APPENDIX D

SUBSURFACE EXPLORATIONS AND GEOTECHNICAL INVESTIGATION

TERRADYNE
Engineers, Geologists & Environmental Scientists

Subsurface Explorations & Geotechnical Investigation

Proposed AutoZone Store #3658
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

AutoZone, Inc.
123 S. Front Street
Memphis, TN 38103

Mr. Robert DeGraaf
Sweetgum Environmental
Plant City, Florida

Terradyne Project No: L201011 **March 10, 2020**

Terradyne Engineering, Inc.
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TERRADYNE
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Re: **Subsurface Explorations & Geotechnical Investigation Report**
Proposed AutoZone Store #3658 at:
Near Ranchero Road and Escondido Ave,
Oak Hills, San Bernardino County, CA 92344
Terradyne Project No.: L201011

Dear Mr. DeGraaf,

In accordance with your request, Terradyne, Inc., Inc. has performed a geotechnical investigation at the subject site. The purpose of our investigation was to evaluate the geotechnical conditions at the site in the areas of proposed construction and to provide geotechnical parameters for design and construction.

Based on our investigation, it is our opinion that the proposed construction is feasible from the geotechnical standpoint provided the recommendations contained herein are incorporated into the project plans and specifications. This report should be reviewed in detail prior to proceeding further with the planned development.

We appreciate and wish to thank you for the opportunity to serve you on this project. Please do not hesitate to contact us if we can be of additional assistance during the Construction Materials Testing and Quality Control phases of construction.

Respectfully Submitted,
Terradyne Engineering, Inc.

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EXECUTIVE SUMMARY

The soil conditions at the site of the proposed Auto Zone Store #3658 located at Ranchero Road and Escondido Avenue, San Bernardino County, California were explored by drilling eight (8) borings up to the maximum depth of 16.5-ft below existing grade. Laboratory tests were performed on selected samples to evaluate the engineering characteristics of various soil strata encountered in our borings.

This report presents a description of subsurface conditions encountered at the site, recommended foundation systems, and design and construction criteria influenced by the subsurface conditions. It is based on data obtained from field investigations, laboratory test results and our previous experience with similar sites.

- Based on our California Geological Survey (CGS) research, the seismic hazard information (Plate F, Appendix A) pertaining to the subject site as follows:

1) This parcel (APN: 0357-42-103) is not within an Earthquake Fault Zone
2) This parcel (APN: 0357-42-103) has not been evaluated by CGS for seismic landslide hazards
3) This parcel (APN: 0357-42-103) has not been evaluated by CGS for liquefaction hazards

- Our review of the available references indicate that the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude M_W6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site. The San Bernardino Valley section of the San Jacinto Fault Zone located at approximately 10.2 miles to the southwest of the site at the closest point. As noted above the subject property is not within a State of California Fault Zone (CGS, 2018).

- Foundation support for the new AutoZone store building could be derived by utilizing a rigid shallow conventional continuous or spread foundation system embedded within the newly placed fill compacted to 95%. For the design of the structure, modulus of subgrade reaction (k_1) of 100 psi/in is recommended. An allowable bearing capacity of 2000 psf may be used for foundation bearing on in-situ soil. The upper five (5) feet of subgrade within the building should be over excavated and recompacted to 95%. The excavation should also be extended five (5) feet outside the building footprint.

- From a geotechnical standpoint, we are of the opinion that the proposed construction/site grading is not expected to have an adverse impact on adjacent properties and vice versa.

- Ground water was not encountered in our borings during field exploration on February 25, 2020.

Detailed descriptions of subsurface conditions, engineering analysis, and design recommendations are included in this report.

1.0 INTRODUCTION

Terradyne Engineering Inc., conducted an onsite field exploration on February 25, 2020 that included drilling, logging and sampling of eight (8) hollow stem auger geotechnical borings to a maximum depth of 16.5 feet below existing elevations for the proposed Auto Zone Store #3658 development located at approximately 300 feet east of the intersection of Ranchero Road and Escondido Avenue along the south side of Ranchero Road in the City of Hesperia, San Bernardino County, California.

This report describes: the evaluation performed; the results and opinions of the findings; and Terradyne Engineering Inc., geotechnical recommendations for design and construction of the proposed structures.

This project was authorized by Mr. Robert DeGraaf of Sweetgum Environmental.

2.0 PROPOSED CONSTRUCTION

The project will involve the construction of a one-story AutoZone retail Store and associated appurtenant structures, walkways and pavement areas. For this project, Auto Zone created a parcel of approximately +/- 40,000 sf (approximately 200 feet x 200 feet) from a larger parcel with APN 0357-42-103. The planned construction will require minor cuts/fills to achieve the proposed subgrades. The estimated maximum column load for the new one-story retail store building is 75 kips, and the line load is about 3 kips per lineal feet.

3.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our geotechnical investigation was based upon the planning information provided to us by the client, and consisted of field, laboratory and engineering evaluation of the site's subsurface soil and groundwater conditions and provide geotechnical engineering recommendations for the design and construction of the proposed building and associated improvements. Our scope of services includes the following:

1) Review of readily available documents pertinent to the subject site (Appendix A).

2) The excavation and sampling of eight (8) exploratory engineering borings to a maximum depth of 16.5-ft below existing ground elevations. The borings were excavated in the vicinity of the proposed building structure and parking areas. The soils encountered in the excavations were logged by our field Geologist and relatively

undisturbed and bulk samples were collected at selected intervals in the various soil types to the maximum depth of the exploration.

3) Laboratory analysis of the collected samples.

4) Observation of the groundwater conditions during drilling operations.

5) Geotechnical analysis of the data and information obtained according to the project requirements; and

6) Preparation of this report presenting our findings, conclusions and recommendations, pertinent to the proposed building and paving sections for drive and parking areas.

The Scope of Services does not include percolation/infiltration assessment nor environmental assessment of the presence or absence of wetlands and/or hazardous or toxic materials in the soil, surface water, groundwater, or air, in the proximity of this site. Any statements in this report or on the boring logs regarding odors, colors or unusual or suspicious items or conditions are strictly for the information of the client.

4.0 SITE DESCRIPTION

Based on review of the property details provided, the parcel under investigation consists of an undeveloped partition of land located to the southeast of the intersection of Ranchero Road and Escondido Avenue in the City of Hesperia, San Bernardino County California (APN Number 0357-42-103). It is composed of a roughly square shaped lot which is currently undeveloped with native flora covering the majority of the lot. Site Topography grades gently to the northeast with site elevations ranging from approximately +3675 to +3681 feet above mean sea level. It is our understanding that the proposed structures are to be constructed at elevations similar to those currently existing at the subject site.

Review of the USGS Hesperia, California 7.5-minute topographic quadrangle (Plate D, Appendix A) and the Google Earth Pro® database indicates the subject property is located on a distal alluvial fan emanating from the San Gabriel Mountains to the south and southwest. The subject property is approximately situated at 34.38279° north latitude and 117.37162° west longitude (Google Earth Pro®, 2018).

5.0 GEOTECHNICAL INVESTIGATION

The field exploration by Terradyne Engineering Inc., was completed on February 25, 2020. Eight (8) hollow-stem auger borings were advanced to a maximum depth of 16.5 feet below ground surface. The locations of these exploratory borings (referenced as Boring-1 through Boring-8) are shown on the Approximate Boring Locations Map (Figure B, Appendix A).

The exploratory boring excavations were advanced using a truck mounted drill rig with an 8-inch diameter hollow-stem auger. Drive samples recovered from all borings, were obtained using a Modified California Drive Sampler (2.5-inches inside diameter and 3-inches outside diameter) with thin brass liners, and a Standard Penetrometer (2-inches outside diameter and 1-3/8-inches inside diameter). The samplers were driven 12 to 18 inches into the soil by a 140-pound hammer free-falling for a distance of 30-inches.

Representative bulk and relatively undisturbed samples were taken of earth materials encountered in this field investigation. Recovered samples were placed in transport containers and returned to our laboratory for further classification and testing. The soils classifications listed in the excavation logs are a result of visual classification of soil with field moisture content. The classifications were assigned in accordance with ASTM D-2488: "Description of Soils (Visual-Manual Method)" and all applicable field soil-identification procedures described therein. These may or may not correspond precisely to those indicated by subsequent laboratory methods. Classifications, made in the field from auger cuttings and drive samples, were verified in the laboratory after further examination and testing of samples.

All eight borings were backfilled with native soil on February 25, 2020. Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands (see Figure C, Appendix A).

The following samples, presented in Table 1, were collected as a part of our field exploration procedure:

Table 1

Type of Sample	Number Collected
Undisturbed Ring Samples	16
Bulk Sample	5

5.1 Regional Groundwater

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site. The nearest recorded wells by order of distance are:

Table 2

Well No.	Ground Elev. (ft. amsl)	Highest GW Depth.	Date	Latest GW Depth.	Date	Distance from Subject Site (mi.)
343958N1173757W001	+3616.8	750.0	01/01/1917	NA	NA	0.91 N
343836N1173490W001	+3560.9	735.0	04/25/1984	748.8	02/03/1996	1.2 E
343808N1173475W001	+3566	743.1	04/01/2010	745.6	05/01/2010	1.38 E

NOTES: Lowest subject site elevation approximately **+3675 msl (Google Earth 2019).
ft. amsl: feet above mean sea level. All measurements and distances are approximate

Groundwater seepage was not observed during drilling operations. Groundwater levels will fluctuate with seasonal climatic variations and changes in the land use. Soils with low permeability may require several days for groundwater to enter and stabilize in the boreholes. It is not unusual to encounter shallow groundwater during or after periods of rainfall. Surface water tends to percolate through the surface until it encounters a relatively imperious layer.

It should be noted that variations in subsurface water (including perched water zones and seepage) may result from fluctuations in the ground surface topography, subsurface stratification, precipitation, irrigation and other factors that may not have been evident at the time of our subsurface exploration.

5.2 Field Log

The field logs were prepared for the borings. These logs include information concerning the boring method, samples attempted and recovered, and the presence of various soil materials (such as silt, clay, gravel or sand) and groundwater observations. It also includes an interpretation of the subsurface conditions between samples. Therefore, these logs include both factual and interpretive information.

5.3 Presentation of the Data

The boring logs represent our interpretation of the field and laboratory soil classification of the samples obtained, it should be noted that conditions between borings locations may vary considerably and it should be expected that site conditions may or may not be precisely represented by any one of the borings. Soil deposition processes and topographic forming processes are such that soil and rock types and conditions may change in small vertical intervals and short horizontal distances. The boring log descriptions represent approximate changes in soil and rock composition, moisture, color and relative density. The final boring logs and key to classification terms and symbols are included in Appendix B.

5.4 General Subsurface Conditions

The soils underlying the site may be grouped into one generalized stratum with similar physical and engineering properties. The lines on the logs designating the interface between soil strata represent approximate boundaries. The transition between materials may be gradual. The soil stratigraphy at the boring locations is presented in the Boring Logs. The engineering characteristics of the underlying soils, based on our field and laboratory test results, are summarized and presented in Table 3.

Table 3

Stratum	Depth Range (feet)	Remarks
0'-16.5' Older ALLUVIUM (Qoa) Silty SAND, light brown to brown, loose to dense, slightly moist	0-16.5	No groundwater encountered

The above description generally highlights the major soil stratification features and soil characteristics. The boring logs should be consulted for specific information at the boring locations.

5.5 Laboratory Testing Program

In addition to field exploration, a supplemental laboratory testing program was conducted to determine additional pertinent engineering characteristics of the subsurface materials that are necessary to evaluate the soil parameters. These tests include:

1) Moisture Content & Density (ASTM D2216 & ASTM D2937)
2) Grain Size Distribution (ASTM D422)
3) Expansion Index (ASTM D4829)
4) One-Dimensional Consolidation (ASTM D2435)
5) Corrosion Potential (CT-417, CT-422, CT-532(643))
6) Direct Shear Test (ASTM D3080)

5.6 Soil Corrosion Potential

A near surface sample was tested to measure pH, soluble sulfate, soluble chloride and resistivity of the soil. The results are presented on Table 4.

Table 4

Sample Location/ Depth, (ft)	pH	Soluble Sulfate (PPM)	Soluble Chloride (PPM)	Soil Resistivity (Ohm-cm)
B-5/ 0-5.0	7.40	37	33	8,400

Sulfate Content

A representative near-surface soil sample was tested during our investigation for soluble sulfate content. The result of this test indicates a soluble sulfate content of (0.0037) percent by weight or negligible sulfate exposure. As such, the soils exposed are not expected to pose a significant potential for sulfate reaction with concrete. Per ACI 318-14 Table 19.3.1.1 the requirement of Exposure Category (S) and Class (S1) is applicable.

Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's pH level, electrical resistivity, and chloride content. In general, soil having a minimum resistivity less than 2,000 ohm-cm is considered corrosive. Soil with a chloride content of 500 ppm or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, a representative soil sample was tested during our investigation to determine soil resistivity, chloride content, and pH level. The soil resistivity measurement of the sample was over (8,400) ohm-cm, chloride content of approximately (33) ppm, and the pH level of approximately (7.40). The results indicate that the near surface soil at the site is considered mildly corrosive to ferrous metals and negligible degree of corrosivity to metals for Chloride Content. However, considering the site history, we recommend a standard level of corrosion protection measure to be considered in the design phase of the project.

Concrete

Laboratory test indicated that the subject site contains soil sulfate content in the negligible range (i.e., less than 150 part per million). However, it is recommended that concrete for all construction at the site utilize a widely available, Type-II Portland cement with a maximum 0.50 water/cement ratio and should comply with all the requirements of governing agencies and current applicable Code. The minimum compressive strength of concrete shall be 4000 psi at 28 days and maximum slump during placement shall be five inches. The minimum concrete cover should be 1.5-inches. Final selection of the appropriate concrete design should be made by the project structural engineer based on the local laws and ordinances, and desired level of conservatism.

6.0 FAULTING AND SEISMICITY

The principal seismic considerations for improvements at the subject site are surface rupture of fault traces, damage caused by ground shaking during a seismic event, and seismically-induced ground settlement. The potential for any or all of these hazards depends upon the recency of fault activity and the proximity of nearby faults to the subject site. The possibility of damage due to ground rupture is considered unlikely since no active faults are known to cross the site and no evidence of active faulting was noted during our investigation. Our review of the proper literature (CGS 2018) indicates that the subject site lies outside the present Earthquake Fault Zones, which are described in the Alquist-Priolo Earthquake Fault Zoning Act as being placed along active faults Based on the review of the available references (USGS), the mapped active fault nearest to the site is the San Bernardino Mountains section of the San Andreas Fault, located at approximately 9.1 miles from to the southwest of the subject site at the closest point, and described as capable of a Magnitude MW6.8 - 8.0 earthquake. Other mapped active faults near the subject site are the western section of North Frontal Thrust Fault system, located at approximately 9.4 miles to the east of the site and the San Bernardino Valley section of the San Jacinto Fault Zone, located at approximately 10.2 miles to the southwest of the site at the closest point.

Based on a review of a liquefaction study by the San Bernardino Valley Municipal Water District (GSS, 2011) the subject property is not located within an area of potential liquefaction. Due to the relatively flat topography the site is not susceptible earthquake induced landslides.

6.1 Seismic Design Parameters

The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in California. Design of the proposed improvements in accordance with current CBC requirements is intended to reduce the impact of seismic shaking on the proposed improvements. Recommended seismic design acceleration

parameters in accordance with the new 2020 California Building Code (CBC) and ASCE 7-16 are presented in Table 5 below (no accurate address for this project, applying the address of 7151 Escondido Avenue, Oak Hills, CA 92344).

Table 5

CBC DESIGN RESPONSE SPECTRUM PARAMETERS	
Latitude	34.380496 degrees north
Longitude	-117.372579 degrees west
Site Class	D – Stiff Soil
Seismic Design Category (SDC)	N/A
MCE_R Ground Motion, Ss (period=0.2s)	1.5 g
MCE_R Ground Motion, S_1(period=1.0s)	0.6 g
Site-modified Spectral Acceleration Value, S_{MS}	1.5 g
Site-modified Spectral Acceleration Value, S_{M1}	N/A
Numeric Seismic Design Value at 0.2s SA, S_{DS}	1.0 g
Numeric Seismic Design Value at 1.0s SA, S_{D1}	N/A
Site Amplification Factor at 0.2s, F_a	1.0
Site Amplification Factor at 1.0s, F_v	N/A
Site Modification Peak Ground Acceleration, PGA_M	0.611 g

Note: Ground motion hazard analysis may be required, see ASCE/SEI 7-16 Section 11.4.8
ASCE 7 Hazards Report is attached in Appendix D. Final selection of the appropriate seismic design coefficients should be made by the structural consultant based on the local laws and ordinances, expected building response, and desired level of conservatism.

7.0 FOUNDATION RECOMMENDATIONS

7.1 Foundation on Expansive Soils

The clayey sections of the artificial fill and natural soils, though generally less expensive than the overlying soils. Expansive soils can be subject to repeated swelling upon wetting and contraction upon drying which can damage concrete slabs or foundations bearing on such soils. Mitigation for foundations in expansive soils generally involves deepening the footing to a depth below that which will be subject to repeated swelling and contraction (shrinking from drying out).

Expansive soils change in volume with change in moisture content. Shrinking and swelling of the clays can cause heaving and cracking on slab-on-grade and structures founded on shallow foundations. The results of our exploration, laboratory testing and engineering evaluation indicate the soils underlying this site have Very Low Expansion (Non-Expansion) Potential characteristics (Expansion Index, EI =

2) per ASTM D4829. As such, special measures per 2016 California Building Code (CBC) Section 1803.5.3 are required to mitigate expansive soil.

Table 6

Expansion Index, (EI)	0 – 20	21 – 50	51 – 90	91 – 130	>130
Expansion Potential	Very low	Low	Medium	High	Very high
2013 CBC Expansion Classification	Non-Expansive	Expansive			

7.2 Settlement

Provided our report recommendations are followed, we estimate the total and differential settlements on the order of one (1) inch and one-half (½) inch, respectively over the span of 30-ft.

7.3 Foundation System

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation. Greater embedment may be necessary to resist lateral loads due to wind and seismic forces of the requirements of 2016 CBC. A coefficient of friction of 0.25 of dead load may be used. We recommend all footings should be reinforced with two #4 bars at the top and 2 #4 bars at the bottom. A minimum allowable bearing capacity of 2000 psf may be used for a continuous or spread foundation system bearing on newly compacted select fill. The allowable bearing value may be increased by 250 pounds per square foot per foot increase in depth or width to a maximum of 2500 psf. The upper **5-ft** of the soil within the building pad area should be over excavated and re-compacted to minimum 95% of maximum dry density as determined by laboratory ASTM D1557 modified proctor test. The over excavation should be extended horizontally a minimum of 5-ft outside from the building footprint measured from the lowest adjacent existing or proposed grade, whichever is more.

Table 7

Earth Material and Foundation Design Parameters		
Earth Material Parameters	Foundation Bearing Material	Competent Native Soil (Older Alluvium) Certified Fill/Approved Soil
	Foundation Bearing Pressures [3]	2,000 psf
	Coefficient of Friction [1]	0.25
	Passive Earth Pressure (EFP) [3]	200 pcf
	Maximum Passive Earth Pressure	2,500 psf
Continuous Footing Design	Minimum Width	24 inches
	Min. Embedment Depth into Bearing Material [2]	18 inches
	Minimum Reinforcement	2 No.4 Rebars at Top and Bottom
Independent Pad Design	Minimum Foundation Dimensions	24" x 24" square
	Min. Embedment Depth into Bearing Material [2]	18 inches

Notes:

[1] When combining frictional resistance and passive pressure, the passive pressure component should be reduced by one-third.
[2] Foundation depths subject to increase per the project structural engineer's design.
[3] One-third increases on the bearing and passive pressures for wind and seismic loads are allowed.

7.4 Slab on Grade

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc., should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation." A vapor barrier over the crushed rock should be considered in the areas where the migration of moisture through the floor slab would be detrimental. To protect the vapor barrier (Visqueen) from punctures during placement, it is recommended that the Visqueen be placed over two-inch thick, clean san layer. The vapor barrier should be at least 10-mil plastic (STEGO or Equivalent) and should be sealed at all splices, around plumbing, and at the parameter of slab areas. Every effort should be made

to provide a continuous barrier and care should be taken no to puncture the membrane. Some contractors exercising special care use heavier membranes or double layers of 10-mil plastic with splices staggered and sealed. Slab design should be in compliance with the 2016 Cal Green Code where applicable.

7.5 Lateral Earth Pressures

7.5.1 Passive Earth Pressure

Lateral loads may be resisted by friction provided by the soil on the base of the foundation and by passive earth pressure. A coefficient of friction of 0.25 of dead load may be used. An allowable passive earth pressure of 200 psf per foot of depth may be used for footings poured on compacted in-situ soil. The maximum value of passive earth pressure should be limited to 2,500 psf. Frictional resistance and passive pressure resistance may be used in combination if friction coefficient is reduced by one-third. A one-third increase in passive pressure may be used for resistance against seismic and wind loading.

7.5.2 Active Earth Pressure

Active earth pressures behind walls depend on wall movement, back fill slope, surcharge loads and back fill material.

Table 8

Equivalent Fluid Pressure, EFP (pcf)	
Active Condition	40
At-rest Condition	65

These equivalent fluid pressure (EFP) does not include the effect of seepage pressures, surcharge loads such as construction equipment, vehicular loads or future storage near the walls. If the basement wall or cantilever retaining wall can tilt forward to generate "active earth pressure" condition, the values under active condition should be used. For rigid non-yielding walls which are part of the building, the values" at rest condition" should be used. The compactive effort should be controlled during backfill operations. Over compaction can produce lateral earth pressures in excess of at rest magnitudes. Compaction levels adjacent to below-grade walls should be maintained at minimum 95 percent of Modified Proctor (ASTM D1557) maximum dry density.

The backfill behind the wall should be drained properly. The simplest drainage system consists of a drain located near the bottom of the wall. The drain collects the water that enters the backfill and this may be disposed of through outlets along the base of the wall. To ensure that the drains are not clogged by fine particles, they should be surrounded by a granular filter wrapped in a geofabric

such as Mirafi 140N or equivalent. Despite a well-constructed toe drain, substantial water pressure may develop behind the wall if the backfill consists of clays or silts. A more satisfactory drainage system, consisting of a back drain of 12 inches to 24 inches width gravel may be provided behind the wall to facilitate to drainage.

7.6 Retaining Wall Design

Recommendations below may be applied to typical masonry or concrete vertical retaining walls to a maximum height of 6 feet. Additional review and recommendations should be requested for higher walls.

Recommendations were developed assuming that wall backfill placed within a 1:1 (horizontal: vertical) gradient (45-degree angle) projection behind any wall is comprised of the onsite granular non-expansive soils which are placed as certified compacted fill. Use of other materials might necessitate revision to the parameters provided and modification of wall designs. The following criteria may be applied to retaining wall design below.

Foundations for vertical masonry and poured concrete retaining walls may be designed and constructed using recommendations in the "Foundations" discussion presented above.

Cantilevered Walls

Cantilevered retaining walls are free to rotate and not restrained with minor deflections. Active earth pressures may be used in the designing of cantilevered walls. An equivalent fluid pressure (EFP) may be used to calculate the horizontal pressure against the walls, as tabulated below for retaining walls less than 6 feet in height.

Table 9

RETAINING WALL DESIGN, 6 FEET OR LESS (NON-EXPANSIVE SOIL)	
Surface Slope of Retained Material (H: V)	Equivalent Fluid Pressure (pcf)
Level	30
5:1	32
4:1	35
3:1	38
2:1	43
1½:1	55

These equivalent fluid pressures do not include other superimposed loading conditions such as expansive soil, vehicular traffic, structures, seismic conditions or adverse geologic conditions.

Retaining walls supporting sloping ground should be provided with a minimum freeboard height of 12 inches. Any slough, debris or trash accumulating behind the freeboard (in the catchment area) should be removed immediately to ensure the freeboard performs as intended.

Restrained Walls

The retaining walls are called non-yielding walls because the walls cannot move lately at the top and should be designed for an equivalent fluid pressure (EFP) of 45 pcf for level backfills.

7.7 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, estimated traffic indices for various pavement-loading conditions, and on a design R-value of 73.3 from the MTGL, Inc. The design R-value was chosen based on laboratory testing of a representative sample and considering the sandy soil conditions at near the surface. The preliminary flexible pavement sections may consist of the following for the Traffic Indices (TI) indicated and the calculations are in the Appendix E. The Asphalt Cement (AC) and Class II Aggregate Base (AB) thickness are presented below for different Traffic Indices. Final pavement design where needed should be based on the Traffic Index determined by the project civil engineer.

Table 10

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78

The final pavement design also should be verified during actual site grading and the above sections may be revised accordingly per actual representative R-value. The minimum required compaction of aggregate base is 95% of maximum dry density.

In areas where rigid concrete pavement is planned, at a minimum, concrete should be 4000 psi with fiber mesh, 5 inches thick in parking areas (light duty) and 6 inches thick (heavy duty) in loading areas. Concrete paving to be placed over a minimum 4-inch thick granular base on prepared subgrade soil. Reinforcement should be specified by the structural engineer but should be a minimum of #3

rebar at 18 inches on center each way. The PCC pavement sections should be provided with crack-control joints spaced no more than 14 feet on center each way. If saw cuts are used, they should have a minimum depth of ¼ of the slab thickness and made within 24 hours of concrete placement. We recommend that sections be as nearly square as possible.

8.0 CONSTRUCTION GUIDELINES

8.1 Construction Monitoring

As Geotechnical Engineer of Record for this project, Terradyne Engineering Inc., should be involved in monitoring the foundation installation and earthwork activities by the special inspections requirements and tests of existing site soil conditions: fill placement and load-bearing requirements shall be performed in accordance with this **section of 1705.6** and **Table 1705.6**. The performance of any foundation system is not only dependent on the foundation design but is strongly influenced by the quality of construction. Prior to construction, please contact our office so that a Foundation and Earthwork Monitoring Plan can be incorporated into the Project Quality Control Program.

TABLE 1705.6

REQUIRED SPECIAL INSPECTIONS AND TESTS OF SOILS

TYPE	CONTINUOUS SPECIAL INSPECTION	PERIODIC SPECIAL INSPECTION
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	—	X
2. Verify excavations are extended to proper depth and have reached proper material.	—	X
3. Perform classification and testing of compacted fill materials.	—	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	X	—
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	—	X

8.2 Site Preparation

Grading should conform to the guidelines presented in the 2019 California Building Code (CBC, 2019), as well as the requirements of the City of Hesperia and County of San Bernardino.

Prior to earthwork or construction operations, the site should be cleared of surface and subsurface obstructions and stripped of any vegetation in the areas proposed for development. Removed vegetation and debris should then be properly disposed of off-site. Holes resulting from removal of buried obstructions which extend below finish site grades should be backfilled with suitable fill soils compacted to a **minimum 95** percent relative compaction (based on ASTM Test Method D1557).

8.3 Removal of Unsuitable Soils

The existing upper soils alluvial deposits soils are considered to be potentially compressible and maybe collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of 5 feet outside the building footprint. Following removal of the upper soils, the bottom of the excavation(s) should be observed and approved by a representative of this office to verify that these potentially compressible materials have been properly removed.

Prior to fill placement, all areas to receive fill and/or other surface improvements, shall be scarified to a minimum depth of **10 inches** below removal grade elevations, be moisture conditioned to **3 percent over optimum** moisture content and compacted to minimum **95** percent relative compaction, based on ASTM Test Method D1557. After this procedure is completed, backfill of the removal excavation should take place by moisture conditioning the removed soils prior to placement to at least optimum to 3 percent over optimum moisture content and recompaction of these soils to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). These operations should be performed under the observation and testing of a representative of this office. It should be understood that based on the observations of our field representative, localized deeper or shallower removals may be recommended. Any removed soils shall be moisture conditioned as necessary to achieve a moisture content of at least optimum to 3 percent over optimum moisture content and be recompacted to a minimum **95** percent relative compaction (based on ASTM Test Method D1557). This earthwork should extend a minimum of 5 feet beyond the proposed footing limits.

Any proposed subgrade for support of appurtenance slabs on grade and miscellaneous improvements should be scarified minimum (18"), moisture conditioned up to three (3) percent over optimum moisture content and compacted. The subgrades should be compacted to minimum 95 percent of maximum dry density as determined by laboratory ASTM D1557 modified proctor test.

When excavations deeper than five feet are made, temporary construction slopes should be no steeper than 1.5:1 (horizontal to vertical). Sheeting and bracing should be provided by the contractor, as necessary, to protect workers in the excavation. Where excavations undermine existing improvements, such as the existing walls, etc., temporary structural support should be provided to reduce the risk of damage resulting from undercutting. Permanent cut and fill slopes (if proposed), should not be constructed steeper than 2:1 (horizontal to vertical) and should be considered subject to review by the geotechnical consultant at the time of grading. These slopes should possess sufficient compacted fines to limit erosion risk. If upon construction, relatively clean, cohesionless sands are encountered, reconstruction by blending in fines to compacted fill and/or flattering of slopes will be advised.

8.4 Fill Placement and Compaction

If necessary, the on-site soils are suitable for reuse as compacted fill, provided they are free of organic materials and debris and material larger than 6 inches in diameter. Should import soils be utilized for near-surface fills, these soils should be predominately granular, possess a low or very low expansion potential (see Section 8.4 below), and be approved by the geotechnical engineer prior to their transportation to the site. Lift thicknesses will be dependent upon the size and type of equipment used. In general, fill should be placed in uniform lifts not exceeding 8 to 10 inches. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. All earthwork should be conducted in accordance with the applicable codes, agency requirements, the recommendations, and the standard grading guidelines. The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

8.5 Temporary Excavations and Backfill

Underground trenches are anticipated to be excavated with moderate effort using conventional construction equipment in good operating condition. Deep trenches may require the use of heavier equipment operations. The encountered soils at the site consisted of loose to medium dense, poorly consolidated sands. As such these soils may be subject to collapse and or cave-ins. To satisfy OSHA requirements and for workmen's safety, it will be necessary to shore excavations deeper than 5 feet. The proposed trenches deeper than 5 feet may also be laid back in a 1:1 horizontal to

vertical (45 degrees). During wet weather, runoff water should be prevented from entering the excavation. The contractor is responsible for the safety of the workers and should observe the federal and local regulations including CALOSHA excavation and trench safety guidelines.

The on-site soils may be used as trench backfill provided, they are screened of rock sizes over 6 inches in maximum dimension and organic matter. Trench backfill should be compacted in uniform lifts (not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (based on ASTM D1557).

8.6 Shoring

Based on the anticipated depth of excavation (5 feet) below existing grade for the construction of the building, it appears that there may be insufficient space for sloped excavations. If so, shoring should be used to support the excavations. Cantilever, or braced shoring may be considered at this site. Cantilevered shoring can be utilized where some deflection is acceptable. However, where shoring will support adjacent properties and excessive deflection can lead to settlement, braced shoring should be utilized. The magnitude of shoring movements and resulting settlements are difficult to estimate because they depend on many factors, including the method and the specialty shoring contractor's skill in the installation. We estimate a properly installed system will limit settlements to adjacent improvements to less than one inch. Settlement of structures or facilities founded adjacent to the shoring will occur in proportion to both the distance between the shoring and the facilities, and the amount of horizontal deflection of the shoring system. The vertical settlement will be a maximum at the shoring face and decrease as the horizontal distance from the shoring increases. Beyond a distance from the shoring equal to the height of the shoring, the settlement is expected to be negligible. The maximum vertical settlement is expected to be about 75 percent of the horizontal deflection of the shoring system.

We judge the most appropriate temporary shoring system for this project is a typical soldier-pile-and-lagging system. For this type of system, soldier piles are placed in predrilled holes which will be backfilled with concrete. Wood or concrete lagging will be placed between the soldier piles as the excavation proceeds. Geotechnical parameters for the design of lagging & soldier pile (such as active & passive soil pressures, skin friction, pile fixity, allowable deflection at top of pile, etc.) are provided below:

- Skin friction along the back of the soldier piles using an allowable skin friction of 250 psf for walls above the excavation level.
- An allowable skin friction of 300 psf may be used on the perimeter of the piles below the bottom of the excavation.
- Cantilever soldier-pile-and-lagging walls should be designed to resist an active earth pressure corresponding to an equivalent fluid weigh of 35 pounds per cubic foot (pcf). This lateral force may be resisted by passive earth pressures against the embedded vertical

faces of the piers. We recommend passive resistance be calculated using an equivalent fluid weight of 250 pcf (Max. 3000 pcf) in the underlying native soil. The calculated passive pressure may be applied over three pier diameters.

- The Point of Fixity is defined as a percentage of the embedment depth 'D' which varies from 0 to 0.75D. For unrestrained shoring systems in most stiff to medium dense soils, a value of 0.25D may be assumed. A greater value may be used for loose sand or soft clay.
- Surcharge coefficient 0.5 may be used with uniform vertical surcharges for cantilever, and braced shoring lateral earth pressures.

It is difficult to accurately predict the amount of deflection of a shored embankment. It should be realized that some deflection will occur. It is recommended that the deflection be minimized to prevent damage to existing structures and adjacent improvements. Where public rights-of-way are present or adjacent offsite structures do not surcharge the shoring excavation, the shoring deflection should be limited to less than 1 inch at the top of the shored embankment. Where offsite structures are within the shoring surcharge area it is recommended that the beam deflection be limited to less than ½ inch at the elevation of the adjacent offsite foundation, and no deflection at all if deflections will damage existing structures. The allowable deflection is dependent on many factors, such as the presence of structures and utilities near the top of the embankment, and will be assessed and designed by the project shoring engineer.

The selection, design, construction, and performance of the shoring system should be the responsibility of the contractor. The shoring system should be designed by a licensed structural engineer experienced in the design of retaining systems, and installed by an experienced shoring specialty contractor. The shoring engineer should be responsible for the design of temporary shoring in accordance with applicable regulatory requirements. We should review the final shoring plans to check that they are consistent with the recommendations presented in this report. Excavations and shoring should be observed by personnel of our firm so that any necessary modifications based on variations in the soil conditions encountered can be made. All applicable safety requirements, including Cal-OSHA requirements, should be met. It is the responsibility of the contractor to maintain safe and stable slopes during construction. Heavy construction equipment, building materials, excavated soil, and vehicle traffic should not be allowed within ten feet of the top of excavations. During wet weather, runoff should be prevented from running across slopes and from entering excavations.

Prior to excavation, it is recommended that walls, structures, or portions of structures within a horizontal distance of 1.5 times the depth of the excavation be inspected to determine their present condition. For documentation purposes, photographs should be taken of preconstruction distress conditions and level surveys of adjacent grade and pavement should be performed. During construction, deflection of the shoring system should be monitored initially on a frequent (weekly) basis until it can be demonstrated that no movement is occurring. At that time, less frequent monitoring can be performed. In addition, the structures should be periodically inspected for signs of

distress. Adjacent grade and pavement should be monitored to determine the amount of movement resulting from the construction activities. If distress, or settlement is noted, an investigation should be performed, and correction measures taken so that continued or worsened distress or settlement is mitigated.

8.7 Temporary Drainage Measures

Temporary drainage provisions should be established to minimize water runoff into construction areas. If standing water does accumulate, it should be removed by pumping as soon as possible. Adequate protection against sloughing of soils should be provided for workers and inspectors entering the excavations. This protection should meet CALOSHA and other applicable building codes.

8.8 Selection of Structural Fill

Any select structural fill used at the site should have a Liquid Limit less than 35 and a Plasticity Index between 5 and 15. The fill should contain no particles greater than one (1) inch in diameter. The percent passing U.S. Standard Sieve No. 4 should be between 40 and 80 percent and passing Sieve No. 40 between 10 and 50 percent. The percent passing Sieve No. 200 should be less than 20 percent.

Pit-run gravels (with some clay binders) and crushed limestone (with sufficient fines to bind the aggregate together) are examples of suitable select structural fill materials. The fill materials should be placed in loose lifts not to exceed 8 inches thick and compacted to 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content up to two percentage points above optimum.

8.9 Groundwater

In areas where significant cuts (2-feet or more) are made to establish final grades for building pads, attention should be given to possible seasonal water seepage that could occur through natural cracks and fissures in the newly exposed stratigraphy. Subsurface drains may be required to intercept seasonal groundwater seepage. The need for these, or other dewatering devices, on building pads should be carefully addressed during construction. Our office could be contacted to visually inspect final pads to evaluate the need for such drains.

Groundwater seepage may occur several years after construction if the rainfall rate or drainage changes in the vicinity of the project site. If seepage runoff occurs towards the building, an engineer should be called on to evaluate its' effect and determine whether French drains are required at the location.

8.10 Control Testing and Field Observation

Subgrade preparation and structural fill placement should be monitored by the project geotechnical engineer or his representative. Field-tests for moisture content and relative compaction of the fill soils shall be performed by Terradyne Engineering, Inc. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction. Any areas do not meet the required relative compaction should be re-compacted and retested until compliance is met the required of relative compaction.

9.0 SITE DRAINAGE AND MAINTENANCE

Final drainage is important for the performance of the proposed construction. Landscaping, plumbing, and downspout drainage is also important. It is vital that all roof drainage be transported away from the building so that water does not pond around it, which can result in a soil volume change underneath the building. Plumbing leaks (if any) should be repaired as soon as possible in order to minimize the magnitude of a moisture change under the slab. Large trees and shrubs should not be planted in the immediate vicinity of the structures, since root systems can cause a substantial reduction in soil volume in the vicinity of the trees during dry periods.

Adequate drainage should be provided to reduce seasonal variations in moisture content of foundation soils. All pavement and sidewalks within 10-feet of the structures should be sloped away from the structures to prevent ponding of water around the foundations. Final grades within 10-feet of the structure should be adjusted to slope away from structures preferably at a minimum slope of 2 percent. Maintaining positive surface drainage throughout the life of the structure is essential.

In areas with pavement or sidewalks adjacent to the new structure, a positive seal must be provided and maintained between the structures and the pavement or sidewalk to minimize seepage of water into the underlying supporting soils. Post-construction movement of pavement and flat-work is not uncommon. Maximum grades practical should be used for paving and flatwork to prevent areas where water can pond. In addition, allowances in final grades should take into consideration post construction movement of flatwork, particularly if such movement would be critical. Normal maintenance should include inspection of all joints in paving and sidewalks, etc. as well as re-sealing where necessary.

Trench backfill for utilities should be properly placed and compacted, as outlined in this report, and in accordance with the requirements of local City, County and/or State Standards. Since granular bedding backfill is used for most utility lines, the backfilled trench should be prevented from becoming a conduit and allowing an access for surface or subsurface water to travel toward the new

structures. Concrete cut-off collars or clay plugs should be provided where utility lines cross building lines to prevent water from traveling in the trench backfill and entering beneath the structures.

10.0 REVIEW and SERVICES

All soil, geologic, and structural aspects of the proposed Project are subject to the review and approval of the governing agency(s). It should be recognized that the governing agency(s) can dictate the manner in which the project proceeds. They could approve or deny any aspect of the proposed improvements and/or could dictate which foundation and grading options are acceptable.

10.1 Plan Review

Upon completion, we should review the project plans and specifications to check that they conform to the intent of our recommendations.

10.2 Additional Geotechnical Services

Additional geotechnical services will be required subsequent to the investigation report. Additional fees will accrue for the additional services. The additional fees will depend on the scope of the additional work. A separate proposal and agreement will be prepared for the additional services. The following services are considered additional services.

- Response to questions from the reviewing agencies.
- Once plans for the proposed development are completed, the geotechnical consultant will need to review and approve the drawings.
- During construction, the geotechnical consultant will need to observe and test earthwork and observe foundation excavations for the proposed development.

11.0 LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from eight (8) borings drilled at the site and the design details furnished by Mr. Robert DeGraaf of Sweetgum Environmental.

This report may not reflect the exact variations of the soil conditions across the site. The nature and extent of variations across the site may not become evident until construction commences. If variations appear evident, it will be necessary to re-evaluate our recommendations after performing on-site observations and tests to establish the engineering significance of these variations. The project geotechnical engineer should review the final plans for the proposed structures so that he may

determine if changes in the foundation recommendations are required. The project geotechnical engineer declares that the findings, recommendations or professional advice contained herein have been made and this report prepared in accordance with generally accepted professional engineering practice in the fields of geotechnical engineering and engineering geology. No other warranties are implied or expressed.

This report is valid until site conditions change due to disturbance (cut and fill grading) or changes to nearby drainage conditions or two (2) years from the date of this report, whichever occurs first. Beyond this expiration date, Terradyne shall not accept any liability associated with the engineering recommendations in the report, particularly if the site conditions have changed. If this report is desired for use for design purposes beyond this expiration date, we highly recommend an update of this report with the possibility of drilling additional borings so that we can verify the subsurface conditions and validate the recommendations in this report.

This report has been prepared for the exclusive use of the owner, owner's representative and the design team for the specific application to the proposed Auto Zone Store #3658 located at near Ranchero Road and Escondido Avenue, Oak Hills, San Bernardino County, California.

REFERENCES

California Building Code (CBC), 2019, California Code of Regulations, Title 24, Part 2, Volume 2 of 2,

Google Earth Pro®, 2019, Version 7.3.2.5776.

American Society for Testing and Materials (ASTM), 2011, Annual Book of ASTM Standards, Volume 04.08, Construction: Soil and Rock (I), Standards D 420 - D 5876.

California Building Code, 2016, California Code of Regulations Title 24, Part 2, Volume 2 of 2.

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NAVFAC DM 7.1 Soil Mechanics, U.S. Department of the Navy 1982 Edition, May 1982

NAVFAC DM 7.2, Foundation and Earth Structures, U.S. Department of the Navy 1984

California State Water Resources Control Board, Website, GeoTracker database, http://geotracker.waterboards.ca.gov/gama/, accessed January 2019.

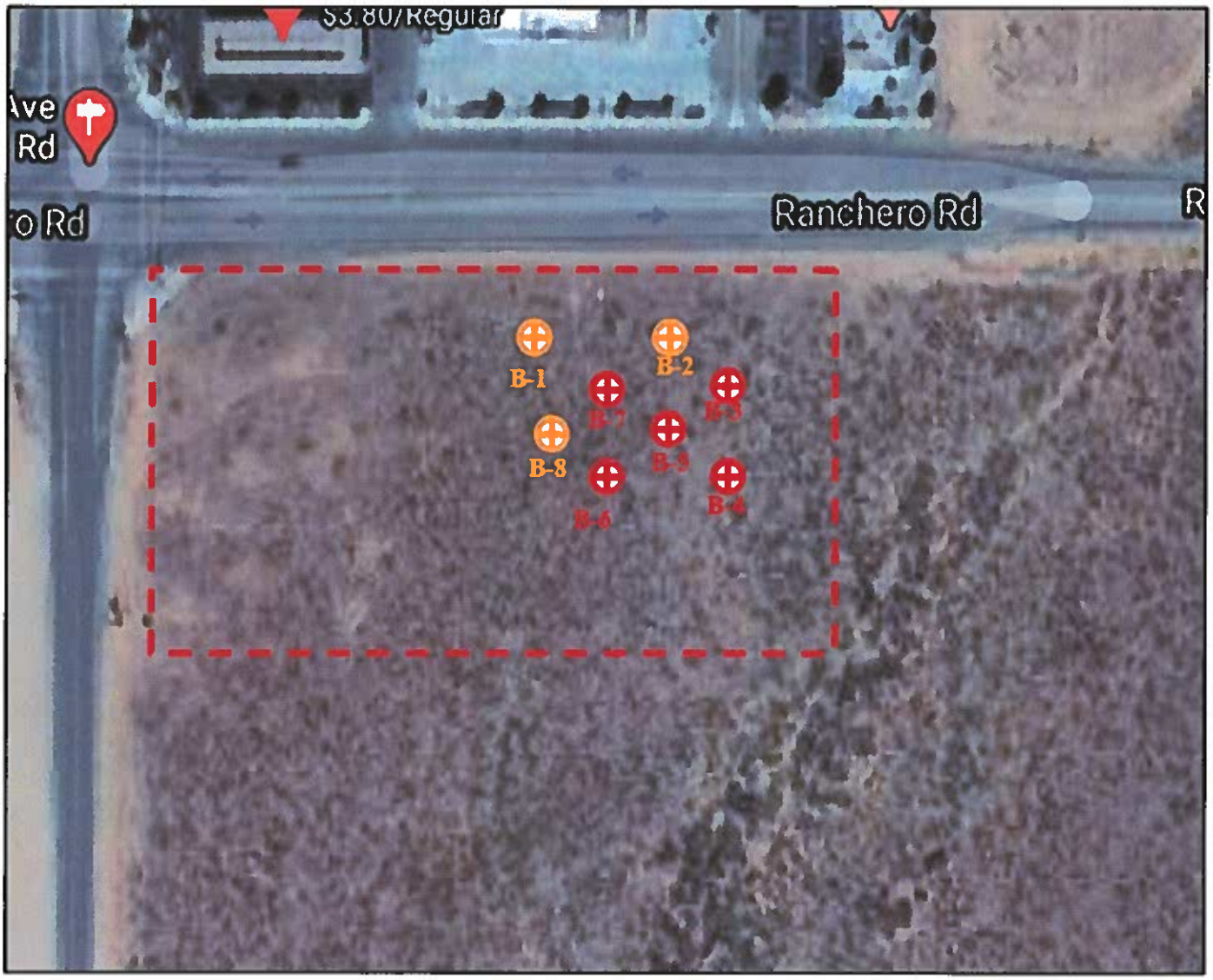
Dibblee, T.W., 1964, Geologic map of the Lucerne Valley quadrangle, San Bernardino County, California: U.S. Geological Survey, Miscellaneous Geologic Investigations Map I-426, scale 1:62,500

United States Geological Survey (USGS), 2015 edition, 7.5' Minute Topographic Map of the Fawnskin Quadrangle, San Bernardino County, California, Scale 1:24,000

ASCE Hazard Tool https://asce7hazardtool.online/

APPENDIX A

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**
	Vicinity Map
Terradyne Project No.: L201011	Figure: A



Approximate Boring Locations 15 feet depth

Approximate Boring Locations 10 feet depth

Approximate Subject Lot Boundary

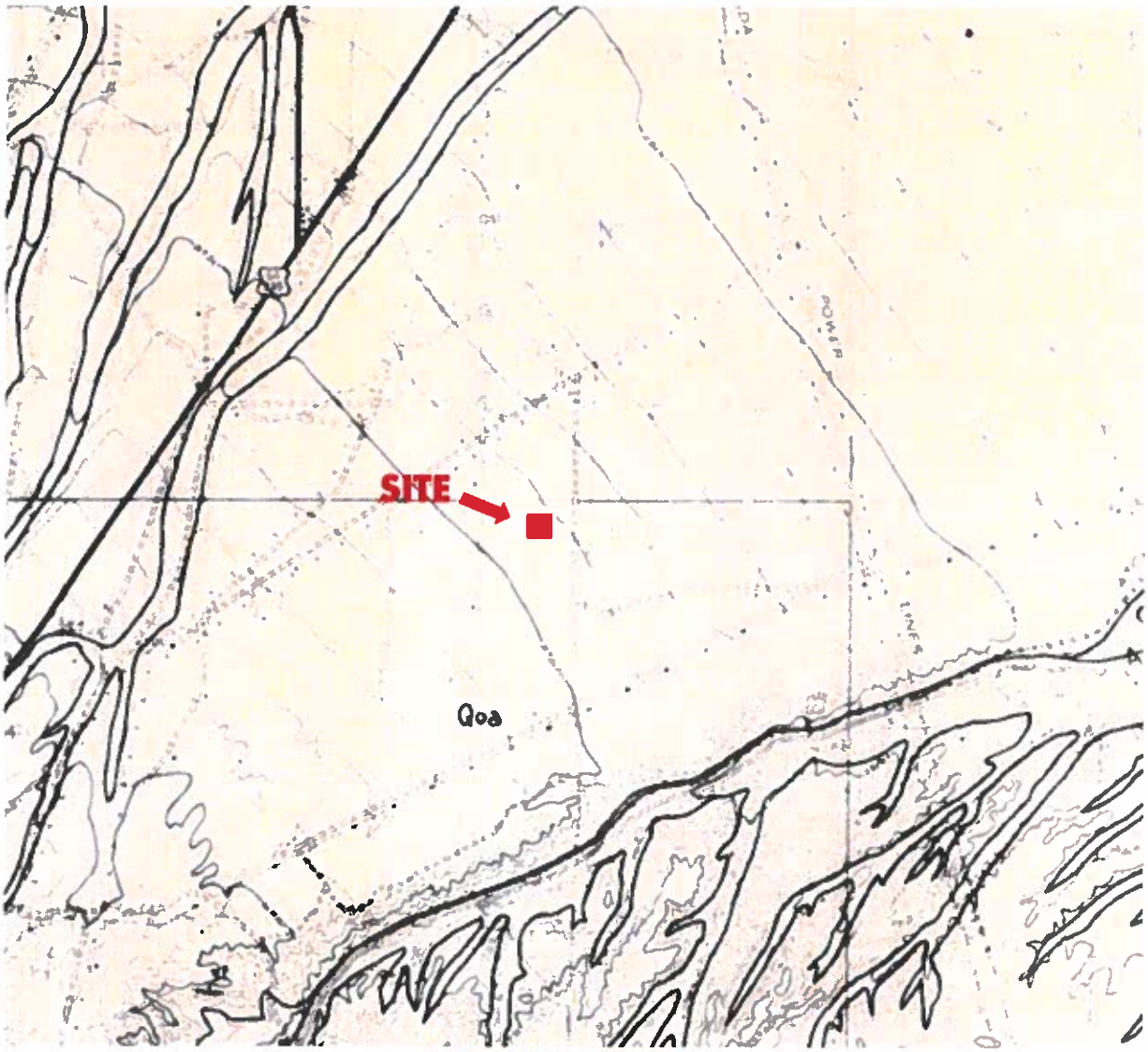
Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Approximate Boring Location Map

Terradyne Project No.: L201011

Figure: B



Qoa

Older alluvium

Scale 1 / 62500

1 2 0 2 3 Miles

1000 500 0 1000 2000 3000 4000 5000 Yards

CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL

15°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 1964

UTM GRID AND 1961 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

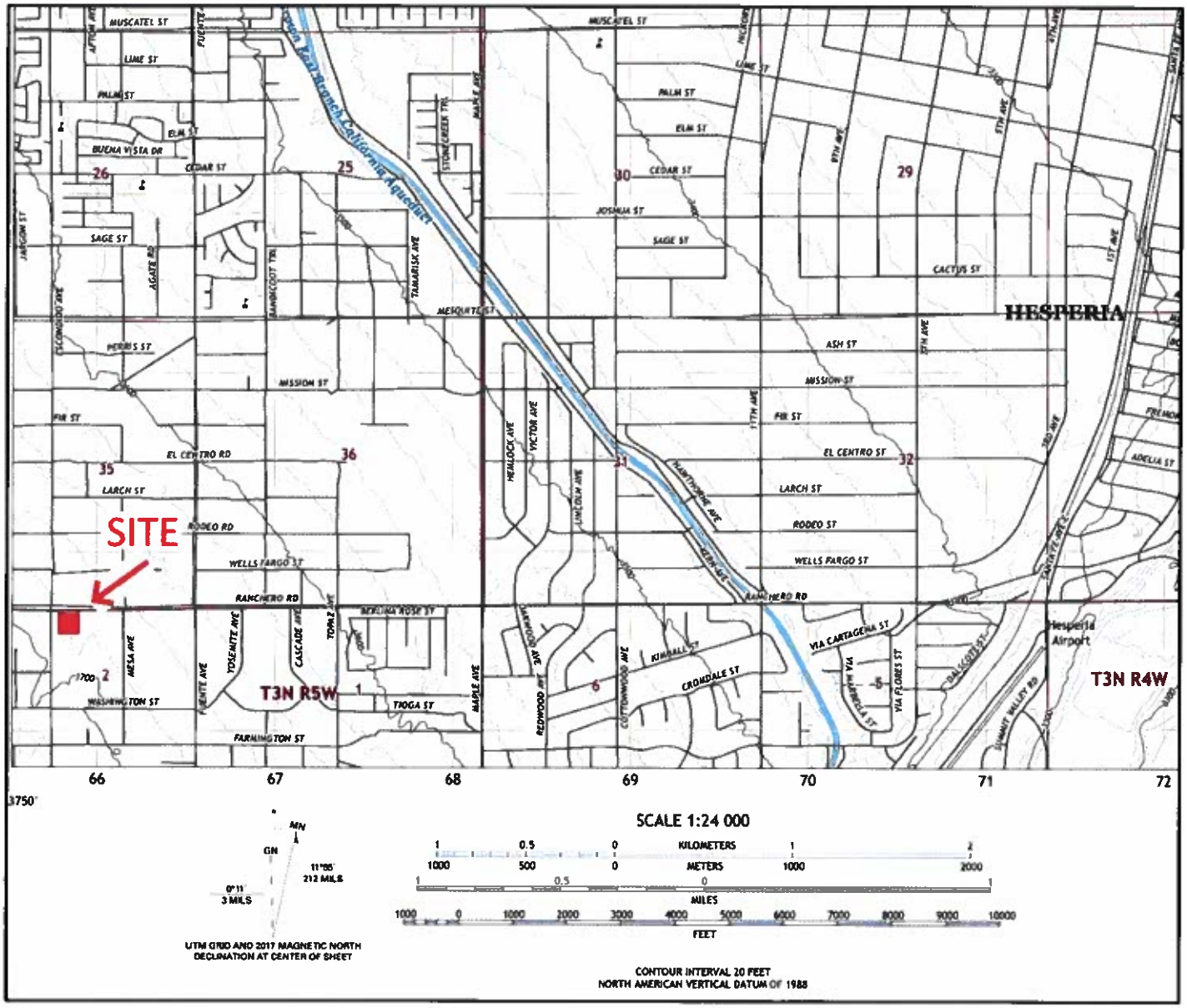
Map Reference: Dibblee, T.W., 1965, Geologic map of the 15-minute Hesperia quadrangle, San Bernardino County, California: U.S. Geological Survey, Open-File Report OF-65-43, scale 1:62,500

Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County; CA 92344

Terradyne Engineering, Inc.

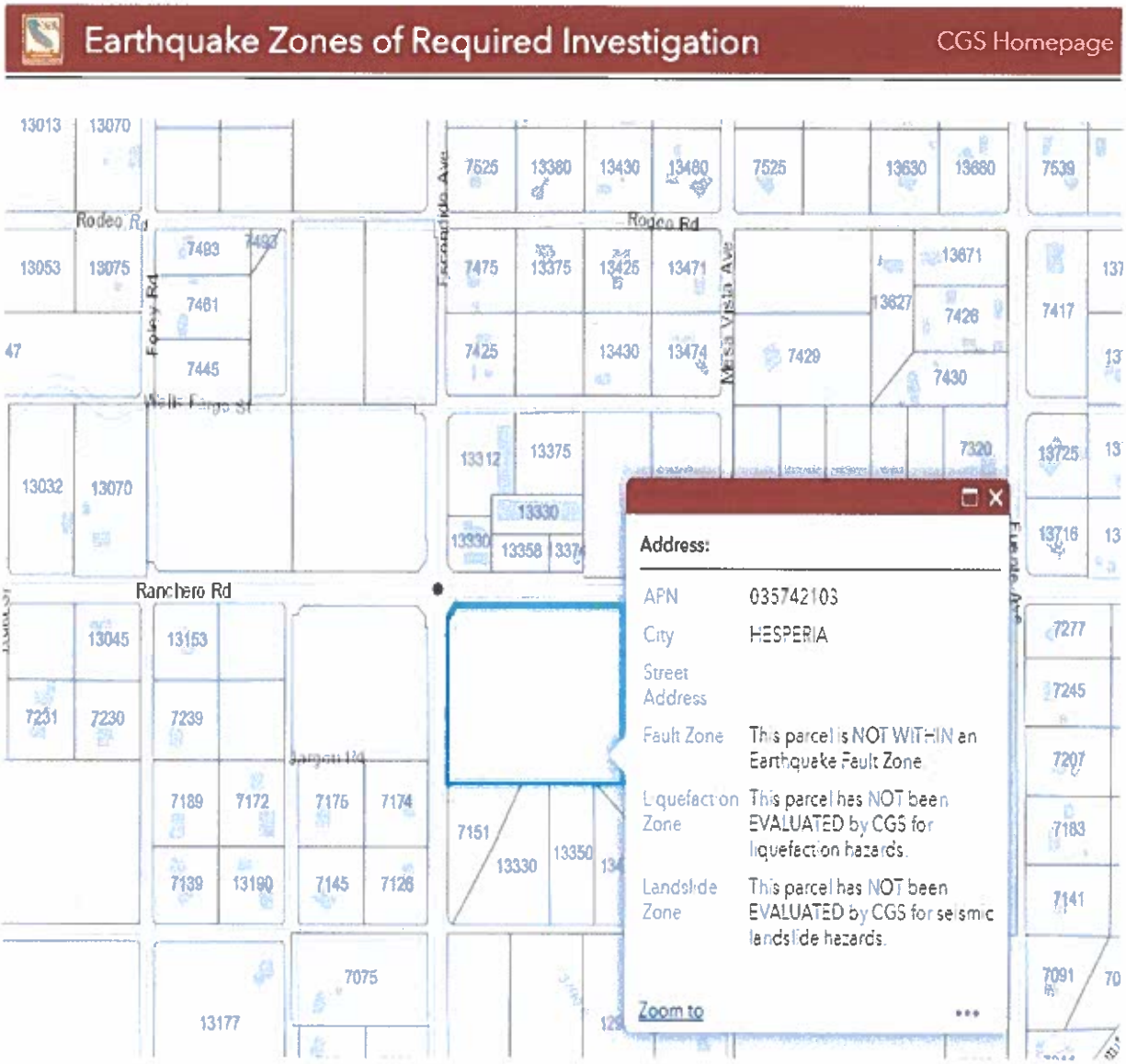
Regional Geologic Map and Legends

Terradyne Project No.: L201011 | Figure: C



Map Reference: : United States Geological Survey (USGS), 2012 edition, 7.5' Minute Topographic Map of the Hesperia Quadrangle, San Bernardino County, California, Scale 1:24,000

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**
	Regional Topographic Map
	Terradyne Project No.: L201011 | Figure: D

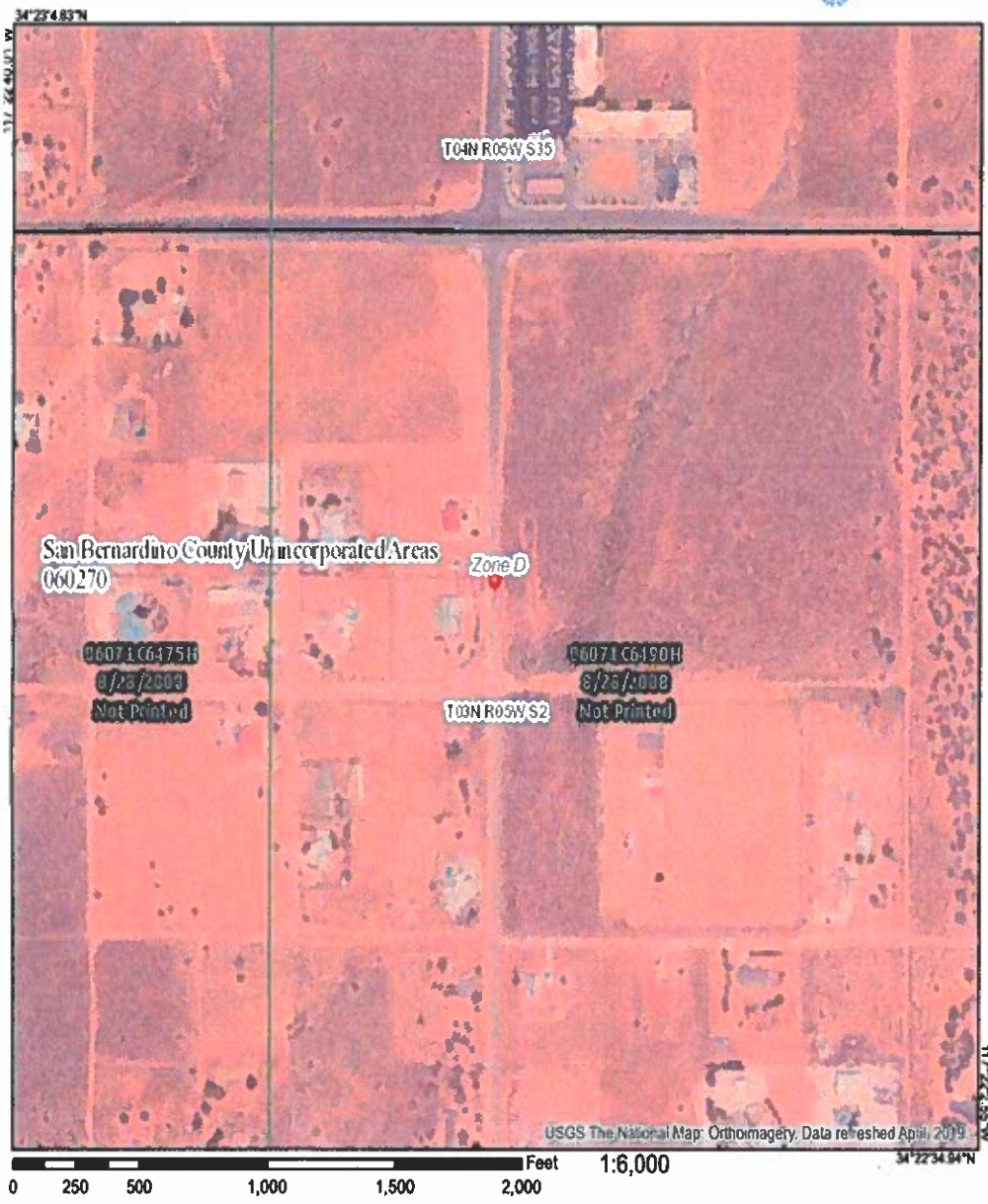


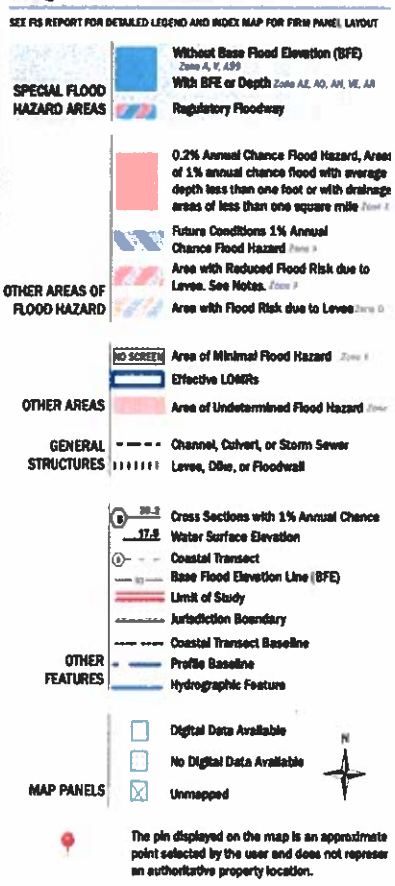
California Geological Survey (CGS)

Ref: https://maps.conservation.ca.gov/cgs/EQZApp/app

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**
	CGS Seismic Hazard Information
	Terradyne Project No.: L201011 | Figure: E

National Flood Hazard Layer FIRMette





Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Groundwater Information Map

Terradyne Project No.: L201011

Figure: F

APPENDIX B

Boring Logs

Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	Log of Boring 1 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 In**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-1 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa)	5.21				
			B-1 @ 2.5'-4'	6/9/14	SM		Silty SAND, brown, medium dense, moist Silty SAND, light brown, medium dense, slightly moist					
	5		B-1 @ 4.5'-5.0'	6/4/5	SM		Silty SAND, light brown, loose, slightly moist	5.26	115.93			
			B-1 @ 7.5'-9'	9/13/13	SM		Consistency changed to medium dense					
	10		B-1 @ 10'-10.5'	25/38/28	SM		Silty SAND, light brown with reddish mixed, dense, slightly moist	2.54	114.73			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 2** **Sheet 1 of 1**

Date(s) Drilled: **2/25/2020**	Logged By: **ZJ**	Checked By: **HE**
Drilling Method: **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type: **8 in**	Total Depth of Borehole: **11.5 feet bgs**
Drill Rig Type: **CME-75**	Drilling Contractor:	Approximate Surface Elevation:
Groundwater Level and Date Measured: **Not Encountered Groundwater**	Sampling Method(s): **Bulk, Modified California, SPT**	Hammer Data: **140lbs 30" drop**
Borehole Backfill: **Native Soil**	Location: **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-2 @ 0'-5'		SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, loose, moist	5.21				
			B-2 @ 2.5'-4'	4/6/7	SM		Silty SAND, brown, medium dense, slightly moist					
	5		B-2 @ 5'-5.0'	4/4/5	SM		Silty SAND, light brown, loose, slightly moist	6.11	113.40	15.7		
			B-2 @ 7.5'-9'	11/17/18	SM		Consistency changed to dense					
	10		B-2 @ 10'-10.5	31/50 for 6"	SM		Silty SAND, brown, very dense, slightly moist	6.46	112.89			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 3** **Sheet 1 of 1**

Date(s) Drilled: **2/25/2020**	Logged By: **ZJ**	Checked By: **HE**
Drilling Method: **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type: **8 In**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **CME-75**	Drilling Contractor:	Approximate Surface Elevation:
Groundwater Level and Date Measured: **Not Encountered Groundwater**	Sampling Method(s): **Modified California, SPT**	Hammer Data: **140lbs 30" drop**
Borehole Backfill: **Native Soil**	Location: **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-3 @ 2.5'-4'	3/4/6	SM							
	5				SM		Silty SAND, light brown, medium dense, slightly moist					
			B-3 @ 7.0'-7.5'	5/10/16	SM		Consistency changed to very dense	4.68	117.21	21.1		
	10		B-3 @ 10'-11.5'	14/15/21	SM		Consistency changed to dense					
			B-3 @ 12.5'-14	6/16/18	SM							
	15		B-3 @	15/50 for 6"	SM		Silty SAND, light brown, very dense, slightly moist, with some gravel	3.88	110.05	16.4		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 4** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
			B-4 @ 2.5'-4'	4/7/6	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, brown, medium dense, slightly moist					
			B-4 @ 7.0'-7.5'	11/16/19	SM		Silty SAND, light brown, very dense, slightly moist, with reddish brown sandstone	3.92	115.55	17.7		
			B-4 @ 8.5'-10'	19/41/50 for 6"								
	10				SM		Consistency changed to dense					
			B-4 @ 11'-12.5'	10/18/24								
					SM		Silty SAND, brown, very dense, slightly moist, with sandstone and some gravel					
	15		B-4 @	50 for 6"	SM			6.59	104.30			
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 5** **Sheet 1 of 1**

Date(s) Drilled: **2/25/2020**	Logged By: **ZJ**	Checked By: **HE**
Drilling Method: **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type: **8 in**	Total Depth of Borehole: **16.5 feet bgs**
Drill Rig Type: **CME-75**	Drilling Contractor:	Approximate Surface Elevation:
Groundwater Level and Date Measured: **Not Encountered Groundwater**	Sampling Method(s): **Bulk, Modified California, SPT**	Hammer Data: **140lbs 30" drop**
Borehole Backfill: **Native Soil**	Location: **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0		B-5 @ 0'-5'		SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist	3.45				
			B-5 @ 2.5'-4'	3/4/7	SM		Consistency changed to medium dense					
	5				SM		Silty SAND, lightt brown, medium dense, slightly moist, with some gravel					
			B-5 @ 7.0'-7.5'	6/11/18	SM		Silty SAND, light brown, very dense, slightly moist, with sandstone	4.13	103.68	20.5		
			B-5 @ 8.5'-10'	27/50 for 5"								
	10				SM		Silty SAND, light brown, dense, slightly moist, with some sandstone and some gravel					
			B-5 @ 12.5'-14'	13/18/25	SM		Silty SAND, light brown, dense, slightly moist, with some gravel					
	15		B-5 @ 15'-15.5'	50 for 6"	SM		Consistency changed to very dense, with sandstone and no gravel	4.84	100.65	29.3		
							End of boring @ 16.5' No groundwater No caving Filled with native soil					
	20											
	25											
	30											

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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	**Log of Boring 6** **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 In**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
0				SM		0'-16.5' Older alluvium (Qoa) Silty SAND, brown, loose, slightly moist					
		B-6 @ 2.5'-4	2/4/6	SM							
5				SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
		B-6 @ 7.0'-7.5'	6/9/8	SM		Consistency changed to dense	5.93	114.58	22.2		
		B-6 @ 8.5'-10'	16/21/23								
10				SM		Silty SAND, light brown, medium dense, slightly moist					
		B-6 @ 12.5'-14	10/12/12	SM		Some sandstone present					
15		B-6 @ 15'-15.5	21/26/38	SM		Silty SAND, brown, dense, slightly moist, with sandstone	5.98	118.04	13.3		
						End of boring @ 16.5' No groundwater No caving Filled with native soil					
20											
25											
30											

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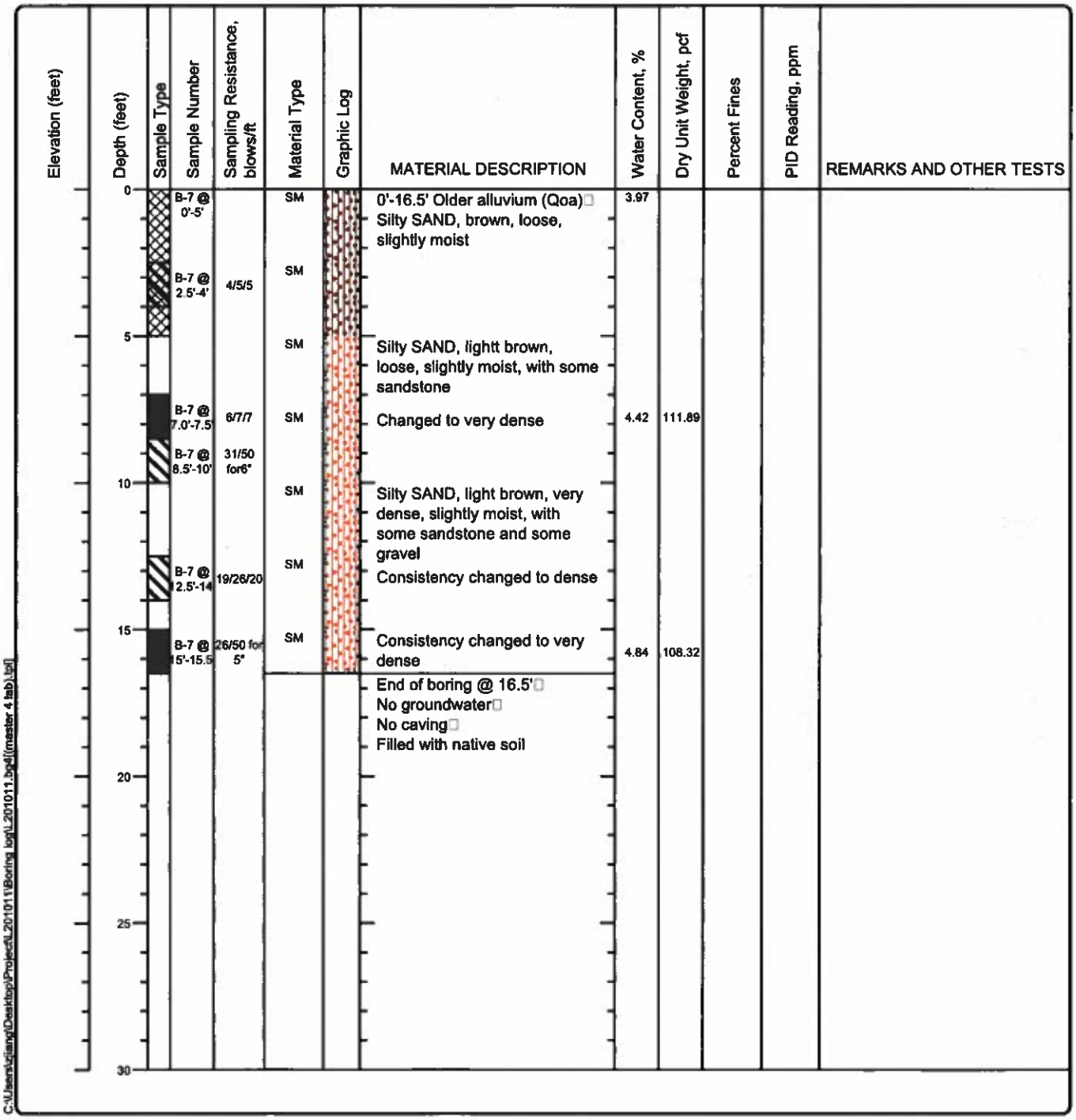
Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	Log of Boring 7 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **16.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Bulk, Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	



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Project: **New Auto Zone Store #3658** Project Location: **Near Ranchero Dr. & Esocindido Ave. Oak Hill CA** Project Number: **L201011**	Log of Boring 8 **Sheet 1 of 1**

Date(s) Drilled **2/25/2020**	Logged By **ZJ**	Checked By **HE**
Drilling Method **Standard Penetration Test Hollow-Stem Auger**	Drill Bit Size/Type **8 in**	Total Depth of Borehole **11.5 feet bgs**
Drill Rig Type **CME-75**	Drilling Contractor	Approximate Surface Elevation
Groundwater Level and Date Measured **Not Encountered Groundwater**	Sampling Method(s) **Modified California, SPT**	Hammer Data **140lbs 30" drop**
Borehole Backfill **Native Soil**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	Percent Fines	PID Reading, ppm	REMARKS AND OTHER TESTS
	0				SM		0'-11.5' Older alluvium (Qoa) Silty SAND, brown, medium dense, moist					
					SM		Silty SAND, brown, medium dense, slightly moist, with some sandstone					
	5		B-8 @ 4.5'-5.0'	4/6/13	SM		Silty SAND, light brown, medium dense, slightly moist, with sandstone and gravel	6.00	116.27	19.1		
			B-8 @ 7.5'-9'	8/14/19	SM							
	10		B-8 @ 10'-10.5'	7/9/10	SM			4.21	101.65			
							End of boring @ 11.5' No groundwater No caving Filled with native soil					
	15											
	20											
	25											
	30											

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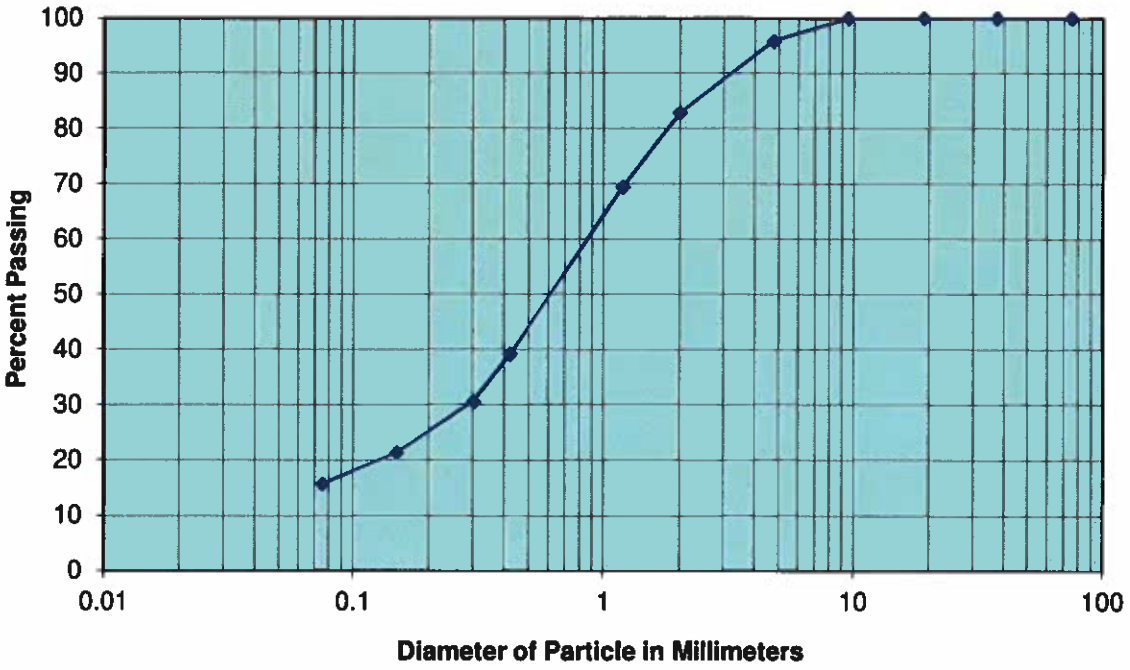
APPENDIX C

Laboratory Tests

Gradation Test Results



B-1 @ 4.5'-5.0'

Gravel	Sand	Fines
4.2 %	80.0 %	15.7 %

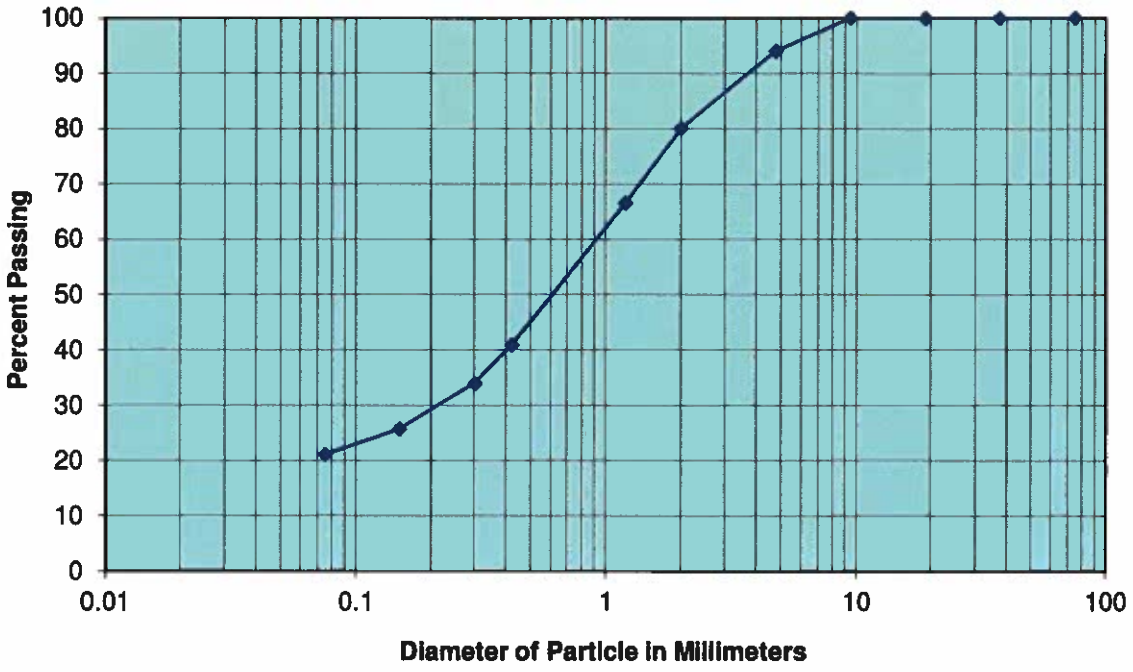
Subsurface Explorations/Geotechnical Investigation
Proposed New Auto Zone Store #3658 at:
Near Ranchero Road and Escondido Avenue
Oak Hill, San Bernardino County, CA 92344

Terradyne Engineering, Inc.

Grain Size Distribution

Terradyne Project No.: L201011 | Plate: G

Gradation Test Results

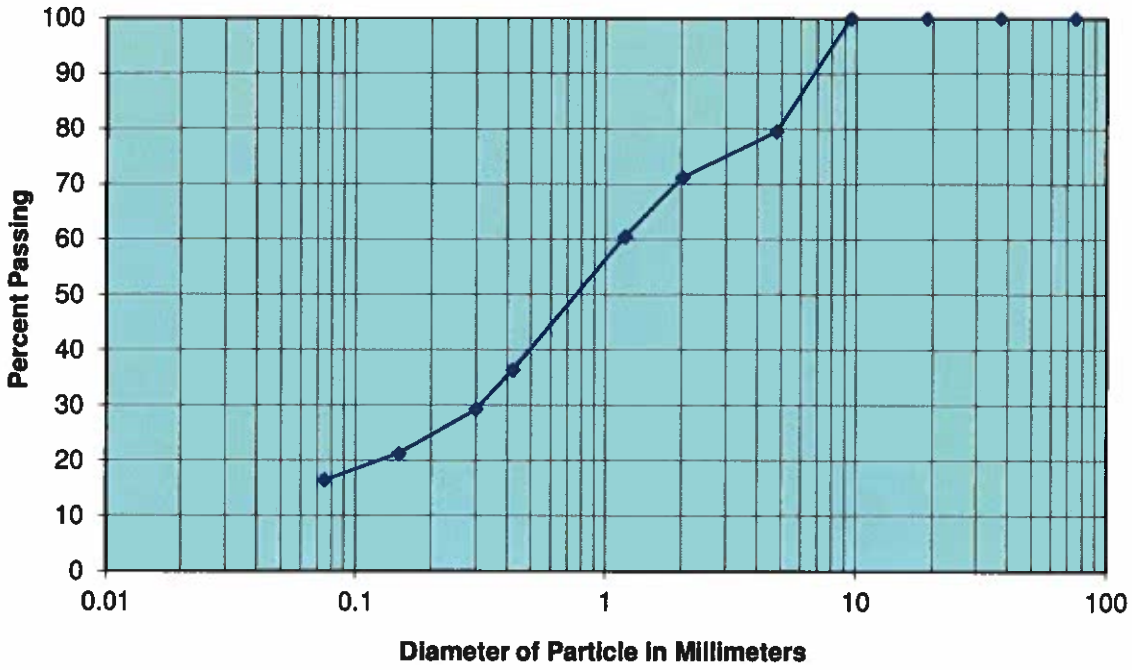


B-3 @ 7.0'- 7.5'

Gravel	Sand	Fines
6.0 %	73.0 %	21.0 %

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution Terradyne Project No.: L201011 — Plate: H

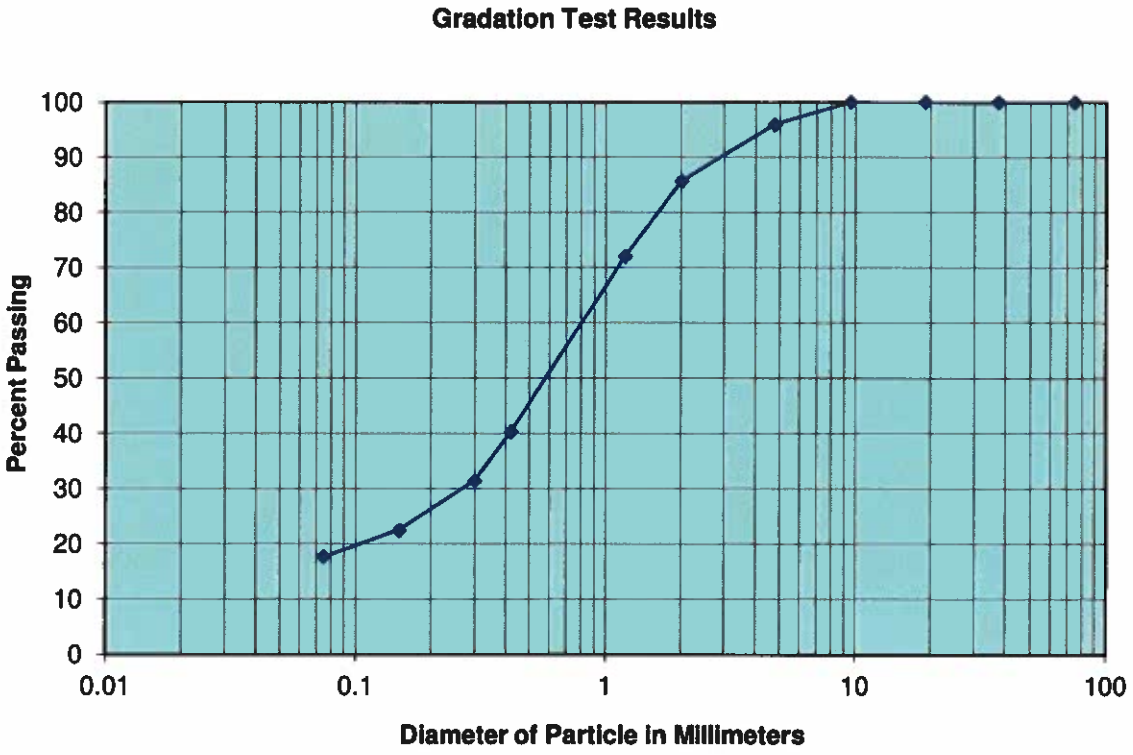
Gradation Test Results



B-3 @ 15.0'- 15.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

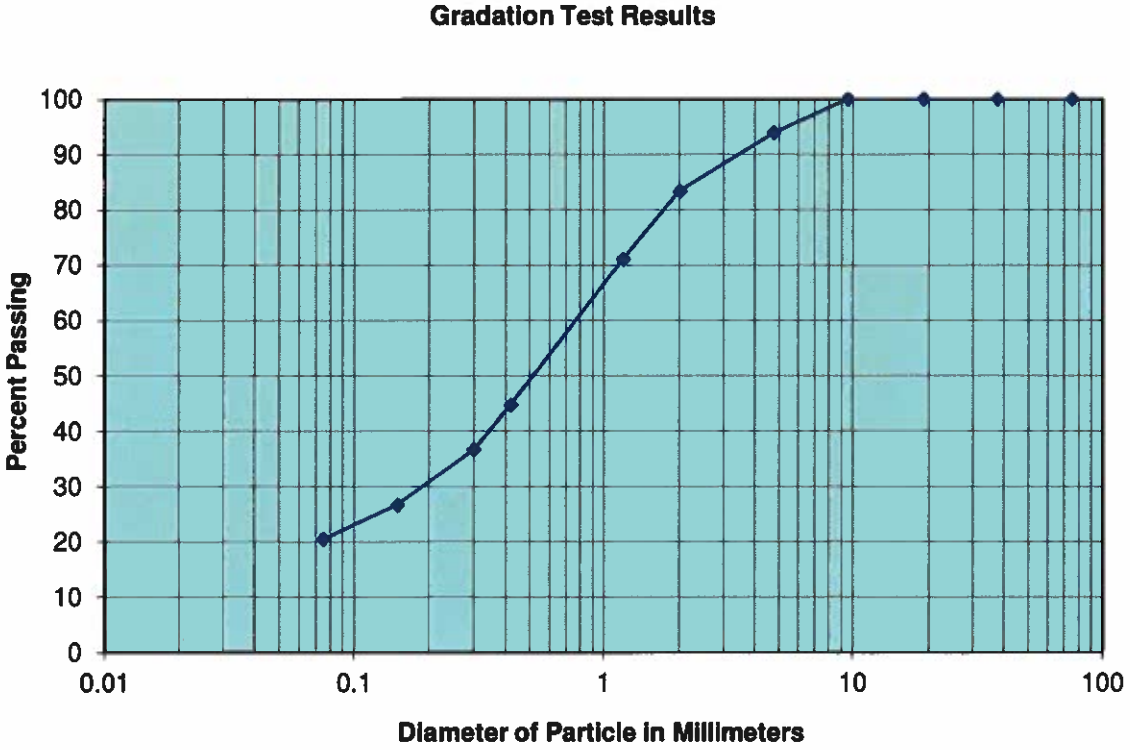
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: I



B-4 @ 7.0'- 7.5'

Gravel	Sand	Fines
4.1 %	78.2 %	17.7 %

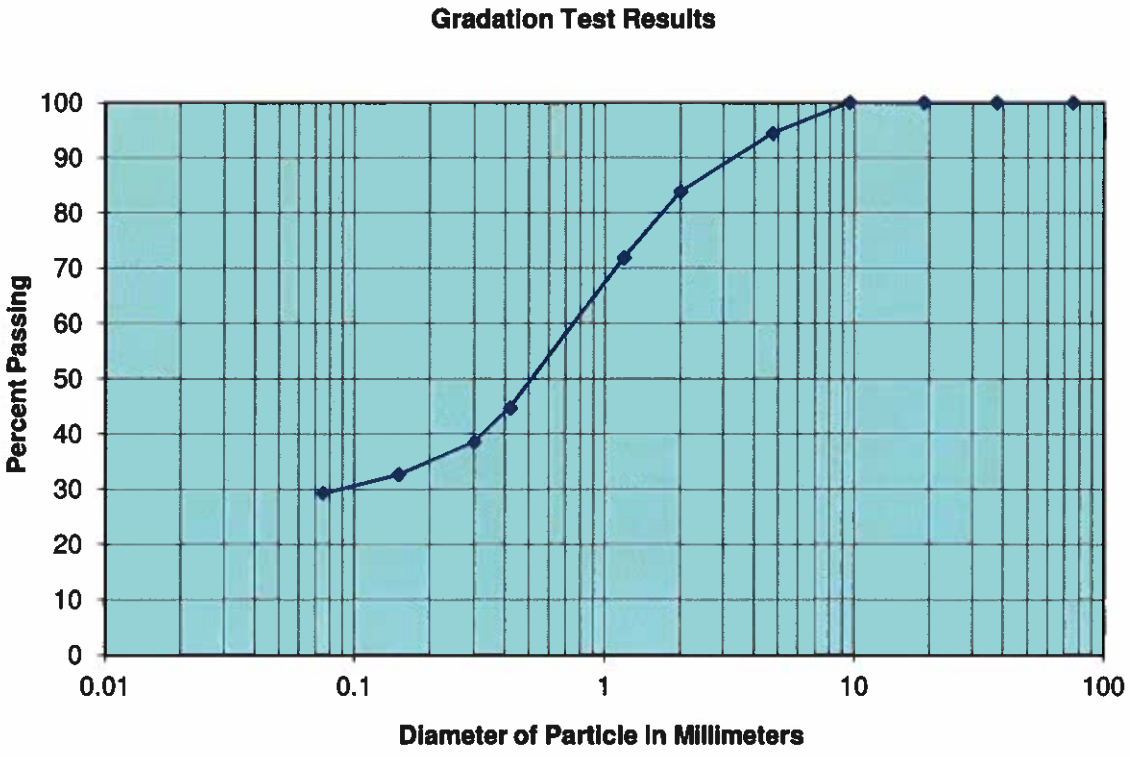
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: J



B-5 @ 7.0'- 7.5'

Gravel	Sand	Fines
20.6 %	63.1 %	16.4 %

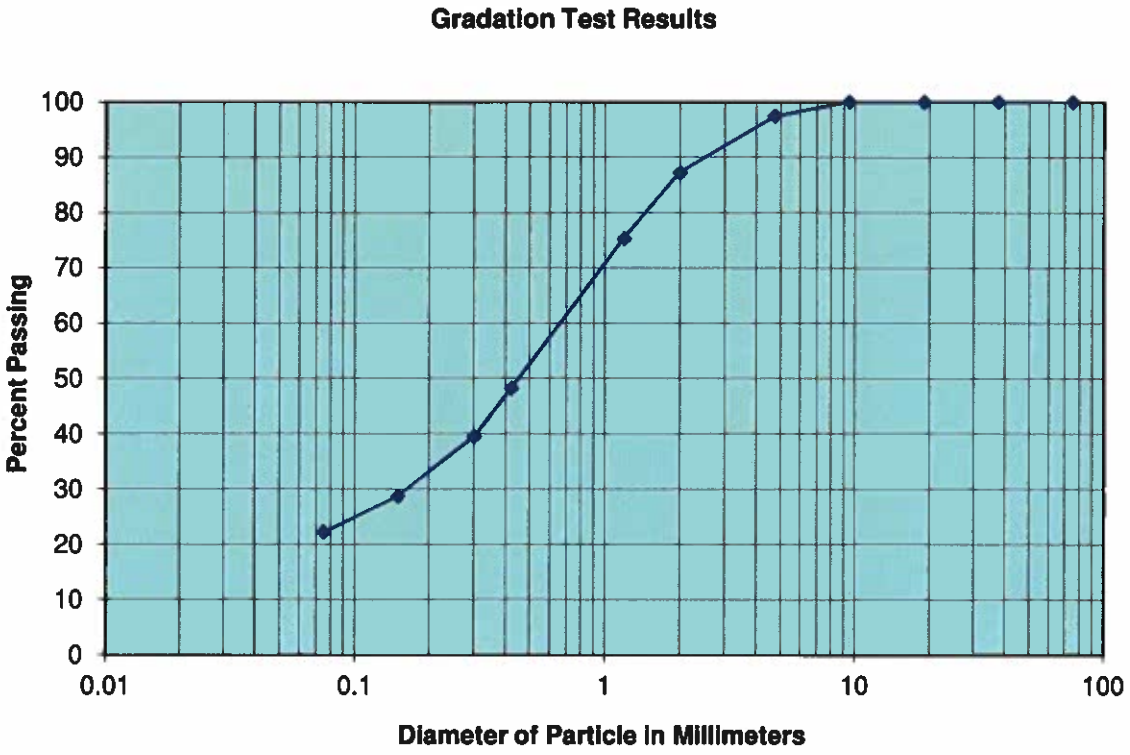
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution Terradyne Project No.: L201011 — Plate: K



B-5 @ 15.0'- 15.5'

Gravel	Sand	Fines
5.6 %	65.1 %	29.3 %

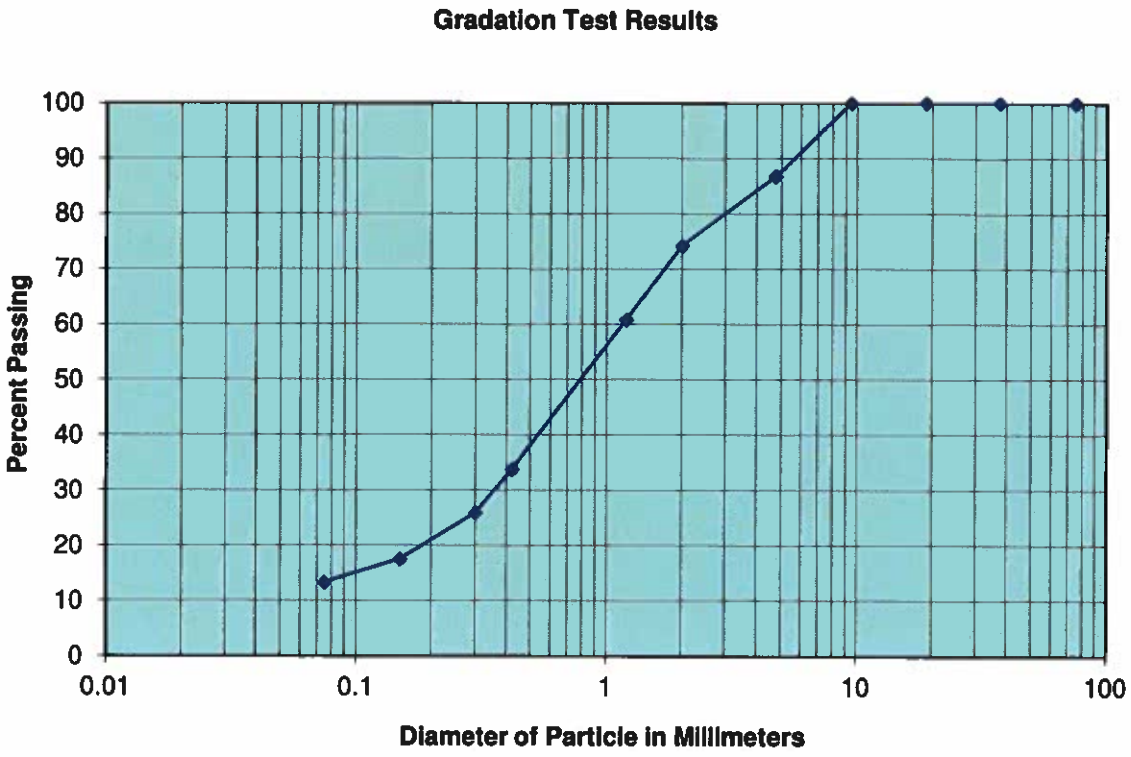
Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution Terradyne Project No.: L201011 | Plate: L



B-6 @ 7.0'- 7.5'

Gravel	Sand	Fines
2.6 %	75.2 %	22.2 %

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution Terradyne Project No.: L201011 | Plate: M

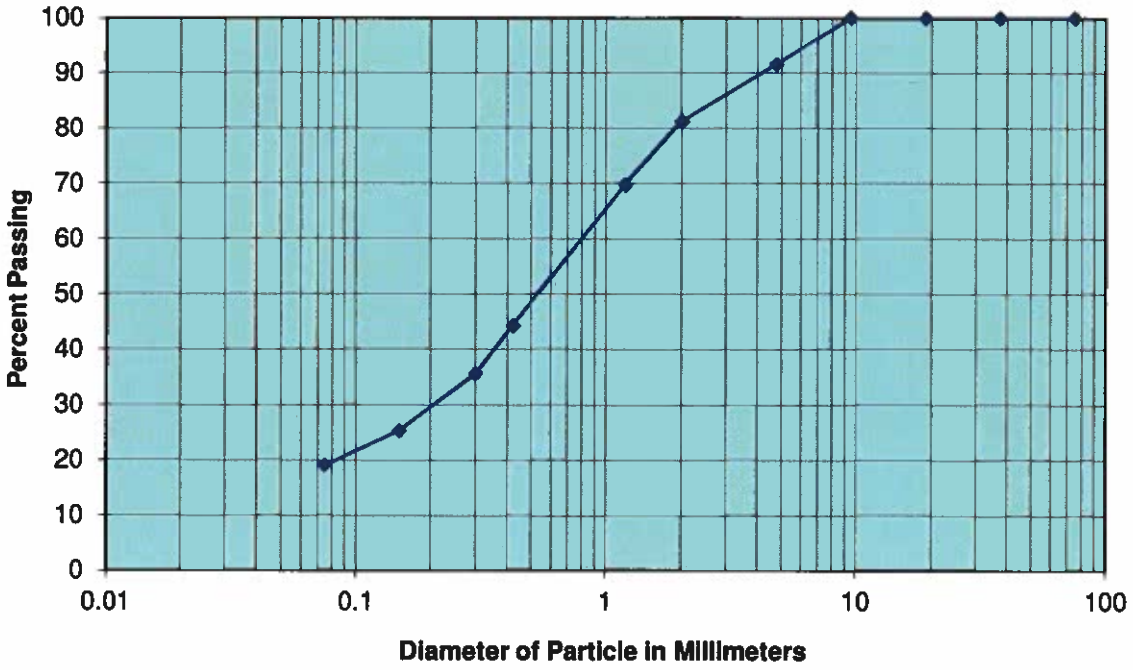


B-6 @ 15.0'- 15.5'

Gravel	Sand	Fines
13.3 %	73.4 %	13.3 %

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.**	
	Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: N

Gradation Test Results



B-8 @ 7.0'- 7.5'

Gravel	Sand	Fines
8.4 %	72.5 %	19.1 %

Subsurface Explorations/Geotechnical Investigation Proposed New Auto Zone Store #3658 at: Near Ranchero Road and Escondido Avenue Oak Hill, San Bernardino County, CA 92344	**Terradyne Engineering, Inc.** Grain Size Distribution	
	Terradyne Project No.: L201011	Plate: O

Expansion Index Test (ASTM D 4829)

Project Name: Auto Zone, Store# 3658, Near Ranchero Dr & Esocondid	Sample By:	CR	Date: 2/7/20
Project No. : L201010	Tested By:	WS	Date: 2/27/20
Boring No.: B8	Depth (ft): 1 - 5'		
Sample No. :			
Soil Identification:			

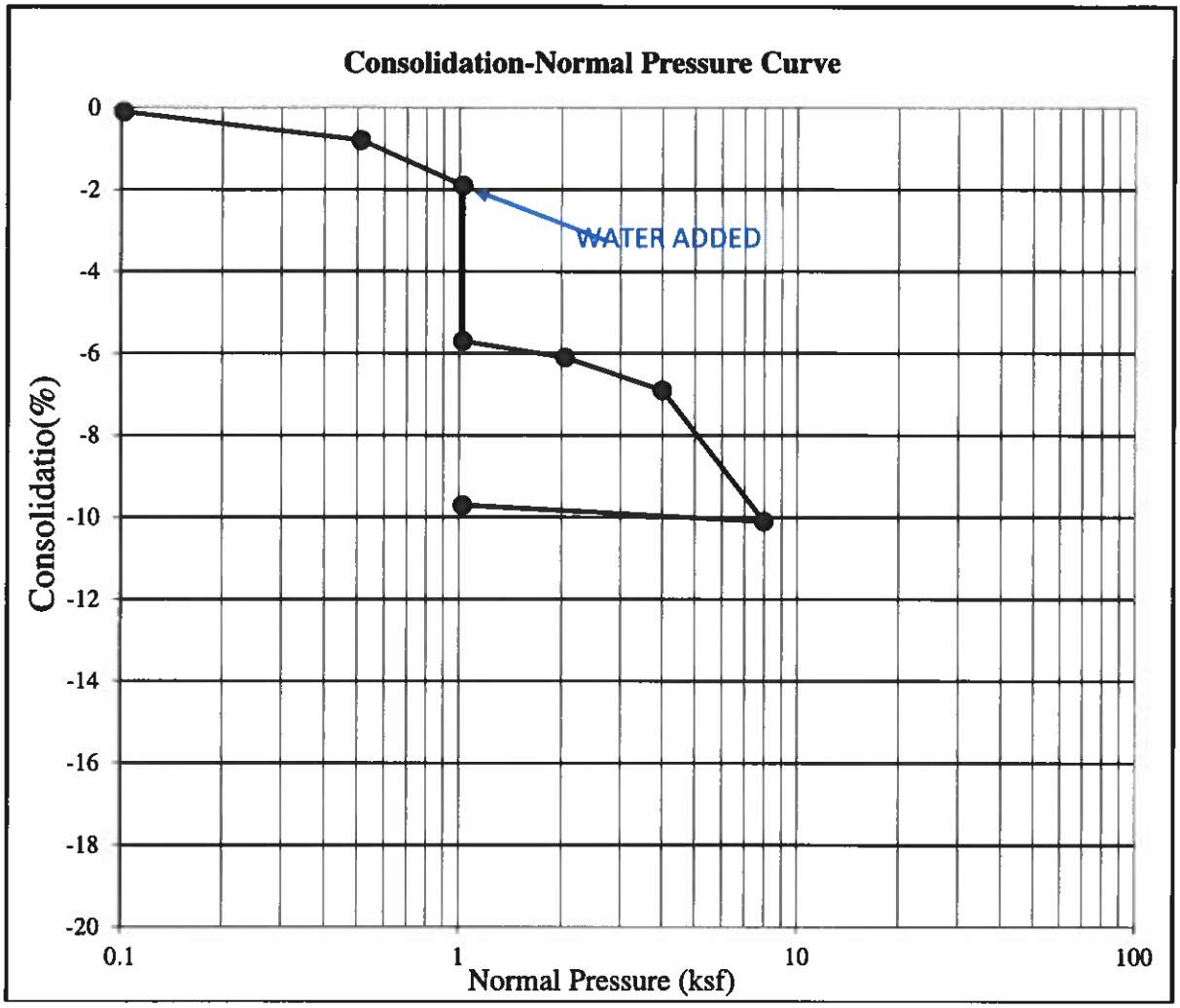
Dry Wt. of Soil + Cont. (g)	
Wt. of Container No. (g)	
Dry Wt. of Soil (g)	0.0
Weight Soil Retained on #4	
Sieve Percent Passing # 4	

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4	4
Specimen Height (in.)	1.00	1.00
Wt. Comp. Soil + Mold (g)	785.7	815.8
Wt. of Mold (g)	367.0	367.0
Specific Gravity (Assumed)	2.65	2.65
Ring Factor	0.301	0.301
Wet Wt. of Soil + Cont. (g)	204.5	203.1
Dry Wt. of Soil + Cont. (g)	198.9	192.4
Wt. of Container (g)	124.0	100.8
Moisture Content (%)	7.5	11.7
Wet Density (pcf)	126.0	135.1
Dry Density (pcf)	117.3	121.0
Degree of Saturation (%) [S meas]	48.3	84.3

SPECIMENT INUNDATION in distilled water for the period of 24h or expansion rate < 0.0002 in./h

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Reading (in.)
2/27/2020	3:40 PM	1		41
2/28/2020	3:50 PM	1		43

Expansion Index (EI)=(Final rdg-InitialRdg)/Initial Thick)x1000	2	**Plate: P**



Boring Info		Before Test		After Test		Record	
Boring No.	B-4	Moisture (%)	3.92	Moisture (%)	16.03	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	179.8	Total Weight (g)	193.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	41.8	Ring Weight (g)	41.8	Start Date	3/6/2020
		Wet Density (pcf)	114.7	Wet Density (pcf)	126.1	End Date	3/9/2020

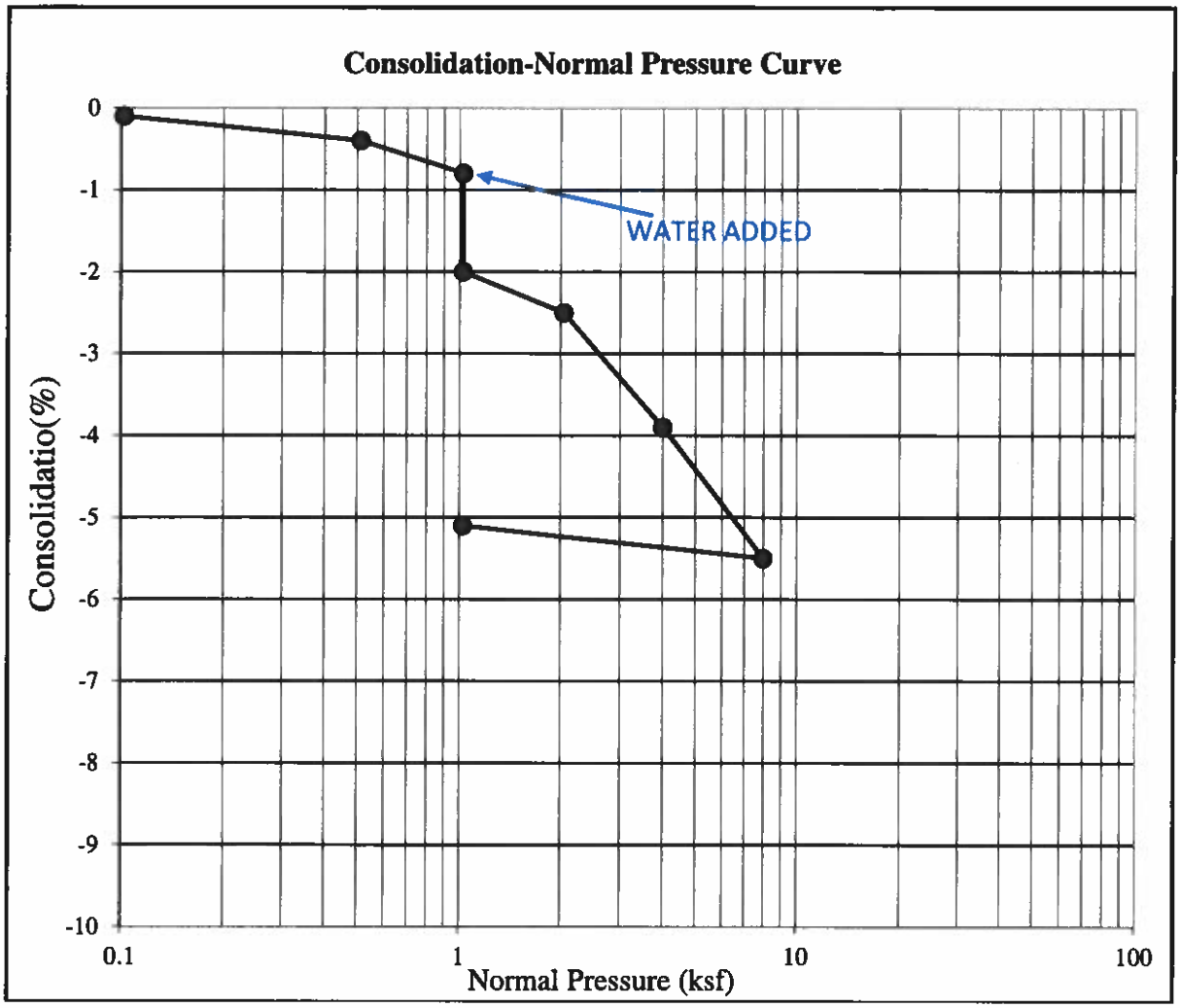
Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr & Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

Terradyne Project No: L201011

Plate: Q



Boring Info		Before Test		After Test		Record	
Boring No.	B-7	Moisture (%)	4.42	Moisture (%)	16.50	Test by	WS
Depth	7' - 7.5'	Total Weight (g)	185.8	Total Weight (g)	201.5	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	46.3	Ring Weight (g)	46.3	Start Date	3/6/2020
		Wet Density (pcf)	115.9	Wet Density (pcf)	129.0	End Date	3/9/2020

Geotechnical Investigation Report:
Auto Zone, Store# 3658, Near Ranchero Dr & Esocondido Ave, Oak Hill, CA.

Terradyne Engineering, Inc.

Consolidation Test Diagram

Terradyne Project No: L201011

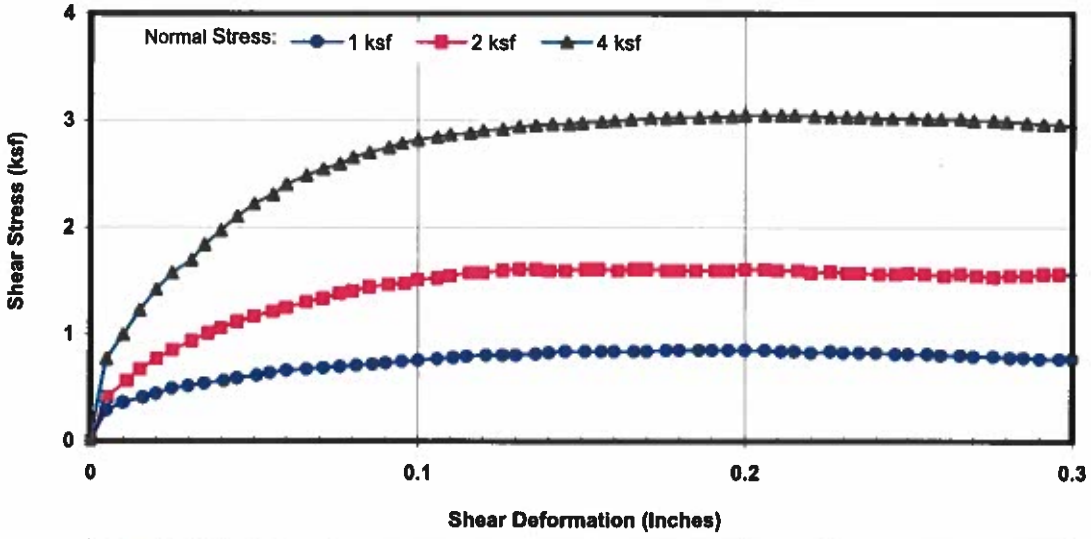
Plate: R

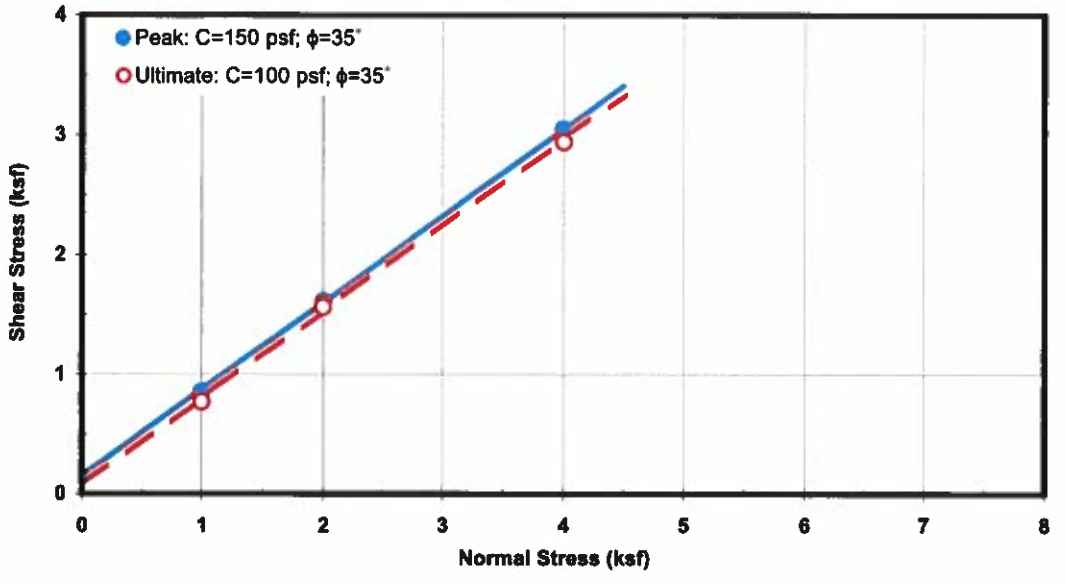
AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Client:	Terradyne Engineering Inc.		**Tested By:**	LS	**Date:** 02/28/20
Project Name:	AutoZone #3658, Oak Hills, CA		**Computed By:**	NR	**Date:** 03/03/20
Project No.:	L201011		**Checked by:**	AP	**Date:** 03/04/20
Boring No.:	B-5				
Sample No.:	-	**Depth (ft):** 7-7.5			
Sample Type:	Mod. Cal.				
Soil Description:	Silty Sand w/gravel				
Test Condition:	Inundated	**Shear Type:** Regular			

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
111.0	107.8	2.9	18.9	14	91	1	0.852	0.768
						2	1.608	1.560
						4	3.050	2.940





APPENDIX D

ASCE 7-16 Hazards Report

ASCE 7 Hazards Report

Address:
7151 Escondido Ave
Hesperia, California
92344

Standard: ASCE/SEI 7-16
Risk Category: II
Soil Class: D - Stiff Soil

Elevation: 3697.07 ft (NAVD 88)
Latitude: 34.380496
Longitude: -117.372579

Seismic

Site Soil Class: D - Stiff Soil

Results:

S_S :	1.5	S_{D1} :	N/A
S_1 :	0.6	T_L :	12
F_a :	1	PGA :	0.555
F_v :	N/A	PGA_M :	0.611
S_{MS} :	1.5	F_{PGA} :	1.1
S_{M1} :	N/A	I_e :	1
S_{DS} :	1	C_v :	1.4

Ground motion hazard analysis may be required. See ASCE/SEI 7-16 Section 11.4.8.

Data Accessed: Sun Mar 08 2020

Date Source: USGS Seismic Design Maps

The ASCE 7 Hazard Tool is provided for your convenience, for informational purposes only, and is provided "as is" and without warranties of any kind. The location data included herein has been obtained from information developed, produced, and maintained by third party providers; or has been extrapolated from maps incorporated in the ASCE 7 standard. While ASCE has made every effort to use data obtained from reliable sources or methodologies, ASCE does not make any representations or warranties as to the accuracy, completeness, reliability, currency, or quality of any data provided herein. Any third-party links provided by this Tool should not be construed as an endorsement, affiliation, relationship, or sponsorship of such third-party content by or from ASCE.

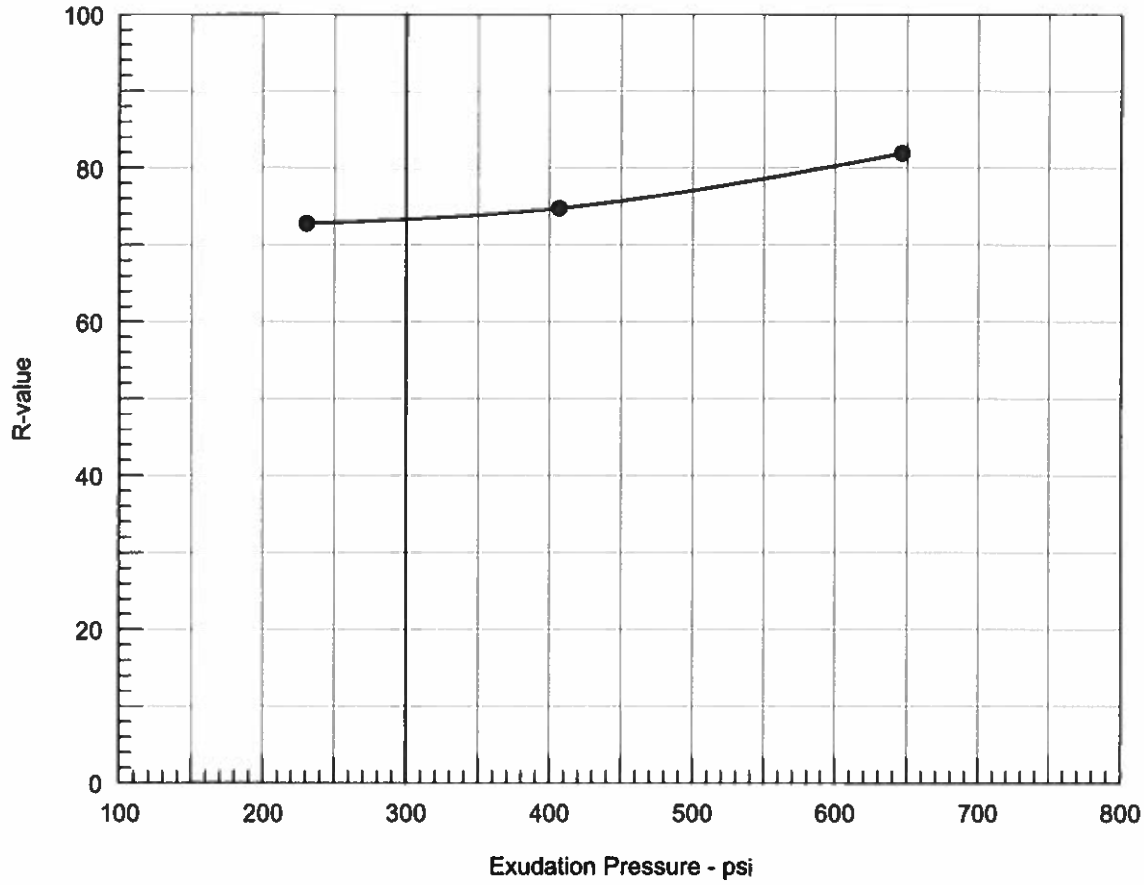
ASCE does not intend, nor should anyone interpret, the results provided by this Tool to replace the sound judgment of a competent professional, having knowledge and experience in the appropriate field(s) of practice, nor to substitute for the standard of care required of such professionals in interpreting and applying the contents of this Tool or the ASCE 7 standard.

In using this Tool, you expressly assume all risks associated with your use. Under no circumstances shall ASCE or its officers, directors, employees, members, affiliates, or agents be liable to you or any other person for any direct, indirect, special, incidental, or consequential damages arising from or related to your use of, or reliance on, the Tool or any information obtained therein. To the fullest extent permitted by law, you agree to release and hold harmless ASCE from any and all liability of any nature arising out of or resulting from any use of data provided by the ASCE 7 Hazard Tool.

APPENDIX E

Pavement Design

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	350	132.8	7.5	0.00	22	2.43	231	74.0	72.8
2	350	131.8	6.8	0.00	15	2.45	646	81.9	81.9
3	350	134.1	7.1	0.00	20	2.40	407	76.4	74.7

Test Results	Material Description
R-value at 300 psi exudation pressure = 73.3	MD REDDISH BRN SILTY SAND W TRACE GRAVEL

Project No.: 3842A01
Project: TERRADYNE
Location: B2 @ 0-5'
Sample Number: 192
Date: 3/2/2020

Tested by: RS
Checked by: CF

Remarks:
SAMPLED BY: CLIENT

R-VALUE TEST REPORT

MTGL, Inc.

Figure _____

Design of Pavement Section by Caltrans Method Using Traffic Index and R-Value

Lowest TI	5		
R-Value of Subgrade	73.3	Project Name:	AutoZone Store#3658
R-Value of Aggregate Base	78 (usually 78)	Project No.:	L201011
R-Value of Aggregate Subbase	50 (usually 50)	Date:	3/10/2020
Gravel factor for AB from Table 663.3	1.1 (usually 1.1)		
Gravel factor for AS from Table 663.3	1 (usually 1.0)		

Summary of Results, mm

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
hickness of dense-graded asphalt concrete (mm)	60	75	75	90	105	105	120	135	135	150	150	165	165
Thickness of Class 2 aggregate base(mm)	135	135	165	165	165	195	195	195	225	225	255	255	285
Thickness of aggregate subbase(mm)	105	105	105	105	105	105	105	105	105	105	105	105	105

Summary of Results, inches

TI	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
Thickness of dense-graded asphalt concrete(in.)	2.5	3	3	3.5	4	4	4.5	5.5	5.5	6	6	6.5	6.5
Thickness of Class 2 aggregate base (in.)	5.5	5.5	6.5	6.5	6.5	7.5	7.5	7.5	8.5	8.5	10	10	11.5
Thickness of aggregate subbase (in.)	4	4	4	4	4	4	4	4	4	4	4	4	4

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GEOTECHNICAL SUMMARY

SOILS

Earth materials encountered in this investigation consisted of older alluvial sediments, silty sands

0'-16.5' Older ALLUVIUM (Qoa)
Silty SAND, light brown to brown, loose to dense, slightly moist (No groundwater encountered)

GROUNDWATER

Groundwater is expected to be more than 100 feet below the ground surface (CADWR, 2020, GSS, 2011). Review of the available references (CADWR, 2020), indicate that several wells are located in the general vicinity of the subject site.

SITE PREPARATIONS

The existing upper soils alluvial deposits soils are considered to be potentially compressible and collapsible in their current condition. As a result, we recommend the reprocessing of these existing soils in all areas to receive building additions or new buildings (where not anticipated to be removed during proposed grading operations). Based on the results of our subsurface investigation, the potential for hydroconsolidation of the underlying soils, it is anticipated that the removal depths in the vicinity of the proposed buildings will be a minimum of **5.0 feet** below existing grade elevations or **36-inches** below the footings depth (whichever is deeper). The removals should extend to a minimum distance of 5 feet outside the building footprint

COMPACTIONS REQUIREMENTS

The minimum required compaction is 95 percent of the maximum dry density as determined by ASTM D1557, with moisture content of three (3) percent over the optimum moisture content of the soil.

SLAB PREPARATION

Slab on grade should be underlain by a layer of four (4) inches free drainage ¾" crushed rocks over firm compacted native or selected fill. Slab thickness, reinforcement etc, should be selected by the structural engineer based on the analysis performed considering the loads anticipated, expansion index and the modulus of subgrade reaction of the soil. As minimum, we recommend a 4-inch thick slab thickness, reinforced with No. 3 bars at 24-inch on center. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended. The subgrade for the new slab should be prepared as recommended under Section 8.2 "Site Preparation."

FOUNDATIONS

A rigid conventional shallow continuous or spread foundation system embedded within the newly placed fill compacted to 95% may be used to support the proposed building. All foundations should be minimum 24 inches in width and embedded a minimum of 18 inches below the finished grade elevation.

PAVEMENT DESIGN

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3	4.0	12.0-inches
7 (truck access)	4.0	6.0	12.0-inches

*Caltrans Class 2 aggregate base, minimum R-value of 78