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TRACT 20581

City of Hesperia

Original Tract Project - April 10, 2007
Tract #20581 Updated: August 9, 2022

PRELIMINARY SOILS REPORT

PROPOSED TOWNHOME COMPLEX

APN 410-221-08
Sultana Street and "G" Avenue
Hesperia

PREPARED AT THE REQUEST OF:

PARK VIEW TRAIL, LLC
15550 MAIN STREE, SUITE C-11
HESPERIA, CA. 92345

Prepared under the supervision of:

Carl P. Coleman, RCE #30322, Expires 3-31-2024

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INTRODUCTION

This Preliminary Soils Investigation Report has been prepared for the site of a proposed Townhome complex on the southwest corner of Sultana Street and "G" Avenue, APN 410-221-08, in the City of Hesperia, California.

The extent of this report includes:

1. Description of the field exploration and laboratory work performed.

2. Conclusions and recommendations regarding site preparation, foundation design and other construction aspects. These are based on our analysis of the data obtained from the exploration and testing program, and knowledge of the general and site specific characteristics of the subsurface soils.

PROJECT DESCRIPTION

Information furnished to this office indicates that the subject site will be developed as a multi-story townhome complex. It is our understanding that the townhome structures will be of wood frame construction bearing on continuous concrete footings. Consequently, light to moderate loads are normally associated with such structures. This information was used as a basis for the exploration and testing programs and the recommendation contained herein.

PURPOSE AND SCOPE OF WORK

The purpose of this study was to evaluate the soil conditions at site, and to provide conclusions and recommendations relative to the site and the proposed development. The scope of work included the following:

1. Site reconnaissance and field observations regarding topography, surface geology & vegetation.

2. Shallow subsurface exploration by the means of backhoe trenching.

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3. Laboratory testing of selected soil samples as recovered by the field exploration.

4. Geotechnical evaluation and analysis of the data results.

5. Appropriate recommendations for the proposed development of the site.

SITE CONDITIONS

The site is located on the southwest corner of Sultana Street and "G" Avenue (see Drawings. 1 thru 6). There are no existing structures on the site. There has been no previous grading on this site. There are existing multi-family residences north, south and west of the site and Sultana High School to the east of the site. Topographically, the site falls generally northeast at approximately 2.5%. There are no natural drainage courses that cross the property. The site is covered with light typical desert vegetation.

FIELD INVESTIGATION

The shallow subsurface conditions at the site were investigated by three trenches at the locations shown on drawing 4. The trenches were excavated down to a depth of 10 to 12 feet. The exposed soil sections were inspected and logged (Drawings. #7 through #9). The trenches were also used to conduct in-situ density tests at the intervals shown on drawings #7 through #9. Results are also shown on drawings #7 through #9.

LABORATORY TESTING

The following laboratory tests were conducted in accordance with the relevant ASTM standards and the State of California Standard Specifications:

A. Classification Tests:
The natural moisture content and the grain-size distribution were determined for several representative soil samples, including the percentage of fines (Drawings. #9 and #10). Results of these tests were used to classify and evaluate the various soil types encountered at the site.

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B. Proctor Compaction Test:
The maximum dry density and optimum moisture content determinations were performed on typical soil samples that were recovered from the trenches. Tests were done in compliance with ASTM D-1557-70T (Drawings. #11 and #12).

REGIONAL GEOLOGICAL SETTING

The site belongs to the Mojave Desert Physiographic Province of Southern California at an approximate elevation of 3200 feet.

The Mojave Desert is a broad, alluvial, triangular-shaped region of relatively low relief interrupted by Northwest-tending Mountain ranges. These are structurally controlled by prominent active faults. The desert surface is presently been covered slowly by alluvial material eroded and transported away by intermittent streams transcending from the surrounding San Gabriel and San Bernardino Mountains. The alluvium, Quaternary-Recent in age, has accumulated to form the generally low, featureless surface of this region. It consists primarily of fine sands, silty sands, coarse sands and gravels with occasional clayey sand interbeds.

SUBSURFACE SETTING

The encountered subsurface deposits are depicted in detail by the trench logs (Drawings. #7 through #9). The soil sequence consists of medium to fine grained silty sand over a lightly cemented coarse to fine sand. The in-situ density results indicate that the subsurface soils at the site are generally medium dense.

GROUND WATER

Free ground water was not encountered within the maximum trenching depth (12') at the time of testing. However, the depth of ground water table is anticipated to be at approximately 360' below existing ground surface.

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GEOLOGIC HAZARD ASSESSMENT

Based on the results of our investigation and a review of selected geologic references, the following potentially hazardous phenomena have been primarily assessed:

SEISMIC HAZARD ASSESSMENT

The site is located in Southern California, thus within a seismically active region. The San Andreas Fault extends approximately 14 miles (22-Km) southwest of the site, the Helendale Fault is about 14 miles (22-Km) northeast of the site, the Cleghorn Fault Zone is approximately 9 miles (15-Km) south of the site and the North-Frontal Fault Zone is approximately 2 miles (3.5-Km) east of the site. All of the faults are considered active and are classified as right lateral strike-slip. Other potentially active faults in the region are a number of easterly to northwesterly tending faults in the vicinity of Barstow. These faults were active within the Quaternary time and possibly the Holocene time.

Based on the available seismic data, the maximum credible earthquake along the San Andreas Fault has a magnitude of Richter M = 8.5. A seismic event of this magnitude could generate peak bedrock accelerations in the order of 0.58 g and a repeatable high ground acceleration of 65% of this value (0.38 g). The maximum probable earthquake, however, is considered to be Richter magnitude M = 7.5. This could produce a peak bedrock acceleration under the site in the range of 0.19 g and a duration of strong shaking of 24+ seconds.

A maximum probable earthquake of Richter magnitude M = 6.5 could be initiated by the Helendale and associated faults. Such an earthquake is expected to cause a maximum ground acceleration in the order of 0.26 g.

A maximum probable earthquake of Richter magnitude M = 5.5 could be initiated by the Cleghorn Fault Zone. Such an earthquake is expected to cause a maximum ground acceleration in the order of 0.10 g.

Using data from Sieh (1978) relating to the recurrence intervals of major seismic events on

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the San Andreas Fault every 100 - 200 years, as that of 1857, the occurrence of an earthquake in this area within the estimated lifetime of any new construction is considered very likely.

Liquefaction is the loss of soil strength as a result of an increase in pore water pressure due to dynamic earthquake loading. Conditions for liquefaction to occur generally include relatively high water table (within 40 feet of the ground surface), low relative densities of the saturated soils, and a susceptibility of the soil to liquefy based on grain size. Since our research indicates that the groundwater is at greater depth than 40' and the soil sequence is predominantly in a dense state, hence the potential for on-site liquefaction is considered negligible.

Another seismically related hazard is earthquake induced flooding and includes tsunamis, seiches and reservoir failure. Due to the inland location of the site, hazards due to tsunamis are considered unlikely. Since there are no large water storage basins or tanks located at the immediate upslope from the project, the potential for damage from earthquake induced flooding or seiches is considered unlikely.

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Soil Profile and Seismic Zone Coefficients

Based on our findings and the requirements of Chapter 16 of the 2019 California Building Code, we have determined the following soil profile and seismic zone coefficients for this site:

Lat/Long of Site – 34.4115 N, 117.2905 W
Occupancy Category – II (Table 1604.5, Pg 7, 2019 CBC)
Seismic Importance Factor – 1.0
Spectral Response Accelerations – S_S – 1.416 , S_1 – 0.546
Site Classification – D (Table 20.3-1, Pg 204, ASCE 7-16)
Spectral Response Coefficients – S_{DS} – 0.944, S_{D1} – Null
Seismic Design Category – D (Table 11.6-2,Pg 85, ASCE 7-16)
Response Modification Factor – 6.5 (Table 12.2-1, Pg 90, ASCE 7-16)
Seismic Response Coefficient – $C_S = S_{DS}/(R/I)$ = 0.15(12.8-2 ASCE 7-10 Page 71)

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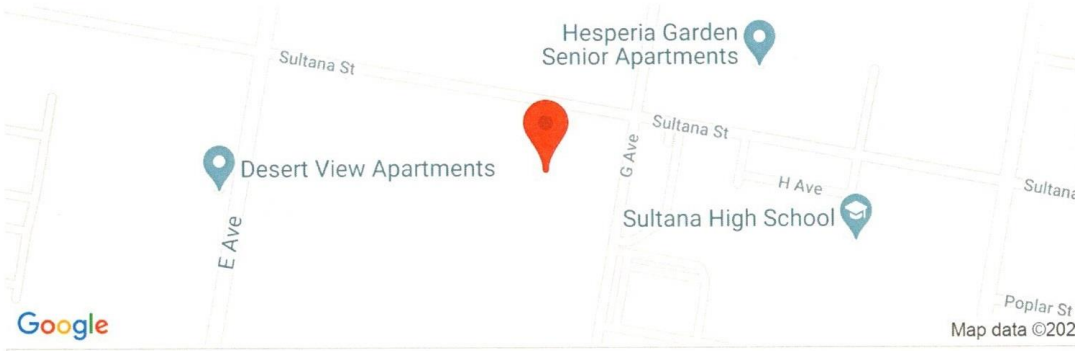
OSHPD

Latitude, Longitude: 34.4115, -117.2905



Date	4/8/2020, 2:27:53 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	1.416	MCE_R ground motion. (for 0.2 second period)
S_1	0.546	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.416	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	0.944	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.573	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.63	Site modified peak ground acceleration
T_L	12	Long-period transition period in seconds
SsRT	1.416	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.528	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	1.5	Factored deterministic acceleration value. (0.2 second)
S1RT	0.546	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.602	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.6	Factored deterministic acceleration value. (1.0 second)
PGAd	0.573	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.927	Mapped value of the risk coefficient at short periods
C_{R1}	0.906	Mapped value of the risk coefficient at a period of 1 s

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CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the various aspects of this soils investigation and a review of the site plan, our conclusions and recommendations are presented hereinafter. These findings and conclusions were prepared in accordance with the contemporary principles and practices.

1. Site Preparation

1.1 Prior to site grading, any existing stumps, roots, foundations, pavements, septic tanks, and wells should be removed from the proposed building and paving areas. The top surface should be stripped of all organic growth, non-complying fill, and along with other debris, be removed to an area outside of the proposed grading.

1.2 Depressions resulting from removals, under item 1 above should have debris and loose soils removed and be backfilled with suitable soil placed as specified in the foregoing items.

1.3 The existing natural soils are not in satisfactory compacted condition and will need to be compacted prior to construction. All footings for the proposed structures shall rest upon minimum 24" properly compacted material.

a) Beneath the proposed building area, including a distance of at least five feet (5') beyond the building perimeter, the soils should be sub-excavated a minimum of twenty-four inches (24"). Local variation in soil condition may warrant increasing the depth of over-excavation and re-compaction. If different conditions are encountered, our office should be contacted to make any necessary modifications.

b) The bottom twelve (12") inches of sub-excavation should be scarified and brought to at least 90% of optimum moisture content and compacted to a relative compaction of at least 90% (ASTM D-1557-70).

c) The on-site soils should provide adequate quality fill materials provided they

are free from organic matter and other deleterious materials. Unless approved by the engineer, rock or similar irreducible material with a maximum dimension greater than six inches (6") shall not be incorporated in fills. If caliche lenses are encountered, they should be either excluded from usage in fill or intermixed with granular soils before placement in the fill.

d) Fill of suitable material should be spread in lifts of six to eight (6" - 8") inches thick, each lift brought to 95% of optimum moisture content and compacted to a relative compaction of at least 90 percent (ASTM D 1557-70).

e) Due to the variation in silt and/or clay content, the soils may be moisture sensitive, and susceptible to pumping during compaction operations. Close monitoring of the soil's moisture content and the proper choice of compaction equipment could reduce the possibility for creating unstable "pumping" soils.

f) Where pumping or unstable subgrade conditions are encountered the soil should be removed or scarified and allowed to dry sufficiently to a depth necessary to achieve a firm stable subgrade. Unstable or pumping subgrade, regardless of relative compaction tests is considered unacceptable.

g) Import soils used to raise site grades should be equal to or better than on-site soils in strength, expansion and compressibility characteristics. Import will not be prequalified by the soil engineer. Acceptance of any import will be given after the material is on the project, either inplace or in stockpiles of adequate quantity to complete the project.

1.4 Shrinkage and Subsidence

a. Reworking the native soils into properly compacted fill causes some volumetric changes. Based on the in-situ densities and testing of the onsite soils and on the estimated average degree of compaction to be achieved during grading. Shrinkage in the native soil could be estimated as following:

From 0.0 - 5.0 Feet Depth ..... Shrinkage of 15 - 20%

These shrinkage factors are based on an average in-place relative compaction between 90-95 percent. Hence, the actual shrinkage to occur during grading will depend on the average degree of relative compaction actually achieved at site.

b. Processing of existing grades and subsequent compaction could result in an additional 0.10 to 0.20 feet subsidence of the underlying soil.

c. The above estimates of both shrinkage and subsidence should not be considered absolute values since they are only intended to allow project planners estimating earthwork quantities. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that will take place during grading and for losses due to stripping operations.

1.5 Final site grade should be such that all water is diverted away from structures and not allowed to pond.

1.6 All roof-draining systems for proposed buildings should be designed so that runoff water is diverted away from all structures.

1.7 The Recommended Grading Specifications are included in the general guidelines only and should not be included directly into project specifications without first incorporating the site specific recommendations contained in the body of this report. Chapter 18 of the California Building Code (2019 Edition) contains specific considerations for grading and is considered a part of these recommendations.

2. Cut and Fill Slopes

Preliminary data indicates that cut and fill slopes should be constructed no steeper than two (2) horizontal to one (1) vertical. Fill slopes should be overfilled during construction and then cut back to expose fully compacted soil. A suitable alternative would be to compact the slopes during construction and then roll the final slope to

provide a dense, erosion-resistant surface.

Cut and fill slopes should adhere to the requirements of Chapter 18 of the California Building Code including the setback condition. Measures should be taken not to allow sheet flow over graded slopes that are steeper than 5:1. Berms and swales should be provided on top of all slopes.

3. Foundations

3.1 If the site is prepared conformably with the preceding recommendations, the footing for the proposed structures could be twelve inches (12") minimum wide and placed at least twelve inches (12") below the lowest final adjacent grade. Actual footing sizes are to be designed by the structural engineer.

3.2 Foundations should be supported by at least twenty-four inches (24") of uniform compacted soil. During construction in areas where foundation depth exceeds 18", the depth of over-excavation should be increased accordingly.

3.3 Excavations should be free of any loose or unsuitable material or debris prior to placement of concrete.

3.4 If above conditions are satisfied, the structure can be safely founded on:

a) Continuous footings which may be proportioned for the following values:

a.1 Design Values: 2000 psf for dead and sustained life loads. This load may be increased 1/3 for total loads including wind and seismic forces.

a.2 Footings should be a minimum of 12" below the lowest adjacent soil grade.

a.3 To mitigate major cracking in foundations caused by

differential settlement, footings should be reinforced with minimum of two #4 bars; one bottom and one top. The structural engineer may require additional reinforcement.

b) Isolated Pad Foundations which can be proportioned for the following values:

b.1 Design Values: 2000 psf for dead and sustained live loads. This load may be increased 1/3 for total live loads including wind and seismic forces.

b.2 Footing depth should be at least twelve inches (12") below the lowest adjacent finished soil grade. Actual depth will be dependent on the applicable sections of the governing building code.

b.3 Reinforcement should be as stated earlier or as required by the structural engineer.

4. Lateral Loading

Resistance to lateral loads will be provided by passive earth pressure and basal friction. For footings bearing against the native soils or compacted fill, passive earth pressure may be considered to be developed at a rate of 200 pounds per square foot per foot of depth. Basal friction may be computed at 0.4 times normal dead load. Basal friction and passive earth pressure may be combined directly without reduction. These values maybe increased by 1/3 for wind or seismic loading. The coefficient of friction could be estimated to be 0.45 for soil compacted to 90% of maximum dry density. Foundation concrete should be poured in neat trenches and foundation backfill compacted as recommended.

5. Slab-On-Grade

To provide adequate support, all concrete slabs-on-grade should bear on a minimum of twelve (12") inches of compacted soil. The final pad

surface should be rolled to provide a smooth, dense surface upon which to place the concrete. It is also recommended that concrete slab-on-grade be reinforced with at least 6" x 6" / #10 x #10 welded wire fabric or #3 bars at 24" on center both ways.

Slabs to receive moisture-sensitive coverings should be provided with a barrier to vapor moisture. This barrier may consist of an impermeable membrane, such as Visqueen. A layer of sand over the Visqueen will promote uniform setting of the concrete.

6. Excavations

6.1 All excavations should be made in accordance with applicable regulations and ordinances. Based on our current investigation and the knowledge of the area in general, subsurface caving may be encountered but should be minimal at this particular site. Hence, there may be a potential for construction problems involving caving. If such situation is encountered, then lateral bracing or appropriate cut slopes should be provided.

6.2 No surcharge loads should be allowed within a horizontal distance equal to the depth of the excavation as measured from the top of the excavated slope.

7. Expansion

The material with clay binder encountered in the trenches showed a negligible expansion potential. Reinforcement as stated in section 3.4.a.3 should be adequate. Although the remainder of the material encountered during this investigation is predominately granular and non-expansive, an additional evaluation to be conducted by this firm during grading operations is recommended.

8. Pavement Structural Design

The on-site surfaces are to be constructed of a minimum of 3" of asphalt paving over 4" of Class II Base. This should be placed over 12" of native material

compacted at a minimum 95%.
The off-site streets are to be constructed of a minimum of 4" of asphalt paving over 8" of Class II Base. This should be placed over 12" of native material compacted at a minimum 95%.

9. Utility Trenches

9.1 Backfill of utilities within road rights-of-way should be placed in strict conformance with the requirements of the governing agency.

9.2 Utility trench backfill within the project boundary should be governed by the provisions of this report relative to minimum compaction standards. In general, service lines extending inside the site may be backfilled with native soils and mechanically compacted to a minimum of 90% of maximum density as determined by the ASTM D 1557 test procedure.

9.3 Backfill operations should be observed and tested by the engineer or their representative to monitor compliance with these recommendations.

10. Additional Services

This report was based on the assumption that an adequate program of client consultation, construction monitoring and testing will be performed during the final design and construction phases to check compliance with these recommendations.

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LIMITATIONS AND UNIFORMITY OF CONDITIONS

The conclusions and recommendations submitted in this report are based in part upon the data obtained from the three (3) trenches. The nature and extent of variations across the site may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report. The logs of the exploratory borings do not provide a guarantee as to the conditions that may exist beneath the entire property. Variations in soil conditions and depth to groundwater may exist beyond the boring locations and may need additional study and recommendation revisions.
In the event that any change in the assumed nature, or design of the proposed project is planned, the conclusion and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the owner or their representative to ensure the information and recommendation contained herein are called to the attention of the architect and engineers for the project and incorporated into the plan, that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

This report does not include any environmental review with respect to hazardous or toxic materials in the soil, groundwater, or on the ground surface. Any parts of this report regarding unusual odors, suspicious items or conditions are informational only. Also the lack of these statements does not infer that any potential environmental problems do not exist on the site.

Physical changes to the site caused by grading and/or clearing, changes in governmental regulations, or changes to the proposed structures or development after this report has been completed will require additional review of this report. Updates and/or additional studies may be needed at that time.

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LIMITATIONS

ALTEC Engineering Corporation has performed its services within the limits prescribed by our client, with the usual thoroughness and competence of the engineering profession. ALTEC Engineering Corporation makes no other warranty or representation, either expressed or implied.

The conclusions and recommendations in this report are based upon data obtained from separate sampling locations and interpolation between them carried out for the project and scope of services described. It is assumed and expected that the conditions between locations are similar to those encountered at individual locations. However, it is possible that conditions between sampling locations may vary. Should conditions be encountered in the field that appear different than those described in this report, we should be contacted immediately in order that we might evaluate their effect.

If this report or portions thereof are provided to contractors or included in specifications, it should be understood by all parties that they are provided for information only, and should be used as such.

The report and its contents resulting from the investigation are not intended or represented to be suitable for reuse on extensions or modifications of the project, or for use on any other project.

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LOCATION MAP – SOUTHWEST CORNER OF SULTANA STREET AND "G" AVENUE HESPERIA

DRAWING 1

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USGS QUAD SHEET – HESPERIA

DRAWING 2

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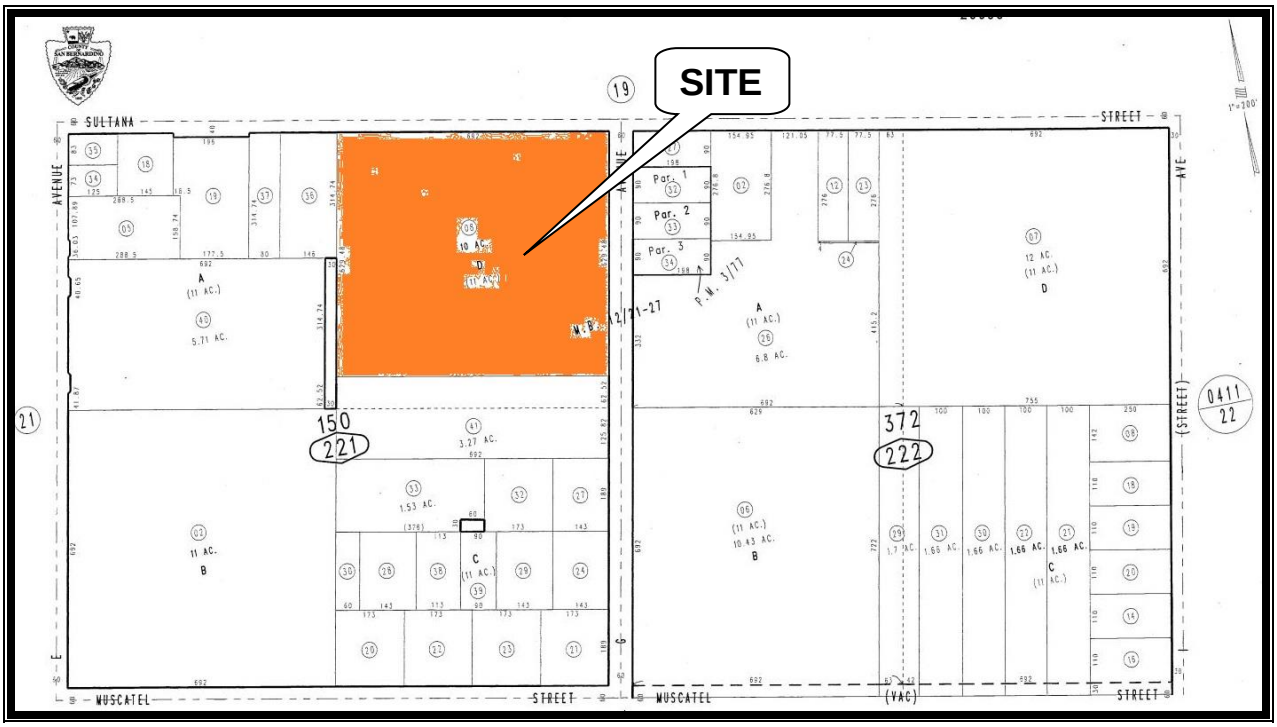

ASSESSOR'S MAP – APN 0410-221-08-0000

DRAWING 3

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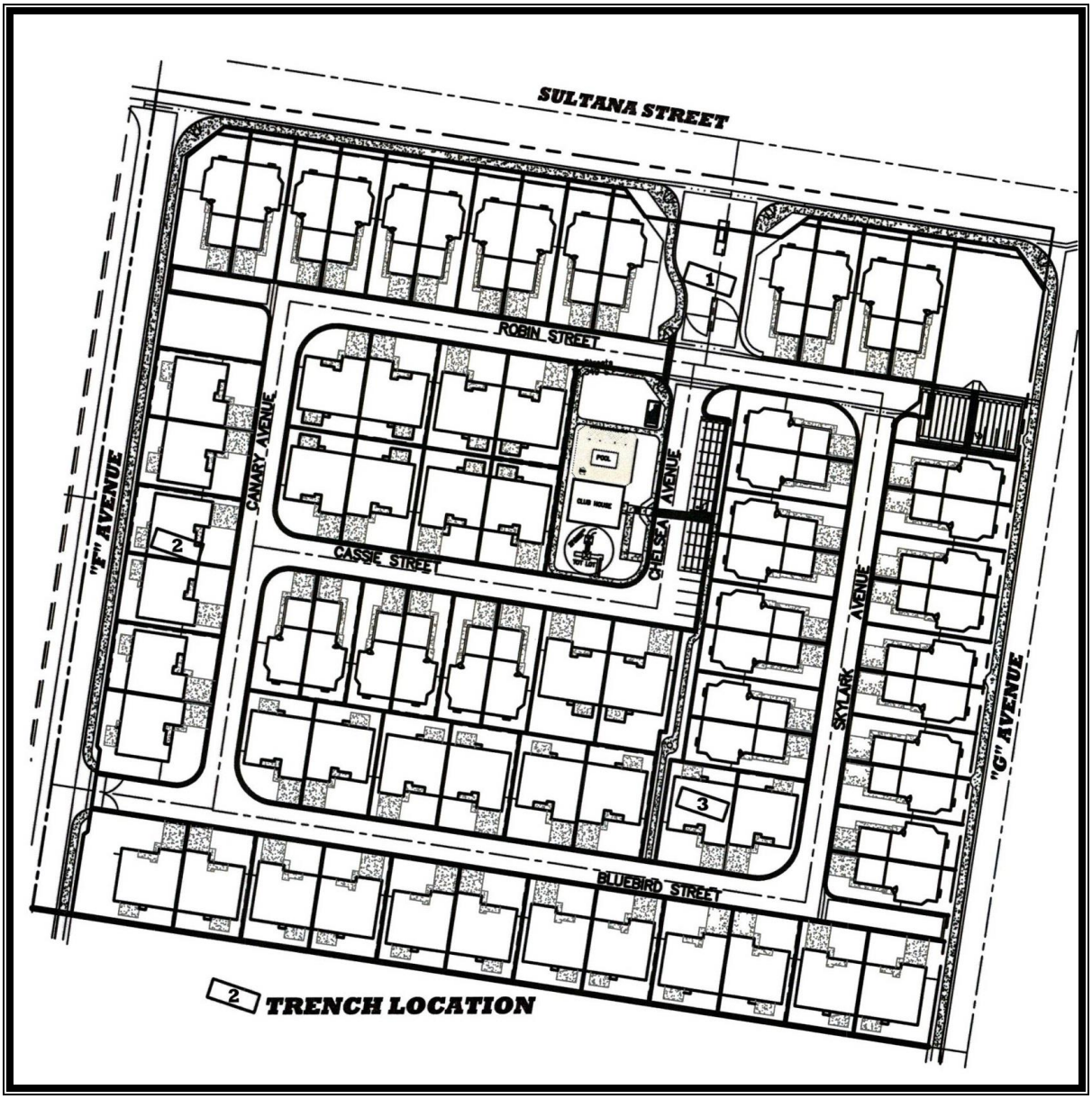

EXPLORATORY TRENCH LOCATIONS/SITE PLAN

DRAWING 4

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AERIAL OF SITE - AUGUST 2018

DRAWING 5

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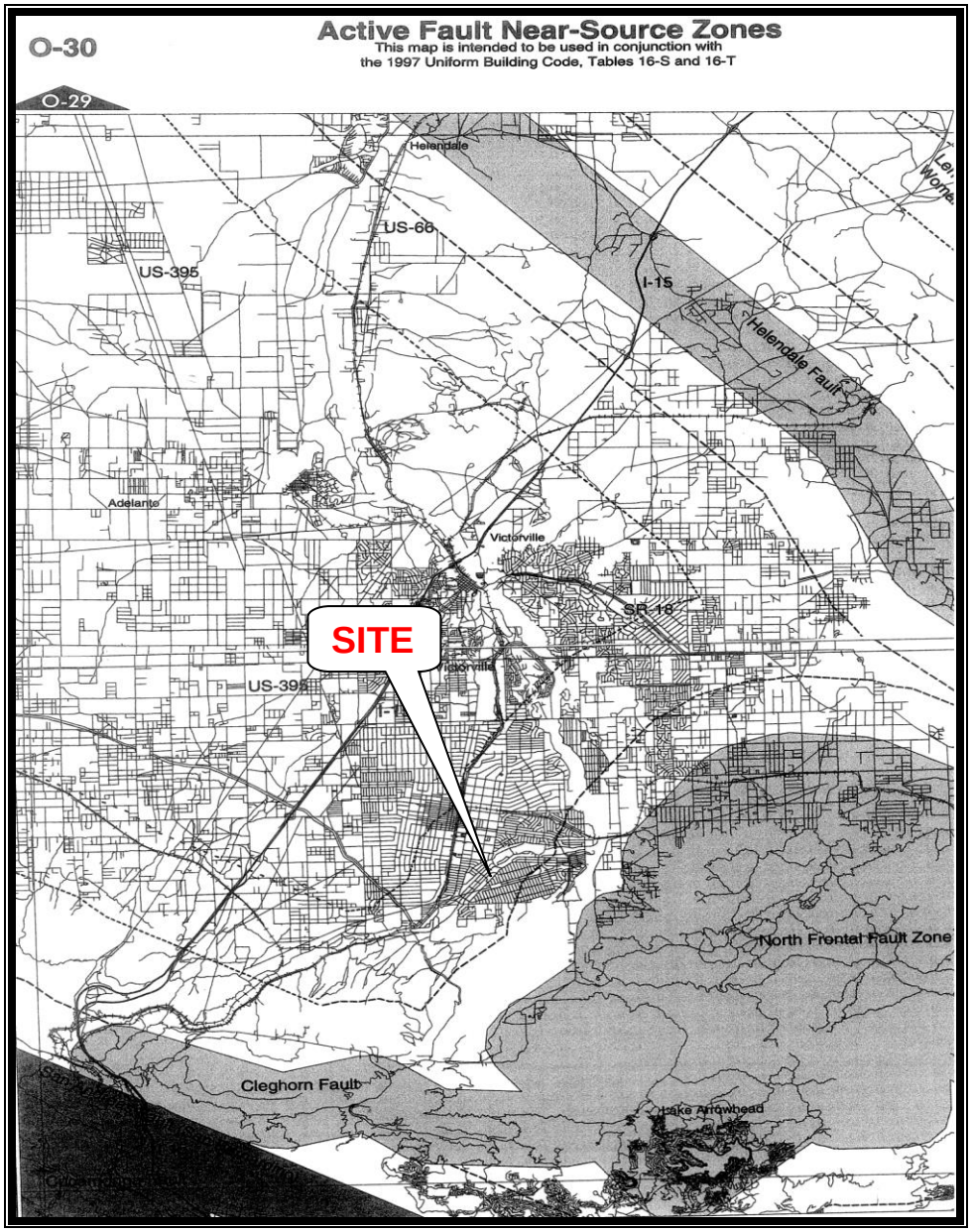

SEISMIC LOCATION MAP

DRAWING 6

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TRENCH LOG

TRENCH NO. 1

DEPTH FT	IN PLACE DENSITY (PCF)	MOISTURE (%)	COMPACTION	CLASSIF.	
1					Medium to Fine Silty Sand with some Clay Binder, Reddish Brown, Damp, Medium Dense (SM) (SP)
2	114.0	5.2	93.8		
3	126.7	4.2	99.0		Medium to Fine Silty Sand, Brown, Sl. Damp, Medium Dense (SM) (SP)
4	121.2	4.4	94.9		
5					
6					
7					
8					
9					
10					Coarse to Medium Sand with Gravel, Gray, Slightly Damp
11					
12					
13					BOTTOM OF TRENCH
14					NO GROUNDWATER
15					NO VOIDS

DRAWING 7

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TRENCH LOG

TRENCH NO. 2

DEPTH FT	INDEX PLACE (PCF)	MOISTURE (%)	COMPERACENY	CLASSIF.	
1					Medium to Fine Silty Sand with some Clay Binder, Reddish Brown, Sl. Damp
2					Medium Dense (SM) (SP)
3					Medium to Fine Silty Sand, Brown,
4					Sl. Damp, Medium Dense (SM) (SP)
5					)
6					
7					
8					
9					
10					Coarse to Medium Sand with Gravel,
11					Gray
12					
13					BOTTOM OF TRENCH
14					NO GROUNDWATER NO VOIDS
15					

DRAWING 8

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TRENCH LOG

TRENCH NO. 3

DEPTH FT	INDEX PLACE (PCF)	MOISTURE (%)	COMPACTION	CLASSIF.	
1					Medium to Fine Silty Sand with some Clay Binder, Reddish Brown, Sl. Damp Medium Dense (SM) (SP)
2		4.8			
3					
4					Medium to Fine Silty Sand, Brown, Sl. Damp, Medium Dense (SM) (SP)
5					
6					
7					
8					Coarse to Medium Sand with Gravel, Gray
9					
10					
11					
12					
13					BOTTOM OF TRENCH NO GROUNDWATER NO VOIDS
14					
15					

DRAWING 9

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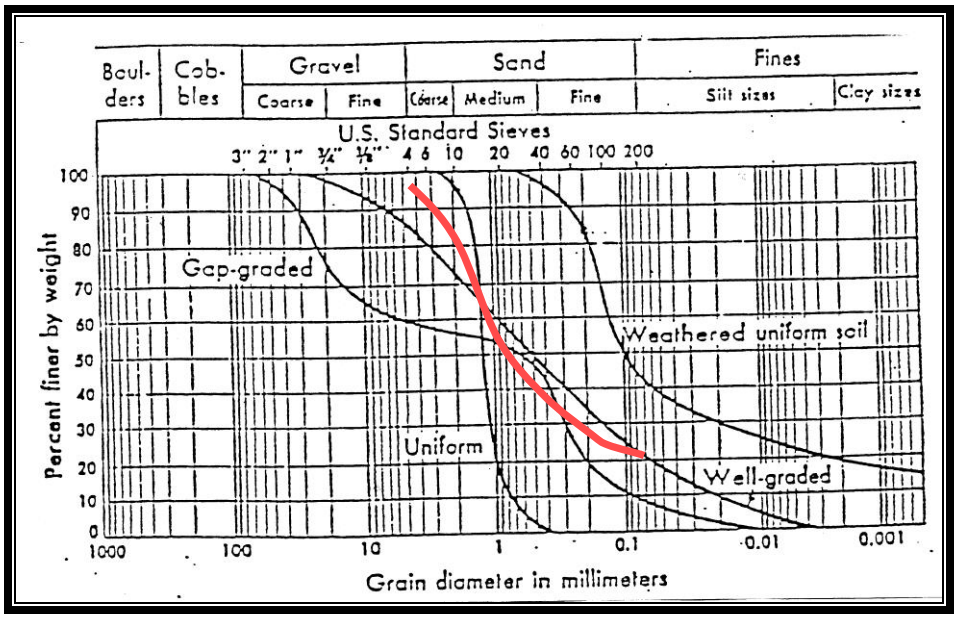
SIEVE ANALYSIS RESULTS

SAMPLE # 1 SAMPLE DEPTH 3.0' BORING/TRENCH # 2

SIEVE #	WEIGHT RETAINED	% RETAINED	% PASSING
4	0.05	2.2	97.8
10	0.38	17.0	83.0
20	0.98	44.0	56.0
40	1.34	60.1	39.9
80	1.60	71.8	28.2
100	1.65	74.0	26.0
200	1.74	78.0	22.0
PAN	2.23	100.0	0.0

TOTAL SAMPLE WEIGHT 2.23 LBS.
PERCENT FINES 22.0%



DRAWING 10

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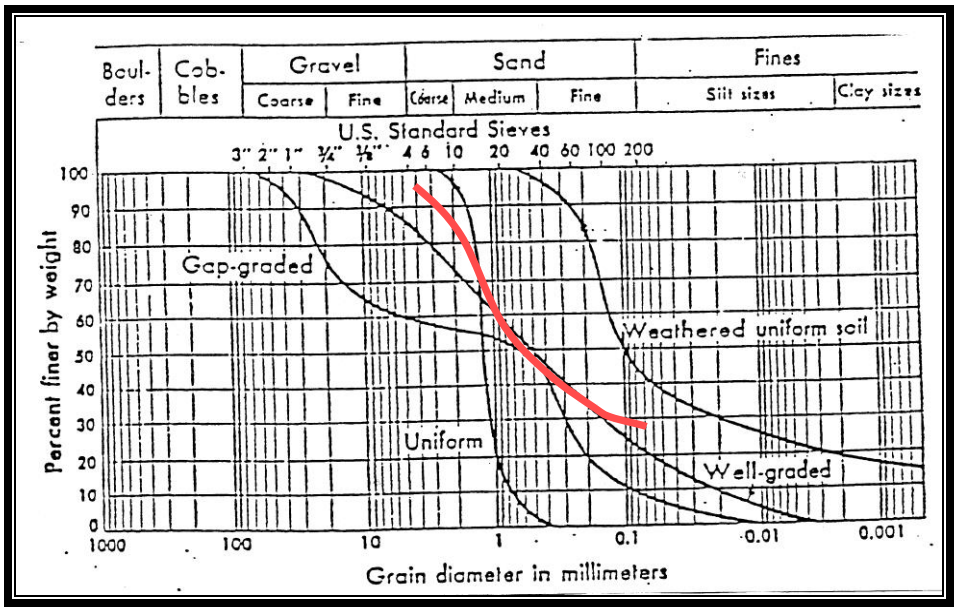
SIEVE ANALYSIS RESULTS

SAMPLE # 2 SAMPLE DEPTH 3.0' BORING/TRENCH # 1

SIEVE #	WEIGHT RETAINED	% RETAINED	% PASSING
4	0.03	1.3	98.7
10	0.09	4.0	96.0
20	0.41	18.3	81.7
40	0.90	40.2	59.8
80	1.35	60.3	39.7
100	1.43	63.8	36.2
200	1.58	70.5	29.5
PAN	2.24	100.0	0.0

TOTAL SAMPLE WEIGHT 2.24 LBS.
PERCENT FINES 29.5%



DRAWING 11

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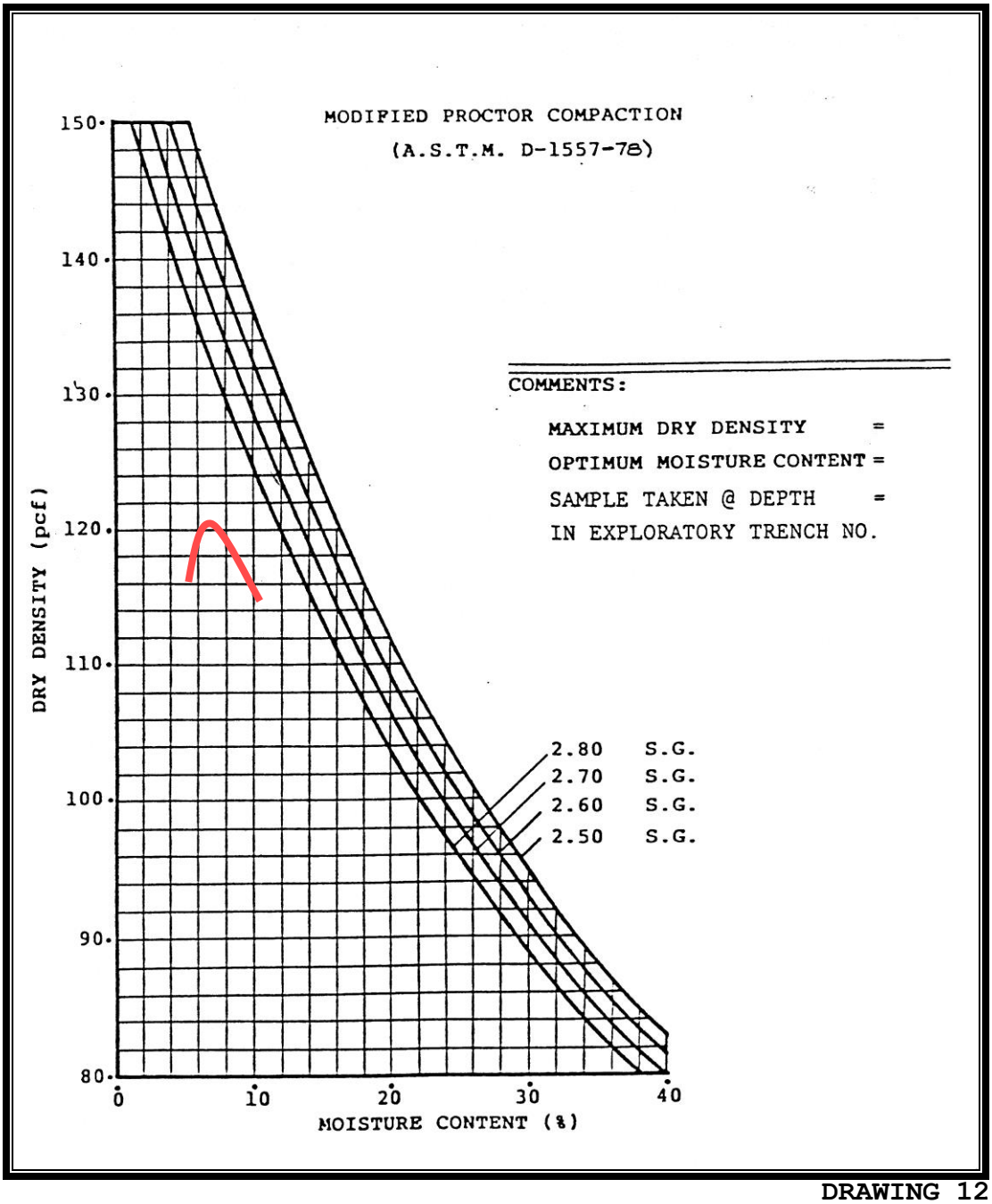

DRAWING 12

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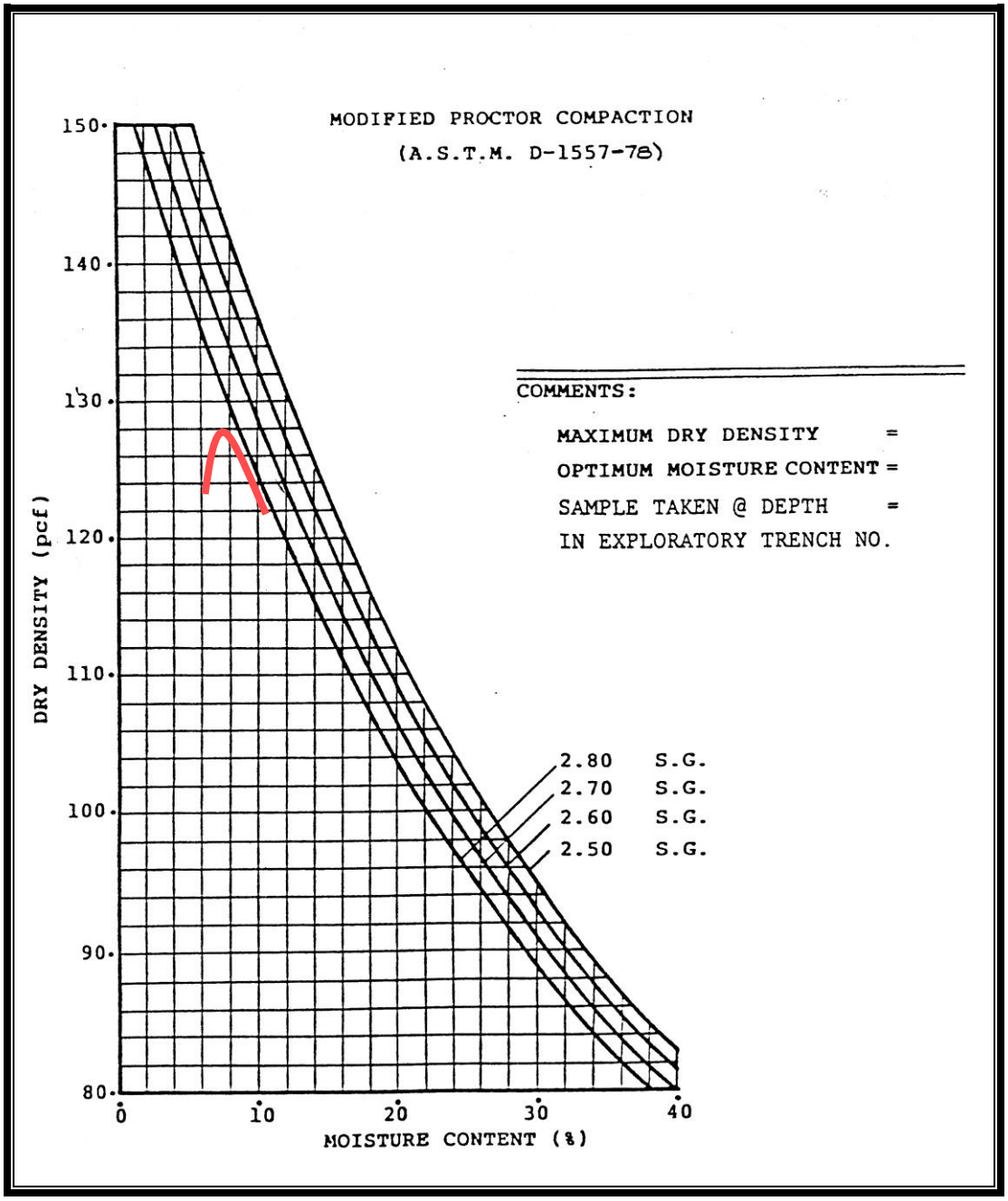

DRAWING 13

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TEST DATA SUMMARY

LABORATORY STANDARD: ASTM 1557-78; METHOD C; 4-INCH DIAMETER MOLD; 1/30 CUBIC FOOT VOLUME; 5 LAYERS; 25 BLOWS PER LAYER; 10 POUND HAMMER; 18 INCH FALL

TYPE	CLASSIFICATION	OPTIMUM MOISTURE (PERCENT)	MAXIMUM DENSITY (PCF)	PLASTICITY INDEX
1	MEDIUM TO FINE SILTY SAND, W/ CLAY BINDER, REDDISH BROWN	9.0	121.5	NON-PLASTIC
2	COARSE TO MEDIUM SAND W/ CLAY BINDER, REDDISH BROWN	8.0	128.0	NON-PLASTIC

DRAWING 14

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UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

COARSE-GRAINED SOILS (more than 50% of material is larger than No. 200 sieve size.)			
GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
	Gravels with fines (More than 12% fines)	GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Sands (Less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
		SP	Poorly graded sands, gravelly sands, little or no fines
	Sands with fines (More than 12% fines)	SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (50% or more of material is smaller than No. 200 sieve size.)			
SILTS AND CLAYS Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty of clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater		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, organic silts
HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils

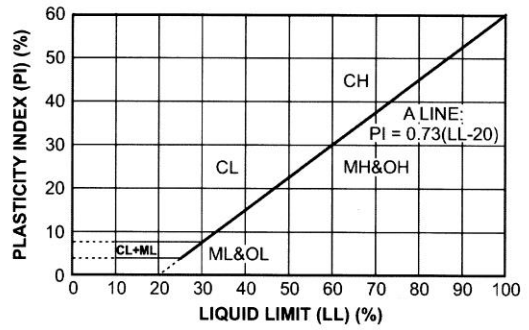
LABORATORY CLASSIFICATION CRITERIA

GW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
GP	Not meeting all gradation requirements for GW	
GM	Atterberg limits below "A" line or P.I. less than 4	Above "A" line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
GC	Atterberg limits above "A" line with P.I. greater than 7	
SW	$C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{D_{30}}{D_{10} \times D_{60}}$ between 1 and 3	
SP	Not meeting all gradation requirements for GW	
SM	Atterberg limits below "A" line or P.I. less than 4	Limits plotting in shaded zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols.
SC	Atterberg limits above "A" line with P.I. greater than 7	

Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:

Less than 5 percent ..... GW, GP, SW, SP
More than 12 percent ..... GM, GC, SM, SC
5 to 12 percent ..... Borderline cases requiring dual symbols

PLASTICITY CHART



DRAWING 15