Braun & Associates Inc.

SOILS INVESTIGATION

PREPARED FOR:

The Carey Group
5325 Calle Real
Santa Barbara, CA 93111.

Proposed Three-story Commercial Structure,
383 Patterson Avenue, Goleta, CA

February 17, 2020

W.O. #2998

TABLE OF CONTENTS

TEXT **PAGE NO.**

Introduction 1
Scope of Work 1
Site Conditions 1
Field Investigation 2
Laboratory Testing 2
Liquefaction Potential 2
Lateral Spreading 2
Groundwater 2
Seismic Design Parameter 3
Soil Conditions 4
Recommendations 4
- Grading 4
- Foundations 5
- Driveway/Parking Areas 7
- Retaining Walls 8
- Underground Facilities Construction 10
- Surface and Subsurface Drainage 10

Limitations 11

APPENDIX

Field Exploration
Laboratory Tests

PLATES **PLATE NO.**

Site Plan A-1.1
Boring Log ..... A-2.1 – A-2.3
Compaction Test Data A-3.1
Expansion Index Determination A-4.1
Consolidation Test Data A-5.1
Grain Size Distribution ..... A-6.1 – A-6.8

ENCLOSURE

Seismic Design Criteria
NRCS Soils Survey

INTRODUCTION

This investigation was requested by Ms. Trudi Carey, owner of the property, and is based on our written agreement dated April 6, 2019. This report presents our findings and recommendations for the proposed three-story commercial structure. The project is located at 383 Patterson Ave in Goleta, California. A plot plan of the site is shown as Plate A-1.1.

SCOPE OF WORK

This investigation was conducted in order to determine the physical characteristics of the soils on the development site and to provide recommendations intended to comply with the considerations for the current California Building Code 2019 Edition and ASCE/SEI 7-16 Minimum Design Loads for Buildings & Other Structures. The recommendations are intended to comply with portions of Chapter 16 & 18, Appendix J of the CBC 2019 Edition and Chapters 12, 16 & 21 of the ASCE/SEI 7-10. More specifically the scope of our investigation includes the following objectives:

- To evaluate the existing surface and subsurface conditions, including soil and ground water within the area of the construction.
- Grading recommendations for proposed structures and parking areas
- Foundation recommendations for proposed three-story structures.
- To present general recommendations concerning construction procedures and quality control measures related to this project.

SITE CONDITIONS

This parcel is located at the corner of Calle Real and N. Patterson Avenue in the Goleta area of Santa Barbara County. Presently the property is undeveloped and consists of a small avocado orchard. Proposed for the parcel is 2 three-story apartment structures.

The scope of this investigation does not include geologic or seismic studies for the site. Also, the assessment of general site environmental conditions or the presence of pollutants in the soils of the site is beyond the scope of this investigation.

Our recommendations are based on the results of our field exploration, laboratory tests and appropriate engineering analysis. The results of both field and laboratory work are presented in the Appendix. The recommendations provided herein are preliminary until they are confirmed in the field by the soils engineer during construction. It is the intent of this report that it be used by the design engineer in preparation of the plans and specifications.

Application beyond the intent of this request is strictly at the user's risk. To verify that all pertinent issues here have been addressed and to ensure conformance with the intent of this report, it is requested that final plans be submitted to this office for review and comment prior to submittal.

FIELD INVESTIGATION

Subsurface soil conditions were explored with three borings extending up to a depth of 50 feet below present ground surface. Drilling equipment utilized was A Semco 2400 and mobile drill CME 75 rig hollow stem drill rig. Samples were obtained using the California Split Tube method. The borings were supplemented with one field density test. Further details of our field exploration are presented in the Appendix.

LABORATORY TESTING

Laboratory tests were performed on selected soil samples to aid in the classification and determination of the engineering properties of the project soils. The following tests were performed:

- Moisture Content (ASTM D2216)
- Dry Density Determination (ASTM D2937)
- Consolidation Characteristics (ASTM D2435)
- Grain Size Distribution (ASTM D422)
- Expansion Soil Index (ASTM D4829)
- Maximum Density-Optimum Moisture Curve (ASTM D1557 Most Current)
- In-Place Relative Density

Laboratory test results are presented in the Appendix.

LIQUEFACTION POTENTIAL

Liquefaction is the loss of strength of cohesionless soils (sandy soils) when the pore water pressure induced in the soil due to earthquake motions become equal to the confirming pressure. The primary factors influencing liquefaction potential include depth of ground water, soil type, relative density of sandy soils, overburden pressure, fines content and the intensity and duration of ground shaking. Liquefaction potential is the greatest in saturated, loose, poorly graded, fine sands with grain size (D50) in the range of 0.1 to 0.5 millimeters. The site has a low potential for liquefaction due to the cohesive onsite soils.

LATERAL SPREADING

Lateral spreading or flow slides are the lateral movement of soil to the unrestrained downhill side. This phenomenon known as flow slide or lateral spreading develops in areas subject to liquefaction. Flow slides occur in the same areas as those which are liquefiable. Lateral spreading requires saturated, uncompacted or slightly compacted artificial fills or loose saturated granular soils. Potential for lateral spreading is low due to the dense nature of the soils encountered on the site.

GROUNDWATER

No groundwater was encountered to the depth of 50 feet.

SEISMIC

Seismic Design Parameters

Seismic Design Per 2019 California Building Code, shall be per the following data. This information shall be incorporated into the structural design:

Latitude (degree) Per WGS84 Geodetic Datum	34.443362
Longitude (degree) Per WGS84 Geodetic Datum	-119.08642
Site Class From Table 20.3.1, Soil Classification, ASCE Standard 7-16	D
Site Coefficient, F_a from Table 11.4-I	1.0
Site coefficient, F_v from Table 11.4-2	1.7
Mapped Spectral Acceleration at 0.2-sec Period, S_s From Equation 11.4-3 Figure 22-2	2.002 g
Mapped Spectral Acceleration at 1.0-sec period, S_1 from Equation 11.4-1	0.768 g
Spectral Acceleration at 0.2-sec Period Adjusted for Site Class, S_{MS} From Equation 11.4-2	2.002 g
Spectral Acceleration at 1.0 -sec Period Adjusted for Site Class, S_{M1} From Equation 11.4-4	1.306
Design Spectral Acceleration at 0.2-sec Period, S_{DS} From Equation 11.4-3	1.335 g
Design Spectral Acceleration at 1.0-sec Period, S_{D1} From Equation 11.4-4	0.870
Site Modified Peak Ground Acceleration PGA_M from EQ 11.3-1 and USGS	0.97

Reference: U.S. Geological Survey, **Geologic Hazards Science Center, U. S. Seismic Design Maps**, http://earthquake.usgs.gov/hazards/designmaps.

The mapped spectral response acceleration parameter for the site for a 1-second period (S_1) is less or greater than 0.75g. Per ACE 7-16, Section 11.6, the seismic structure shall be assigned to a Seismic Design of category D or E.

Seismic coefficients are based on a site class D from Table 20.3.3 of ASCE 7-16. The proposed structure is to be a wood light Framed building. Per exception 2 of Section 11.4.8 no site specific ground motion analysis was conducted.

SOIL CONDITIONS

The geotechnical engineering investigation for this project consisted of a program of field exploration, laboratory testing and engineering evaluation. The field and laboratory data generated for our evaluations are presented in the Appendix. Our description of the supporting soil and groundwater conditions is based on the results of the field and laboratory testing program. A summary of the soil conditions encountered within the area of the proposed project is as follows:

- **Surficial sediments** were encountered in all borings to the total depth of 50 feet. This material generally consisted of brown to light brown silty sand with some gravel. The material was noted to be moist and loose to moderately firm. During drilling expansive clay soil lenses were encountered. Laboratory testing indicates this material has a low expansion index at 2 feet and highly expansive at 3 feet in depth. and is slightly sensitive to sudden moisture changes.

RECOMMENDATIONS

The understanding of this firm is that the proposed work will be 1 new three-story apartment structures. Recommendations are as follows:

Grading

Level Grading

1. The area upon which grading is to be performed shall be cleared of surface vegetation including roots and root structures.

2. Due to the expansive nature of the onsite soils removal and replacement with non-expansive import soil is required within the footprint of building and for 10 feet beyond.

3. During the grading operation expansive clay lenses are expected to be encountered. These layers within the building footprint will need to be wasted in landscape and other non-structural areas including open carport areas.

4. In areas where fill material is to be placed and in areas that will remain at grade which will ultimately support the proposed structures and driveway/parking areas, the top 48 inches of existing surface soils shall be removed, the exposed ground surface scarified an additional 6 inches, moistened or dried to near optimum moisture content, mixed as necessary in order to obtain a homogenous uniform soil mixture and compacted to a minimum of 90% relative compaction.

5. During the excavation process, a thorough search shall be made, under the direction of this firm, to locate and remove any man-made buried structures and utilities.

6. Import soils shall be non-expansive sands and silty sands. Import fill shall be approved by this firm prior to delivery to the site.

7. Fill within the footprint of the structure shall be of uniform thickness. This is required to mitigate differential settlement.

8. Fill pads shall extend, as a compacted certified fill, a minimum distance of 10 feet beyond the exterior perimeter of the foundation system and parking lots.

9. Backfill for all utility trenches shall be clean coarse sand which is placed in loose lifts of approximately 6 inches which has been moistened or dried to near optimum moisture content and compacted to a minimum of 90% relative compaction.

10. Compaction standard shall be ASTM D-1557 Method of Compaction, most current edition.

11. All cut and fill slopes created during the grading operation shall be properly shaped to a maximum slope angle of 3 to 1^{V}.

12. Fill slopes shall be compacted by a rolling sheep-foot roller or similar compaction equipment device over the slope face at vertical lift intervals of 30 inches or less.

13. Per Santa Barbara County Grading Ordinances, a minimum of 90% relative compaction shall be achieved on all fill slopes a minimum of 8 inches below surface grade.

14. Import soils shall be granular, well-graded sands or silty sands. All import material shall be inspected by a representative of this firm prior to importation to the site.

15. Due to the concern by local governing agencies, grading within the drip line of oak trees and other designated species is prohibited, therefore grading in this area shall be taken to 2 feet outside the drip line as for over excavation. Should the building footprint extend beyond, the use of deepened footings or caissons as directed in the foundation portion of this report will be utilized.

16. During the grading process should roots from protected tree species greater than 1/8" in diameter be encountered the owner or design architect shall be notified. The exposed roots can then be reviewed by a certified arborist who will then provide recommendations for repairing or protecting the root structure.

17. Surface drainage shall direct water away from all man-made slopes and the foundation system of the proposed structure. Further, the residence shall utilize rain gutters and down spouts about the structure and yard drains in the landscaped portions of the property.

18. Current building code standards require all soft scaping shall slope away from the structure at 5% for a minimum of 10 feet.

Building Foundations

Slab-On-Grade

1. All footings shall be continuous. No isolated piers shall be utilized.

2. Slab on grade foundations shall be prepared by grading of the site. The finished pad shall be a certified fill created per the enclosed grading recommendations Inspection of the finished pad shall be conducted by the Soils Engineer.

3. All footings shall extend a minimum of 36 inches below surface grade and shall be properly reinforced to uniformly distribute the imposed building loads, with a minimum of 6 #5 rebar placed 3 in the base and 3 in the stem of the footing.

4. A soil passive pressure to resist lateral movement due to seismic loading of 300 psf may be assumed. This value shall be taken for footings extending into the firm certified fill.

5. Concrete slab on grade shall be a minimum of 6 inches in thickness. Reinforcing for slab on grade shall consist of #3 rebar spaced at 12 inches on center each way. Reinforcing steel shall be doweled into all exterior footings with a minimum of one #4 rebar spaced at 12 inches on center.

6. Should slab placement be constructed more than one month after completion of grading for the building pad re-saturation of the surface soils are required. This is due to the relatively dry conditions which are normal for are locale. Saturating shall consist of sprinkling or wetting the pad surface for a minimum of 1 day and allowed to remain for 5 days untouched. This will allow the water to penetrate the near surface soils and re-hydrate any silt and clay within the pad.

7. A vapor barrier consisting of clean coarse sand and 15 mil or heavier visqueen shall be used. Sand gradation shall conform to Green Book Standards 300-3.5.2 for pervious backfill. Construction shall consist of two inches of sand overlain by the visqueen membrane and an additional 6 inches of gravel.

8. Prior to submittal for building permit, this firm shall be requested to review the foundation and grading plans for the project. Comments and revisions if necessary, will be provided at that time.

9. A representative of this firm shall be requested to inspect all excavations prior to backfilling, steel reinforcement and concrete or soil placement.

10. Based upon compliance with the above recommendations a maximum safe soil bearing value of 1950 psf may be assumed.

11. The maximum safe soil bearing value may be increased by 1/3 when considering short-term wind or seismic movement.

12. Using these criteria, settlement under static loading conditions should not exceed 1-inch total and 3/4-inch differential within thirty feet.

Driveway/Parking Areas

1. The area to be paved for driving surface or parking areas shall be graded per the grading recommendations enclosed herein.

2. Subgrade soils shall be prepared by scarifying the top 12 inches, moisture conditioning to near optimum moisture content, mixed as necessary in order to obtain a uniform soil mixture and compacted to a minimum of 95% relative compaction.

3. In areas which become unstable during the recompaction process shall be stabilized by removing the unstable soils down to firm material. Backfill of the excavation shall then be conducted by replacing native soils which are moisture conditioned to 1% under optimum moisture content placed in 6 inch lifts and compacted to a minimum of 95% relative compaction.

4. During the removal and recompaction of the subgrade soils the potential for encountering existing utility trenches in which the soils are either saturated or unstable should be expected. In these areas care should be taken to remove the unstable soils down to the sand bedding or to the depth of approximately 12 inches. Backfill in the trenches shall utilize Class II Aggregate Base which is placed in a lift of 12 inches and compacted to a minimum of 95 % relative compaction.

5. A representative of this firm shall be requested to observe and test the subgrade soils prior to base placement.

6. Structural section for parking stalls accessed by only light vehicles shall consist of a structural section of 3 inches of asphalt concrete underlain by 6 inches of Class II aggregate base.

7. Structural sections in which truck traffic and driving areas shall consist of a structural section consisting of 3-1/2 inches of asphalt concrete underlain by 8 inches of Class II aggregate base.

8. In the truck loading and unloading areas the structural section shall consist of reinforced Portland Cement Concrete paving. The structural section shall be 8 inch thick Portland Cement Concrete over 6 inches of Class II aggregate base. Reinforcement in the areas of concrete shall consist of #4 rebar spaced at 12 inches on center each way.

9. It is recommended Portland Cement Concrete ribbon gutters be utilized for surface drainage in the asphalt concrete areas. These ribbon gutters shall be constructed per Greenbook Standards for driveway ribbon gutters. Beneath the ribbon gutters a minimum of 4 inches of aggregate base shall be placed on the prepared subgrade.

10. Concrete pavement shall meet standards for design and compression strength per Greenbook Standards Table 201-1.1.2 (Concrete Pavement).

11. Maintenance to help reduce potential for rapid deterioration of the parking areas should include surface treatments approximately 6 months to 1 year after construction and approximately 3 years from the 1st treatment. Pavement condition shall be reviewed at least once a year for cracks, puddling or surface water for overall performance. If possible this review should be done in the fall so cracks which allow moisture to pass through the pavement can be repaired.

12. Compaction standard for subgrade soil shall be ASTM D-1557 Method of Compaction, most current edition.

Retaining Walls

Design values presented in this section assume proper drainage will be provided. The recommended lateral pressures assume a static drained condition. This is achieved by ensuring surface water is directed away from the wall while subsurface moisture is collected by a properly installed subdrain system. Saturation of backfill soils, which creates an undrained condition, can increase lateral earth pressures above 65 pcf.

Unrestrained

For cantilever retaining walls, which do not form part of the structure and are not rigidly attached to sidewalks or other permanent structures the following recommendations are given:

1. Unrestrained cantilever retaining walls shall be designed assuming an active soil pressure equivalent to a fluid whose weight is 40 pounds per cubic foot. This value shall be increased for surcharge backfill by 1 pound per cubic foot for each degree of slope angle over 12°. To resist this lateral pressure a passive soil pressure equivalent to a fluid whose weight is 300 pounds per cubic foot and a coefficient of friction against sliding of 0.30 may be assumed. When combining passive pressure and coefficient of friction to resist lateral movement the passive value shall be reduced by 1/3.

2. Per Bluebook Article 9.10.10, walls designed on an at rest soil pressure need not include additional lateral loading due to seismic activity.

3. Retaining walls footings shall extend a minimum of 36" into certified fill material.

4. Surcharge loads, which will affect the loading on the wall, should be considered to be within a projected $1^{H}:1^{V}$ line extending upward from the inside base of the wall.

5. The retaining wall shall be serviced by a subdrain system. The subdrain shall be backfilled with a ¾ inch gravel mixture, Pervious Backfill of the Standard Specifications for the Public Works Construction (Green Book). The gravel blanket shall be wrapped by a non-woven geotextile filter fabric. Within the gravel blanket, a 4-inch perforated drainpipe will be placed at the bottom of the trench and properly sloped to discharge at the bottom of the slope.

6. All retaining walls shall be serviced by appropriately placed weep holes or a subdrain system.

7. If retaining walls are to support surface features such as detached sidewalks or patio areas backfill material shall be properly compacted to a minimum of 95% relative compaction. This backfill material shall be non-expansive sands or silty sands. Import material shall be inspected by a representative of this firm before delivery to the site.

8. Using these criteria, settlement under static loading conditions should not exceed 1-inch total and 3/4-inch differential within thirty feet.

9. Safe soil bearing value for footings testing in certified fill may be assumed to be 1750 psf.

It should be noted that cantilever retaining walls are designed assuming an active soil condition. This condition is obtained by anticipated slight rotation, with time, in a downhill direction. In addition, surface features, which obtain their support from compacted retaining wall backfill materials, are anticipated to undergo distress due to this differential movement. Further, additional differential movement may occur due to the retaining wall structure resting upon undisturbed original ground and the surface features behind the retaining wall resting upon compacted fill blanket, with settlement characteristics different from those of the undisturbed original ground.

Restrained/Partially Restrained

For restrained or partially restrained retaining walls, which form portions of the foundation system or are attached to permanent structures, the following recommendations are given:

1. Retaining walls shall be designed assuming an at rest soil pressure equivalent to a fluid whose weight is 68 pounds per cubic foot for level backfill conditions. This value shall be increased by 1 pcf for each degree of slope angle above 12° with a maximum slope of 2H to 1V.

2. All restrained retaining wall footings may assume a safe soil bearing value of 1950 psf for footings resting in certified fill. Footing extending into firm native soil may assume a safe soil bearing value of 2400 psf.

3. Retaining walls shall be serviced by a subdrain placed a minimum of 12 inches below interior slab grade.

4. The subdrain trench shall be backfilled with a ¾ inch gravel mixture, conforming to Pervious Backfill of the Standard Specifications for the Public Works Construction (Green Book). The gravel blanket shall be wrapped by a non-woven geotextile filter fabric. Within the gravel blanket, a 4-inch perforated drainpipe will be placed at the bottom of the trench and properly sloped to discharge at the bottom of the slope.

5. Retaining walls forming living portions of the structure shall be protected against moisture penetration with the use of moisture barrier, such as Miradrain by Miralfi. All moisture barriers shall be applied in strict conformance with the manufacturer's recommendations. All moisture collected by the moisture barrier shall be transported away from the foundation system and all existing or future slopes, and into a properly designed storm drain system.

6. Backfill material shall extend as a compacted wedge starting from back of footing at an angle of 1.5^{H} to 1^{V} to within 1 foot of slope surface.

7. Surcharge loads, which will affect the loading on the wall, should be considered to be within a projected 1^{H}:1^{V} line extending upward from the inside base of the wall.

8. Per Bluebook Article 9.10.10, walls designed on an at rest soil pressure need not include additional lateral loading due to seismic activity.

9. The soil bearing values may be increase by 1/3 when considering short-term wind or seismic movement.

10. Using these criteria, settlement under static loading conditions should not exceed 1-inch total and 3/4-inch differential within thirty feet.

GENERAL NOTES

Underground Facilities Construction

All contractors shall be familiar with the State of California Construction Safety Orders for "Excavations, Trenches, Earthwork". Trenches or excavations greater than 4 feet in depth should be shored or sloped back in accordance with OSHA Regulations prior to entry.

Sand bedding should be used below and above all utility pipes. Bedding is designed as material placed in the trench both above/below the designated utility pipe while backfill is all material placed in the trench above the bedding. Bedding material should be free draining sand and should be compacted by mechanical means to achieve at least 90% relative compaction based on ASTM Test D-1557-91, most current edition.

Proper compaction of all trenches is necessary under and adjacent to structural fill, building foundations, concrete slabs and vehicle pavement areas.

Surface and Subsurface Drainage

1. Concentrated surface water runoff within or immediately adjacent to the project should be conveyed in pipes or in lined channels to discharge areas that are relatively level or into an approved storm drain system.

2. Water from downspouts should be conveyed in pipes that discharge in areas away from structures. Surface drainage gradients should be planned to prevent ponding and promote drainage of surface water away from foundations, edges of pavements and sidewalks. In general it is recommended a minimum of 5% slope be maintained for the first 10 feet adjacent to these structures.

3. Drainage should be established at the time of fine grading and once all landscaping has been installed. This drainage shall be maintained throughout the life of the structure and only altered to increase the effectiveness of the drainage. Property owners should be aware that altering drainage patterns, landscaping, the addition of patios, planters, and other improvements may affect the performance of the existing drainage but the structural performance of all permanent structures.

4. Routine maintenance of the drainage system including roof gutters, downspouts and discharge pipes should be implemented at least twice a year for clogging, debris and proper slope. Any debris shall be removed and properly disposed of.

5. Sprinkler systems should be routinely checked and visible signs of leakage shall be immediately repaired. Watering schedules should be varied and adjusted according to the season and types of landscaping.

6. Site maintenance for residences, which have both or either cut and fill slopes it, is crucial to prevent concentrated erosion and potential for slope slippage. Water shall not be allowed to pond or overflow these slopes at any point along their way.

7. All slopes shall be planted with deep-rooted drought resistant vegetation. Ideas for these types of plants can be obtained from your local nursery. Control of burrowing animals is important to prevent water from being collected in these underground holes and possibly being discharged onto slopes. Control of burrowing animals should be conducted in a safe manner in accordance with animal control organizations.

Limitations

The recommendations provided in this report are based upon this firm's understanding of the described project information and our interpretations of data collected during the subsurface exploration. Conclusions and professional opinions presented here were developed by Braun & Associates, Inc., in accordance with generally accepted geotechnical engineering principles and practices for this area. No other warranty is either expressed or implied.

This report has been prepared for use only by Ms. Trudy Carey and the appointed representatives. This report may not contain sufficient information for use on other projects. If any changes are made to the project as outlined in this report, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the conclusions and recommendations of the report are modified and approved in writing by Braun & Associates, Inc.

This report is based on the assumption that the necessary reviews technical observation and testing, during construction, will be provided by a representative of this firm.

Field observation service is a continuation of the geotechnical investigation and intended to verify that the actual conditions are as anticipated. This also provides the client the means of dealing with unanticipated changes to existing conditions, which may require modification of the original recommendations. If another firm is obtained for the geotechnical observation of this project, the responsibility and liability of Braun & Associates, Inc., will be limited to the analytic results obtained during laboratory testing.

Sincerely,
BRAUN & ASSOCIATES, INC.

Mark D. Braun, G.E. 2313

MDB/dsf

APPENDIX

EXPLORATIONS

Exploratory borings were conducted for the purpose of logging the subsurface profile and obtaining relatively undisturbed samples of the underlying soils. Drilling was conducted using a Semco 2400 rig & a CME 75 rig with 4-1/4 inch ID hollow stem auger drills.

Soils encountered were logged by our field technician and relatively undisturbed samples were collected for laboratory inspection and testing. The samples were obtained using a modified California split spoon sampler. The modified California sampler is a three-inch outside diameter by 2.4 inch inside diameter tube, which is split longitudinally. This allows the insertion and removal of inch long brass rings and six-inch long brass tubes with minimal disturbance to the sample. The sampler is generally driven 12 to 18 inches into the materials at the bottom of the drill stems using a 140-pound trip hammer with a 30-inch drop. The number of blows needed to drive the sampler the last 12 inches into the soils are recorded and shown on the left of the boring log.

Recovered samples are identified, tagged and sealed into plastic tubes. All samples were placed in transport containers and returned to our laboratory for testing.

The logs of borings are presented on Plates A-2.1 thru A- 2.3. The depth and description of soils encountered are indicated on the right of the boring log. Stratification lines on the logs represent the approximate boundary between predominant soil types. Minor layers of differing material types may be contained within the strata and a gradual transition should be expected between strata. Engineering description and material classification used on the boring logs are in accordance with the Unified Soil Classification System.

LABORATORY

The results of laboratory testing are presented on the enclosed plates. The following laboratory tests were conducted on representative samples in accordance with the latest applicable ASTM standards.

The field moisture content and dry density of the soils encountered were determined by performing tests on the undisturbed samples. The results of the tests are shown to the left of the boring logs.

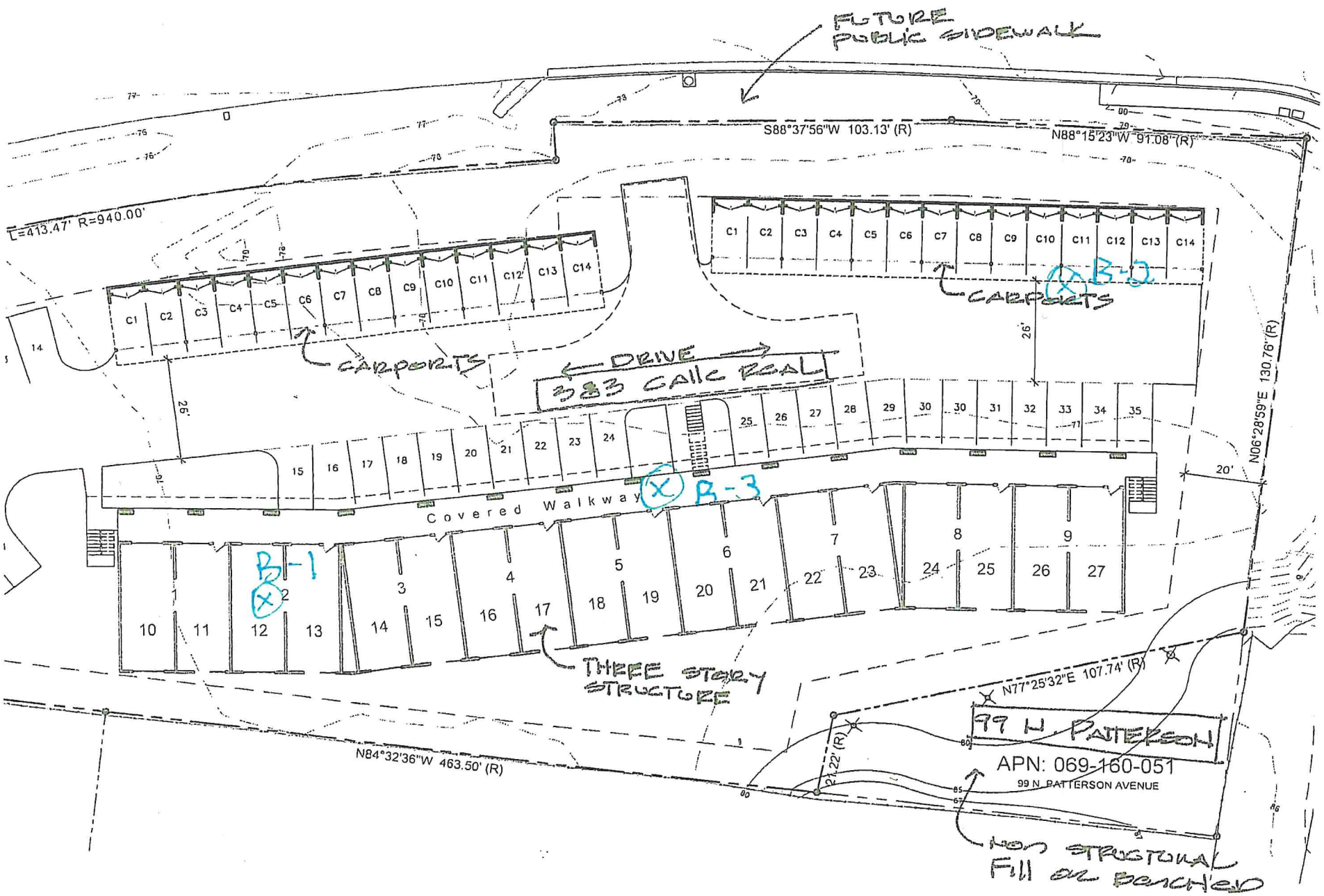
In place relative density of the native soils was determined at the main residence. Testing was performed by ASTM D-1556 the Sand Cone Method. Results are shown on Plate A- 3.1, SUMMARY OF COMPACTION TEST RESULTS.

The optimum moisture content and maximum dry density of the upper soils were determined by performing a maximum density test on the sample obtained from the field density test. The testing was performed in accordance with the ASTM Designation D-1557 Method of Compaction. The results of the test are presented on Plate A- 3.1, SUMMARY OF COMPACTION TEST RESULTS.

Soil expansion characteristics of the existing surface soils were determined by Uniform Building Code Standard No. 29-2. Results are shown on Plate A- 4.1, Expansion INDEX Determination.

Confined consolidation tests were performed on three (3) relatively undisturbed samples to determine the compressibility of the soils. Water was added to the samples during the tests to illustrate the effect of moisture on the compressibility. The results of the tests are presented on Plate A- 5.1 , CONSOLIDATION TEST DATA.

Mechanical and Hydrometer analyses were performed on various samples to determine the particle size distribution of the soils. Testing was performed in accordance with ASTM D422. The results are presented on Plates A- 6.1 thru A- 6.8, GRAIN SIZE DISTRIBUTION.



5325 Calle Real

4.2.19

PLATE A-1.1

Major Divisions			Graphic Symbols	Letter Symbols	Typical Descriptions
More than 50% of material retained on No. 200 sieve — Coarse Grained Soils	Gravel & Gravelly Soils	Clean Gravels (Little or no fines)		GW	Well graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly graded gravels, gravel-sand mixtures, little or no fines
	More than 50% of coarse fraction retained on No. 4 sieve	Gravels with Fines (Appreciable amount of fines		GM	Silty gravels, gravel-sand-silt mixtures
				GC	Clayey gravels, gravel-sand-clay mixtures
	Sand & Sandy Soils	Clean Sands (Little or no fines)		SW	Well graded sands, gravelly sands, little or no fines
				SP	Poorly graded sands, gravelly sands, little or no fines
	50% or more of coarse fraction passing No. 4 sieve	Sands with Fines (Appreciable amount of fines)		SM	Silty sands, sand-silt mixtures
				SC	Clayey sands, sand-clay mixtures
Less than 50% of material retained on No. 200 sieve — Fine Grained Soils	Silts & Clays	Liquid limit less than 50		ML	Inorganic silts, rock flour or clayey silt with low plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts and clayey silts of low plasticity
	Silts & Clays	Liquid limit less than 50		MH	Inorganic plastic silts, micaceous or diatamaceous silts
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic clays of medium to high plasticity, organic silty clays
Highly Organic Soils				PT	Peat, humus, swamp soils with high organic contents, fiberous

NOTE: Dual symbols are used to indicate borderline soil classifications.

UNIFIED SOIL CLASSIFICATION SYSTEM

BORING LOG

BORING NUMBER: 1

Date Drilled: November 8, 2019
Equipment Used: Semco 2400
Latitude: 34.443436 Longitude: -119.809301

Elevation (ft.)	Std. Pen. Test	Moisture Content	Dry Density	Depth (ft.)	Sample Location		
				1			
				2			
				3		SM	Brown SILTY fine SAND, moist, loose
				4		CH	Brown expansive SILTY CLAY, very moist, stiff
				5		SM	Brown SILTY fine SAND, moist, loose
				6			
				7			
				8			
				9			
				10		SM	Brown SILTY fine SAND, moist, moderately firm
				11			
				12			
				13			
				14			
		10		15	B		
				16			
				17		SC	Brown CLAYEY SILTY SAND, moist, firm
				18			moist, firm
				19			
				20			
							Total depth 20 ft

Note: The log of subsurface conditions shown hereon applies only at specific boring location and at date indicated.

PLATE A-2.1

BORING LOG

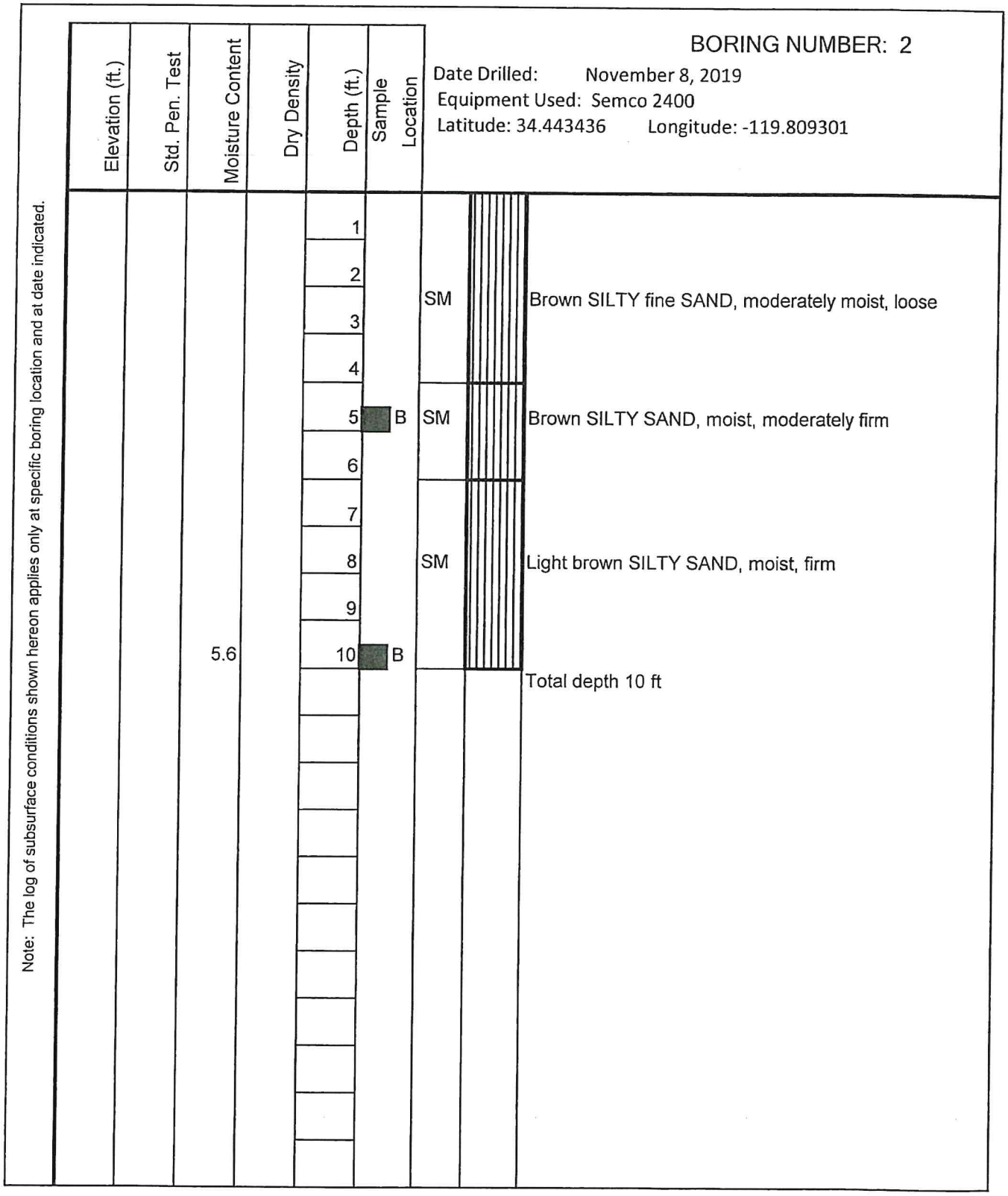


PLATE A-2.2

BORING LOG

BORING NUMBER: 3

Date Drilled: November 8, 2019
Equipment Used: CME 75
Latitude: 34.443436 Longitude: -119.809301

Elevation (ft.)	Std. Pen. Test	Moisture Content	Dry Density	Depth (ft.)	Sample Location		
				1		CH	Brown expansive SILTY CLAY, moist, soft
	9	8.7		2			
				3			
				4		SM	Brown SILTY fine SAND, moist, loose
	6	17		5			
				6			
				7			
				8			
				9			
	9	17.3		10			
				11			
				12			
				13			
				14			
	8	16.4		15	B	SC	Brown CLAYEY SILTY SAND, moist, firm
				16			
				17			
				18			
				19			
	28	11.3		20			
				21		SC	Light brown CLAYEY SILTY SAND, moist, firm

Note: The log of subsurface conditions shown hereon applies only at specific boring location and at date indicated.

PLATE A-2.3

BORING LOG

BORING NUMBER: 3 cont'd

Date Drilled: November 8, 2019
Equipment Used: CME 75
Latitude: 34.443436 Longitude: -119.809301

Elevation (ft.)	Std. Pen. Test	Moisture Content	Dry Density	Depth (ft.)	Sample Location		
				43		SM	Yellow-brown SILTY cemneted SAND, moist, hard
				44			
	60			45			
				46		SM	Tan-gray SILTY cemented SAND, moist, hard
				47			
				48			
				49			
	50/6"	6.3		50	B		Total depth 50 ft
							NO GROUNDWATER ENCOUNTERED

Note: The log of subsurface conditions shown hereon applies only at specific boring location and at date indicated.

PLATE A-2.3 cont'd

BORING LOG

BORING NUMBER: 3 cont'd

Date Drilled: November 8, 2019
Equipment Used: CME 75
Latitude: 34.443436 Longitude: -119.809301

Elevation (ft.)	Std. Pen. Test	Moisture Content	Dry Density	Depth (ft.)	Sample Location		
				22			
				23		SC	Light brown CLAYEY SILTY SAND, moist, firm
				24			
	41	16.4		25	B		
				26			
				27			
				28			
				29			
	75	16.3		30	B	SC	Yellow-brown CLAYEY SILTY SAND with SAND-STONE, moderately moist, firm
				31			
				32			
				33			
				34			
	15/2"			35			
				36			
				37			
				38		SM	Yellow brown SILTY SAND with CLAY with SAND-STONE, moist, firm
				39			
	60			40			
				41		SM	Yellow-brown SILTY cemented SAND, moist, hard
				42			

Note: The log of subsurface conditions shown hereon applies only at specific boring location and at date indicated.

PLATE A-2.3 cont'd

SUMMARY OF COMPACTION TEST RESULTS

PROJECT: 383 N. Patterson Ave
Carey Group

Test No	Date	Depth of test from F.G. (ft.)	Soil Type	Moisture Content (%)	Dry Density (pcf)	Max. Dry Density (pcf)	% of Max. Density	Remarks
1	8/18/19	2.0	I	11.1	111.5	111.0	91.3	

MAXIMUM DENSITY - OPTIMUM MOISTURE RESULTS

Soil Type	Description		Maximum Density (pcf)	Optimum Moisture (%)
I	Brown SILTY fine SAND slight GRAVEL		122.0	12.0
	Curve Points	(119.7@9.4)	(122.0@12.1)	(118.2@13.4)

PLATE A-3.1

EXPANSION INDEX DETERMINATION

ASTM D 4829

Location:

Sample No.	:	1
Boring	:	B-1
Depth, feet	:	2 ft
Soil Description	:	Brown SILTY SAND slight GRAVELS

Unit Weight and Moisture:

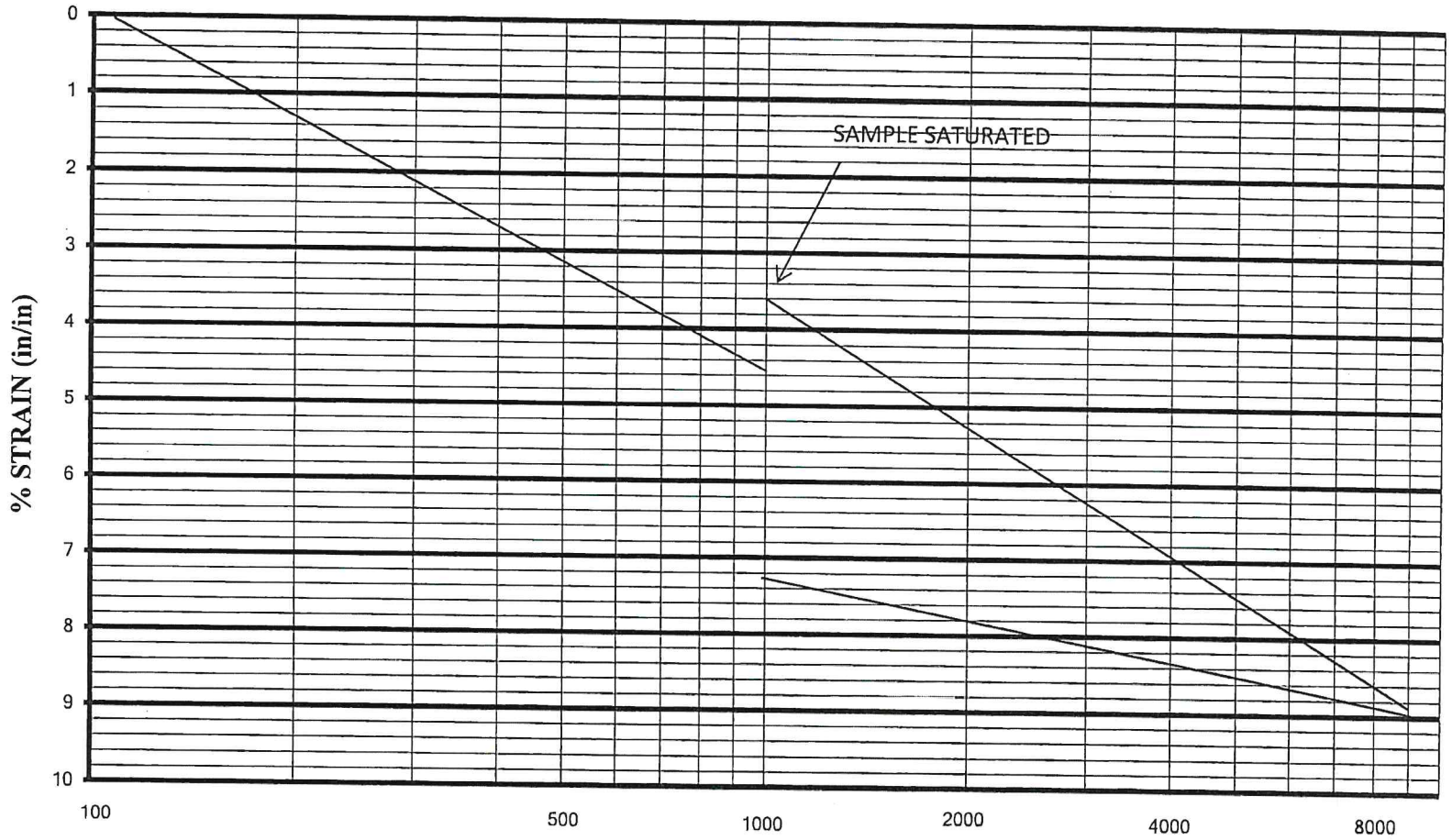
Dry Density, pcf	:	113.3
Moisture, % at 50% saturation	:	14.9
Moisture, % at 100% saturation	:	17.9

Swell Test Results:

Swell at 144 psf	:	4.7%
Expansion Index	:	47
Expansive Potential	:	Low

PLATE A-4.1

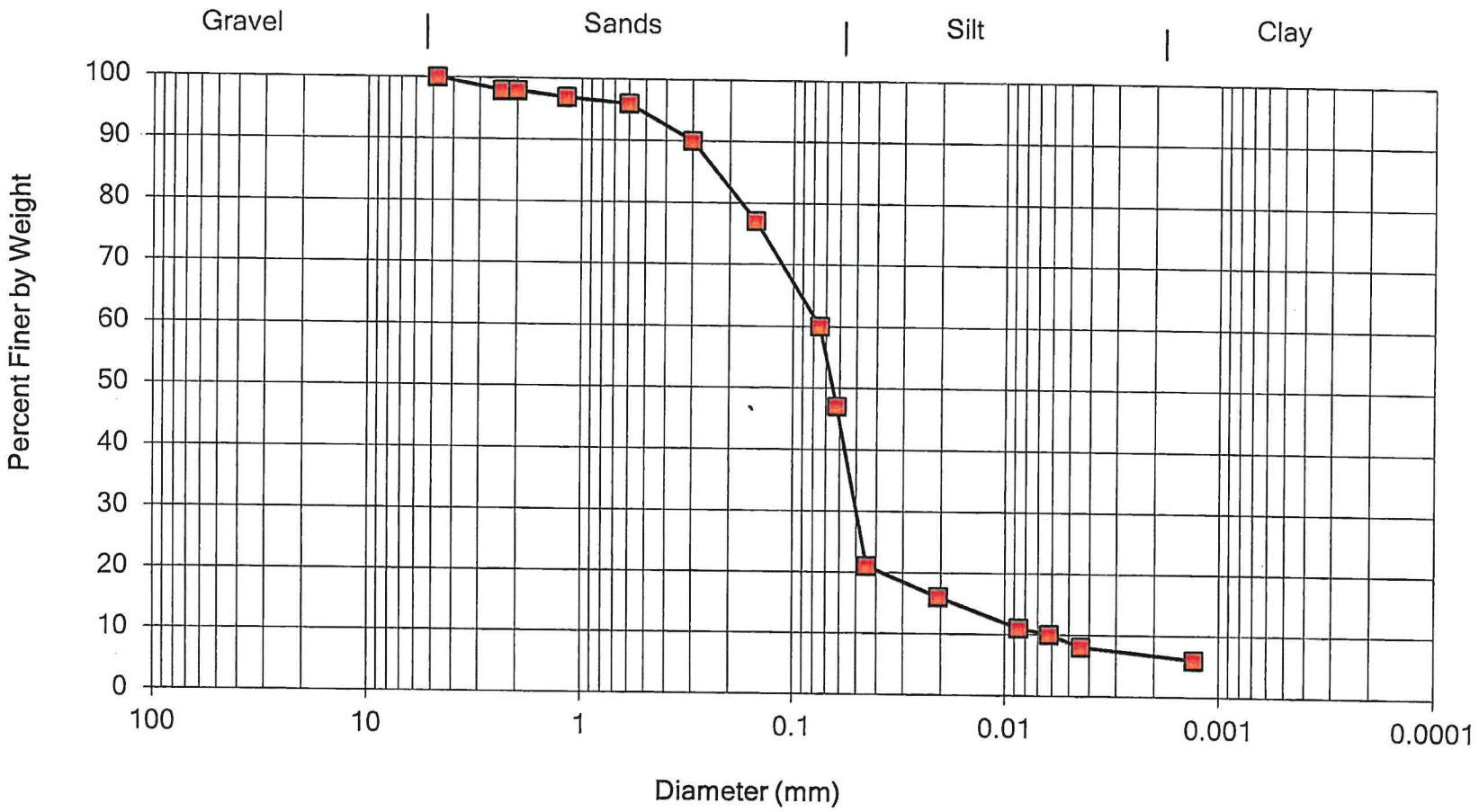
CONSOLIDATION TEST DATA



LOCATION B-1
DEPTH: 3 ft

PLATE A-5.1

Grain Size Distribution

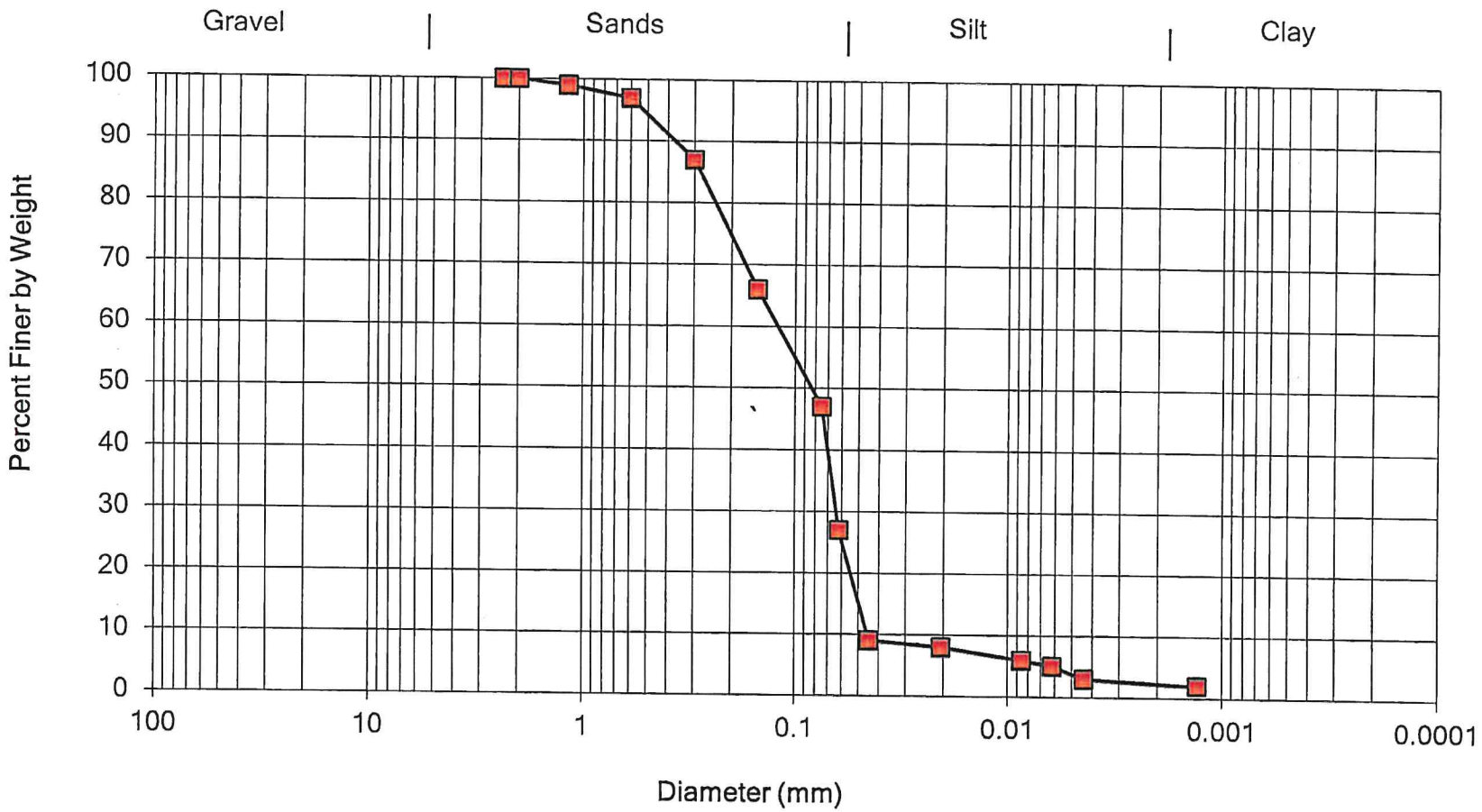


Location B-1
Depth:1.5-20 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.1

Grain Size Distribution

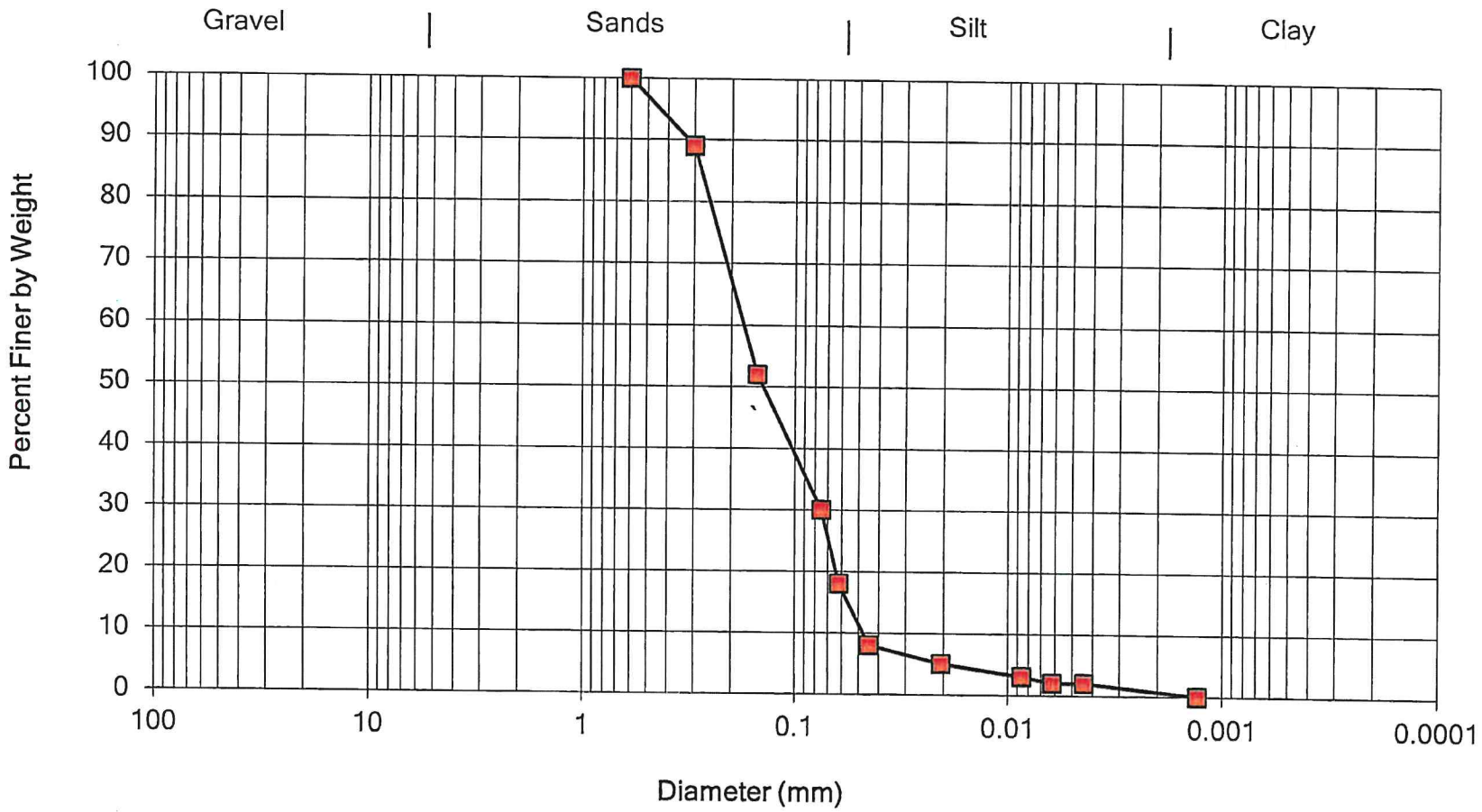


Location B-2
Depth:1.5-5 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.2

Grain Size Distribution

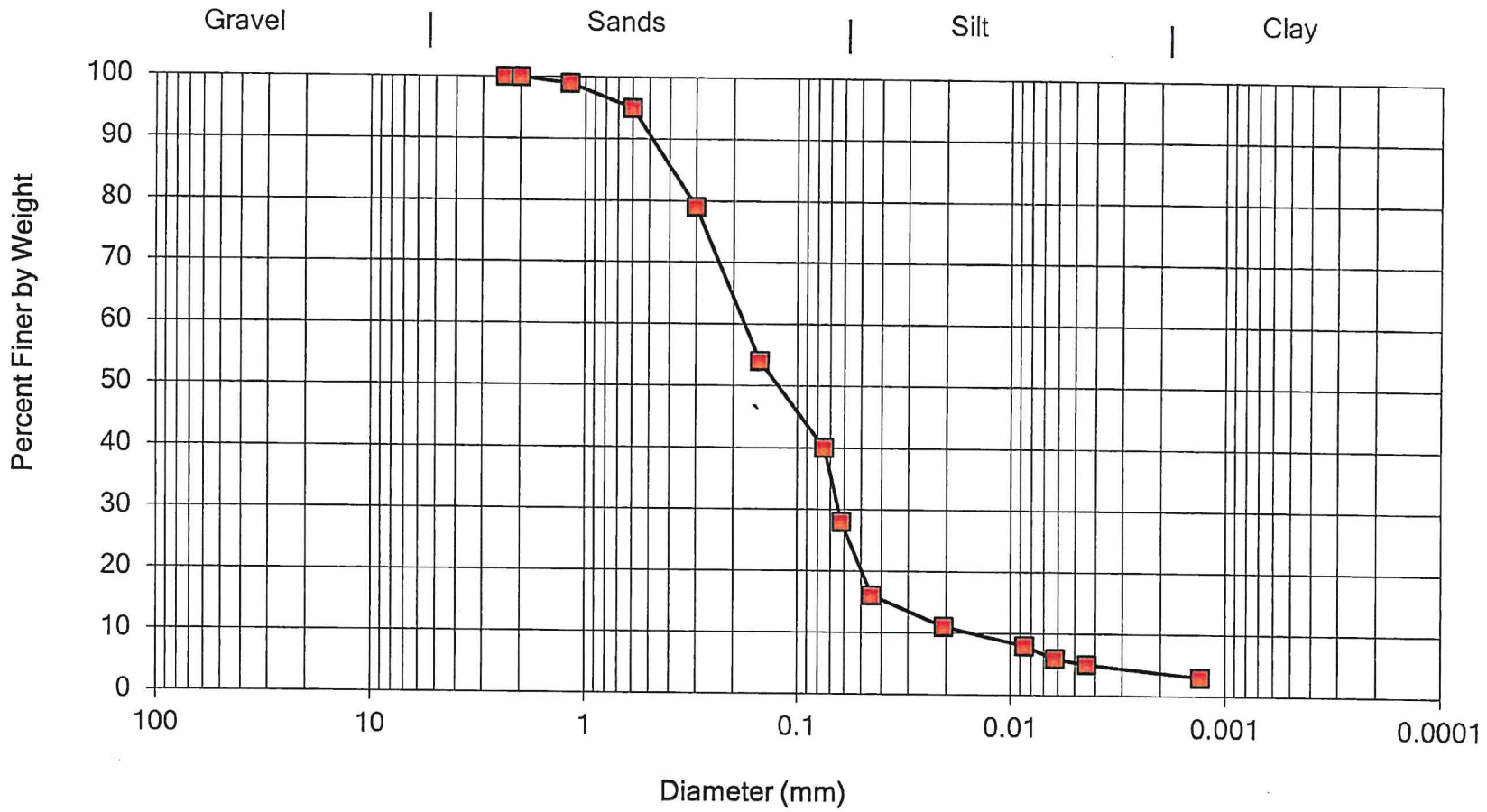


Location B-2
Depth:10 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.3

Grain Size Distribution

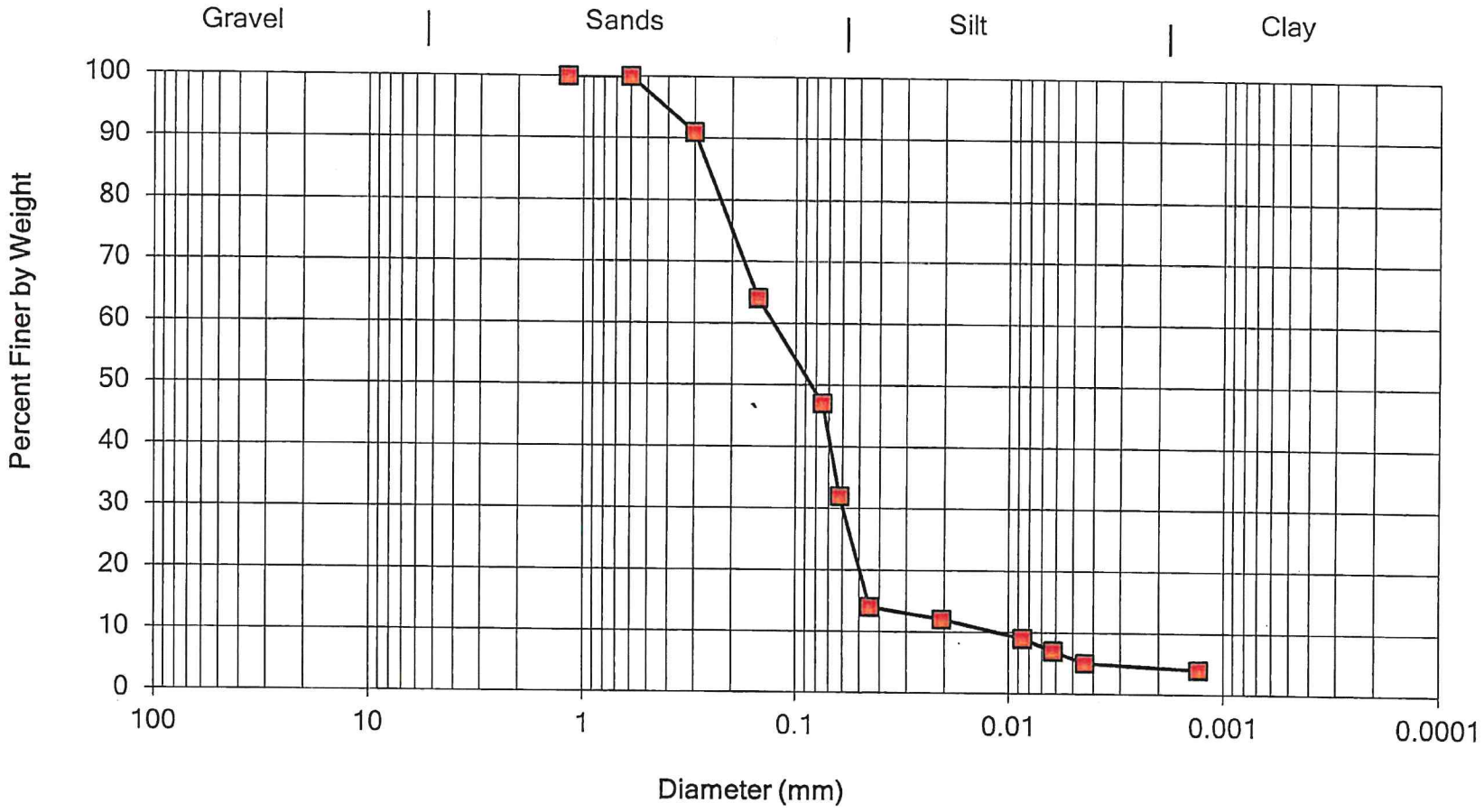


Location B-3
Depth:2 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.4

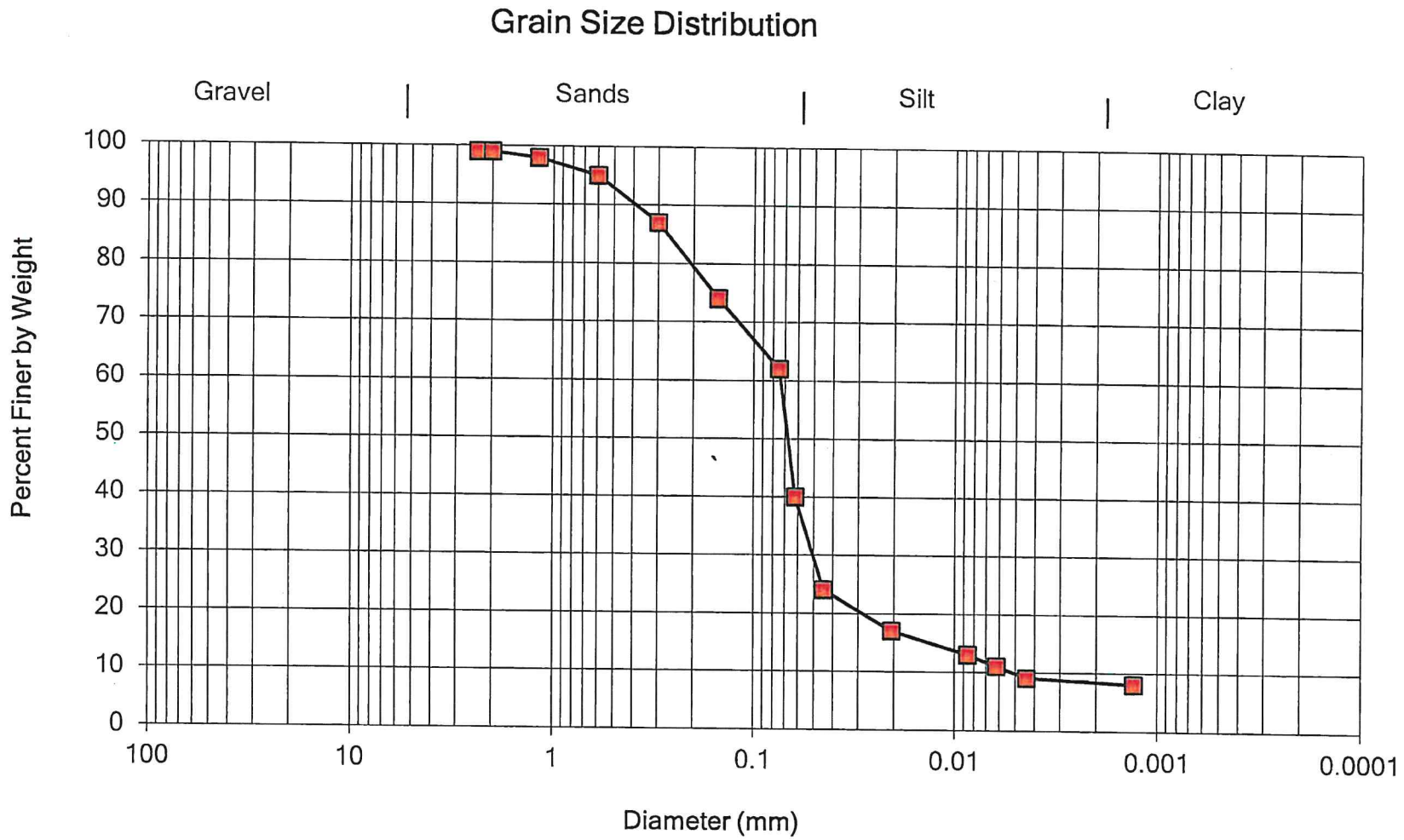
Grain Size Distribution



Location B-3
Depth:5-10 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.5

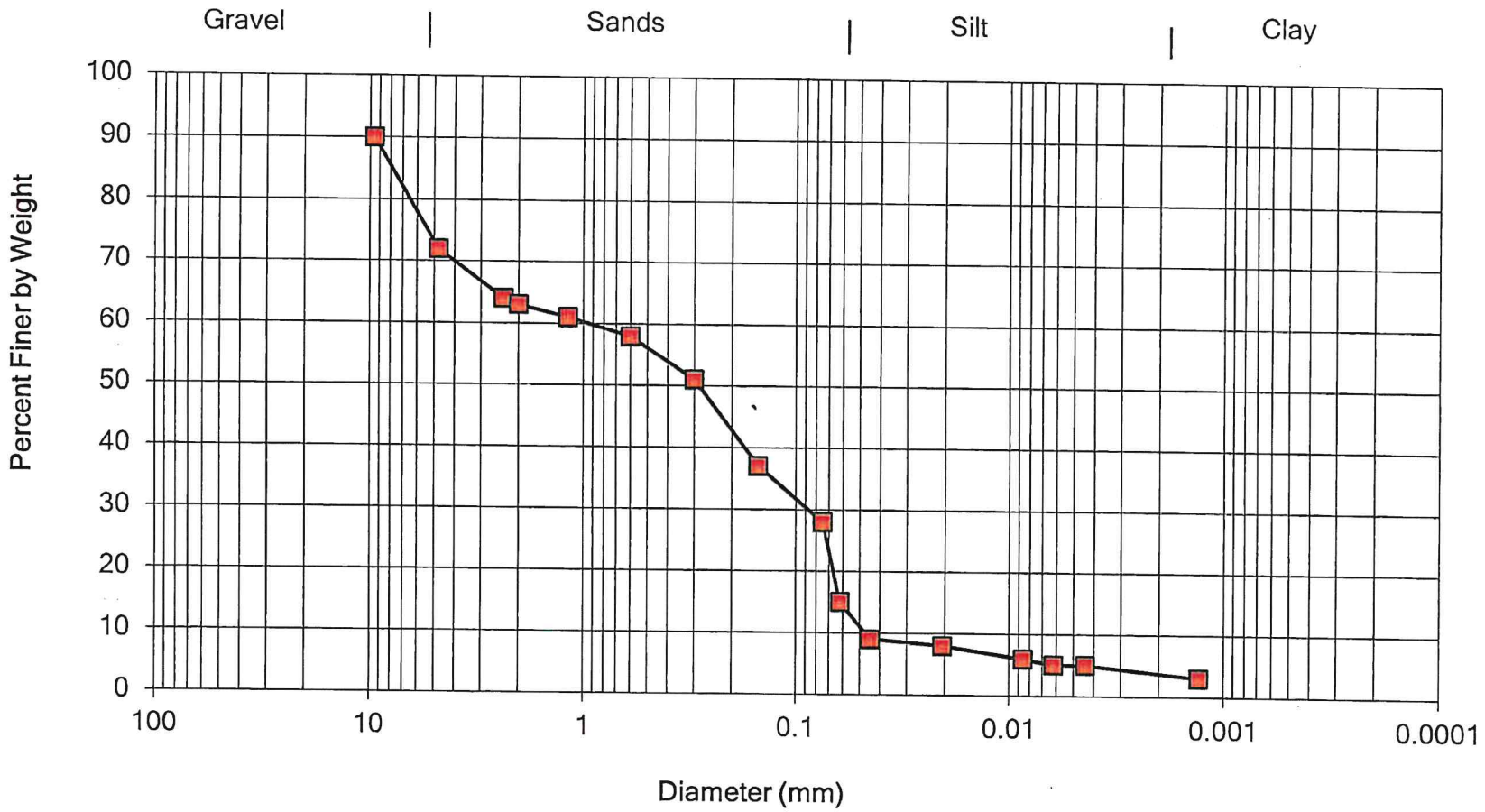


Location B-3
Depth:15-20 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.6

Grain Size Distribution

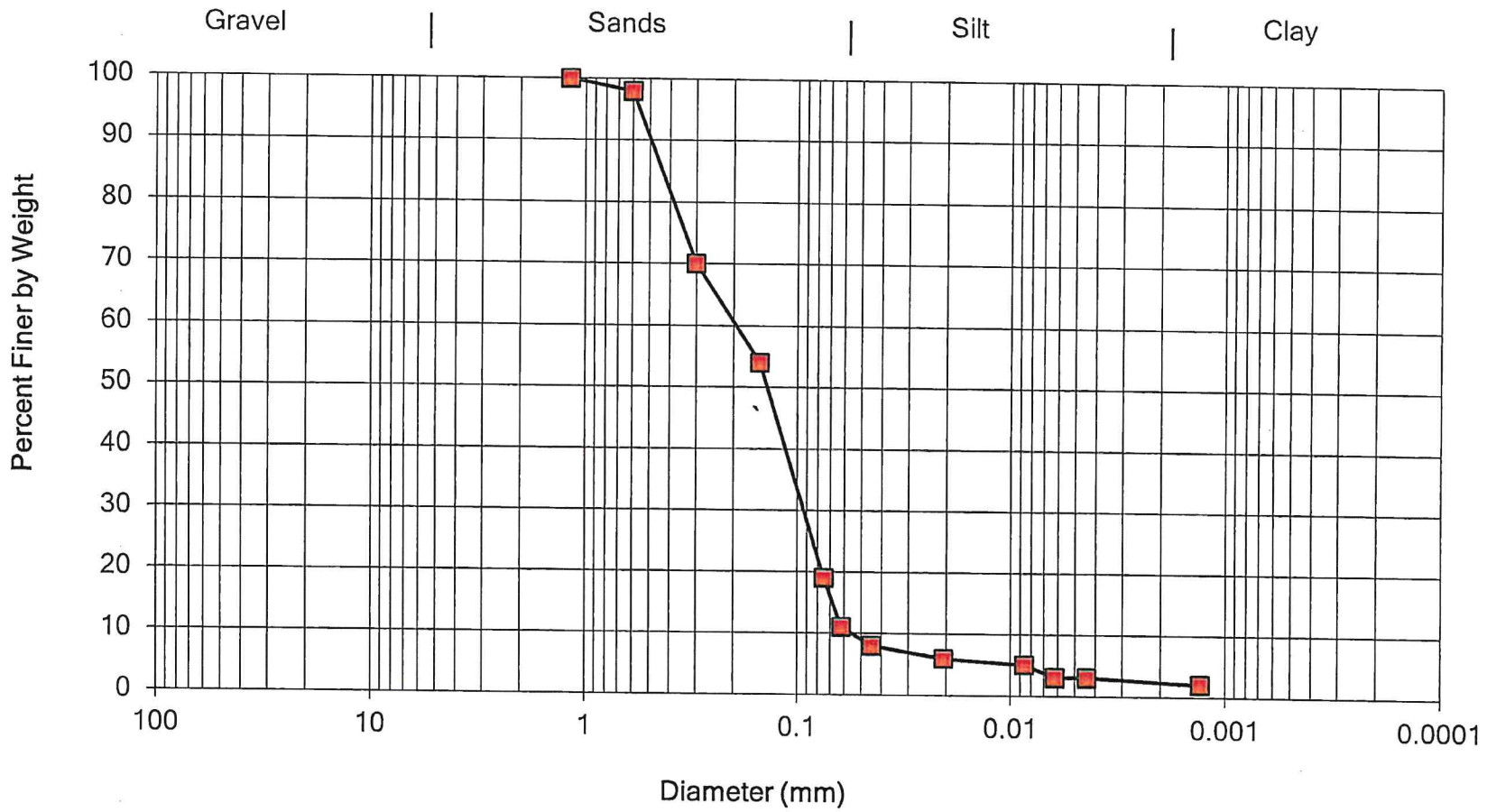


Location B-3
Depth:25-30 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.7

Grain Size Distribution



Location B-3
Depth:35-50 ft

WO/3007/GRIN SIZE DIST FOR SOIL REPORT

Plate A-6.8

Enclosure A

Seismic Design Criteria

OSHPD

383 North Patterson Avenue

Latitude, Longitude: 34.443369, -119.08642

Date	1/25/2020, 3:49:11 PM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Stiff Soil

Type	Value	Description
S_S	2.002	MCE_R ground motion. (for 0.2 second period)
S_1	0.768	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.002	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.335	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	0.882	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	0.97	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.002	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.259	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.335	Factored deterministic acceleration value. (0.2 second)
S1RT	0.768	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.866	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.841	Factored deterministic acceleration value. (1.0 second)
PGAd	0.963	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.886	Mapped value of the risk coefficient at short periods
C_{R1}	0.887	Mapped value of the risk coefficient at a period of 1 s

DISCLAIMER

While the information presented on this website is believed to be correct, SEAOC /OSHPD and its sponsors and contributors assume no responsibility or liability for its accuracy. The material presented in this web application should not be used or relied upon for any specific application without competent examination and verification of its accuracy, suitability and applicability by engineers or other licensed professionals. SEAOC / OSHPD do not intend that the use of this information replace the sound judgment of such competent professionals, having experience and knowledge in the field of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the results of the seismic data provided by this website. Users of the information from this website assume all liability arising from such use. Use of the output of this website does not imply approval by the governing building code bodies responsible for building code approval and interpretation for the building site described by latitude/longitude location in the search results of this website.

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Dynamic: Conterminous U.S. 2014 (upda...

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.443369

Time Horizon

Return period in years

2475

Longitude

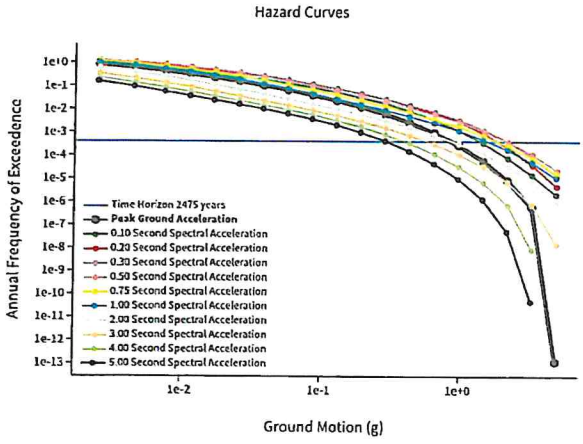
Decimal degrees, negative values for western longitudes

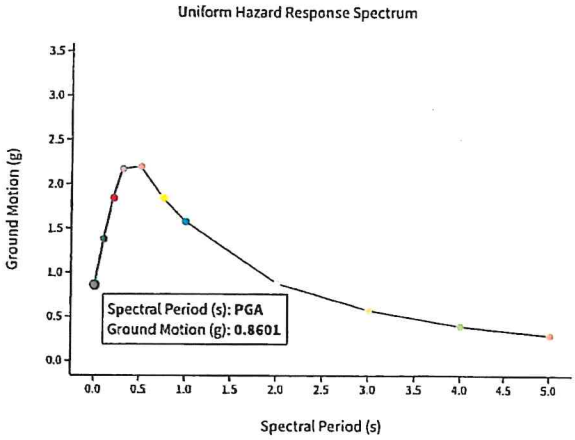
-119.08642

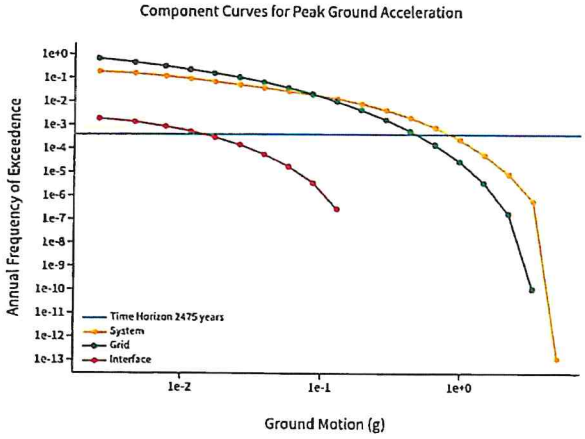
Site Class

259 m/s (Site class D)

Hazard Curve





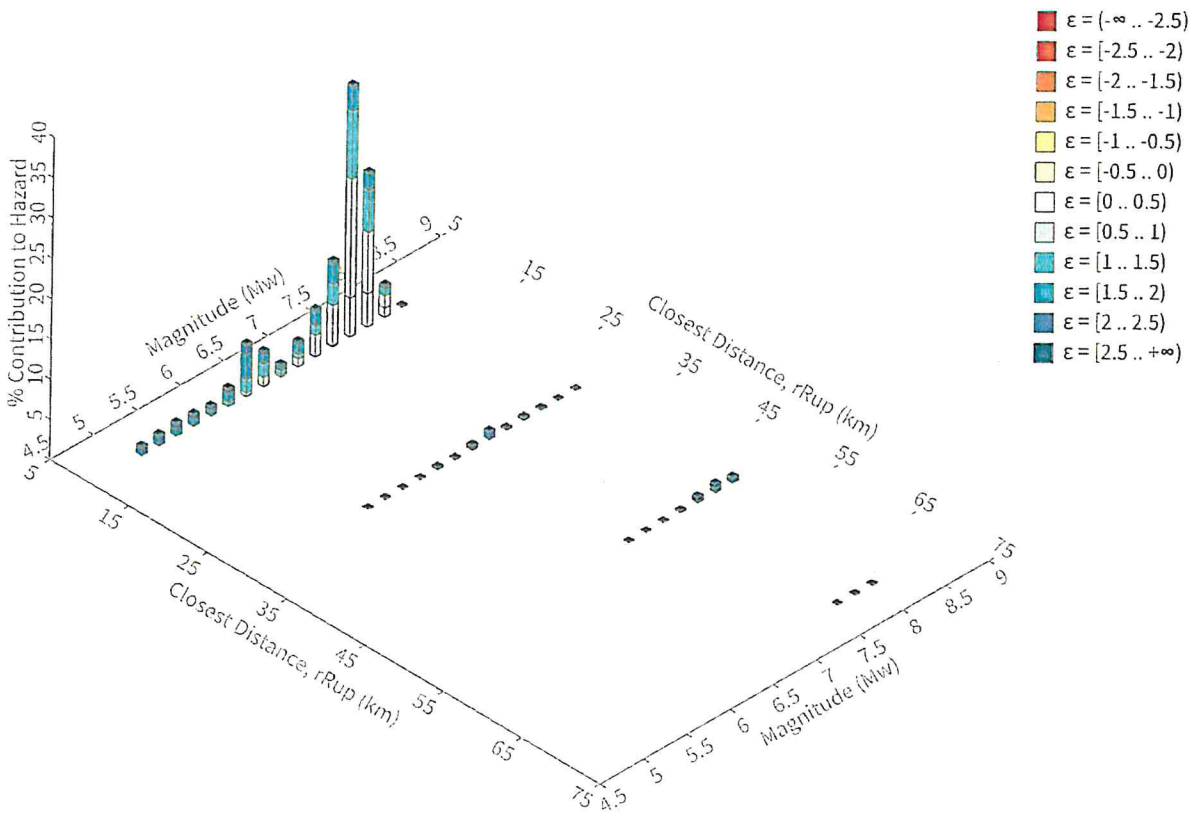


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.86012968 g

Recovered targets

Return period: 2925.227 yrs
Exceedance rate: 0.00034185381 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.06 %

Mean (over all sources)

m: 7.21
r: 6.9 km
ε_0: 1.22 σ

Mode (largest m-r bin)

m: 7.52
r: 3.86 km
ε_0: 0.91 σ
Contribution: 31.11 %

Mode (largest m-r-ε_0 bin)

m: 7.52
r: 2.92 km
ε_0: 0.74 σ
Contribution: 14.7 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ϵ_0	lon	lat	az	%
UC33brAvg_FM31	System							45.30
San Cayetano [3]		1.81	7.50	0.80	119.089°W	34.451°N	342.77	16.02
San Cayetano [2]		3.76	7.55	0.82	119.049°W	34.443°N	91.16	9.77
Sisar [1]		4.52	7.67	0.97	119.080°W	34.406°N	171.90	3.45
Ventura-Pitas Point [0]		6.72	6.59	1.19	119.053°W	34.394°N	150.71	3.44
Oak Ridge (Onshore) [2]		12.21	7.51	1.63	119.036°W	34.345°N	156.92	2.81
Santa Ynez (East) [7]		10.45	7.32	1.42	119.110°W	34.537°N	348.26	2.52
Santa Ynez (East) [8]		12.02	6.33	2.01	119.048°W	34.548°N	16.98	1.46
Oak Ridge (Onshore) [1]		12.21	7.10	1.85	119.036°W	34.345°N	156.92	1.25
San Andreas (Big Bend) [5]		43.10	8.10	2.54	119.005°W	34.825°N	9.93	1.09
UC33brAvg_FM32	System							43.63
San Cayetano [3]		1.81	7.47	0.80	119.089°W	34.451°N	342.77	17.66
San Cayetano [2]		3.76	7.51	0.84	119.049°W	34.443°N	91.16	8.76
Oak Ridge (Onshore) [2]		12.21	7.44	1.67	119.036°W	34.345°N	156.92	3.18
Sisar [1]		4.52	7.63	0.98	119.080°W	34.406°N	171.90	3.14
Santa Ynez (East) [7]		10.45	7.29	1.44	119.110°W	34.537°N	348.26	2.88
Ventura-Pitas Point [0]		6.72	6.80	1.12	119.053°W	34.394°N	150.71	1.57
Santa Ynez (East) [8]		12.02	6.32	2.01	119.048°W	34.548°N	16.98	1.49
San Andreas (Big Bend) [5]		43.10	8.10	2.54	119.005°W	34.825°N	9.93	1.08
Oak Ridge (Onshore) [1]		12.21	7.03	1.90	119.036°W	34.345°N	156.92	1.08
UC33brAvg_FM32 (opt)	Grid							5.54
PointSourceFinite: -119.086, 34.484		6.70	5.72	1.73	119.086°W	34.484°N	0.00	1.23
PointSourceFinite: -119.086, 34.484		6.70	5.72	1.73	119.086°W	34.484°N	0.00	1.23
UC33brAvg_FM31 (opt)	Grid							5.54
PointSourceFinite: -119.086, 34.484		6.70	5.72	1.73	119.086°W	34.484°N	0.00	1.23
PointSourceFinite: -119.086, 34.484		6.70	5.72	1.73	119.086°W	34.484°N	0.00	1.23

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

^ Input

Edition

Dynamic: Conterminous U.S. 2014 (upda...

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.443369

Time Horizon

Return period in years

475

Longitude

Decimal degrees, negative values for western longitudes

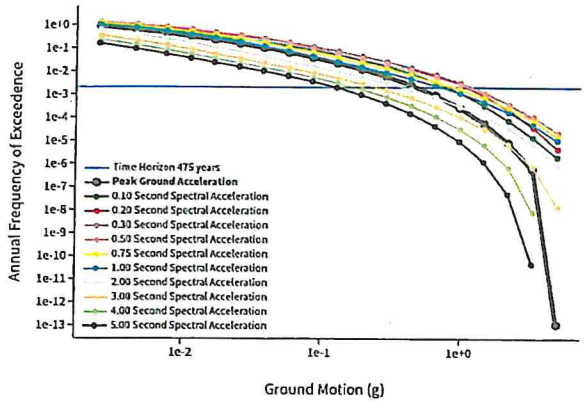
-119.08642

Site Class

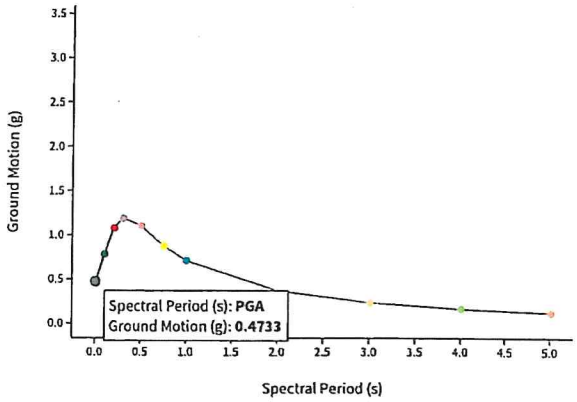
259 m/s (Site class D)

^ Hazard Curve

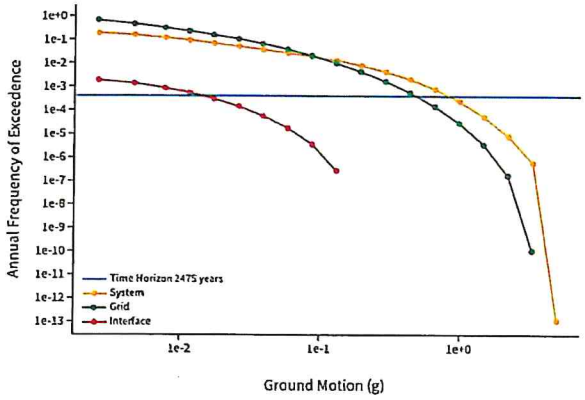
Hazard Curves



Uniform Hazard Response Spectrum



Component Curves for Peak Ground Acceleration

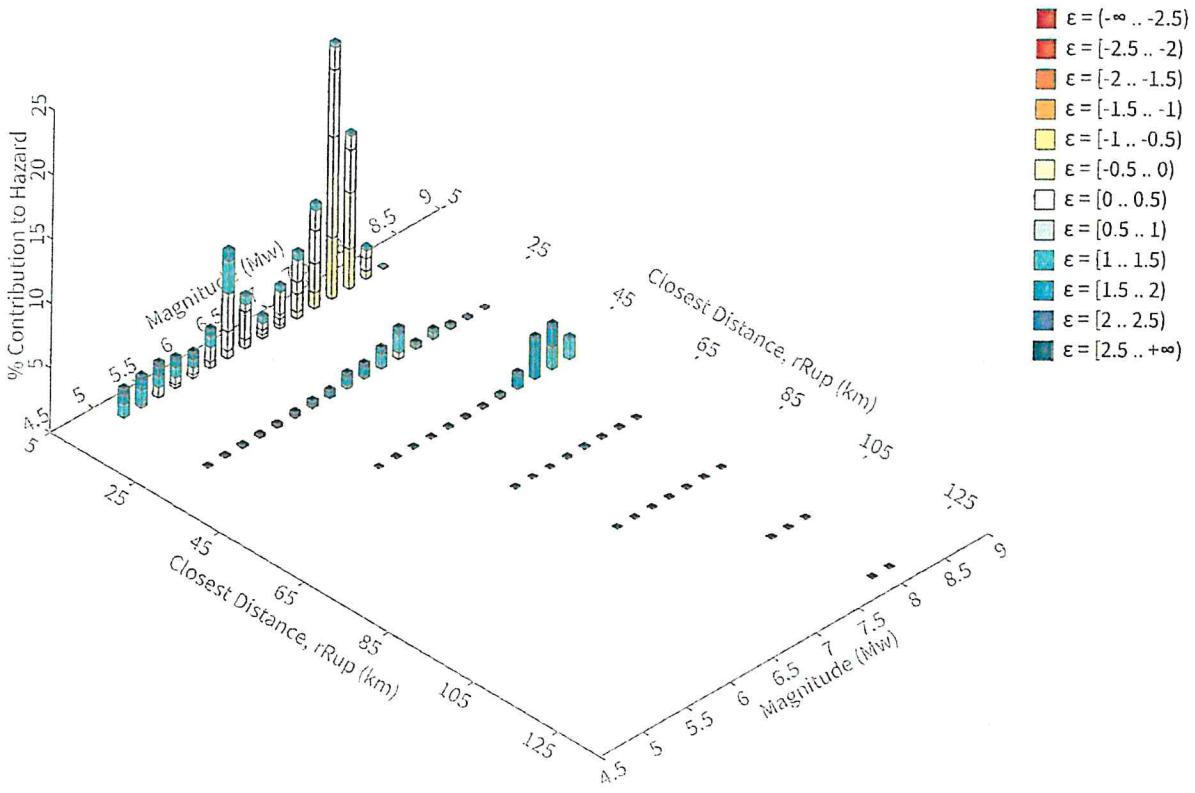


View Raw Data

^ Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 475 yrs
Exceedance rate: 0.0021052632 yr^{-1}
PGA ground motion: 0.47330242 g

Recovered targets

Return period: 503.53177 yrs
Exceedance rate: 0.001985972 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.12 %

Mean (over all sources)

m: 7.04
r: 12.98 km
ε_0: 0.64 σ

Mode (largest m-r bin)

m: 7.52
r: 4.61 km
ε_0: -0.11 σ
Contribution: 19.75 %

Mode (largest m-r-ε_0 bin)

m: 7.52
r: 2.87 km
ε_0: -0.2 σ
Contribution: 7.78 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							40.58
San Cayetano [3]		1.81	7.49	-0.28	119.089°W	34.451°N	342.77	9.10
San Cayetano [2]		3.76	7.54	-0.30	119.049°W	34.443°N	91.16	5.58
San Andreas (Big Bend) [5]		43.10	8.04	1.59	119.005°W	34.825°N	9.93	3.87
Oak Ridge (Onshore) [2]		12.21	7.47	0.57	119.036°W	34.345°N	156.92	3.22
Ventura-Pitas Point [0]		6.72	6.58	0.09	119.053°W	34.394°N	150.71	2.63
Santa Ynez (East) [7]		10.45	7.26	0.41	119.110°W	34.537°N	348.26	2.40
Santa Ynez (East) [8]		12.02	6.33	1.07	119.048°W	34.548°N	16.98	2.35
Sisar [1]		4.52	7.67	-0.13	119.080°W	34.406°N	171.90	2.23
Red Mountain [0]		22.09	7.21	1.27	119.304°W	34.347°N	241.84	1.92
Oak Ridge (Onshore) [1]		12.21	7.08	0.77	119.036°W	34.345°N	156.92	1.74
UC33brAvg_FM32	System							40.18
San Cayetano [3]		1.81	7.46	-0.28	119.089°W	34.451°N	342.77	10.05
San Cayetano [2]		3.76	7.50	-0.27	119.049°W	34.443°N	91.16	5.08
San Andreas (Big Bend) [5]		43.10	8.04	1.59	119.005°W	34.825°N	9.93	3.87
Oak Ridge (Onshore) [2]		12.21	7.40	0.61	119.036°W	34.345°N	156.92	3.76
Santa Ynez (East) [7]		10.45	7.23	0.44	119.110°W	34.537°N	348.26	2.79
Santa Ynez (East) [8]		12.02	6.31	1.08	119.048°W	34.548°N	16.98	2.42
Sisar [1]		4.52	7.63	-0.11	119.080°W	34.406°N	171.90	2.05
Red Mountain [0]		22.09	7.12	1.36	119.304°W	34.347°N	241.84	1.72
Oak Ridge (Onshore) [1]		12.21	7.01	0.82	119.036°W	34.345°N	156.92	1.58
Ventura-Pitas Point [0]		6.72	6.77	0.04	119.053°W	34.394°N	150.71	1.14
UC33brAvg_FM31 (opt)	Grid							9.63
PointSourceFinite: -119.086, 34.484		6.78	5.65	0.85	119.086°W	34.484°N	0.00	1.34
PointSourceFinite: -119.086, 34.484		6.78	5.65	0.85	119.086°W	34.484°N	0.00	1.34
UC33brAvg_FM32 (opt)	Grid							9.61
PointSourceFinite: -119.086, 34.484		6.78	5.65	0.85	119.086°W	34.484°N	0.00	1.34
PointSourceFinite: -119.086, 34.484		6.78	5.65	0.85	119.086°W	34.484°N	0.00	1.34

Enclosure B

NRCS Soils Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Santa Barbara County, California, South Coastal Part

383 North Patterson Avenue, Goleta, CA

January 22, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Preface 2
How Soil Surveys Are Made 5
Soil Map 8
Soil Map (383 North Patterson Avenue, Goleta, CA) 9
Legend 10
Map Unit Legend (383 North Patterson Avenue, Goleta, CA) 11
Map Unit Descriptions (383 North Patterson Avenue, Goleta, CA) 11
Santa Barbara County, California, South Coastal Part 13
EaA—Elder sandy loam, 0 to 2 percent slopes, MLRA 14 13
Soil Information for All Uses 16
Soil Properties and Qualities 16
Soil Qualities and Features 16
Hydrologic Soil Group (383 North Patterson Avenue, Goleta, CA) 16
Soil Reports 21
AOI Inventory 21
Component Legend (383 North Patterson Avenue, Goleta, CA) 21
References 22

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

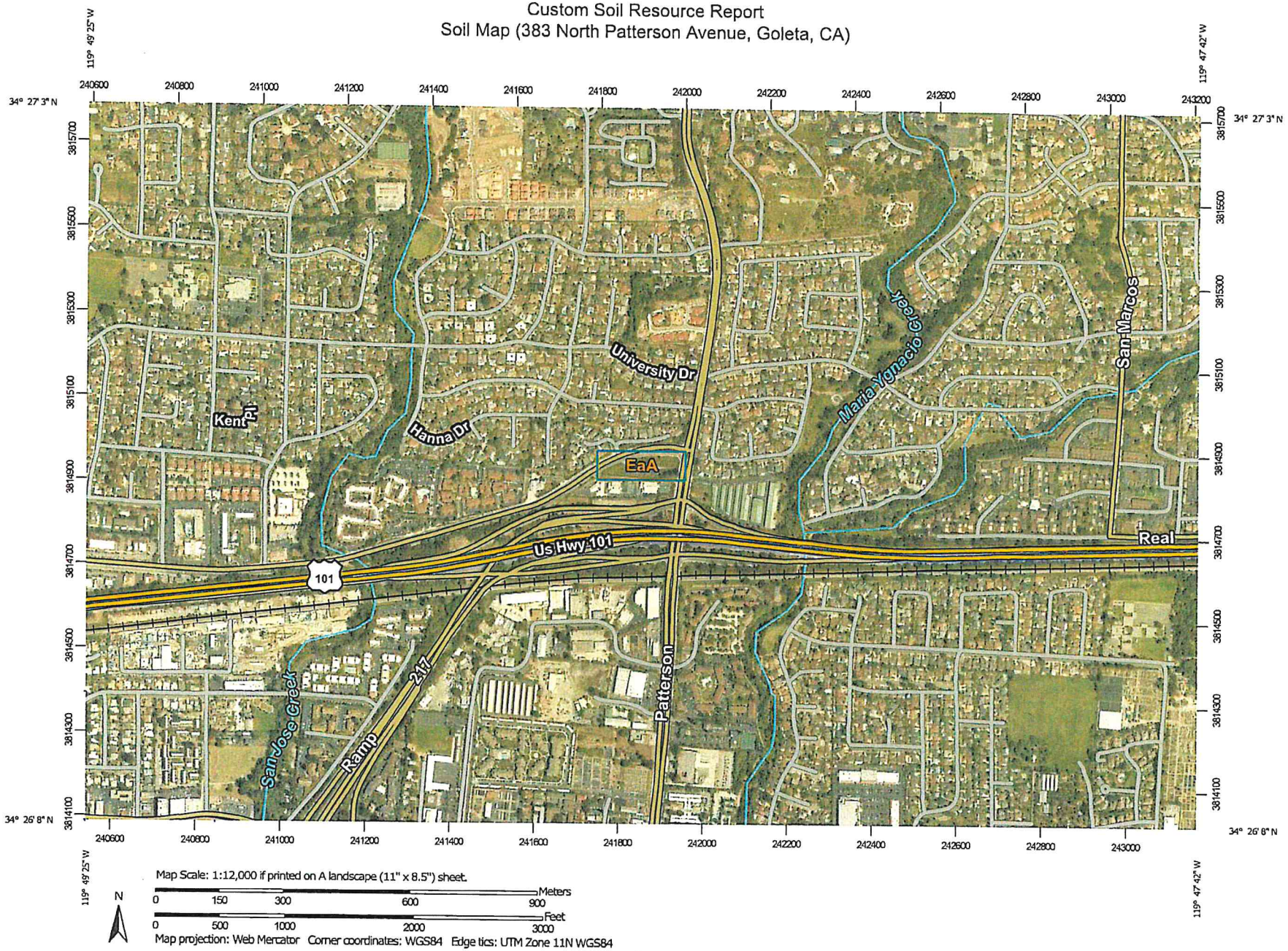
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map (383 North Patterson Avenue, Goleta, CA)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Barbara County, California, South Coastal Part
Survey Area Data: Version 12, Sep 17, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 12, 2018—May 7, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend (383 North Patterson Avenue, Goleta, CA)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
EaA	Elder sandy loam, 0 to 2 percent slopes, MLRA 14	3.6	100.0%
Totals for Area of Interest		3.6	100.0%

Map Unit Descriptions (383 North Patterson Avenue, Goleta, CA)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The

delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Santa Barbara County, California, South Coastal Part

EaA—Elder sandy loam, 0 to 2 percent slopes, MLRA 14

Map Unit Setting

National map unit symbol: 2tyyj
Elevation: 50 to 1,570 feet
Mean annual precipitation: 11 to 29 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 300 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Elder and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Elder

Setting

Landform: Alluvial fans, flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

Ap - 0 to 8 inches: sandy loam
A - 8 to 23 inches: sandy loam
AC - 23 to 31 inches: sandy loam
C - 31 to 60 inches: sandy loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.83 to 9.92 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.6 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: A
Ecological site: LOAMY BOTTOMLAND (R014XY001CA)
Hydric soil rating: No

Minor Components

Gorgonio

Percent of map unit: 4 percent

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Arroyo seco

Percent of map unit: 4 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Elkhorn, sandy loam

Percent of map unit: 2 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Xerofluvents, sand

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Watsonville, loam

Percent of map unit: 1 percent
Landform: Marine terraces
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Baywood, loamy sand

Percent of map unit: 1 percent
Landform: Dunes
Landform position (two-dimensional): Backslope, toeslope
Landform position (three-dimensional): Tread, rise
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Metz, loamy sand

Percent of map unit: 1 percent
Landform: Flood plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

San emigdio, sandy loam

Percent of map unit: 1 percent
Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (383 North Patterson Avenue, Goleta, CA)

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

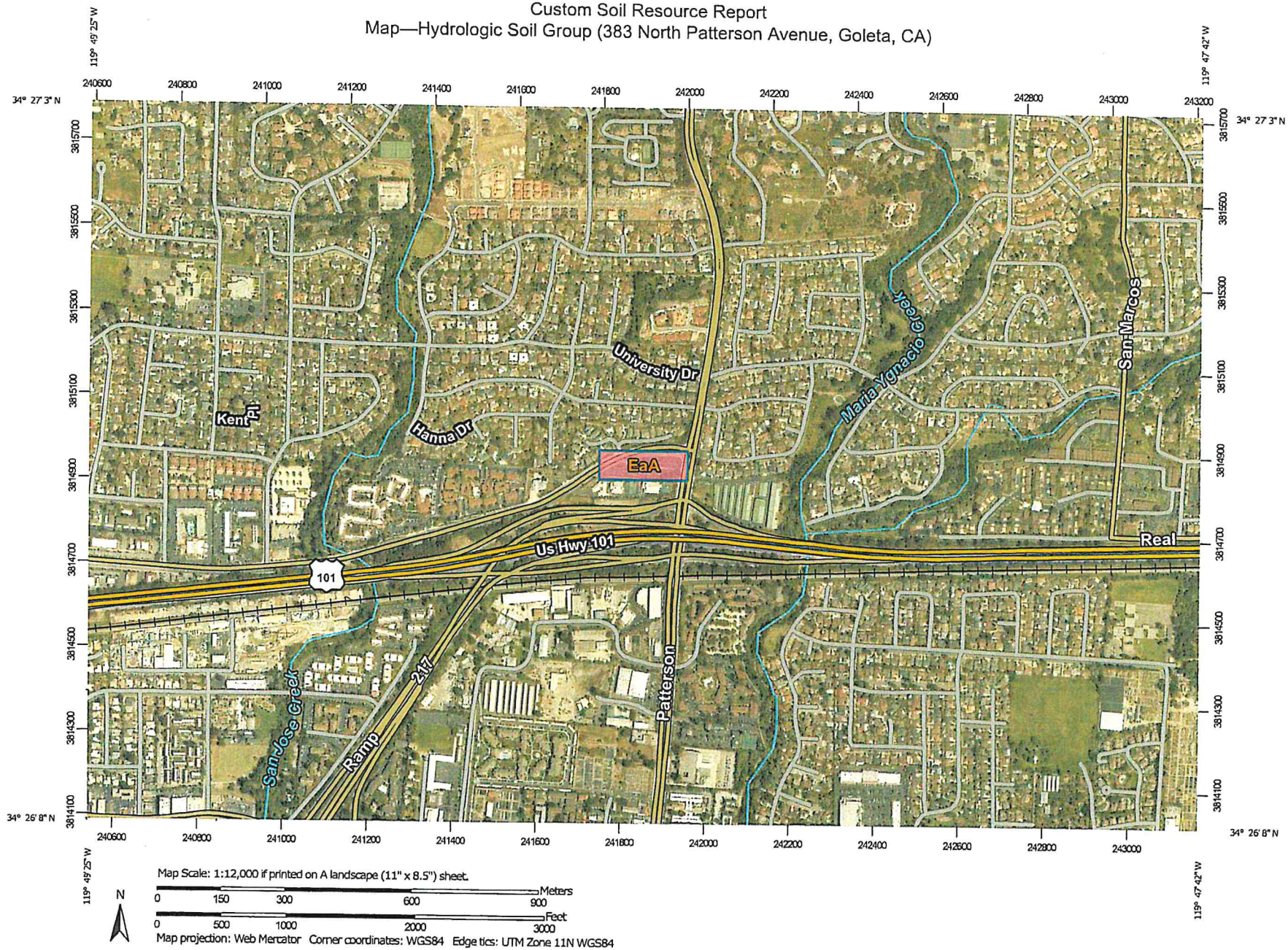
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group (383 North Patterson Avenue, Goleta, CA)



MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Santa Barbara County, California, South Coastal Part
Survey Area Data: Version 12, Sep 17, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 12, 2018—May 7, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group (383 North Patterson Avenue, Goleta, CA)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
EaA	Elder sandy loam, 0 to 2 percent slopes, MLRA 14	A	3.6	100.0%
Totals for Area of Interest			**3.6**	**100.0%**

Rating Options—Hydrologic Soil Group (383 North Patterson Avenue, Goleta, CA)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Reports

The Soil Reports section includes various formatted tabular and narrative reports (tables) containing data for each selected soil map unit and each component of each unit. No aggregation of data has occurred as is done in reports in the Soil Properties and Qualities and Suitabilities and Limitations sections.

The reports contain soil interpretive information as well as basic soil properties and qualities. A description of each report (table) is included.

AOI Inventory

This folder contains a collection of tabular reports that present a variety of soil information. Included are various map unit description reports, special soil interpretation reports, and data summary reports.

Component Legend (383 North Patterson Avenue, Goleta, CA)

This report presents general information about the map units and map unit components in the selected area. It shows map unit symbols and names and the components in each map unit. It also shows the percent of the components in the map units, the kind of component, and the slope range of each component.

Report—Component Legend (383 North Patterson Avenue, Goleta, CA)

Component Legend–Santa Barbara County, California, South Coastal Part							
Map unit symbol and name	Map unit acres	Pct. of map unit	Component name	Component kind	Pct. slope		
					Low	RV	High
EaA—Elder sandy loam, 0 to 2 percent slopes, MLRA 14	1,693						
		85	Elder	Series	0.0	1.0	2.0

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf