RANCHO COASTAL ENGINEERING

Single Source Development Consultant

September 11, 2017

HYDROLOGY/ DRAINAGE ANALYSIS

FOR

THE FAKHIMI INVESTMENT GROUP RESIDENCE, APN: 346-610-10

DESCRIPTION:

PROPOSED SINGLE FAMILY RESIDENCE
2702 COSTEBELLE DRIVE
LA JOLLA, CA 92037

OWNER/APPLICANT:

FAKHIMI INVESTMENT GROUP, LLC
3735 CLAIREMONT MESA BLVD.
SAN DIEGO, CA 92117
619-517-6245

REGISTERED PROFESSIONAL ENGINEER
DOUGLAS E. LOGAN
C 39726
CIVIL
STATE OF CALIFORNIA

OWNER/APPLICANT:

ALI FAKHIMI
PHONE: 619-517-6245
EMAIL: ALI@FAKHIMIGROUP.COM

9-11-17

DOUGLAS E. LOGAN — DATE
R.C.E. 39726
EXPIRES 12-31-17

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HYDROLOGY / DRAINAGE ANALYSIS

Rancho Coastal Engineering and Surveying, Inc.
Mailing Address: 310 S. Twin Oaks Valley Rd., #107-297, San Marcos, CA 92078
Physical Address: 310 Via Vera Cruz, #205, San Marcos, CA 92078
Phone (760) 510-3152 / Fax: (760) 510-3153 / www.rcesd.com

EXISTING PROJECT DESCRIPTION

This is a currently habited single family residence within the Village of La Jolla. All the site drainage flows to the North across the residence and towards the steep slope within the property.

The Hydrologic Soils Group for the site has been classified as Type "C" through the USDA NRCS soils report. Soil Group C has moderately high runoff potential when thoroughly wet. Water transmission through the soil is somewhat restricted.

PROPOSED PROJECT DESCRIPTION

The scope of the proposed project includes an addition to the existing house as well as expanding the back yard to the North. In order to minimize an increase in impervious area, one of the three driveway access to Costebelle Drive will be eliminated and the remaining two will be modified. The proposed drainage system for this lot is to mimic the existing as both conditions slope towards the North. Both existing and proposed conditions will have the same outlet location. The Grading Plan has been prepared by our firm and includes all the necessary details for construction.

Proposed Design Point #1 (hereinafter referred to as P-DP #1) is located on the North side of the property where the grading limit meets the steep slope. Along these limits, an energy dissipating berm is to be constructed per the plan details which all the properties drainage will outlet to. This design point location and flow rate is identical for the existing and proposed conditions. Both the Pre-development and Post-development condition has a Q100 of 0.91 CFS.

DESIGN CRITERIA/ASSUMPTIONS

- Use Rational Method per S.D. County Hydrology Manual: Q = C I A.
- Evaluate both Pre & Post development Q_{100}.
- Site has been previously graded.
- Hydrologic Soils Group "C" per USDA Soil Report
- Assumptions for Runoff Coefficients:
  - Pre-Construction (42% Impervious Surface): C = 0.55
  - Post-Construction (50% Impervious Surface): C = 0.60

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HYDROLOGY ANALYSIS

- **PRE-CONSTRUCTION**
  - **Design Point (D.P.) # 1**

    A_1 = 0.46 ac.
    C = 0.55
    D = 175 ft.
    S_0 = 25% ±
    P_6 = 2.0
    T_i = 4.65
  - **Use FIG's 3-1 & 3-3**

$$T_t = \frac{1.8\,(1.1 - C)\sqrt{D}}{\sqrt[3]{S_0}} = \frac{1.8\,(1.1 - 0.55)\sqrt{175}}{\sqrt[3]{25}} = 4.48 \text{ min.}$$

$$T_c = T_t + T_i = 4.48 + 4.65 = 9.13 \text{ min.}$$

$$I = 7.44\,(P_6)\,(T_C)^{-0.645} = 7.44\,(2.0)(9.13)^{-0.645} = 3.58\,{}^{in.}/_{hr.}$$

$$Q_{100} = C\,I\,A = 0.55(3.58)(0.46) = 0.91 \text{ cfs}$$

- **POST-CONSTRUCTION**
  - **Design Point (D.P.) # 1**

    A_1 = 0.46 ac.
    C = 0.60
    D =275 ft.
    S_0 = 15% ±
    P_6 = 2.0
    T_i = 4.3
  - **Use FIG's 3-1 & 3-3**

$$T_t = \frac{1.8\,(1.1 - C)\sqrt{D}}{\sqrt[3]{S_0}} = \frac{1.8\,(1.1 - 0.60)\sqrt{275}}{\sqrt[3]{15}} = 6.05 \text{ min.}$$

$$T_c = T_t + T_i = 6.05 + 4.3 = 10.35 \text{ min.}$$

$$I = 7.44\,(P_6)\,(T_C)^{-0.645} = 7.44\,(2.0)(10.35)^{-0.645} = 3.30\,{}^{in.}/_{hr.}$$

$$Q_{100} = C\,I\,A = 0.60(3.30)(0.46) = 0.91 \text{ cfs}$$

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CONCLUSIONS

- Drainage outlet location is not altered from existing to proposed conditions.
- There is no flow increase from Pre-development to Post-development due to an increase in the time of concentration through the proposed drainage system.
- Energy Dissipating Berm per Grading Plans is to be constructed along drainage outlet location to further decrease runoff impact.

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Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57 EX.	.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60 PROP.	.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

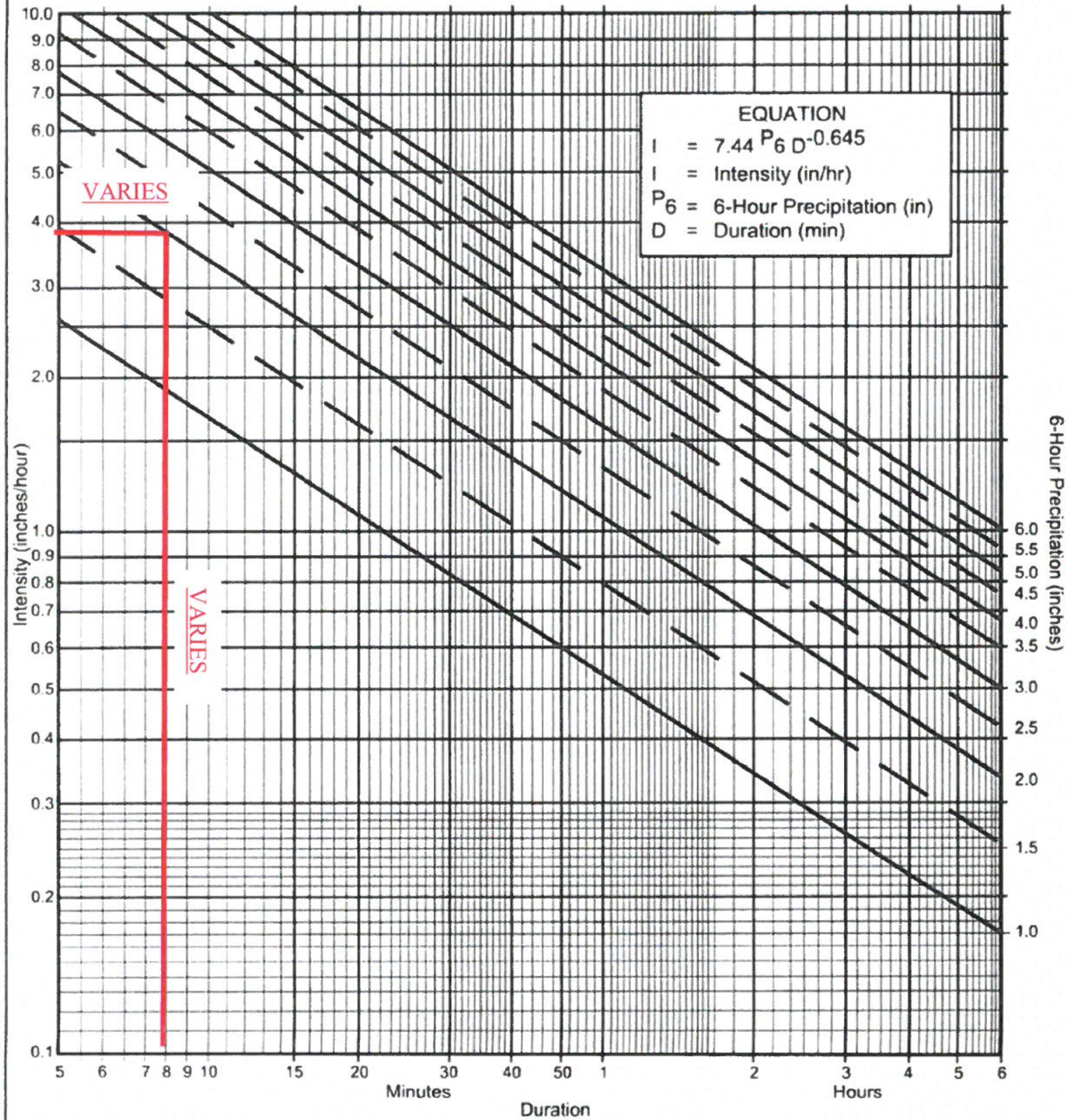
MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

EX.

PROP.

*See Table 3-1 for more detailed description



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.0 in., P_{24} = 4.0, $\frac{P_6}{P_{24}}$ = 50 %(2)

(c) Adjusted $P_6^{(2)}$ = 2.0 in.

(d) t_x = VARIES min.

(e) I = VARIES in./hr.

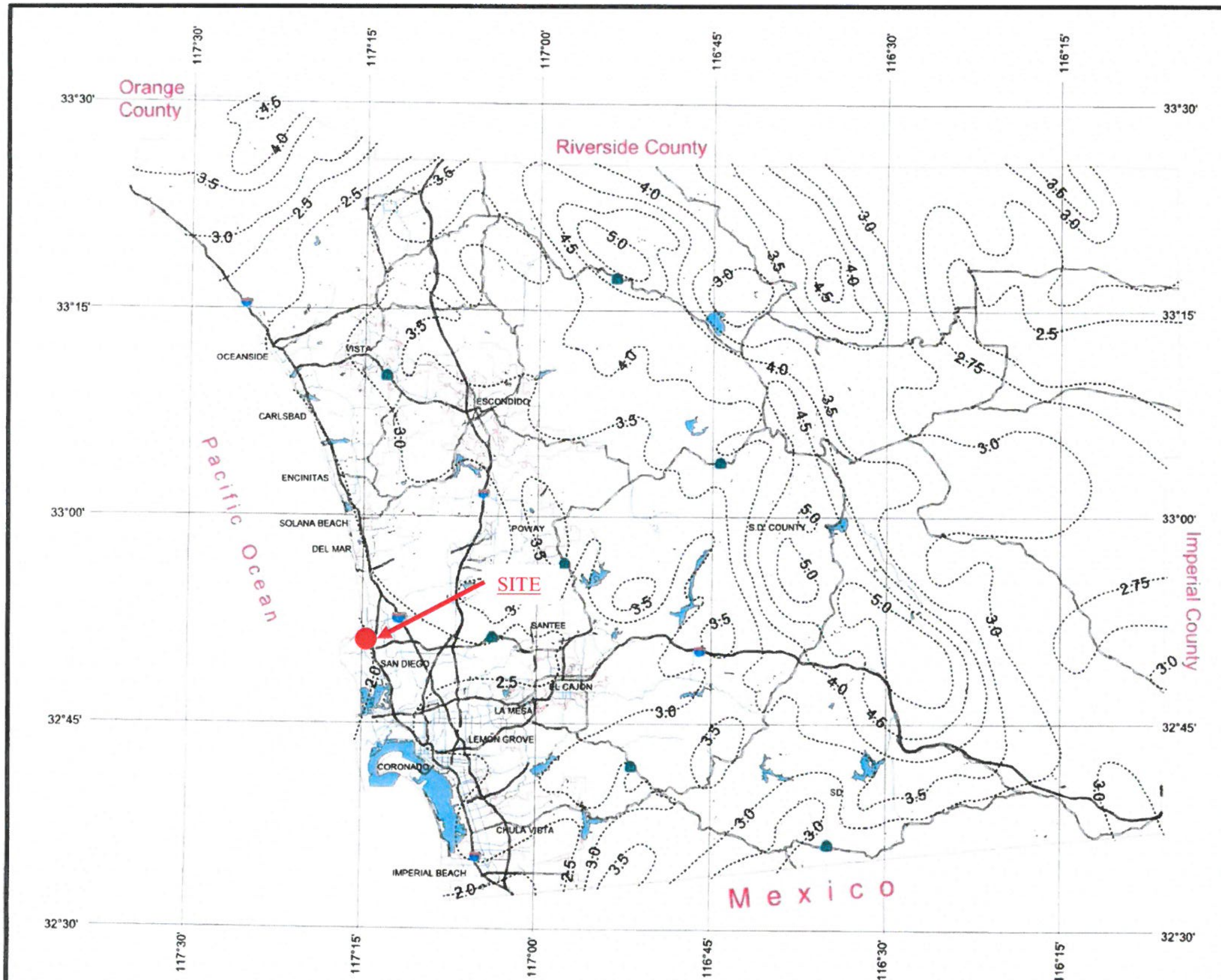
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	[illegible]	[illegible]	[illegible]	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	VARIES	[illegible]	[illegible]	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	[illegible]	[illegible]	[illegible]	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego
Hydrology Manual

Rainfall Isopluvials

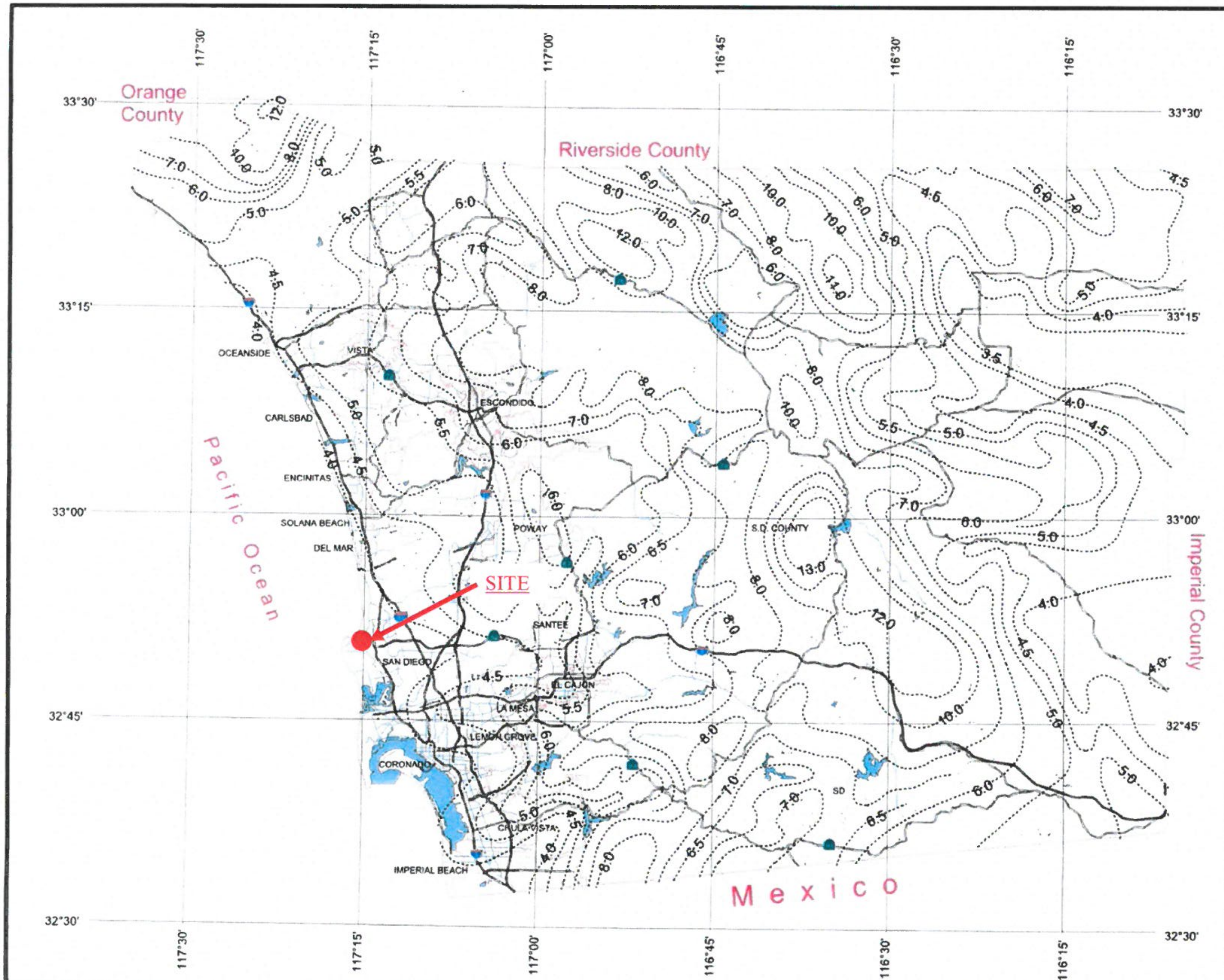
100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

DPW GIS
SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

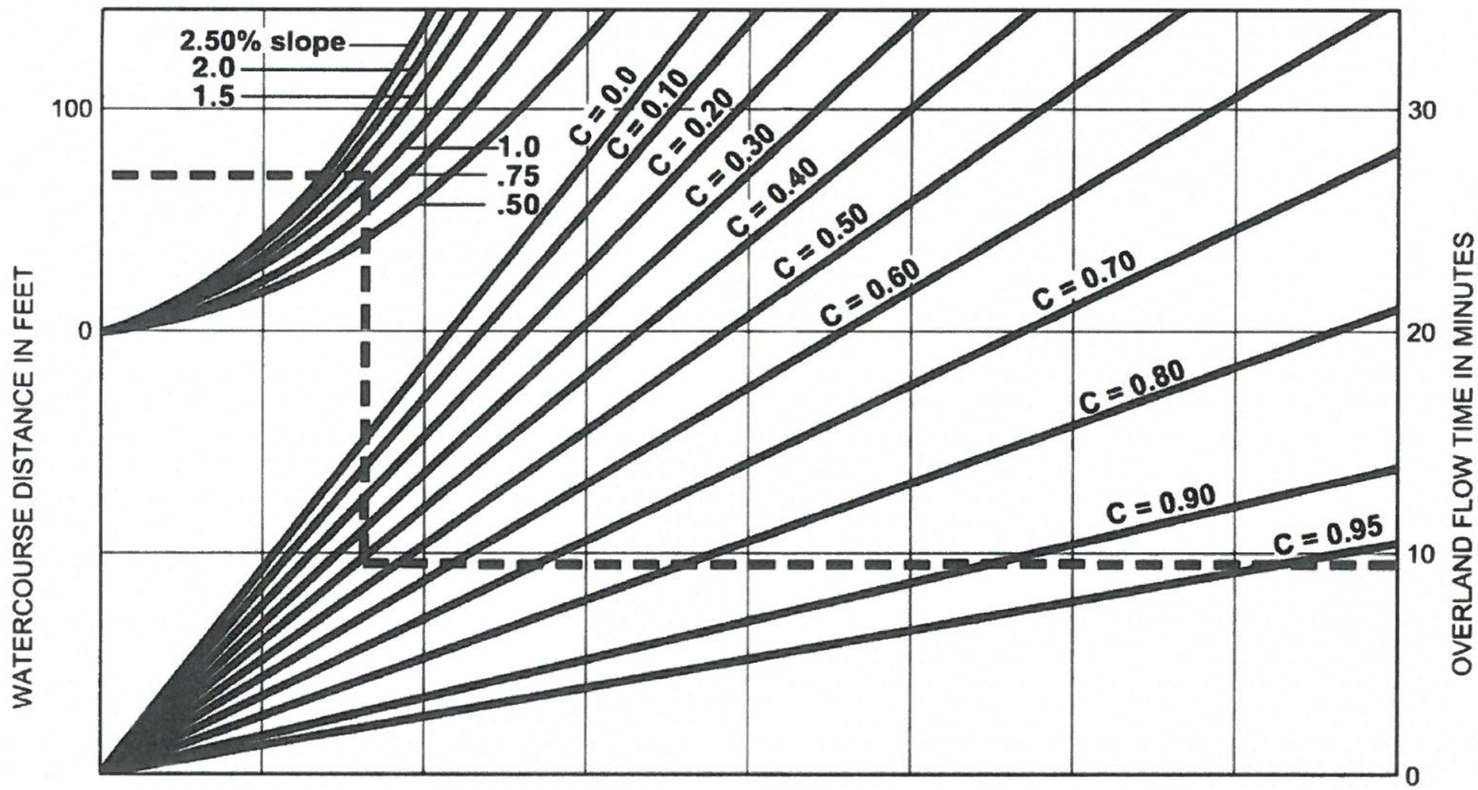
100 Year Rainfall Event - 24 Hours

.... Isopluvial (inches)

DPW GIS
SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles



EXAMPLE:

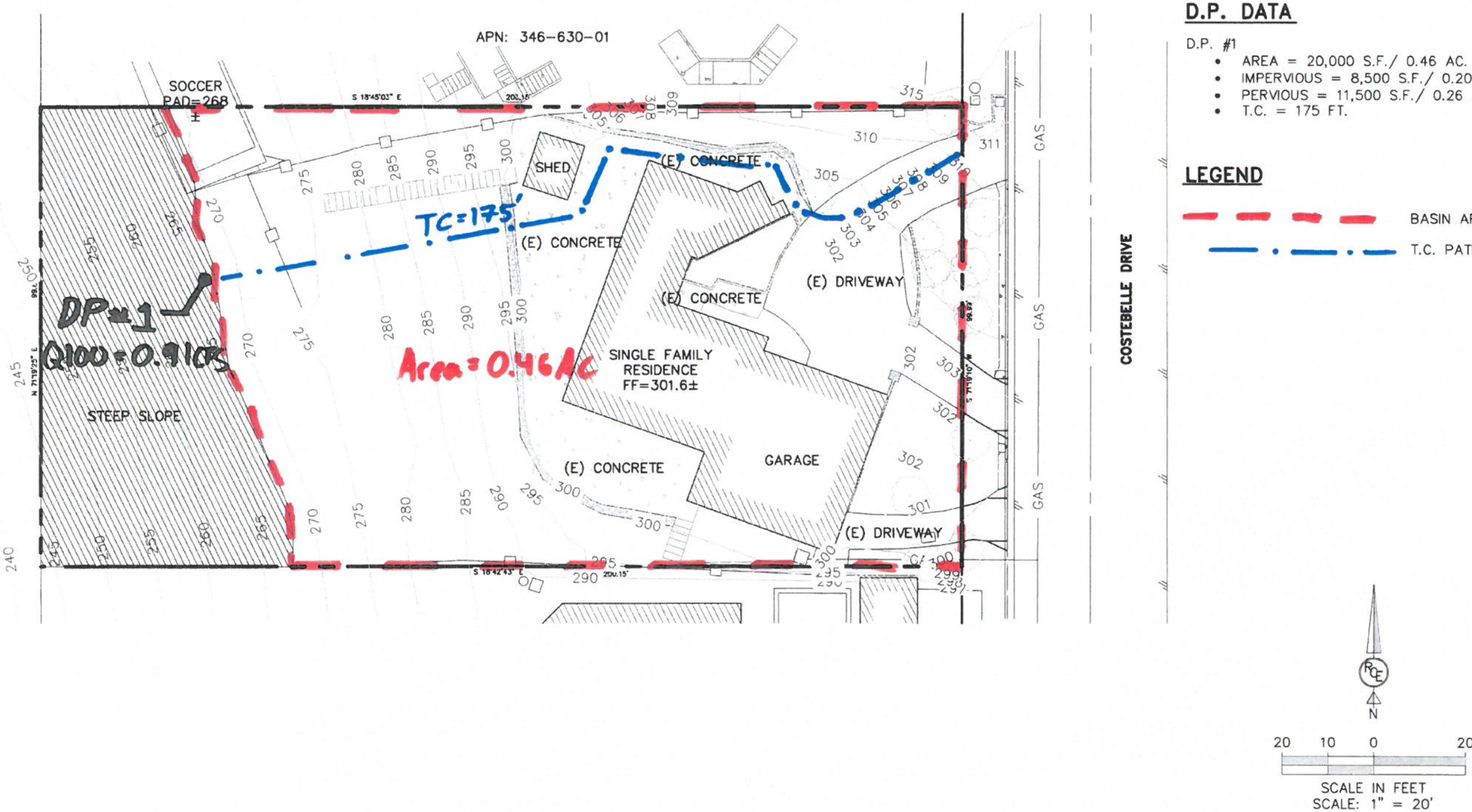
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

Rational Formula - Overland Time of Flow Nomograph

FIGURE
3-3



PRE-CONSTRUCTION

HYDROLOGY BASIN

D.P. DATA

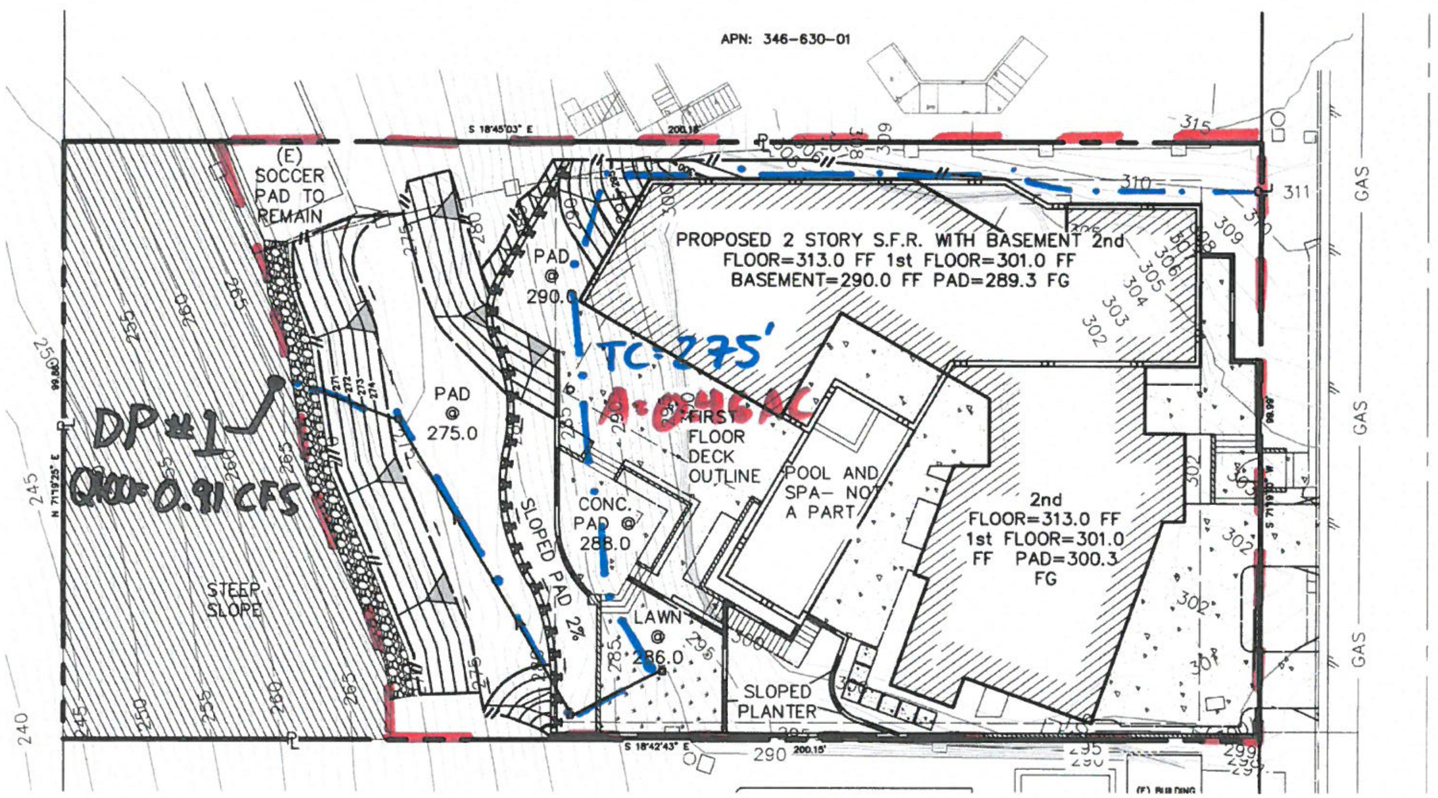
D.P. #1

- AREA = 20,000 S.F./ 0.46 AC.
- IMPERVIOUS = 8,500 S.F./ 0.20 AC.
- PERVIOUS = 11,500 S.F./ 0.26 AC.
- T.C. = 175 FT.

LEGEND

BASIN AREA

T.C. PATH



POST-CONSTRUCTION HYDROLOGY BASINS

D.P. DATA

D.P. #1

- AREA = 20,000 S.F./ 0.46 AC.
- IMPERVIOUS = 9,500 S.F./ 0.22 AC.
- PERVIOUS = 10,500 S.F./ 0.24 AC.
- T.C. = 275 FT.

LEGEND

BASIN AREA

T.C. PATH

N

20 10 0 20

SCALE IN FEET
SCALE: 1" = 20'

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Single Source Development Consultant

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WATER QUALITY STUDY

FOR

THE FAKHIMI INVESTMENT GROUP RESIDENCE, APN: 346-610-10

DESCRIPTION:

PROPOSED SINGLE FAMILY RESIDENCE
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Required Permanent Best Management Practices for Standard Development Projects

Source Control (SC) BMP Requirements:

How to comply: Projects shall comply with this requirement by implementing source control BMPs listed in this section that are applicable to their project. Applicability shall be determined through consideration of the development project's features and anticipated pollutant sources. Appendix E provides guidance for identifying source control BMPs applicable to a project. The "Source Control BMP Checklist for All Development Projects" located in Appendix I-4 shall be used to document compliance with source control BMP requirements.

SC-1: Prevent illicit discharges into the MS4

An illicit discharge is any discharge to the MS4 that is not composed entirely of storm water except discharges pursuant to a National Pollutant Discharge Elimination System permit and discharges resulting from firefighting activities. Projects must effectively eliminate discharges of non-storm water into the MS4. This may involve a suite of housekeeping BMPs which could include effective irrigation, dispersion of non-storm water discharges into landscaping for infiltration, and controlling wash water from vehicle washing.

DISCUSSION:

This project will not produce any illicit discharge into the MS4 as all of the runoff is directed to natural vegetation in both the existing and proposed condition. However, any possibility of illicit discharge into the MS4 will be eliminated through the use of silt fence around the perimeter of the site. This will capture any runoff containing sediments as well as trash and debris. Also, the amount needed to be captured will be limited as there are no maintenance bays, wash areas, outdoor processing areas, fueling areas, or loading docks located within the project.

SC-2: Identify the storm drain system using stenciling or signage

Storm drain signs and stencils are visible source controls typically placed adjacent to the inlets. Posting notices regarding discharge prohibitions at storm drain inlets can prevent waste dumping. Stenciling shall be provided for all storm water conveyance system inlets and catch basins within the project area. Inlet stenciling may include concrete stamping, concrete painting, placards, or other methods approved by the local municipality. In addition to storm drain stenciling, projects are encouraged to post signs and prohibitive language (with graphical icons) which prohibit illegal dumping at trailheads, parks, building entrances and public access points along channels and creeks within the project area.
Language associated with the stamping (e.g., "No Dumping-Drains to Ocean") must be satisfactory to the City Engineer. Stamping may also be required in Spanish.

DISCUSSION:

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Storm drain stenciling and signage is to be implemented throughout the project in accordance with Appendix E, SD-13.

SC-3: Protect outdoor material storage areas from rainfall, run-on, runoff, and wind dispersal

Materials with the potential to pollute storm water runoff shall be stored in a manner that prevents contact with rainfall and storm water runoff. Contaminated runoff shall be managed for treatment incorporate the following structural or pollutant control BMPs for outdoor material storage areas, as applicable and feasible:
Materials with the potential to contaminate storm water shall be:

• Placed in an enclosure such as, but not limited to, a cabinet, or similar structure, or under a roof or awning that prevents contact with rainfall runoff or spillage to the storm water conveyance system; or
• Protected by secondary containment structures such as berms, dikes, or curbs.
• The storage areas shall be paved and sufficiently impervious to contain leaks and spills, where necessary.
(Continued below)
• The storage area shall be sloped towards a sump or another equivalent measure that is effective to contain spills.
• Runoff from downspouts/roofs shall be directed away from storage areas.
• The storage area shall have a roof or awning that extends beyond the storage area to minimize collection of storm water within the secondary containment area. A manufactured storage shed may be used for small containers.

DISCUSSION:

Outdoor material storage will be provided in accordance with the standards described.

SC-4: Protect materials stored in outdoor work areas from rainfall, run-on, runoff, and wind dispersal

Outdoor work areas have an elevated potential for pollutant loading and spills. All development projects shall include the following structural or pollutant control BMPs for any outdoor work areas with potential for pollutant generation, as applicable and feasible:

• Create an impermeable surface such as concrete or asphalt, or a prefabricated metal drip pan, depending on the size needed to protect the materials.
• Cover the area with a roof or other acceptable cover.
• Berm the perimeter of the area to prevent water from adjacent areas from flowing on to the surface of the work area.
• Directly connect runoff to sanitary sewer or other specialized containment system(s), as needed and where feasible. This allows the more highly concentrated pollutants from these areas to receive special treatment that removes particular constituents. Approval for this connection must be obtained from the appropriate sanitary sewer agency.
• Locate the work area away from storm drains or catch basins.

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DISCUSSION:

Materials stored outdoors will be adequately protected in accordance with the standards described above.

SC-5: Protect trash storage areas from rainfall, run-on, runoff, and wind dispersal

Storm water runoff from areas where trash is stored or disposed of can be polluted. In addition, loose trash and debris can be easily transported by water or wind into nearby storm drain inlets, channels, and/or creeks. All development projects shall include the following structural or pollutant control BMPs, as applicable:

• Design trash container areas so that drainage from adjoining roofs and pavement is diverted around the area(s) to avoid run-on. This can include berming or grading the waste handling area to prevent run-on of storm water.
• Ensure trash container areas are screened or walled to prevent offsite transport of trash.
• Provide roofs, awnings, or attached lids on all trash containers to minimize direct precipitation and prevent rainfall from entering containers.
• Locate storm drains away from immediate vicinity of the trash storage area and vice versa.
• Post signs on all dumpsters informing users that hazardous material are not to be disposed.

DISCUSSION:

Trash storage will be adequately protected in accordance with the standards described above.

SC-6: Use any additional BMPs determined to be necessary by the Comittee to minimize pollutant generation at each project site
Appendix E.1 provides guidance on permanent controls and operational BMPs that are applicable at a project site based on potential sources of runoff pollutants at the project site. The project shall implement all applicable and feasible source control BMPs listed in Appendix E.1. In addition to the source control BMPs in Appendix E.1, additional source control requirements apply for the following project types within the City jurisdiction. Guidance for implementing these additional source control requirements are presented in Appendix E.

• **SC-6A: Large Trash Generating Facilities**: Includes but are not limited to restaurants, supermarkets, "big box" retail stores serving food, and pet stores. Refer to Appendix E.20

• **SC-6B: Animal Facilities**: Includes but are not limited to animal shelters, dog daycare centers, veterinary clinics, groomers, pet care stores, and breeding, boarding, and training facilities. Refer to Appendix E.21

• **SC-6C: Plant Nurseries and Garden Centers**: Includes but are not limited to commercial facilities that grow, distribute, sell, or store plants and plant material. Refer to Appendix E.22

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• **SC-6D: Automotive-related Uses**: include but are not limited to facilities that perform maintenance or repair of vehicles, vehicle washing facilities, and retail gasoline outlets. Refer to Appendix E.23

DISCUSSION:

This Source Control BMP does not apply to this site because it is a non-commercial single family residence being proposed.

Site Design (SD) BMP Requirements:

How to comply: Projects shall comply with this requirement by using all of the site design BMPs listed in this section that are applicable and practicable to their project type and site conditions. Applicability of a given site design BMP shall be determined based on project type, soil conditions, presence of natural features (e.g. streams), and presence of site features (e.g. parking areas). Explanation shall be provided by the applicant when a certain site design BMP is considered to be not applicable or not practicable/feasible. Site plans shall show site design BMPs and provide adequate details necessary for effective implementation of site design BMPs. The "Site Design BMP Checklist for All Development Projects" located in Appendix I-5 shall be used to document compliance with site design BMP requirements.

SD-1: Maintain natural drainage pathways and hydrologic features
Maintain or restore natural storage reservoirs and drainage corridors (including topographic depressions, areas of permeable soils, natural swales, and ephemeral and intermittent streams)

Buffer zones for natural water bodies (where buffer zones are technically infeasible, require project applicant to include other buffers such as trees, access restrictions, etc.)

During the site assessment, natural drainages must be identified along with their connection to creeks and/or streams, if any. Natural drainages offer a benefit to storm water management as the soils and habitat already function as a natural filtering/infiltrating swale. When determining the development footprint of the site, altering natural drainages should be avoided. By providing a development envelope set back from natural drainages, the drainage can retain some water quality benefits to the watershed. In some situations, site constraints, regulations, economics, or other factors may not allow avoidance of drainages and sensitive areas. Projects proposing to dredge or fill materials in Waters of the U.S. must obtain Clean Water Act Section 401 Water Quality Certification. Projects proposing to dredge or fill waters of the State must obtain waste discharge requirements. Both the 401 Certification and the Waste Discharge Requirements are administered by the San Diego Water Board. The project applicant shall consult the local jurisdiction for other specific requirements.

Projects can incorporate SD-1 into a project by implementing the following planning and design phase techniques as applicable and practicable:

• Evaluate surface drainage and topography in considering selection of Site Design BMPs that will be most beneficial for a given project site. Where feasible, maintain topographic depressions for infiltration.
• Optimize the site layout and reduce the need for grading. Where possible, conform the site layout along natural landforms, avoid grading and disturbance of vegetation and soils, and replicate the site's natural drainage patterns. Integrating existing drainage patterns into the site plan will help maintain the site's predevelopment hydrologic function.
• Preserve existing drainage paths and depressions, where feasible and applicable, to help
• Structural BMPs cannot be located in buffer zones if a State and/or Federal resource agency (e.g. SDRWQCB, California Department of Fish and Wildlife; U.S. Army Corps of Engineers, etc.) prohibits maintenance or activity in the area.

DISCUSSION:

Hydraulic analysis shows that through the use of careful planning and site layout, the existing and proposed conditions will have the same runoff outlet location and discharge intensity.

SD-2: Conserve natural areas, soils and vegetation

• Conserve natural areas within the project footprint including existing trees, other vegetation, and soils

To enhance a site's ability to support source control and reduce runoff, the conservation and restoration of natural areas must be considered in the site design process. By conserving or restoring the natural drainage features, natural processes are able to intercept storm water, thereby reducing the amount of runoff. The upper soil layers of a natural area contain organic material, soil biota, vegetation, and a configuration favorable for storing and slowly conveying storm water and establishing or restoring vegetation to stabilize the site after construction. The canopy of existing native trees and shrubs also provide a water conservation benefit by intercepting rain water before it hits the ground. By minimizing disturbances in these areas, natural processes are able to intercept storm water, providing a water quality benefit. By keeping the development concentrated to the least environmentally sensitive areas of the site and set back from natural areas, storm water runoff is reduced, water quality can be improved, environmental impacts can be decreased, and many of the site's most attractive native landscape features can be retained. In some situations, site constraints, regulations, economics, and/or other factors may not allow avoidance of all sensitive areas on a project site. Project applicant shall consult the local municipality for jurisdictional specific requirements for mitigation of removal of sensitive areas.

Projects can incorporate SD-2 by implementing the following planning and design phase techniques as applicable and practicable:

• Identify areas most suitable for development and areas that should be left undisturbed. Additionally, reduced disturbance can be accomplished by increasing building density and increasing height, if possible.
• Cluster development on least-sensitive portions of a site while leaving the remaining land in a natural undisturbed condition.

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• Avoid areas with thick, undisturbed vegetation. Soils in these areas have a much higher capacity to store and infiltrate runoff than disturbed soils, and reestablishment of a mature vegetative community can take decades. Vegetative cover can also provide additional volume storage of rainfall by retaining water on the surfaces of leaves, branches, and trunks of trees during and after storm events.
• Preserve trees, especially native trees and shrubs, and identify locations for planting additional native or drought tolerant trees and large shrubs.
• In areas of disturbance, topsoil should be removed before construction and replaced after the project is completed. When handled carefully, such an approach limits the disturbance to native soils and reduces the need for additional (purchased) topsoil during later phases.
• Avoid sensitive areas, such as wetlands, biological open space areas, biological mitigation sites, streams, floodplains, or particular vegetation communities, such as coastal sage scrub and intact forest. Also, avoid areas that are habitat for sensitive plants and animals, particularly those, State or federally listed as endangered, threatened or rare. Development in these areas is often restricted by federal, state and local laws.

DISCUSSION:

The project site has optimized the site layout by utilizing as much of the existing residential areas as possible for new the new construction. Additional slopes and small walls have been added to minimize the impacts to the areas not under development by the projects layout. As a single family residence, the project site has been optimized for site usage with area surrounding the property.

SD-3: Minimize impervious area

• Construct streets, sidewalks or parking lots aisles to the minimum widths necessary, provided public safety is not compromised
• Minimize the impervious footprint of the project

One of the principal causes of environmental impacts by development is the creation of impervious surfaces. Imperviousness links urban land development to degradation of aquatic ecosystems in two ways:

• First, the combination of paved surfaces and piped runoff efficiently collects urban pollutants and transports them, in suspended or dissolved form, to surface waters. These pollutants may originate as airborne dust, be washed from the atmosphere during rains, or may be generated by automobiles and outdoor work activities.

• Second, increased peak flows and runoff durations typically cause erosion of stream banks and beds, transport of fine sediments, and disruption of aquatic habitat. Measures taken to control stream erosion, such as hardening banks with riprap or concrete, may permanently eliminate habitat. Impervious cover can be minimized through identification of the smallest possible land area that can be practically impacted or disturbed during site development. Reducing impervious surfaces retains the permeability of the project site, allowing natural processes to filter and reduce sources of pollution.

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Projects can incorporate SD-3 by implementing the following planning and design phase techniques as applicable and practicable:

• Decrease building footprint through (the design of compact and taller structures when allowed by local zoning and design standards and provided public safety is not compromised.
• Construct walkways, trails, patios, overflow parking lots, alleys and other low-traffic areas with permeable surfaces.
• Construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and alternative transportation (e.g. pedestrians, bikes) are not compromised.
• Consider the implementation of shared parking lots and driveways where possible.
• Landscaped area in the center of a cul-de-sac can reduce impervious area depending on configuration. Design of a landscaped cul-de-sac must be coordinated with fire department personnel to accommodate turning radii and other operational needs.
• Design smaller parking lots with fewer stalls, smaller stalls, more efficient lanes.
• Design indoor or underground parking.
• Minimize the use of impervious surfaces in the landscape design.

DISCUSSION:

The project site will minimize the impervious footprint by building a two story single family residence on the property. In addition, as a single family residence with only one driveway, the minimal amount of impervious construction is being utilized.

SD-4: Minimize soil compaction

• Minimize soil compaction in landscaped areas

The upper soil layers contain organic material, soil biota, and a configuration favorable for storing and slowly conveying storm water down gradient. By protecting native soils and vegetation in appropriate areas during the clearing and grading phase of development the site can retain some of its existing beneficial hydrologic function. Soil compaction resulting from the movement of heavy construction equipment can reduce soil infiltration rates. It is important to recognize that areas adjacent to and under building foundations, roads and manufactured slopes must be compacted with minimum soil density requirements in compliance with local building and grading ordinances.

Projects can incorporate SD-4 by implementing the following planning and design phase techniques as applicable and practicable:

• Avoid disturbance in planned green space and proposed landscaped areas where feasible. These areas that are planned for retaining their beneficial hydrological function should be protected during the grading/construction phase so that vehicles and construction equipment do not intrude and inadvertently compact the area.
• In areas planned for landscaping where compaction could not be avoided, re-till the soil surface to allow for better infiltration capacity. Soil amendments are recommended and may be necessary to increase permeability and organic content. Soil stability, density requirements, and other geotechnical

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considerations associated with soil compaction must be reviewed by a qualified landscape architect or licensed geotechnical, civil or other professional engineer.

DISCUSSION:

During Construction, the project site will only disturb the areas needed to construct the improvements associated with the removal of the existing single-family residence and the construction of the proposed new single family residence. Every effort will be made to minimize construction impacts to associated lawn, landscaping, and similar areas per the LID manual.

SD-5: Disperse impervious areas
Disconnect impervious surfaces through disturbed pervious areas
Design and construct landscaped or other pervious areas to effectively receive and infiltrate, retain and/or treat runoff from impervious areas prior to discharging to the MS4

Impervious area dispersion (dispersion) refers to the practice of essentially disconnecting impervious areas from directly draining to the storm drain system by routing runoff from impervious areas such as rooftops, walkways, and driveways onto the surface of adjacent pervious areas. The intent is to slow runoff discharges, and reduce volumes while achieving incidental treatment. Volume reduction from dispersion is dependent on the infiltration characteristics of the pervious area and the amount of impervious area draining to the pervious area. Treatment is achieved through filtration, shallow sedimentation, sorption, infiltration, evapotranspiration, biochemical processes and plant uptake.
The effects of imperviousness can be mitigated by disconnecting impervious areas from the drainage system and by encouraging detention and retention of runoff near the point where it is generated. Detention and retention of runoff reduces peak flows and volumes and allows pollutants to settle out or adhere to soils before they can be transported downstream. Disconnection practices may be applied in almost any location, but impervious surfaces must discharge into a suitable receiving area for the practices to be effective. Information gathered during the site assessment will help determine appropriate receiving areas.
Project designs should direct runoff from impervious areas to adjacent landscaping areas that have higher potential for infiltration and surface water storage. This will limit the amount of runoff generated, and therefore the size of the mitigation BMPs downstream. The design, including consideration of slopes and soils, must reflect a reasonable expectation that runoff will soak into the soil and produce no runoff of the DCV. On hillside sites, drainage from upper areas may be collected in conventional catch basins and piped to landscaped areas that have higher potential for infiltration. Or use low retaining walls to create terraces that can accommodate BMPs.
Projects can incorporate SD-5 by implementing the following planning and design phase techniques as applicable and practicable:

- Implement design criteria and considerations listed in impervious area dispersion fact sheet (SD-5) presented in Appendix E.
- Drain rooftops into adjacent landscape areas.
- Drain impervious parking lots, sidewalks, walkways, trails, and patios into adjacent landscape areas.
- Reduce or eliminate curb and gutters from roadway sections, thus allowing roadway runoff to drain to adjacent pervious areas.

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• Replace curbs and gutters with roadside vegetated swales and direct runoff from the paved street or parking areas to adjacent LID facilities. Such an approach for alternative design can reduce the overall capital cost of the site development while improving the storm water quantity and quality issues and the site's aesthetics.
• Plan site layout and grading to allow for runoff from impervious surfaces to be directed into distributed permeable areas such as turf, landscaped or permeable recreational areas, medians, parking islands, planter boxes, etc.
• Detain and retain runoff throughout the site. On flatter sites, landscaped areas can be interspersed among the buildings and pavement areas. On hillside sites, drainage from upper areas may be collected in conventional catch basins and conveyed to landscaped areas in lower areas of the site.
• Pervious area that receives run on from impervious surfaces shall have a minimum width of 10 feet and a maximum slope of 5%.

DISCUSSION:

The project is dispersing runoff to adjacent landscaping elements as much as possible. Roof drains will be directed to landscaping and lawn areas as much as feasible. In addition, SD-5: Impervious Area Dispersion will also be used as a guidance. A copy is provided in Attachment 1 for reference.

SD-6: Collect runoff

• Use small collection strategies located at, or as close to as possible to the sources (i.e. the point where storm water initially meets the ground) to minimize the transport of runoff and pollutants to the MS4 and receiving waters
• Use permeable material for projects with low traffic areas and appropriate soil conditions

Distributed control of storm water runoff from the site can be accomplished by applying small collection techniques (e.g. green roofs), or integrated management practices, on small sub-catchments or on residential lots. Small collection techniques foster opportunities to maintain the natural hydrology provide a much greater range of control practices. Integration of storm water management into landscape design and natural features of the site, reduce site development and long-term maintenance costs, and provide redundancy if one technique fails. On flatter sites, it typically works best to intersperse landscaped areas and integrate small scale retention practices among the buildings and paving. Permeable pavements contain small voids that allow water to pass through to a gravel base. They come in a variety of forms; they may be a modular paving system (concrete pavers, grass-pave, or gravel-pave) or poured in place pavement (porous concrete, permeable asphalt). Project applicants should identify locations where permeable pavements could be substituted for impervious concrete or asphalt paving. The O&M of the site must ensure that permeable pavements will not be sealed in the future. In areas where infiltration is not appropriate, permeable paving systems can be fitted with an under drain to allow filtration, storage, and evaporation, prior to drainage into the storm drain system.

Projects can incorporate SD-6 by implementing the following planning and design phase techniques as applicable and practicable:

• Implementing distributed small collection techniques to collect and retain runoff
• Installing permeable pavements (see SD-6B in Appendix E)

DISCUSSION:
The following LID considerations shall be considered by the project site:

- Stabilize the slopes. Vegetate disturbed soils and slopes with drought tolerant vegetation and stabilize permanent channel crossings.
- Convey runoff safely away from the tops of slopes (to prevent slope instability caused by infiltrated runoff).
- Install energy dissipating berm at the outlets of new storm drains to reduce the potential for erosion and minimize impacts to receiving waters.
- Install non-toxic roofing materials by avoiding copper or steel roofs, gutters and downspouts

SD-7: Landscape with native or drought tolerant species

All development projects are required to select a landscape design and plant palette that minimizes required resources (irrigation, fertilizers and pesticides) and pollutants generated from landscape areas. Native plants require less fertilizers and pesticides because they are already adapted to the rainfall patterns and soils conditions. Plants should be selected to be drought tolerant and not require watering after establishment (2 to 3 years). Watering should only be required during prolonged dry periods after plants are established. Final selection of plant material needs to be made by a landscape architect experienced with LID techniques. Microclimates vary significantly throughout the region and consulting local municipal resources will help to select plant material suitable for a specific geographic location.

Projects can incorporate SD-7 by landscaping with native and drought tolerant species. Recommended plant list is included in Appendix E (Fact Sheet PL).

DISCUSSION:

Native drought tolerant plants are to be used throughout the project. Also, integrated pest management principles such as barriers, screens, and caulking while also relying on natural enemies to eliminate pests are proposed within this project.

SD-8: Harvest and use precipitation

Harvest and use BMPs capture and stores storm water runoff for later use. Harvest and use can be applied at smaller scales (Standard Projects) using rain barrels or at larger scales (PDPs) using cisterns. This harvest and use technique has been successful in reducing runoff discharged to the storm drain system conserving potable water and recharging groundwater.
Rain barrels are above ground storage vessels that capture runoff from roof downspouts during rain events and detain that runoff for later reuse for irrigating landscaped areas. The temporary storage of roof runoff reduces the runoff volume from a property and may reduce the peak runoff velocity for small, frequently occurring storms. In addition, by reducing the amount of storm water runoff that flows

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overland into a storm water conveyance system (storm drain inlets and drain pipes), less pollutants are transported through the conveyance system into local creeks and the ocean. The reuse of the detained water for irrigation purposes leads to the conservation of potable water and the recharge of groundwater. SD-8 fact sheet in Appendix E provides additional detail for designing Harvest and Use BMPs. Projects can incorporate SD-8 by installing rain barrels or cisterns, as applicable.

DISCUSSION:

Harvesting is not feasible for single family residences.

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REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION

Proposed Shirazi/Salami Residence
2702 Costebelle Drive
La Jolla, California

JOB NO. 15-10884
07 December 2015

Prepared for:

Ali Salami and Ali Fakhimi

Geotechnical Exploration, Inc.

SOIL AND FOUNDATION ENGINEERING ● GROUNDWATER ● ENGINEERING GEOLOGY

07 December 2015

Ali Salami and Ali Fakhimi
2712 Costebelle Drive
La Jolla, CA 92037

Job No. 15-10884

Subject: **Report of Preliminary Geotechnical Investigation**
Proposed Shirazi/Salami Residence
2702 Costebelle Drive
La Jolla, California

Dear Dr. Salami and Dr. Fakhimi:

In accordance with your request and our proposal dated September 17, 2015, ***Geotechnical Exploration, Inc.*** has performed an investigation of the geotechnical and general geologic conditions at the location of the proposed residential project that will include a new two-story single-family residence with a partial basement and associated improvements. The field work was performed on October 2, 2015.

If the conclusions and recommendations presented in this report are implemented in the design and construction of the project, it is our opinion that the site will be suitable for the proposed residence and associated improvements.

This opportunity to be of service is sincerely appreciated. Should you have any questions concerning the following report, please do not hesitate to contact us. Reference to our **Job No. 15-10884** will expedite a response to your inquiries.

Respectfully submitted,

GEOTECHNICAL EXPLORATION, INC.

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REPORT OF PRELIMINARY GEOTECHNICAL INVESTIGATION
Proposed Shirazi/Salami Residence
2702 Costebelle Drive
La Jolla, California

JOB NO. 15-10884

The following report presents the findings and recommendations of ***Geotechnical Exploration, Inc.*** for the subject project.

I. PROJECT SUMMARY AND SCOPE OF SERVICES

It is our understanding, based on discussions with the client and review of preliminary plans prepared by Island Architects, that the existing single-story, single-family residence will be removed and the site is to receive a new two-story, single-family residence with a partial basement and associated improvements.

Final construction plans for the proposed residence have not been provided to us during the preparation of this report. We recommend that they be provided to us for review as they are developed.

The scope of work performed for this investigation included a review of available published information pertaining to the site geology, a site reconnaissance and subsurface exploration program, laboratory testing, geotechnical engineering analysis of the research, field and laboratory data, and the preparation of this report. The data obtained and the analyses performed were for the purpose of providing design and construction criteria for the project earthwork, building foundations, and slab-on-grade floors.

II. SITE DESCRIPTION

The property is known as Assessor's Parcel No. 346-610-10-00, Lot 36, according to Recorded Map 4995, in the City and County of San Diego, State of California.

The site, consisting of slightly less than 0.5-acre, is located at 2702 Costebelle Drive in the La Jolla area of the City of San Diego (for site location, refer to the Vicinity Map, Figure No. I). The wedge-shaped property is bordered on the north by a descending natural hillside that abuts Torrey Pines Road at its downslope terminus; on the south by the westerly descending Costebelle Drive; on the east and at a higher elevation by a similar residential property; and on the west by a similar residential property at a lower elevation (for Site Plan, refer to Figure No. II).

The existing single-story, single-family residence and attached two-car garage are located on a relatively level building pad and are of wood frame and stucco construction with slab on-grade floors. Exterior improvements include a concrete driveway, concrete walkways and a brick paver patio area bordered by a keystone retaining wall to the north and west. Vegetation consists primarily of ornamental landscaping including decorative shrubbery and mature trees.

The property consists of a relatively level building pad cut into a northerly and westerly sloping hillside. The building pad is at an approximate elevation of 301 feet above mean sea level (AMSL). Elevations across the property range from approximately 310 feet AMSL near the southeast corner of the property to approximately 245 feet AMSL at the north corner of the property on the descending hillside. Information concerning approximate elevations across the site was obtained from a Preliminary Site Plan prepared by Island Architects, dated September 28, 2012.

III. FIELD INVESTIGATION

A. Subsurface Exploration

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using a limited-access, continuous-flight auger drill to investigate and sample the subsurface soils on October 2, 2015. Three exploratory borings were placed around the perimeter of the existing residence where access and soil conditions allowed and in areas where the new residential structure and improvements are to be located. The exploratory borings were drilled to depths of approximately 3 to 10 feet in order to obtain representative soil samples and to define a soil profile across the lot. The soils encountered in the borings were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (refer to Appendix A). The approximate locations of the borings are shown on Figure No. II.

Representative samples were obtained from the exploratory borings at selected depths appropriate to the investigation. All samples were returned to our laboratory for evaluation and testing. Samples contained in liners were recovered by driving a 3-inch O.D. Modified California sampler 18 inches into the soil using a 45-pound hammer.

Boring logs have been prepared on the basis of our observations and laboratory test results. Logs of the borings are attached as Figure No. III.

The boring logs and related information depict subsurface conditions only at the specific locations shown on Figure No. II and on the particular date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these boring and hand auger locations. Also, the passage of time may result in changes in the subsurface conditions due to environmental changes.

IV. LABORATORY TESTS

Laboratory tests were performed on samples of the soils and formational materials encountered in order to evaluate their index, strength, expansion, and compressibility properties. The following tests were conducted on the sampled soils:

1. Standard Practice for Thick Wall Ring-lined Split Barrel Drive Sampling of Soils (ASTM D3550-07)
2. Laboratory Compaction Characteristics (ASTM D1557-12)
3. Determination of Percentage of Particles Smaller than #200 (ASTM D1140-14)
4. Expansion Index (ASTM D4829-11)

Soil samples for density measurements were retrieved using samplers driven into the exploratory borings by a drill rig apparatus. This helps to establish the in situ density of retrieved samples. Laboratory compaction tests establish the laboratory maximum dry density and optimum moisture content of the tested soils and are also used to aid in evaluating the strength characteristics of the soils. The test results are presented on the boring and hand pit logs at the appropriate sample depths.

The particle size smaller than a No. 200 sieve analysis aids in classifying the tested soils in accordance with the Unified Soil Classification System and provides qualitative information related to engineering characteristics such as expansion potential, permeability, and shear strength. The test results are presented on the boring logs at the appropriate sample depths (refer to Figure Nos. III and IV).

The expansion potential of samples of the existing fill soils encountered was determined utilizing the procedures specified in ASTM D4829. The measured Expansion Index value was 42. The test results are presented on the boring logs. Based on these tests, the classification tests and our past experience with similar soils, it is our opinion that the existing fill soils and Ardath Shale materials encountered possess a low potential for expansion.

V. REGIONAL GEOLOGIC DESCRIPTION

San Diego County has been divided into three major geomorphic provinces: the Coastal Plain, the Peninsular Ranges and the Salton Trough. The Coastal Plain exists west of the Peninsular Ranges. The Salton Trough is east of the Peninsular Ranges. These divisions are the result of the basic geologic distinctions between the areas. Mesozoic metavolcanic, metasedimentary and plutonic rocks predominate in the Peninsular Ranges with primarily Cenozoic sedimentary rocks to the west and east of this central mountain range (Demere, 1997).

In the Coastal Plain region, where the subject property is located, the "basement" consists of Mesozoic crystalline rocks. Basement rocks are also exposed as high relief areas (e.g., Black Mountain northeast of the subject property and Cowles Mountain near the San Carlos area of San Diego). Younger Cretaceous and Tertiary sediments lap up against these older features. The Cretaceous sediments form the local basement rocks on the Point Loma area. These sediments form a "layer cake" sequence of marine and non-marine sedimentary rock units, with some formations up to 140 million years old. Faulting related to the La Nacion and Rose Canyon Fault zones has broken up this sequence into a number of distinct fault blocks in the southwestern part of the county. Northwestern portions of the county are relatively undeformed by faulting (Demere, 1997).

The Peninsular Ranges form the granitic spine of San Diego County. These rocks are primarily plutonic, forming at depth beneath the earth's crust 140 to 90 million years ago as the result of the subduction of an oceanic crustal plate beneath the North American continent. These rocks formed the much larger Southern California batholith. Metamorphism associated with the intrusion of these great granitic masses affected the much older sediments that existed near the surface over that period of time. These metasedimentary rocks remain as roof pendants of marble, schist, slate, quartzite and gneiss throughout the Peninsular Ranges. Locally, Miocene-age volcanic rocks and flows have also accumulated within these mountains (e.g., Jacumba Valley). Regional tectonic forces and erosion over time have uplifted and unroofed these granitic rocks to expose them at the surface (Demere, 1997).

The Salton Trough is the northerly extension of the Gulf of California. This zone is undergoing active deformation related to faulting along the Elsinore and San Jacinto Fault Zones, which are part of the major regional tectonic feature in the southwestern portion of California, the San Andreas Fault Zone. Translational movement along these fault zones has resulted in crustal rifting and subsidence. The Salton Trough, also referred to as the Colorado Desert, has been filled with sediments to a depth of approximately 5 miles since the movement began in the early Miocene, 24 million years ago. The source of these sediments has been the local mountains as well as the ancestral and modern Colorado River (Demere, 1997).

As indicated previously, the San Diego area is part of a seismically active region of California. It is on the eastern boundary of the Southern California Continental Borderland, part of the Peninsular Ranges Geomorphic Province. This region is part of a broad tectonic boundary between the North American and Pacific Plates. The actual plate boundary is characterized by a complex system of active, major, right-lateral strike-slip faults, trending northwest/southeast. This fault system extends eastward to the San Andreas Fault, approximately 70 miles from San Diego, and westward to the San Clemente Fault, approximately 50 miles off-shore from San Diego (Berger and Schug, 1991).

During recent history (prior to April 2010), the San Diego County area has been relatively quiet seismically. No fault ruptures or major earthquakes had been experienced in historic time within the greater San Diego area. Since earthquakes have been recorded by instruments (since the 1930s), the San Diego area has experienced scattered seismic events with magnitudes generally less than M4.0. During June 1985, a series of small earthquakes occurred beneath San Diego Bay, three of which were recorded at M4.0 to M4.2. In addition, the Oceanside earthquake of July 13, 1986, located approximately 26 miles offshore of the City of Oceanside, had a magnitude of M5.3 (Hauksson and Jones, 1988).

On June 15, 2004, a M5.3 earthquake occurred approximately 45 miles southwest of downtown San Diego (26 miles west of Rosarito, Mexico). Although this earthquake was widely felt, no significant damage was reported. Another widely felt earthquake on a distant southern California fault was a M5.4 event that took place on July 29, 2008, west-southwest of the Chino Hills area of Riverside County.

Several earthquakes ranging from M5.0 to M6.0 occurred in northern Baja California, centered in the Gulf of California on August 3, 2009. These were felt in San Diego but no injuries or damage was reported. A M5.8 earthquake followed by a M4.9 aftershock occurred on December 30, 2009, centered about 20 miles south of the Mexican border city of Mexicali. These were also felt in San Diego, swaying high-rise buildings, but again no significant damage or injuries were reported.

On Easter Sunday April 4, 2010, a large earthquake occurred in Baja California, Mexico. It was widely felt throughout the southwest including Phoenix, Arizona and San Diego in California. This M7.2 event, the Sierra El Mayor earthquake, occurred in northern Baja California, approximately 40 miles south of the Mexico-USA border at shallow depth along the principal plate boundary between the North American and Pacific plates. According to the U. S. Geological Survey this is an area with a high level of historical seismicity, and it has recently also been seismically active, though this is the largest event to strike in this area since 1892. The April 4, 2010, earthquake appears to have been larger than the M6.9 earthquake in 1940 or any of the early 20th century events (e.g., 1915 and 1934) in this region of northern Baja California. The event caused widespread damage to structures, closure of businesses, government offices and schools, power outages, displacement of people from their homes and injuries in the nearby major metropolitan areas of Mexicali in Mexico and Calexico in Southern California. Estimates of the cost of the damage range to $100 million.

This event's aftershock zone extends significantly to the northwest, overlapping with the portion of the fault system that is thought to have ruptured in 1892. Some structures in the San Diego area experienced minor damage and there were some injuries. Ground motions for the April 4, 2010, main event, recorded at stations in San Diego and reported by the California Strong Motion Instrumentation

Program (CSMIP), ranged up to 0.058g. Aftershocks from this event continue to the date of this report along the trend northwest and south of the original event, including within San Diego County, closer to the San Diego metropolitan area. There have been hundreds of these earthquakes including events up to M5.7.

On July 7, 2010, a M5.4 earthquake occurred in Southern California at 4:53 pm (Pacific Time) about 30 miles south of Palm Springs, 25 miles southwest of Indio, and 13 miles north-northwest of Borrego Springs. The earthquake occurred near the Coyote Creek segment of the San Jacinto Fault. The earthquake exhibited right lateral slip to the northwest, consistent with the direction of movement on the San Jacinto Fault. The earthquake was felt throughout Southern California, with strong shaking near the epicenter. It was followed by more than 60 aftershocks of M1.3 and greater during the first hour. Seismologists expect continued aftershock activity.

In the last 50 years, there have been four other earthquakes in the magnitude M5.0 range within 20 kilometers of the Coyote Creek segment: M5.8 in 1968, M5.3 on 2/25/1980, M5.0 on 10/31/2001, and M5.2 on 6/12/2005. The biggest earthquake near this location was the M6.0 Buck Ridge earthquake on 3/25/1937.

In California, major earthquakes can generally be correlated with movement on active faults. As defined by the California Division of Mines and Geology (Hart, E.W., 1980), an "active" fault is one that has had ground surface displacement within Holocene time (about the last 11,000 years). Additionally, faults along which major historical earthquakes have occurred (about the last 210 years in California) are also considered to be active (Association of Engineering Geologists, 1973). The California Division of Mines and Geology (now the California Geological Survey) defines a *"potentially active"* fault as one that has had ground surface displacement during Quaternary time, that is, between 11,000 and 1.6 million years (Hart, E.W., 1980).

VI. SITE-SPECIFIC SOIL AND GEOLOGIC DESCRIPTION

Our reconnaissance, field work, and review of pertinent geologic maps and reports indicate that Tertiary-age Ardath Shale (Ta) formational soils underlie the entire site (see Figure No. V; Kennedy and Tan, 2005). The soil profile at the site includes surficial fill soils ranging from less than 1 foot to approximately 10 feet overlying the formational soils.

Fill Soils (Qaf): The lot is overlain by less than 1 foot to approximately 10 feet of fill soils and slopewash materials. Fill soils were encountered at all boring locations outside the existing building footprint. The fill soils consist of yellow-brown, sandy clay with abundant roots and siltstone fragments. The fill soils are generally firm in the upper 2 feet and stiff below 2 feet, moist, and of low expansion potential. The upper 2 feet of the fill soils are not suitable in their current condition for the support of the proposed new addition or other associated improvements.

The slopewash was only encountered in boring B-1 and will be removed during the excavation for the partial basement.

Ardath Shale Formation (Ta): The encountered Ardath Shale formational materials underlie the fill soils and generally consist of dense to hard, yellow-brown, clayey sand/sandy clay. These soils were encountered at depths of 1 to 9 feet.

VII. GEOLOGIC HAZARDS

A review of the City of San Diego Seismic Safety Study, Geologic Hazards Map Sheet No. 29, indicates that the site is located in a low to moderate risk geologic hazard area designated as Category 25. Category 25 is listed under the heading of "*slide-prone formations*" and further described as underlain by the Ardath Shale Formation with "*neutral or favorable geologic structure*." An excerpted portion of the Geologic Hazards Map and the legend are presented as Figure No. VI.

The following is a discussion of the geologic conditions and hazards common to this area of the City of San Diego, as well as project-specific geologic information relating to development of the subject property.

A. Local and Regional Faults

Rose Canyon Fault: The Rose Canyon Fault Zone (Mount Soledad and Rose Canyon Faults), located approximately 1 mile southwest of the subject site, is mapped trending north-south from Oceanside to downtown San Diego, from where it appears to head southward into San Diego Bay, through Coronado and offshore. The Rose Canyon Fault Zone is considered to be a complex zone of onshore and offshore, en echelon strike slip, oblique reverse, and oblique normal faults. The Rose Canyon Fault is considered to be capable of causing a M7.2 earthquake per the California Geologic Survey (2002) and considered microseismically active, although no significant recent earthquake is known to have occurred on the fault.

Investigative work on faults that are part of the Rose Canyon Fault Zone at the Police Administration and Technical Center in downtown San Diego, at the SDG&E facility in Rose Canyon, and within San Diego Bay and elsewhere within downtown

San Diego, has encountered offsets in Holocene (geologically recent) sediments. These findings confirm Holocene displacement on the Rose Canyon Fault, which was designated an "active" fault in November 1991 (California Division of Mines and Geology -- Fault Rupture Hazard Zones in California, 1999).

Coronado Bank Fault: The Coronado Bank Fault is located approximately 16 miles southwest of the site. Evidence for this fault is based upon geophysical data (acoustic profiles) and the general alignment of epicenters of recorded seismic activity (Greene, 1979). The Oceanside earthquake of M5.3, recorded July 13, 1986, is known to have been centered on the fault or within the Coronado Bank Fault Zone. Although this fault is considered active, due to the seismicity within the fault zone, it is significantly less active seismically than the Elsinore Fault (Hileman, 1973). It is postulated that the Coronado Bank Fault is capable of generating a M7.6 earthquake and is of great interest due to its close proximity to the greater San Diego metropolitan area.

Elsinore Fault: The Elsinore Fault is located approximately 31 miles northeast of the site. The fault extends approximately 200 km (125 miles) from the Mexican border to the northern end of the Santa Ana Mountains. The Elsinore Fault zone is a 1 to 4-mile-wide, northwest-southeast-trending zone of discontinuous and en echelon faults extending through portions of Orange, Riverside, San Diego, and Imperial Counties. Individual faults within the Elsinore Fault Zone range from less than 1 mile to 16 miles in length. The trend, length and geomorphic expression of the Elsinore Fault Zone identify it as being a part of the highly active San Andreas Fault system.

Like the other faults in the San Andreas system, the Elsinore Fault is a transverse fault showing predominantly right-lateral movement. According to Hart, et al. (1979), this movement averages less than 1 centimeter per year. Along most of its length, the Elsinore Fault Zone is marked by a bold topographic expression consisting of linearly aligned ridges, swales and hallows. Faulted Holocene alluvial deposits (believed to be less than 11,000 years old) found along several segments of the fault zone suggest that at least part of the zone is currently active.

Although the Elsinore Fault Zone belongs to the San Andreas set of active, northwest-trending, right-slip faults in the southern California area (Crowell, 1962), it has not been the site of a major earthquake in historic time, other than a M6.0 earthquake near the town of Elsinore in 1910 (Richter, 1958; Toppozada and Parke, 1982). However, based on length and evidence of late-Pleistocene or Holocene displacement, Greensfelder (1974) has estimated that the Elsinore Fault Zone is reasonably capable of generating an earthquake as large as M7.5. Study and logging of exposures in trenches placed in Glen Ivy Marsh across the Glen Ivy North Fault (a strand of the Elsinore Fault Zone between Corona and Lake Elsinore), suggest a maximum earthquake recurrence interval of 300 years, and when combined with previous estimates of the long-term horizontal slip rate of 0.8 to 7.0 mm/year, suggest typical earthquakes of M6.0 to M7.0 (Rockwell, 1985). More recently, the California Geologic Survey (2002) considers the Elsinore Fault capable of producing an earthquake of M6.8 to M7.1.

San Jacinto Fault: The San Jacinto Fault is located 54 miles to the northeast of the site. The San Jacinto Fault Zone consists of a series of closely spaced faults, including the Coyote Creek Fault, that form the western margin of the San Jacinto Mountains. The fault zone extends from its junction with the San Andreas Fault in San Bernardino, southeasterly toward the Brawley area, where it continues south of the international border as the Imperial Transform Fault (Earth Consultants International [ECI], 2009).

The San Jacinto Fault zone has a high level of historical seismic activity, with at least 10 damaging earthquakes (M6.0 to M7.0) having occurred on this fault zone between 1890 and 1986. Earthquakes on the San Jacinto Fault in 1899 and 1918 caused fatalities in the Riverside County area. Offset across this fault is predominantly right-lateral, similar to the San Andreas Fault, although some investigators have suggested that dip-slip motion contributes up to 10% of the net slip (ECI, 2009).

The segments of the San Jacinto Fault that are of most concern to major metropolitan areas are the San Bernardino, San Jacinto Valley and Anza segments. Fault slip rates on the various segments of the San Jacinto are less well constrained than for the San Andreas Fault, but the available data suggest slip rates of 12 ±6 mm/yr for the northern segments of the fault, and slip rates of 4 ±2 mm/yr for the southern segments. For large ground-rupturing earthquakes on the San Jacinto fault, various investigators have suggested a recurrence interval of 150 to 300 years. The Working Group on California Earthquake Probabilities (WGCEP, 2008) has estimated that there is a 31 percent probability that an earthquake of M6.7 or greater will occur within 30 years on this fault. Maximum credible earthquakes of M6.7, M6.9, and M7.2 are expected on the San Bernardino, San Jacinto Valley and Anza segments, respectively, capable of generating peak horizontal ground accelerations of 0.48 to 0.53g in the County of Riverside, (ECI, 2009). A M5.4 earthquake occurred on the San Jacinto Fault on July 7, 2010.

The United States Geological Survey has issued the following statements with respect to the recent seismic activity on southern California faults:

The San Jacinto fault, along with the Elsinore, San Andreas, and other faults, is part of the plate boundary that accommodates about 2 inches/year of motion as the Pacific plate moves northwest relative to the North American plate. The largest recent earthquake on the San Jacinto fault, near this location, the M6.5 1968 Borrego Mountain earthquake April 8, 1968, occurred about 25 miles southeast of the July 7, 2010, M5.4 earthquake.

This M5.4 earthquake follows the 4th of April 2010, Easter Sunday, M7.2 earthquake, located about 125 miles to the south, well south of the US Mexico international border. A M4.9 earthquake occurred in the same area on June 12th at 8:08 pm (Pacific Time). Thus this section of the San Jacinto fault remains active.

Seismologists are watching two major earthquake faults in southern California. The San Jacinto fault, the most active earthquake fault in southern California, extends for more than 100 miles from the international border into San Bernardino and Riverside, a major metropolitan area often called the Inland Empire. The Elsinore fault is more than 110 miles long, and extends into the Orange County and Los Angeles area as the Whittier fault. The Elsinore fault is capable of a major earthquake that would significantly affect the large metropolitan areas of southern California. The Elsinore fault has not hosted a major earthquake in more than 100 years. The occurrence of these earthquakes along the San Jacinto fault and continued aftershocks demonstrates that the earthquake activity in the region remains at an elevated level. The San Jacinto fault is known as the most active earthquake fault in southern California. Caltech and USGS seismologists continue to monitor the ongoing earthquake activity using the Caltech/USGS Southern California Seismic Network and a GPS network of more than 100 stations.

B. Other Geologic Hazards

Ground Rupture: Ground rupture is characterized by bedrock slippage along an established fault and may result in displacement of the ground surface. For ground rupture to occur along a fault, an earthquake usually exceeds M5.0. If a M5.0

earthquake were to take place on a local fault, an estimated surface-rupture length 1 mile long could be expected (Greensfelder, 1974). Our investigation indicates that the subject site is not directly on a known fault trace and, therefore, the risk of ground rupture is remote.

Ground Shaking: Structural damage caused by seismically induced ground shaking is a detrimental effect directly related to faulting and earthquake activity. Ground shaking is considered to be the greatest seismic hazard in San Diego County. The intensity of ground shaking is dependent on the magnitude of the earthquake, the distance from the earthquake, and the seismic response characteristics of underlying soils and geologic units. Earthquakes of M5.0 or greater are generally associated with notable to significant damage. It is our opinion that the most serious damage to the site would be caused by a large earthquake originating on a nearby strand of the Rose Canyon Fault Zone. Although the chance of such an event is remote, it could occur within the useful life of the structure.

Landslides: Based upon our geologic reconnaissance, review of the geologic map (Kennedy and Tan, 2005), review of the City of San Diego Seismic Safety Study -- Geologic Hazards Map Sheet No. 29 and aerial photographs (4-11-53, AXN-8M-1 and 2), there are no known or suspected ancient landslides located on the site.

Liquefaction: The liquefaction of saturated sands during earthquakes can be a major cause of damage to buildings. Liquefaction is the process by which soils are transformed into a viscous fluid that will flow as a liquid when unconfined. It occurs primarily in loose, saturated sands and silts when they are sufficiently shaken by an earthquake.

On this site, the risk of liquefaction of foundation materials due to seismic shaking is considered to be essentially non-existent due to the dense nature of the natural-ground material and the lack of a shallow static groundwater surface under the site. The site does not have a potential for soil strength loss to occur due to a seismic event.

Tsunami: In general, the orientation of the southern California coastline and the bathymetry of the offshore southern California borderland have, during historical times, combined to protect the shoreline from any large magnitude tsunami height increases, as shown by records of tsunami occurrences that have been observed and/or recorded along the southern California shoreline since 1810 (Lander et al, 1993). For this segment of the California coastline (south of Santa Monica), there is no evidence of any high magnitude tsunamis generated during the last 200 years by large-scale regional sea floor movements (Gayman, 1998). The risk of a tsunami affecting the site is considered low as the site is situated at an elevation of approximately 301 feet above mean sea level and is not in immediate proximity to an exposed beach.

Summary: It is our opinion, based upon a review of the available maps and our site investigation, that the site is underlain by relatively stable formational materials, and is suited for the proposed residential structure and associated improvements provided the recommendations herein are implemented.

The most significant geologic hazard at the site is anticipated ground shaking from earthquakes on active Southern California and Baja California faults. The United States Geologic Survey has issued statements indicating that seismic activity in Southern California may continue at elevated levels with increased risk to major metropolitan areas near the Elsinore and San Jacinto faults. To date, the nearest known "active" faults to the subject site are the northwest-trending Rose Canyon Fault, Coronado Bank Fault and the Elsinore Fault. No significant geologic hazards are known to exist on or near the site that would prevent the proposed construction.

VIII. GROUNDWATER

Groundwater conditions were not encountered at the excavation locations and we do not expect significant groundwater problems to develop in the future ***if proper drainage is maintained on the property***. The potential does exist for perched water conditions to occur if rainwater and irrigation waters are allowed to infiltrate through the upper, more permeable fill soils and encounter less permeable natural ground materials.

On properties such as the subject site, where low permeability fine-grained soils exist at shallow depths, even normal landscape irrigation practices or periods of extended rainfall can result in shallow "perched" water conditions. The perching (shallow depth) accumulation of water on a low permeability surface can result in areas of persistent wetting and drowning of lawns, plants and trees. Resolution of such conditions, should they occur, may require site-specific design and construction of subdrain and shallow "wick" drain dewatering systems.

It must be understood that unless discovered during initial site exploration or encountered during site grading operations, it is extremely difficult to predict if or where perched or true groundwater conditions may appear in the future. When site fill or formational soils are fine-grained and of low permeability, water problems may not become apparent for extended periods of time.

Water conditions, where suspected or encountered during construction, should be evaluated and remedied by the project civil and geotechnical consultants. The project developer and property owner, however, must realize that post-construction appearances of groundwater may have to be dealt with on a site-specific basis. Proper surface drainage usually helps reduce the potential for high soil moisture.

IX. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based on the practical field investigation conducted by our firm, laboratory test results, and our knowledge and experience with the soils in the La Jolla area of the City of San Diego.

Our geotechnical investigation revealed that the site is underlain by less than 1 foot to approximately 10 feet of variable density, sandy clay fill soils, which are underlain by dense to hard, clayey sand/sandy clay formational materials. The new footings founded on medium dense fill soils and stiff formational materials should be adequate to support the proposed single-family residence and associated improvements from a geotechnical viewpoint.

The opinions, conclusions and recommendations presented in this report are contingent upon ***Geotechnical Exploration, Inc.*** being retained to review the final plans and specifications as they are developed and to observe the site earthwork and installation of foundations. Accordingly, we recommend that the following paragraph be included on the grading and foundation plans for the project:

> If the geotechnical consultant of record is changed for the project, the work shall be stopped until the replacement has agreed in writing to accept the responsibility within their area of technical competence for approval upon completion of the work. It shall be the responsibility of the permittee to notify the governing agency in writing of such change

prior to the commencement or recommencement of grading and/or foundation installation work.

A. Preparation of Soils for Site Development

1. *Clearing and Stripping:* The area of the proposed new two-story residence and any associated new flatwork or driveway pavement should be cleared of any existing improvements to be abandoned and stripped of all vegetation. The cleared and stripped materials should be properly disposed of off-site. Holes resulting from the removal of old footings or other buried obstructions that extend below the proposed finished site grades should be cleared and backfilled with suitable material compacted to the requirements provided under Recommendation No. 4, "Compaction."

2. *Subgrade Preparation:* After the area of new construction has been cleared, stripped, and the required excavations made, any remaining existing fill soils and/or slopewash should be removed and recompacted to the requirements of Recommendation No. 4, "Compaction."

3. *Material for Fill:* All existing on-site soils with an organic content of less than 3 percent by volume are, in general, suitable for use as fill. Any required imported fill material should be a low-expansion potential (Expansion Index of 30 to 50), granular soil with a plasticity index of 12 or less. In addition, imported fill materials should not contain rocks or lumps more than 6 inches in greatest dimension, not more than 15 percent larger than 2½ inches, and no more than 25 percent of the fill should be larger than ¼-inch. All materials for use as fill should be approved by our representative prior to filling.

4. *Fill Compaction:* All structural fill should be compacted to a minimum degree of compaction of 90 percent at a moisture content at least 2 percent above the optimum based upon ASTM D1557-12. In addition, the upper 6 inches of subgrade soil beneath any new concrete pavement should be scarified, moisture conditioned, and compacted to a minimum degree of compaction of 95 percent just prior to placement of the concrete. Fill material should be spread and compacted in uniform horizontal lifts not exceeding 8 inches in uncompacted thickness. Before compaction begins, the fill should be brought to a water content that will permit proper compaction by either: (1) aerating and drying the fill if it is too wet, or (2) moistening the fill with water if it is too dry. Each lift should be thoroughly mixed before compaction to ensure a uniform distribution of moisture.

5. *New Permanent Slopes:* We recommend that any required new permanent cut and fill slopes up to 10 feet in height be constructed to an inclination no steeper than 2.0:1.0 (horizontal to vertical). The project plans and specifications should contain all necessary design features and construction requirements to prevent erosion of the on-site soils both during and after construction. Slopes and other exposed ground surfaces should be appropriately planted with a protective groundcover.

6. *Trench Backfill:* All backfill soils placed in utility trenches or behind retaining walls should be compacted to a minimum degree of compaction of 90 percent. Backfill material should be placed in lift thicknesses appropriate to the type of compaction equipment utilized and compacted to a minimum degree of 90 percent by mechanical means. Our experience has shown that even shallow, narrow trenches, such as for irrigation and electrical lines, that

are not properly compacted can result in problems, particularly with respect to shallow ground water accumulation and migration.

B. ***Foundations***

7. *New Footings:* Footings for the new two-story residence should bear on undisturbed formational materials or properly compacted fill soils. The footings should be founded at least 18 inches below the lowest adjacent finished grade. Footings located adjacent to utility trenches should have their bearing surfaces situated below an imaginary 1.5:1.0 plane projected upward from the bottom edge of the adjacent utility trench.

   At the recommended depth the footings may be designed for an allowable soil bearing pressure of 2,000 psf for combined dead and live loads and 2,700 psf for all loads, including wind or seismic. All footings should, however, have a minimum width of 12 inches.

   Footings should contain top and bottom reinforcement to provide structural continuity and to permit spanning of local irregularities. We recommend that a minimum of two No. 5 top and two No. 5 bottom reinforcing bars be provided in the new footings. A minimum clearance of 3 inches should be maintained between steel reinforcement and the bottom or sides of the footing. In order for us to offer an opinion as to whether the footings are founded on soils of sufficient load bearing capacity, it is essential that our representative inspect the footing excavations prior to the placement of reinforcing steel or concrete.

NOTE: The project Civil/Structural Engineer should review all reinforcing schedules. The reinforcing minimums recommended herein are not to be construed as structural designs, but merely as minimum reinforcement to reduce the potential for cracking and separations.

8. *Lateral Loads:* Lateral load resistance for the new residence may be developed in friction between the foundation bottoms and the supporting subgrade. An allowable friction coefficient of 0.30 is considered applicable. An additional allowable passive resistance equal to an equivalent fluid weight of 250 pounds per cubic foot (pcf) acting against the foundations may be used in design provided the footings are poured neat against the adjacent undisturbed compacted fill materials. These lateral resistance values assume a level surface in front of the footing for a minimum distance of three times the embedment depth of the footing and any shear keys.

9. *Settlement:* Settlement under building loads is expected to be within tolerable limits for the proposed structure. For footings designed in accordance with the recommendations presented in the preceding paragraphs, we anticipate that total settlements should not exceed 1 inch and that post-construction differential settlements should be less than ¼-inch in 20 feet.

10. *Seismic Design Criteria:* Site-specific seismic design criteria for the proposed structures are presented in the following table in accordance with the 2013 CBC, which incorporates by reference ASCE 7-10 for seismic design. We have determined the mapped spectral acceleration values for the site, based on a latitude of 32.8511 degrees and longitude of -117.2453 degrees, utilizing a tool provided by the USGS, which provides a solution for ASCE 7-

10 (2013 CBC) utilizing digitized files for the Spectral Acceleration maps. Based on our past experience with similar conditions we have assigned a Site Soil Classification of D.

TABLE I
Mapped Spectral Acceleration Values and Design Parameters

S_s	S_1	F_a	F_v	S_{ms}	S_{m1}	S_{ds}	S_{d1}
1.303g	0.506g	1.000	1.500	1.303g	0.759g	0.868g	0.506g

11. *Retaining/Basement Walls*: Any required retaining walls and basement walls must be designed to resist lateral earth pressures and any additional lateral pressures caused by surcharge loads on the adjoining retained surface. We recommend that unrestrained (cantilever) walls with level backfill be designed for an equivalent fluid pressure of 35 pcf. We recommend that restrained walls (i.e., any walls with angle points or are curvilinear that restrain them from rotation) and basement walls with level backfill be designed for an equivalent fluid pressure of 35 pcf plus an additional uniform lateral pressure of 8H pounds per square foot, where H is equal to the height of backfill above the top of the wall footing in feet.

    For seismic design of unrestrained walls if required, we recommend that the seismic pressure increment be taken as a fluid pressure distribution utilizing an equivalent fluid weight of 15 pcf. For restrained walls and basement walls, we recommend that the seismic pressure increment be taken as a fluid pressure distribution utilizing an equivalent fluid weight of 22 pcf added to the active static fluid pressure utilizing an equivalent fluid weight of 35 pcf.

The preceding design pressures assume that the walls are backfilled with low expansion potential materials (Expansion Index less than 50) and that there is sufficient drainage behind the walls to prevent the build-up of hydrostatic pressures from surface water infiltration. We recommend that drainage be provided by a composite drainage material such as Miradrain 6000/6200 or equivalent. The drain material should terminate 12 inches below the finish surface where the surface is covered by slabs or 18 inches below the finish surface in landscape areas.

Backfill placed behind the walls should be compacted to a minimum degree of compaction of 90 percent using light compaction equipment. If heavy equipment is used, the walls should be appropriately temporarily braced.

12. *Drainage Quality Control*: It must be understood that it is not within the scope of our services to provide quality control oversight for surface or subsurface drainage construction or retaining wall sealing and base of wall drain construction. It is the responsibility of the contractor to verify proper wall sealing, geofabric installation, protection board (if needed), drain depth below interior floor or yard surface, pipe percent slope to the outlet, etc.

C. Concrete Slab-on-grade Criteria

13. *Minimum Floor Slab Thickness and Reinforcement:* Based on our experience, we have found that, for various reasons, floor slabs occasionally crack, causing brittle surfaces such as ceramic tiles to become damaged. Therefore, we recommend that all slabs-on-grade contain at least a minimum amount of reinforcing steel to reduce the separation of cracks, should they

occur. Structural slabs should be designed by the structural engineer. Slabs on-grade should be supported and built only on properly compacted fills.

13.1 Interior floor slabs should be a minimum of 5 inches actual thickness and be reinforced with No. 4 bars on 18-inch centers, both ways, placed at midheight in the slab. Slab subgrade soil should be verified by a ***Geotechnical Exploration, Inc.*** representative to have the proper moisture content within 48 hours prior to placement of the vapor barrier and pouring of concrete.

13.2 Following placement of any concrete floor slabs, sufficient drying time must be allowed prior to placement of floor coverings. Premature placement of floor coverings may result in degradation of adhesive materials and loosening of the finish floor materials.

14. *Concrete Isolation Joints:* We recommend the project Civil/Structural Engineer incorporate isolation joints and sawcuts to at least one-fourth the thickness of the slab in any floor designs. The joints and cuts, if properly placed, should reduce the potential for and help control floor slab cracking. We recommend that concrete shrinkage joints be spaced no farther than approximately 20 feet apart, and also at re-entrant corners. However, due to a number of reasons (such as base preparation, construction techniques, curing procedures, and normal shrinkage of concrete), some cracking of slabs can be expected. Structural slabs should not have control joints.

15. *Slab Moisture Emission:* Although it is not the responsibility of geotechnical engineering firms to provide moisture protection recommendations, as a service to our clients we provide the following discussion and suggested

minimum protection criteria. Actual recommendations should be provided by the architect and waterproofing consultants.

Soil moisture vapor can result in damage to moisture-sensitive floors, some floor sealers or sensitive equipment in direct contact with the floor, in addition to mold and staining on slabs, walls and carpets. Similar damage is possible in suspended floors above inadequately ventilated crawl spaces.

The common practice in Southern California has been to place vapor retarders made of PVC, or of polyethylene. PVC retarders are made in thickness ranging from 10- to 60-mil. Polyethylene retarders, called visqueen, range from 5- to 10-mil in thickness. These products are no longer considered adequate for moisture protection and can actually deteriorate over time.

Specialty vapor retarding and barrier products possess higher tensile strength and are more specifically designed for and intended to retard moisture transmission into and through concrete slabs. The use of such products is highly recommended for reduction of floor slab moisture emission.

The following American Society for Testing and Materials (ASTM) and American Concrete Institute (ACI) sections address the issue of moisture transmission into and through concrete slabs: ASTM E1745-97 (2009) Standard Specification for Plastic Water Vapor Retarders Used in Contact Concrete Slabs; ASTM E154-88 (2005) Standard Test Methods for Water Vapor Retarders Used in Contact with Earth; ASTM E96-95 Standard Test Methods for Water Vapor Transmission of Materials; ASTM E1643-98 (2009) Standard Practice for Installation of Water Vapor Retarders Used in Contact

Under Concrete Slabs; and ACI 302.2R-06 Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.

Based on the above, we recommend that the vapor barrier consist of a minimum 15-mil extruded polyolefin plastic (no recycled content or woven materials permitted). Permeance as tested before and after mandatory conditioning (ASTM E1745 Section 7.1 and sub-paragraphs 7.1.1-7.1.5) should be less than 0.01 perms (grains/square foot/hour in Hg) and comply with the ASTM E1745 Class A requirements. Installation of vapor barriers should be in accordance with ASTM E1643. The basis of design is Stego wrap vapor barrier 15-mil.

15.1 Common to all acceptable products, vapor retarder/barrier joints must be lapped and sealed with mastic or the manufacturer's recommended tape or sealing products. In actual practice, stakes are often driven through the retarder material, equipment is dragged or rolled across the retarder, overlapping or jointing is not properly implemented, etc. All these construction deficiencies reduce the retarder's effectiveness. In no case should retarder/barrier products be punctured or gaps be allowed to form prior to or during concrete placement.

15.2 Vapor retarders/barriers do not provide full waterproofing for structures constructed below free water surfaces. They are intended to help reduce or prevent vapor transmission and/or capillary migration through the soil and through the concrete slabs. Waterproofing systems must be designed and properly constructed if full waterproofing is desired. The owner and project designers should be consulted to determine the specific level of protection required.

16. *Exterior Slab Thickness and Reinforcement:* Exterior concrete slabs should be at least 4 inches thick. As a minimum for protection of on-site improvements, we recommend that all exterior concrete slabs (such as patios, sidewalks, etc.), be founded on properly compacted and tested fill or dense native formation, with No. 3 bars at 18-inch centers, both ways, at the center of the slab. Exterior slabs should contain adequate isolation and control joints.

    The performance of on-site improvements can be greatly affected by soil base preparation and the quality of construction. It is therefore important that all improvements are properly designed and constructed for the existing soil conditions. The improvements should not be built on loose soils or fills placed without our observation and testing. The moisture content of clayey soils should be verified within 48 hours prior to concrete placement (5 percent over optimum).

    For exterior slabs with the minimum shrinkage reinforcement, control joints should be placed at spaces no farther than 15 feet apart or the width of the slab, whichever is less, and also at re-entrant corners. Control and isolation joints in exterior slabs should be sealed with elastomeric joint sealant. The sealant should be inspected every 6 months and be properly maintained. All slab joints should be provided with dowels to help reduce the effects of vertical differential soil movement.

17. *Slope Top Structure Performance:* Rigid improvements such as top-of-slope walls, columns, decorative planters, concrete flatwork, swimming pools and other similar types of improvements can be expected to display varying degrees of separation typical of improvements constructed at the top of a

slope. The separations result primarily from slope top lateral and vertical soil deformation processes. These separations often occur regardless of being underlain by cut or fill slope material. Proximity to a slope top is often the primary factor affecting the degree of separations occurring.

Typical and to-be-expected separations can range from minimal to up to 1 inch or greater in width. In order to reduce the effect of slope-top lateral soil deformation, we recommend that the top-of-slope improvements be designed with flexible connections and joints in rigid structures so that the separations do not result in visually apparent cracking damage and/or can be cosmetically dressed as part of the ongoing property maintenance. These flexible connections may include "slip joints" in wrought iron fencing, evenly spaced vertical joints in block walls or fences, control joints with flexible caulking in exterior flatwork improvements, etc.

In addition, use of planters to provide separation between top-of-slope hardscape such as patio slabs and pool decking from top-of-slope walls can aid greatly in reducing cosmetic cracking and separations in exterior improvements. Actual materials and techniques would need to be determined by the project architect or the landscape architect for individual properties. Steel dowels placed in flatwork may prevent noticeable vertical differentials, but if provided with a slip-end they may still allow some lateral displacement.

D. Site Drainage Considerations

18. *Surface Drainage:* Adequate measures should be taken to properly finish-grade the lot after the structure and other improvements are in place.

Drainage waters from this site and adjacent properties should be directed away from the footings, floor slabs, and slopes, onto the natural drainage direction for this area or into properly designed and approved drainage facilities provided by the project civil engineer. Roof gutters and downspouts should be installed on the residence, with the runoff directed away from the foundations via closed drainage lines.

Proper subsurface and surface drainage will help minimize the potential for waters to seek the level of the bearing soils under the footings and floor slabs. Failure to observe this recommendation could result in erosion, undermining and possible differential settlement of the structure or other improvements or cause other moisture-related problems. Currently, the CBC requires a minimum 2-percent surface gradient for proper drainage of building pads unless waived by the building official. Concrete pavement may have a minimum gradient of 0.5-percent.

19. *Erosion Control*: Appropriate erosion control measures should be taken at all times during and after construction to prevent surface runoff waters from entering footing excavations or ponding on finished building pad areas.

20. *Planter Drainage:* Planter areas, flower beds and planter boxes should be sloped to drain away from the footings and floor slabs at a gradient of at least 5 percent within 5 feet from the perimeter walls. Any planter areas adjacent to the residence or surrounded by concrete improvements should be provided with sufficient area drains to help with rapid runoff disposal. No water should be allowed to pond adjacent to the residence or other improvements.

E. General Recommendations

21. *Project Start Up Notification:* In order to reduce any work delays during site development, this firm should be contacted at least 48 hours prior to any need for observation of footing excavations or field density testing of compacted fill soils. If possible, placement of formwork and steel reinforcement in footing excavations should not occur prior to observing the excavations. In the event that our observations reveal the need for deepening or re-designing foundation structures at any locations, any formwork or steel reinforcement in the affected footing excavation areas would have to be removed prior to correction of the observed problem (i.e., deepening the footing excavation, recompacting soil in the bottom of the excavation, etc.).

22. *Cal-OSHA*: Where not superseded by specific recommendations presented in this report, trenches, excavations, and temporary slopes at the subject site should be constructed in accordance with Title 8, Construction Safety Orders, issued by Cal-OSHA.

23. *Construction Best Management Practices (BMPs):* Construction BMPs must be implemented in accordance with the requirements of the controlling jurisdiction. Sufficient BMPs must be installed to prevent silt, mud or other construction debris from being tracked into the adjacent street(s) or storm water conveyance systems due to construction vehicles or any other construction activity. The contractor is responsible for cleaning any such debris that may be in the street at the end of each work day or after a storm event that causes breach in the installed construction BMPs.

All stockpiles of uncompacted soil and/or building materials that are intended to be left unprotected for a period greater than 7 days are to be provided with erosion and sediment controls. Such soil must be protected each day when the probability of rain is 40% or greater. A concrete washout should be provided on all projects that propose the construction of any concrete improvements that are to be poured in place. All erosion/sediment control devices should be maintained in working order at all times. All slopes that are created or disturbed by construction activity must be protected against erosion and sediment transport at all times. The storage of all construction materials and equipment must be protected against any potential release of pollutants into the environment.

X. GRADING NOTES

Geotechnical Exploration, Inc. recommends that we be retained to verify the actual soil conditions revealed during site grading work and footing excavation to be as anticipated in this "*Report of Preliminary Geotechnical Investigation*" for the project. In addition, the compaction of any fill soils placed during site grading work must be observed and tested by the soil engineer.

It is the responsibility of the grading contractor to comply with the requirements on the grading plans and the local grading ordinance. All retaining wall and trench backfill should be properly compacted. ***Geotechnical Exploration, Inc.*** will assume no liability for damage occurring due to improperly or uncompacted backfill placed without our observations and testing.

XI. LIMITATIONS

Our conclusions and recommendations have been based on available data obtained from our field investigation and laboratory analysis, as well as our experience with similar soils and formational materials located in this area of San Diego. Of necessity, we must assume a certain degree of continuity between exploratory excavations and/or natural exposures. It is, therefore, necessary that all observations, conclusions, and recommendations be verified at the time grading operations begin or when footing excavations are placed. In the event discrepancies are noted, additional recommendations may be issued, if required.

As stated previously, it is not within the scope of our services to provide quality control oversight for surface or subsurface drainage construction or retaining wall sealing and base of wall drain construction. It is the responsibility of the contractor to verify proper wall sealing, geofabric installation, protection board installation (if needed), drain depth below interior floor or yard surfaces; pipe percent slope to the outlet, etc.

The work performed and recommendations presented herein are the result of an investigation and analysis that meet the contemporary standard of care in our profession within the County of San Diego. No warranty is provided. This report should be considered valid for a period of two (2) years, and is subject to review by our firm following that time. If significant modifications are made to the building plans, especially with respect to the height and location of any proposed structures, this report must be presented to us for immediate review and possible revision.

It is the responsibility of the owner and/or developer to ensure that the recommendations summarized in this report are carried out in the field operations and that our recommendations for design of this project are incorporated in the structural plans. We should be retained to review the project plans once they are available, to verify that our recommendations are adequately incorporated in them.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of personnel other than our own; the safety of others is the responsibility of the contractor. The contractor should notify the owner if any of the recommended actions presented herein are considered to be unsafe.

The firm of ***Geotechnical Exploration, Inc.*** shall not be held responsible for changes to the physical condition of the property, such as addition of fill soils or changing drainage patterns, which occur subsequent to issuance of this report and the changes are made without our observations, testing, and approval.

Once again, should any questions arise concerning this report, please feel free to contact the undersigned. Reference to our **Job No. 15-10884** will expedite a reply to your inquiries.

Respectfully submitted,

GEOTECHNICAL EXPLORATION, INC.

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Senior Geotechnical Engineer

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Jay K. Heiser
Senior Project Geologist

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STATE OF CALIFORNIA

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REFERENCES
JOB NO. 15-10884
December 2015

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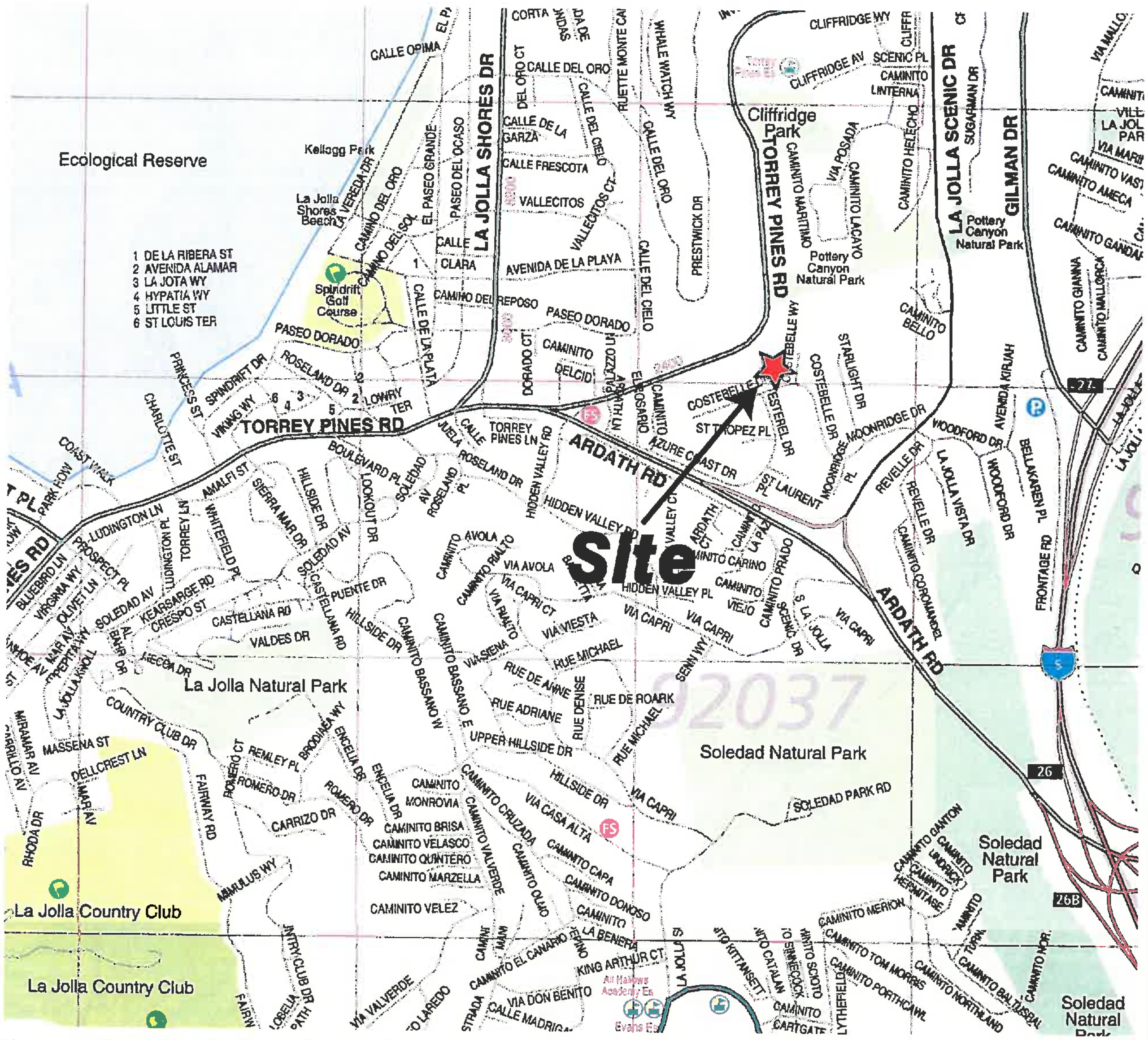
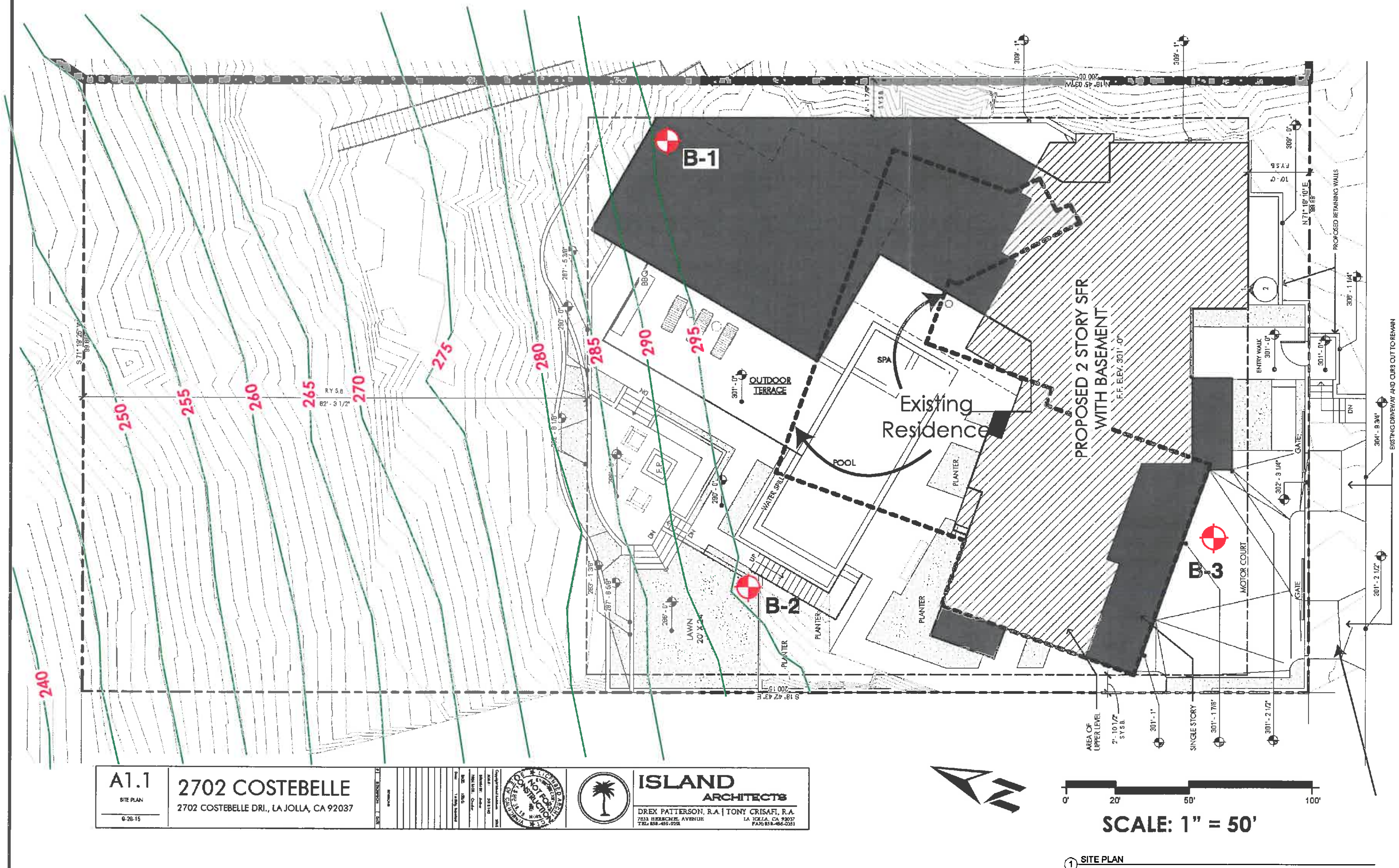
VICINITY MAP



Thomas Bros Guide San Diego County pg 1227

Shirazi/Salami Residence
2712 Costebelle Road
La Jolla, CA.

Figure No. I
Job No. 15-10884



LEGEND

B-3	Approximate Location of Exploratory Boring
240	Existing Topography (feet)

REFERENCE: *This Plot Plan was prepared from an existing SITE PLAN by Island Architects dated 09/28/2015 and from on-site field reconnaissance performed by GEI.*

PLOT PLAN

Shirazi/Salami Residence
2702 Costebelle Road
La Jolla, CA.
Figure No. II
Job No. 15-10884

Geotechnical Exploration, Inc.

December 2015

15-10884-p3.ai

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Limited Access Auger Drill Rig	**6-inch diameter Boring**	**10-2-15**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 300' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	EXPANSION INDEX	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–3			**SANDY CLAY**, with abundant roots and siltstone fragments. Stiff. Dry to damp. Yellow-brown. **FILL (Qaf)** -- 76% passing #200 sieve.	CL									
2							13.9	110.0			42		
					8.8	100.1			91			75	3"
3–9			**SANDY CLAY**, with some siltstone fragments. Very stiff. Damp to moist. Dark brown. **SLOPEWASH (Qsw)**	CL									
					16.8	110.7			100			90	3"
9–10			**CLAYEY SAND**. Dense. Damp. Yellow-brown. **ARDATH SHALE FORMATION (Ta)**	SC								50	3"
10			Bottom @ 10'										

PERCHED WATER TABLE
BULK BAG SAMPLE
1 IN-PLACE SAMPLE
MODIFIED CALIFORNIA SAMPLE
S NUCLEAR FIELD DENSITY TEST
STANDARD PENETRATION TEST

JOB NAME
Shirazi/ Salami Residence

SITE LOCATION
2702 Costebelle Drive, La Jolla, CA

JOB NUMBER
15-10884

REVIEWED BY
WDH

Geotechnical Exploration, Inc.

FIGURE NUMBER
IIIa

LOG No.
B-1

EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Limited Access Auger Drill Rig	**6-inch diameter Boring**	**10-2-15**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 297' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–7			**SANDY CLAY**, with siltstone fragments. Firm to stiff. Damp. Yellow-brown. **FILL (Qaf)**	CL								
2–3.5		Modified California sample			13.6	99.0			90		63	3"
7–8		Modified California sample	**CLAYEY SAND/ SANDY CLAY**, moderately fractured. Dense/ hard. Damp. Yellow-brown. **ARDATH SHALE FORMATION (Ta)**	SC/ CL							50+	3"
8			Bottom @ 8'									

PERCHED WATER TABLE
BULK BAG SAMPLE
IN-PLACE SAMPLE
MODIFIED CALIFORNIA SAMPLE
NUCLEAR FIELD DENSITY TEST
STANDARD PENETRATION TEST

JOB NAME	**Shirazi/ Salami Residence**
SITE LOCATION	**2702 Costebelle Drive, La Jolla, CA**
JOB NUMBER	**15-10884**
REVIEWED BY	**WDH**
FIGURE NUMBER	**IIIb**
LOG No.	**B-2**

Geotechnical Exploration, Inc.

EXPLORATION LOG 10884 SHIRAZI-SALAMI.GPJ GEO_EXPL.GDT 12/8/15

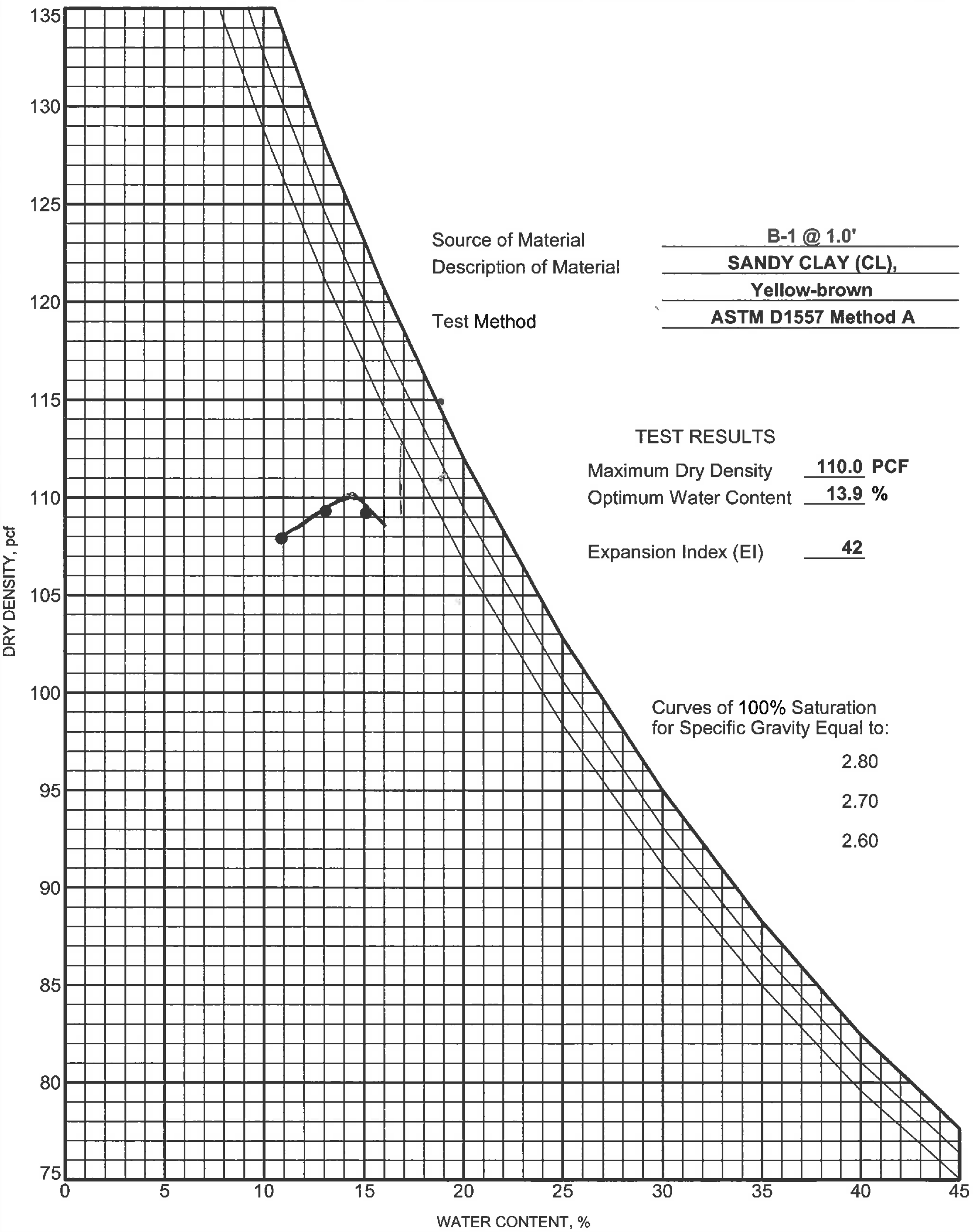
EQUIPMENT	DIMENSION & TYPE OF EXCAVATION	DATE LOGGED
Limited Access Auger Drill Rig	**6-inch diameter Boring**	**10-2-15**
SURFACE ELEVATION	GROUNDWATER/ SEEPAGE DEPTH	LOGGED BY
± 305' Mean Sea Level	**Not Encountered**	**JKH**

DEPTH (feet)	SYMBOL	SAMPLE	FIELD DESCRIPTION AND CLASSIFICATION — DESCRIPTION AND REMARKS (Grain size, Density, Moisture, Color)	U.S.C.S.	IN-PLACE MOISTURE (%)	IN-PLACE DRY DENSITY (pcf)	OPTIMUM MOISTURE (%)	MAXIMUM DRY DENSITY (pcf)	DENSITY (% of M.D.D.)	EXPAN. + CONSOL. - (%)	BLOW COUNTS/FT.	SAMPLE O.D. (INCHES)
0–1			**SANDY CLAY**, with siltstone fragments. Firm to stiff. Damp. Yellow-brown. **FILL (Qaf)**	CL								
1–3		Modified California Sample	**CLAYEY SAND/ SANDY CLAY**, moderately fractured. Dense/ hard. Damp. Yellow-brown. **ARDATH SHALE FORMATION (Ta)**	SC/ CL							50+	3"
3			Bottom @ 3'									

- PERCHED WATER TABLE
- BULK BAG SAMPLE
- 1 IN-PLACE SAMPLE
- MODIFIED CALIFORNIA SAMPLE
- S NUCLEAR FIELD DENSITY TEST
- STANDARD PENETRATION TEST

JOB NAME		
Shirazi/ Salami Residence		
SITE LOCATION		
2702 Costebelle Drive, La Jolla, CA		
JOB NUMBER **15-10884**	REVIEWED BY **WDH**	LOG No. **B-3**
FIGURE NUMBER **IIIc**	Geotechnical Exploration, Inc.	

EXPLORATION LOG 10884 SHIRAZI-SALAMI.GPJ GEO EXPL.GDT 12/8/15



Geotechnical Exploration, Inc.

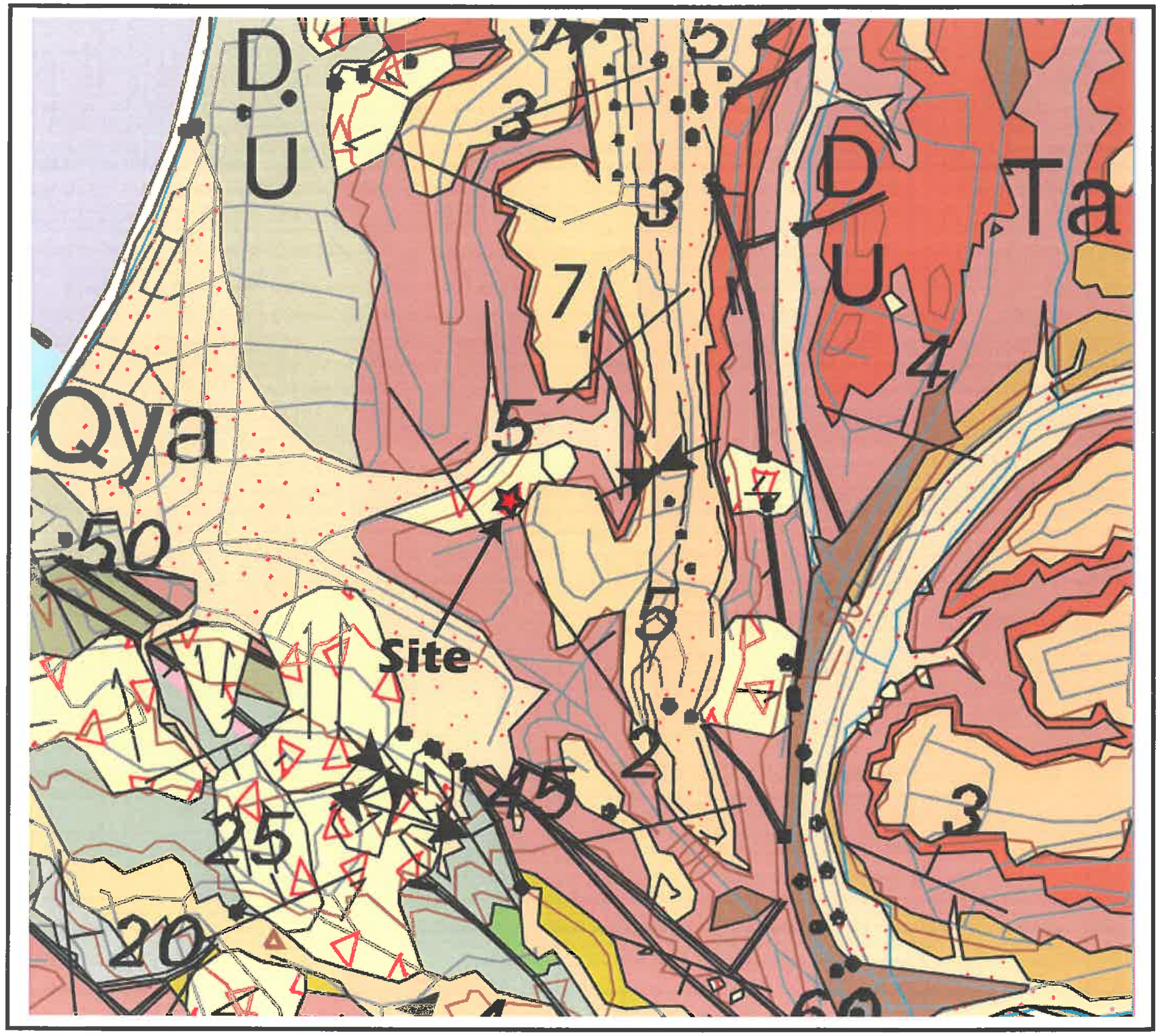
MOISTURE-DENSITY RELATIONSHIP

Figure Number: IV
Job Name: Shirazi/ Salami Residence
Site Location: 2702 Costebelle Drive, La Jolla, CA
Job Number: 15-10884

COMPACTION + EI DARK GRID 10884 SHIRAZI-SALAMI.GPJ GEI FEB06.GDT 10/13/15

GEOLOGIC MAP
2005

compiled by Michael P. Kennedy
and Siang S Tan



Salami/Shirazi Residence
2702 Costebelle Drive
San Diego, CA.

GEOLOGIC MAP OF THE SAN DIEGO 30' X 60' QUADRANGLE, CALIFORNIA

Compiled by
Michael P. Kennedy and Siang S. Tan
2005
Digital Preparation by
Kelly R. Bovard[1], Anne G. Garcia[1] and Diane Burns[1]
1. U.S. Geological Survey, Department of Earth Sciences, University of California, Riverside

ONSHORE MAP SYMBOLS

Contact—Contact between geologic units; dotted where concealed.

Fault—Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

Anticline—Solid where accurately located; dotted where concealed.

Syncline—Solid where accurately located; dotted where concealed.

Kgd—granite pegmatite dike

Closed depression—Closed depression in Elsinore fault zone.

Landslide—Arrows indicate principal direction of movement. Queried where existence is questionable.

Strike and dip of beds
- Inclined
- Overturned
- Vertical
- Horizontal

Strike and dip of igneous foliation
- Inclined
- Vertical

Strike and dip of igneous joints
- Inclined
- Vertical

Strike and dip of metamorphic foliation
- Inclined

Strike and dip of sedimentary joints
- Vertical

DESCRIPTION OF MAP UNITS

Artificial fill (late Holocene)—Deposits of fill resulting from human construction, mining, or quarrying activities; includes compacted engineered and non compacted non engineered fill. Some large deposits are mapped, but in some areas no deposits are shown

Ardath Shale (middle Eocene)—Mostly uniform, weakly fissile olive-gray silty shale. The upper part contains thin beds of medium-grained sandstone, similar to thicker ones in the overlying Scripps Formation, and concretionary beds with molluscan fossils. The type section of the Ardath Shale is on the east side of Rose Canyon, 800 m south of the Ardath Road intersection with Interstate 5 (Kennedy and Moore, 1971)

Figure No. V
Job No. 15-10884

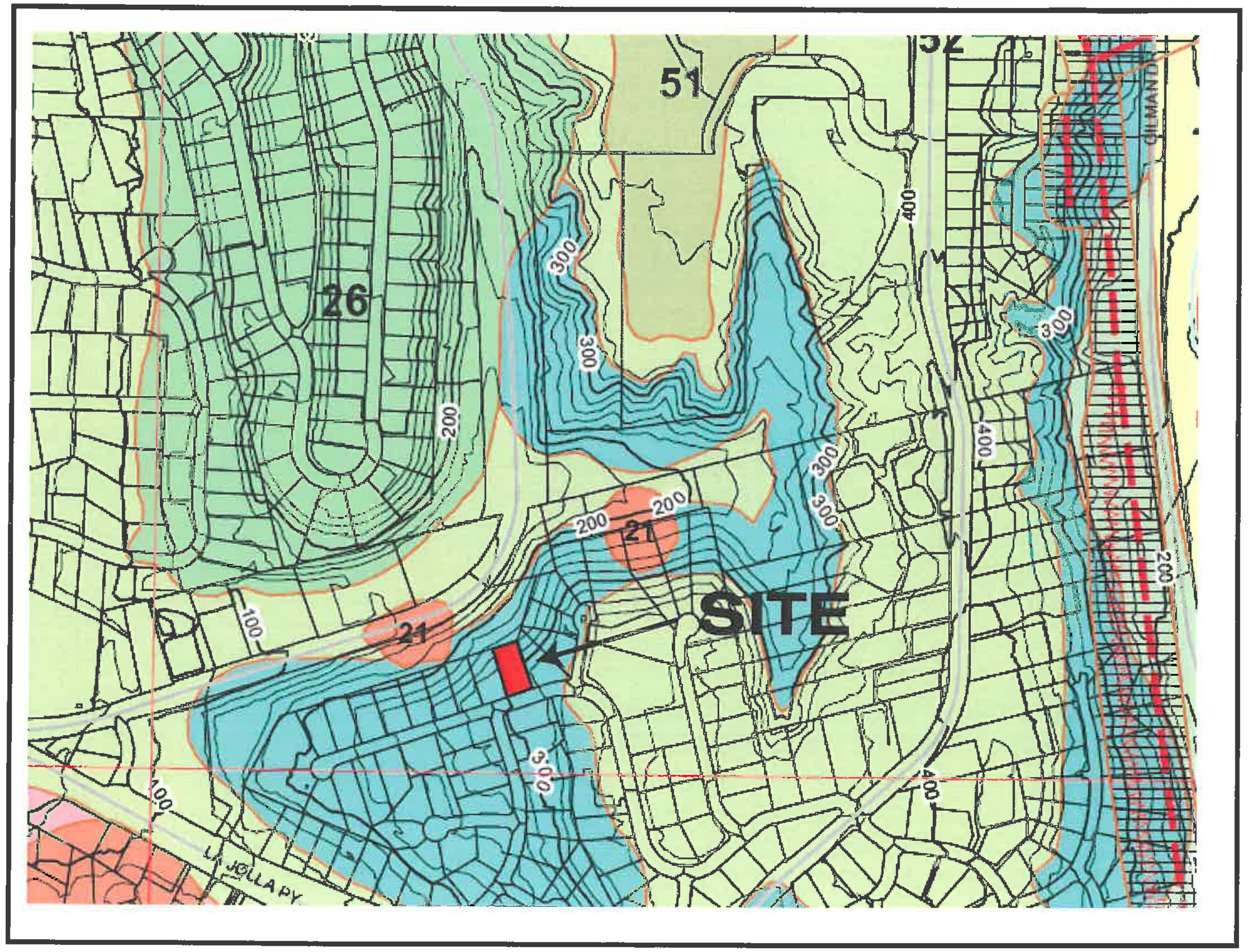
Geotechnical Exploration, Inc.

salami-2702-geo-combo.ai

City of San Diego
SEISMIC SAFETY STUDY
Geologic Hazards and Faults

Development Services Department

DATE: 4/3/2008



Salami/Shirazi Residence
2702 Costebelle Drive
La Jolla, CA.

LEGEND

Geologic Hazard Categories

FAULT ZONES
- 11 Active, Alquist-Priolo Earthquake Fault Zone
- 12 Potentially Active, Inactive, Presumed Inactive, or Activity Unknown
- 13 Downtown special fault zone

LANDSLIDES
- 21 Confirmed, known, or highly suspected
- 22 Possible or conjectured

SLIDE-PRONE FORMATIONS
- 23 Friars: neutral or favorable geologic structure
- 24 Friars: unfavorable geologic structure
- 25 Ardath: neutral or favorable geologic structure
- 26 Ardath: unfavorable geologic structure
- 27 Otay, Sweetwater, and others

LIQUEFACTION
- 31 High Potential -- shallow groundwater major drainages, hydraulic fills
- 32 Low Potential -- fluctuating groundwater minor drainages

COASTAL BLUFFS
- 41 Generally unstable Numerous landslides, high steep bluffs, severe erosion, unfavorable geologic structure
- 42 Generally unstable Unfavorable bedding plains, high erosion
- 43 Generally unstable Unfavorable jointing, local high erosion
- 44 Moderately stable Mostly stable formations, local high erosion
- 45 Moderately stable Some minor landslides, minor erosion
- 46 Moderately stable Some unfavorable geologic structure, minor or no erosion
- 47 Generally stable Favorable geologic structure, minor or no erosion, no landslides
- 48 Generally stable Broad beach areas, developed harbor

OTHER TERRAIN
- 51 Level mesas -- underlain by terrace deposits and bedrock nominal risk
- 52 Other level areas, gently sloping to steep terrain, favorable geologic structure, Low risk
- 53 Level or sloping terrain, unfavorable geologic structure, Low to moderate risk
- 54 Steeply sloping terrain, unfavorable or fault controlled geologic structure, Moderate risk
- 55 Modified terrain (graded sites) Nominal risk

Water (Bays and Lakes)

FAULTS
- Fault
- Inferred Fault
- Concealed Fault
- Shear Zone

Figure No. VI
Job No. 15-10884

Geotechnical Exploration, Inc.

salami-2702-seis-combo.ai

APPENDIX A
UNIFIED SOIL CLASSIFICATION CHART
SOIL DESCRIPTION

Coarse-grained (More than half of material is larger than a No. 200 sieve)

GRAVELS, CLEAN GRAVELS (More than half of coarse fraction is larger than No. 4 sieve size, but smaller than 3")	GW	Well-graded gravels, gravel and sand mixtures, little or no fines.
	GP	Poorly graded gravels, gravel and sand mixtures, little or no fines.
GRAVELS WITH FINES (Appreciable amount)	GC	Clay gravels, poorly graded gravel-sand-silt mixtures
SANDS, CLEAN SANDS (More than half of coarse fraction is smaller than a No. 4 sieve)	SW	Well-graded sand, gravelly sands, little or no fines
	SP	Poorly graded sands, gravelly sands, little or no fines.
SANDS WITH FINES (Appreciable amount)	SM	Silty sands, poorly graded sand and silty mixtures.
	SC	Clayey sands, poorly graded sand and clay mixtures.

Fine-grained (More than half of material is smaller than a No. 200 sieve)

SILTS AND CLAYS

Liquid Limit Less than 50	ML	Inorganic silts and very fine sands, rock flour, sandy silt and clayey-silt sand mixtures with a slight plasticity
	CL	Inorganic clays of low to medium plasticity, gravelly clays, silty clays, clean clays.
	OL	Organic silts and organic silty clays of low plasticity.
Liquid Limit Greater than 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	CH	Inorganic clays of high plasticity, fat clays.
	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	PT	Peat and other highly organic soils

(rev. 6/05)