dry, fine grained, loose		2.1	Passing #200 = 15.3%
15			26		SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense	85.5	0.6	
20			22				0.7	Passing #200 = 7.1%
25			18				0.5	
30			22				0.4	Passing #200 = 4.1%
35			19				0.8	
40			64		trace gravel		0.2	Passing #200 = 7.0%
45								
50								
55					Total Depth = 41.5' Groundwater not encountered at time of drilling Backfilled with excavated soil			
60								

DATE DRILLED: 8/31/17
TOTAL DEPTH: 41.5 Feet
DEPTH TO WATER: NA
LOGGED BY: G. Chandra
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: Approximately 370'
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT NO. LP17122

LANDMARK
Geo-Engineers and Geologists

PLATE B-3

LOG OF BORING No. B-4

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–14					SAND (SP-SM): Grayish brown, dry, fine grained, medium dense			
5			22			114.8	0.6	Passing #200 = 7.5%
10			10				1.9	
15			32		SILTY SAND (SM): Grayish brown, dry, fine grained, dense	111.1	3.8	Passing #200 = 26.0%
20			25		SAND (SP-SM): Grayish brown, dry, fine grained, medium dense		0.6	

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Total Depth = 21.5'
Groundwater not encountered at time of drilling
Backfilled with excavated soil

DATE DRILLED: 8/31/17
TOTAL DEPTH: 21.5 Feet
DEPTH TO WATER: NA
LOGGED BY: G. Chandra
TYPE OF BIT: Hollow Stem Auger
DIAMETER: 8 in.
SURFACE ELEVATION: Approximately 370'
HAMMER WT.: 140 lbs.
DROP: 30 in.

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-4

LOG OF BORING No. B-5

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
0–9					SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense			
5			22			104.7	2.2	
10			13		SILTY SAND (SM): Grayish brown, dry, fine grained, dense		4.2	Passing #200 = 32.0%
15			27		SAND (SP-SM): Grayish brown, dry, fine grained, medium dense to dense	105.5	1.1	
20			29				0.4	Passing #200 = 6.9%

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60

Total Depth = 21.5'
Groundwater not encountered at time of drilling
Backfilled with excavated soil

DATE DRILLED: 8/31/17
LOGGED BY: G. Chandra
SURFACE ELEVATION: Approximately 370'

TOTAL DEPTH: 21.5 Feet
TYPE OF BIT: Hollow Stem Auger
HAMMER WT.: 140 lbs.

DEPTH TO WATER: NA
DIAMETER: 8 in.
DROP: 30 in.

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-5

LOG OF TEST PIT NO. T-1

SHEET 1 OF 1

DEPTH	FIELD: SAMPLE	FIELD: USCS CLASS.	FIELD: BLOW COUNT	FIELD: POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	LABORATORY: DRY DENSITY (pcf)	LABORATORY: MOISTURE CONTENT (% dry wt.)	LABORATORY: OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained	104.4	1.8	
5					increase in silt content			
10								
15					Total Depth = 15.0' Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			
20								
25								
30								

DATE EXCAVATED:	5/14/17	TOTAL DEPTH:	15 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Lorenzana	TYPE OF BIT:	Backhoe	DIAMETER:	N/A
SURFACE ELEVATION:	Approximately 370'	HAMMER WT.:	N/A	DROP:	N/A

PROJECT NO. LP17122

LANDMARK
Geo-Engineers and Geologists

PLATE B-6

LOG OF TEST PIT NO. T-2

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
0–15		SP-SM			SAND (SP-SM): Grayish brown, dry, fine grained	105.4	2.5	
						104.0	2.8	
					increase in silt content			
15					Total Depth = 15.0' Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			

Depth scale: 5, 10, 15, 20, 25, 30

DATE EXCAVATED:	5/14/17	TOTAL DEPTH:	15 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Lorenzana	TYPE OF BIT:	Backhoe	DIAMETER:	N/A
SURFACE ELEVATION:	Approximately 370'	HAMMER WT.:	N/A	DROP:	N/A

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-7

LOG OF TEST PIT NO. T-3

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained	105.3	2.3	
						105.1	3.0	
5					increase in silt content			
10								
15					Total Depth = 15.0’ Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			
20								
25								
30								

DATE EXCAVATED:	5/14/17	TOTAL DEPTH:	15 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Lorenzana	TYPE OF BIT:	Backhoe	DIAMETER:	N/A
SURFACE ELEVATION:	Approximately 370’	HAMMER WT.:	N/A	DROP:	N/A

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-8

LOG OF TEST PIT NO. T-4

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained	98.9	2.0	
						100.0	2.6	
5					increase in silt content			
10								
15					Total Depth = 15.0' Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			
20								
25								
30								

DATE EXCAVATED: 5/14/17 TOTAL DEPTH: 15 Feet DEPTH TO WATER: N/A

LOGGED BY: J. Lorenzana TYPE OF BIT: Backhoe DIAMETER: N/A

SURFACE ELEVATION: Approximately 370' HAMMER WT.: N/A DROP: N/A

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-9

LOG OF TEST PIT NO. T-5

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained	109.0	1.6	
						103.0	2.3	
5					increase in silt content			
10								
15					Total Depth = 15.0' Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			
20								
25								
30								

DATE EXCAVATED: 5/14/17 TOTAL DEPTH: 15 Feet DEPTH TO WATER: N/A

LOGGED BY: J. Lorenzana TYPE OF BIT: Backhoe DIAMETER: N/A

SURFACE ELEVATION: Approximately 370' HAMMER WT.: N/A DROP: N/A

PROJECT NO. LP17122

LANDMARK Geo-Engineers and Geologists

PLATE B-10

LOG OF TEST PIT NO. T-6

SHEET 1 OF 1

DEPTH	SAMPLE	USCS CLASS.	BLOW COUNT	POCKET PEN. (tsf)	DESCRIPTION OF MATERIAL	DRY DENSITY (pcf)	MOISTURE CONTENT (% dry wt.)	OTHER TESTS
					SAND (SP-SM): Grayish brown, dry, fine grained	104.0	1.8	
						105.9	1.9	
5					increase in silt content			
10								
15					Total Depth = 15.0’ Moisture and density values by Nuclear Densometer (ASTM 6938) Backfilled with excavated soil			
20								
25								
30								

DATE EXCAVATED:	5/14/17	TOTAL DEPTH:	15 Feet	DEPTH TO WATER:	N/A
LOGGED BY:	J. Lorenzana	TYPE OF BIT:	Backhoe	DIAMETER:	N/A
SURFACE ELEVATION:	Approximately 370’	HAMMER WT.:	N/A	DROP:	N/A

DEFINITION OF TERMS

PRIMARY DIVISIONS			SYMBOLS	SECONDARY DIVISIONS
Coarse grained soils More than half of material is larger that No. 200 sieve	Gravels — More than half of coarse fraction is larger than No. 4 sieve	Clean gravels (less than 5% fines)	GW	Well graded gravels, gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels, or gravel-sand mixtures, little or no fines
		Gravel with fines	GM	Silty gravels, gravel-sand-silt mixtures, non-plastic fines
			GC	Clayey gravels, gravel-sand-clay mixtures, plastic fines
	Sands — More than half of coarse fraction is smaller than No. 4 sieve	Clean sands (less than 5% fines)	SW	Well graded sands, gravelly sands, little or no fines
			SP	Poorly graded sands or gravelly sands, little or no fines
		Sands with fines	SM	Silty sands, sand-silt mixtures, non-plastic fines
			SC	Clayey sands, sand-clay mixtures, plastic fines
Fine grained soils More than half of material is smaller than No. 200 sieve	Silts and clays		ML	Inorganic silts, clayey silts with slight plasticity
	Liquid limit is less than 50%		CL	Inorganic clays of low to medium plasticity, gravely, sandy, or lean clays
			OL	Organic silts and organic clays of low plasticity
	Silts and clays		MH	Inorganic silts, micaceous or diatomaceous silty soils, elastic silts
	Liquid limit is more than 50%		CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
Highly organic soils			PT	Peat and other highly organic soils

GRAIN SIZES

Silts and Clays	Sand			Gravel		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

200 40 10 4 3/4" 3" 12"

US Standard Series Sieve — Clear Square Openings

Sands, Gravels, etc.	Blows/ft. *
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	Over 50

Clays & Plastic Silts	Strength **	Blows/ft. *
Very Soft	0-0.25	0-2
Soft	0.25-0.5	2-4
Firm	0.5-1.0	4-8
Stiff	1.0-2.0	8-16
Very Stiff	2.0-4.0	16-32
Hard	Over 4.0	Over 32

* Number of blows of 140 lb. hammer falling 30 inches to drive a 2 inch O.D. (1 3/8 in. I.D.) split spoon (ASTM D1586).

** Unconfined compressive strength in tons/s.f. as determined by laboratory testing or approximated by the Standard Penetration Test (ASTM D1586), Pocket Penetrometer, Torvane, or visual observation.

Type of Samples:

Ring Sample — Standard Penetration Test — Shelby Tube — Bulk (Bag) Sample

Drilling Notes:

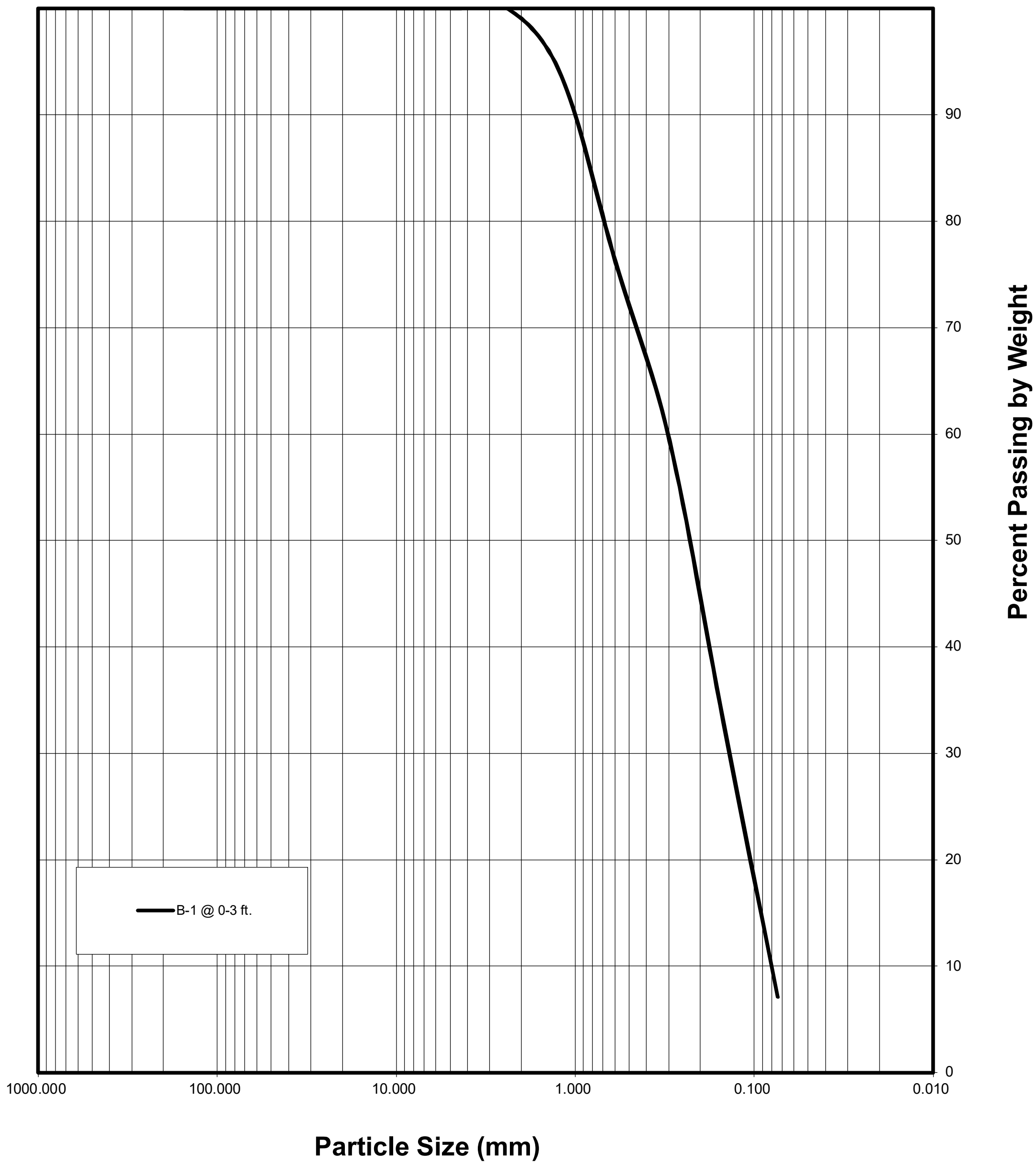
1. Sampling and Blow Counts
   - Ring Sampler - Number of blows per foot of a 140 lb. hammer falling 30 inches.
   - Standard Penetration Test - Number of blows per foot.
   - Shelby Tube - Three (3) inch nominal diameter tube hydraulically pushed.
2. P. P. = Pocket Penetrometer (tons/s.f.).
3. NR = No recovery.
4. GWT = Ground Water Table observed @ specified time.

LANDMARK Geo-Engineers and Geologists

Project No. LP17122 — **Key to Logs** — **Plate B-12**

APPENDIX C

SIEVE ANALYSIS						
Cobbles and Boulders	Gravel		Sand			Silt and Clay
	Coarse	Fine	Coarse	Medium	Fine	

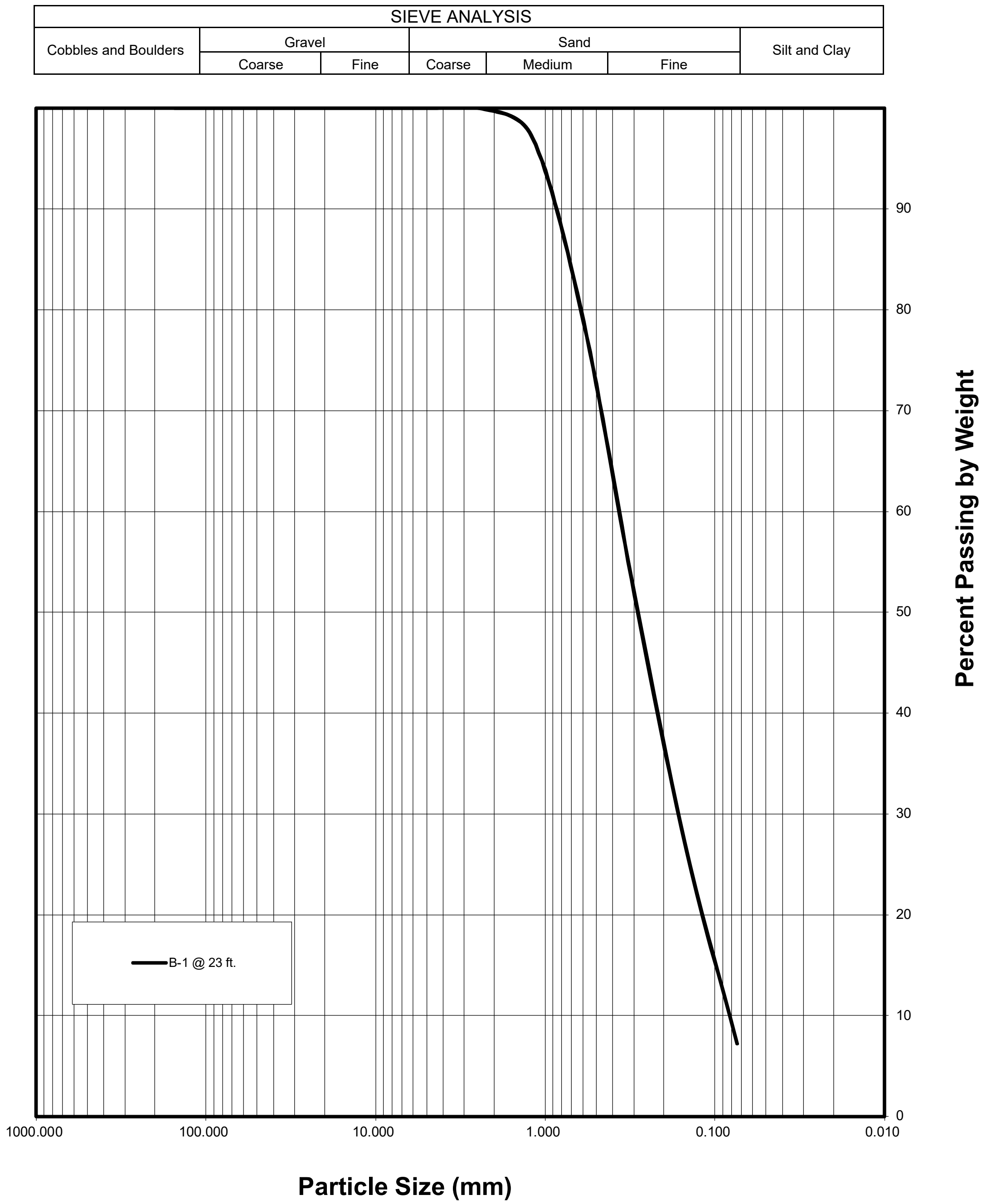


LANDMARK Geo-Engineers and Geologists

Project No.: LP17122

Grain Size Analysis

Plate C-1

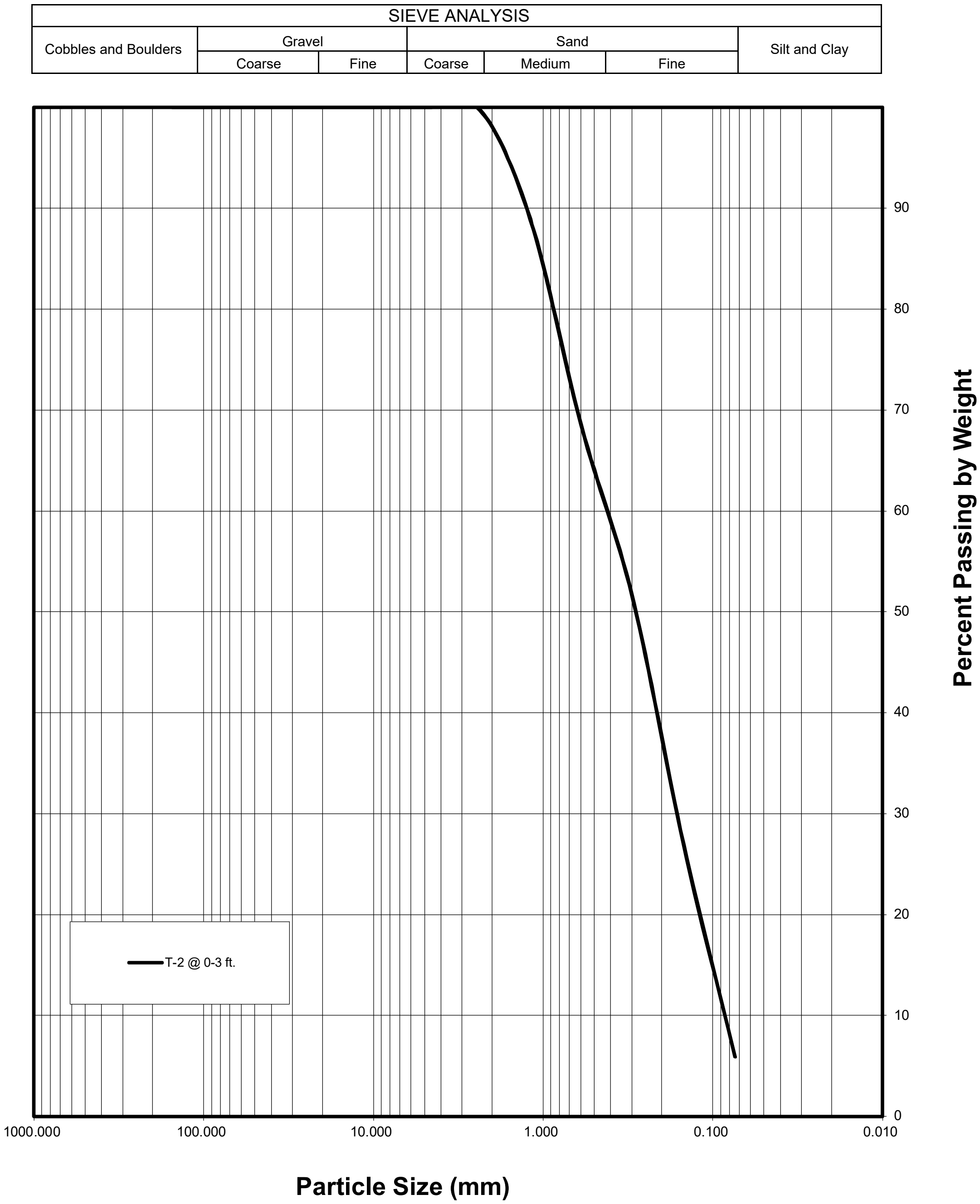


LANDMARK Geo-Engineers and Geologists

Project No.: LP17122

Grain Size Analysis

Plate C-2



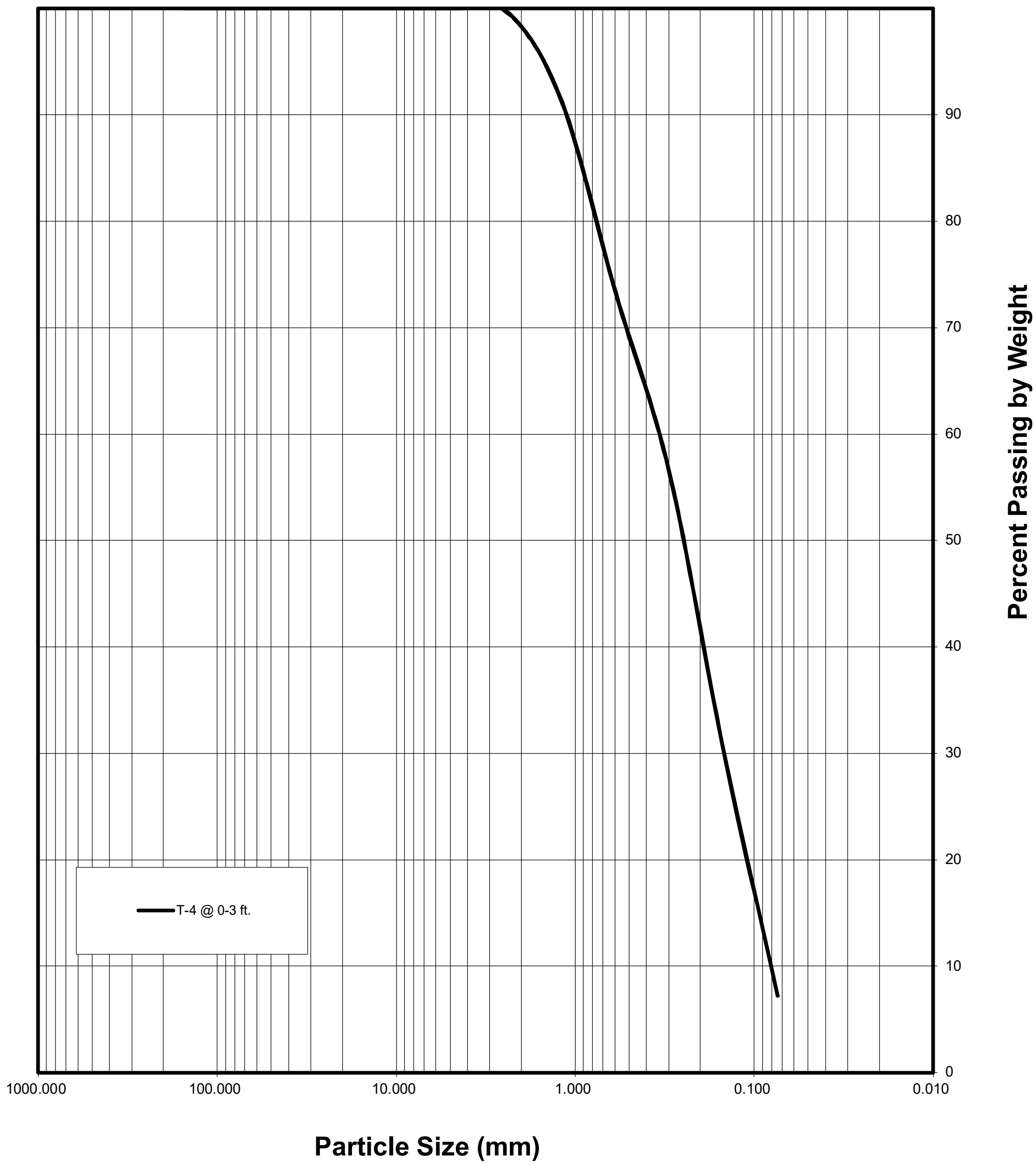
LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

Grain Size Analysis

Plate C-3

SIEVE ANALYSIS						
Cobbles and Boulders	Gravel		Sand			Silt and Clay
	Coarse	Fine	Coarse	Medium	Fine	



LANDMARK
Geo-Engineers and Geologists

Project No.: **LP17122**

Grain Size Analysis

Plate
C-4

LANDMARK CONSULTANTS, INC.

CLIENT: Desert Care LLC
PROJECT: Living Care Assisted Living
JOB No.: LP17122
DATE: 10/09/17

CHEMICAL ANALYSIS

		Caltrans Method
Boring:	B-1	
Sample Depth, ft:	0-3	
pH:	8.7	**643**
Electrical Conductivity (mmhos):	--	**424**
Resistivity (ohm-cm):	11,000	**643**
Chloride (Cl), ppm:	40	**422**
Sulfate (SO4), ppm:	0	**417**

General Guidelines for Soil Corrosivity

Material Affected	Chemical Agent	Range of Values	Degree of Corrosivity
Concrete	Soluble Sulfates (ppm)	0 - 1,000 1,000 - 2,000 2,000 - 20,000 > 20,000	Low Moderate Severe Very Severe
Normal Grade Steel	Soluble Chlorides (ppm)	0 - 200 200 - 700 700 - 1,500 > 1,500	Low Moderate Severe Very Severe
Normal Grade Steel	Resistivity (ohm-cm)	1 - 1,000 1,000 - 2,000 2,000 - 10,000 > 10,000	Very Severe Severe Moderate Low

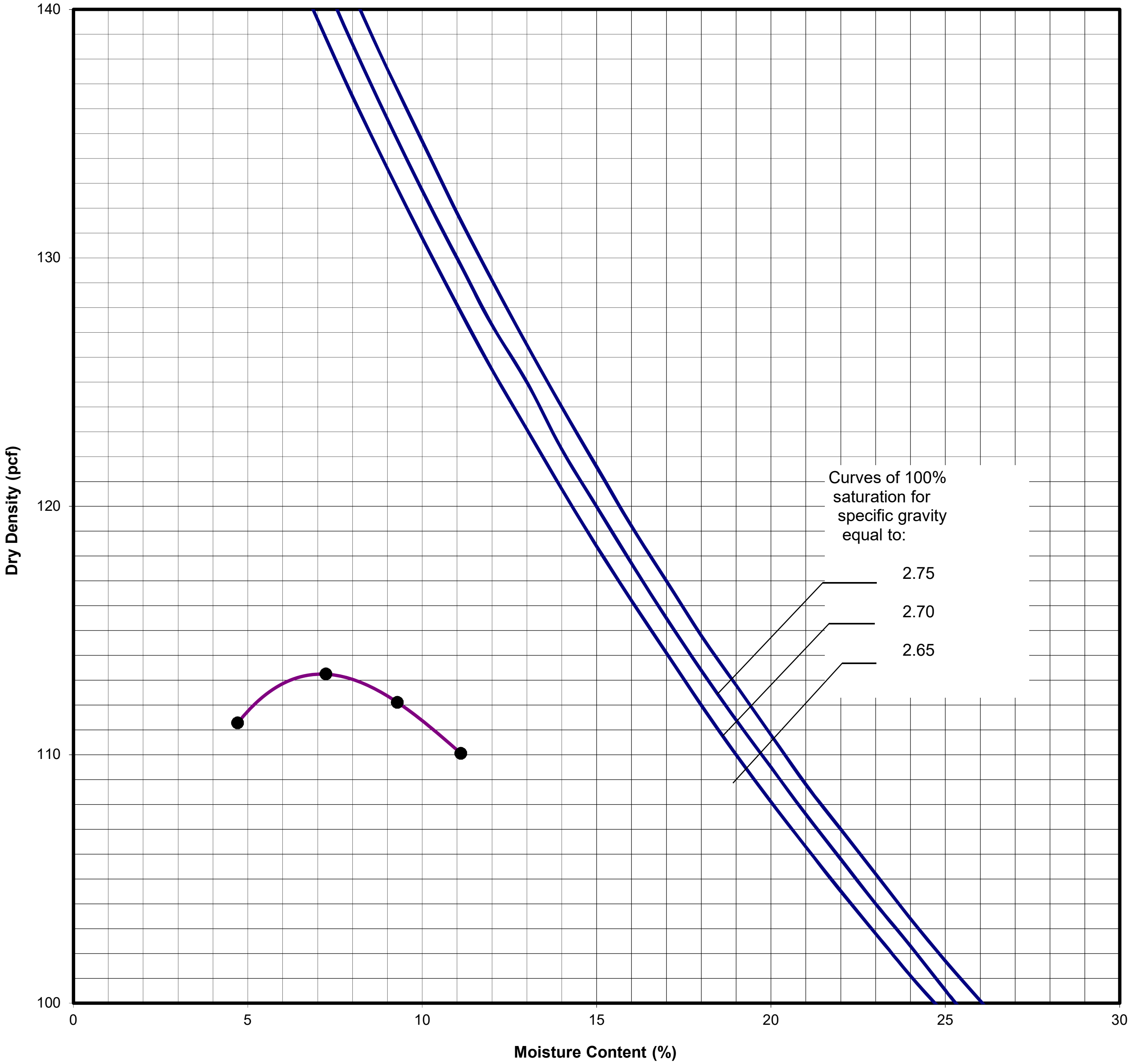
LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

Selected Chemical Test Results

Plate C-5

Client:	Desert Care LLC	**Soil Description:**	Gray Find Sand
Project:	Living Care Assisted Living	**Sample Location:**	B-1 @ 0-3'
Project No.:	LP17122	**Test Method:**	ASTM D-1557 A
Date:	9/5/2017	**Maximum Dry Density (pcf):**	**113.0**
Lab. No.:	N/A	**Optimum Moisture Content (%):**	**7.2**



LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

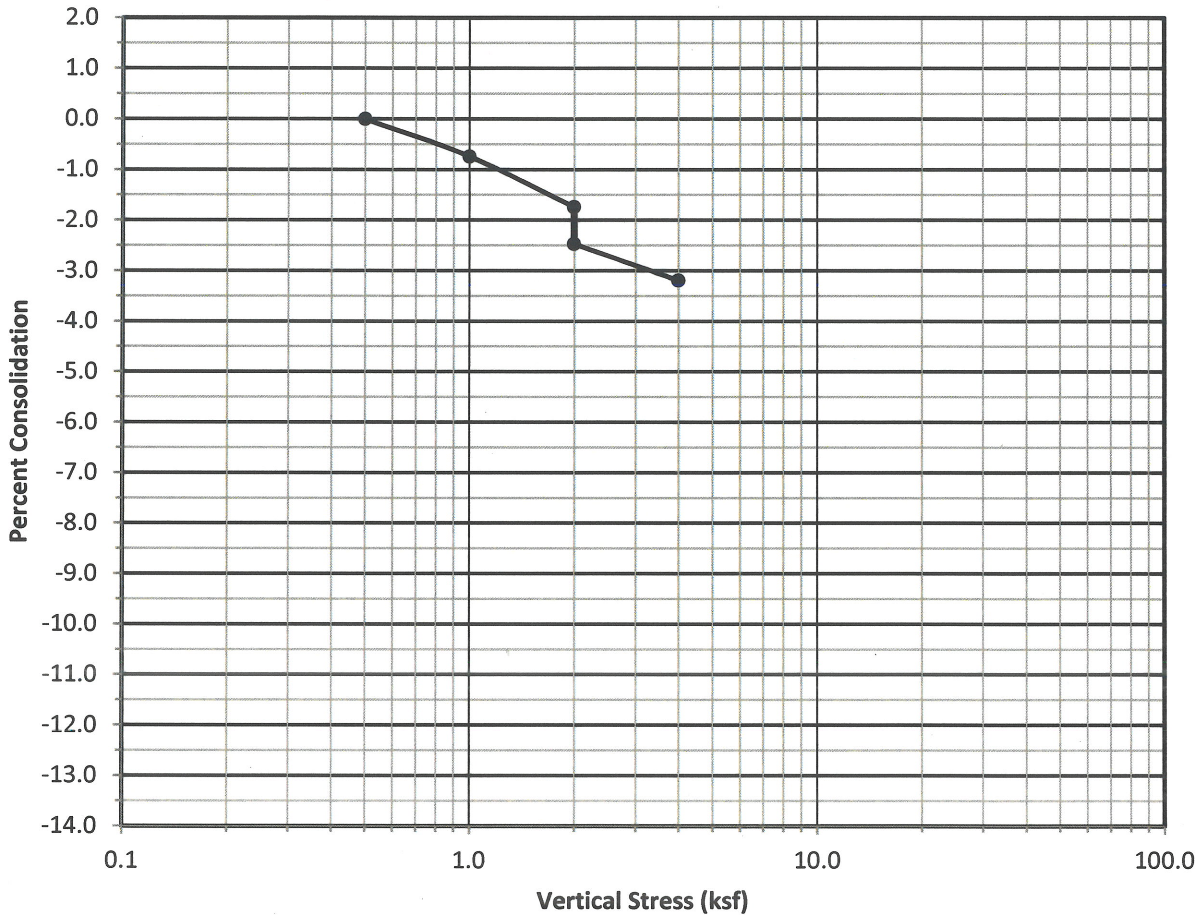
Moisture Density Relationship

Plate C-6

LANDMARK CONSULTANTS, INC.

CLIENT: Desert Care LLC
PROJECT: Living Care Assisted Living
JOB NO: LP17122
DATE: 9/15/2017

COLAPSE POTENTIAL TEST (ASTM D5333)



Collapse Potential: **0.7 %** **(Slight)**

Results of Test

Sample Location: B-3 @ 15 ft.
Soil Type: Sand (SP-SM)
Overburden Pressure, Po: 1.34 ksf

	Initial	Final
Dry Density (pcf):	85.7	92.7
Water Content (%):	3.9	29.8
Void Ratio (e):	0.930	0.785
Saturation (%):	11.1	100.7

LANDMARK
Geo-Engineers and Geologists

Project No.: LP17122

Colapse Potential
Test Results

Plate
C-7

APPENDIX D

REFERENCES

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