

Appendix E

Geotechnical Report



Report of Subsurface Exploration & Geotechnical Investigation

Proposed New AutoZone Store #4499

Near El Evado & Mojave Drive,

Victorville, San Bernardino County, CA 92394

Terradyne Project No.: L201055

**Mr. Rob DeGraaf, LEP, PWS
Sweetgum Environmental**

Terradyne Project No: L201055

8/24/2020



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Re: **Report of Subsurface Exploration & Geotechnical Investigation**
Proposed New AutoZone Store #4499
Near El Evado & Mojave Drive,
Victorville, San Bernardino County, CA 92394
Terradyne Project No.: L201055

Dear Mr. DeGraaf,

In accordance with your request, Terradyne, Inc., Inc. has performed this Report of Subsurface Exploration and 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.

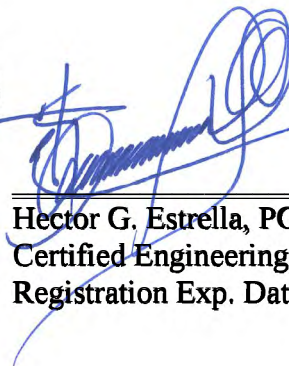
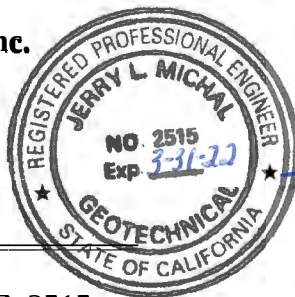
We appreciate and wish to thank you for the opportunity to serve you on this project. Please do not hesitate to contact us if we can be of additional assistance during the Construction Materials Testing and Quality Control phases of construction.

Respectfully Submitted,

Terradyne Engineering, Inc.



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ASCE 7-16

EXECUTIVE SUMMARY

The soil conditions at the site of the proposed new AutoZone Store #4499 located Near El Evado & Mojave Drive, in Victorville San Bernardino County, CA 92394, were explored by drilling eight (8) geotechnical borings 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 website research at California Geological Survey (CGS), the CGS seismic hazard information pertaining to the subject site as follows:

The site is not located in an Earthquake Fault Zone

The site has not been evaluated for seismic landslide hazards

The site has not been evaluated for liquefaction susceptibility

- Our review of the available references indicate that the active fault mapped nearest to the site is the western section of North Frontal Thrust System. This system which is an Alquist-Priolo zoned fault, this fault zone is mapped at approximately 11.5 miles to the southeast at the closest point to a fault strand. As noted above the subject property is not within a State of California Fault Zone (CGS, 2018).
- The sampled soils were observed based on our laboratory testing to be prone to hydroconsolidation when water is introduced in their natural condition and will require improvement prior to building construction.
- Foundation support for the new one-story commercial building could be derived by utilizing a rigid shallow conventional continuous or spread foundation system embedded within the newly placed fill compacted to 92%. 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 properly compacted fill soil. The upper three (3) feet of subgrade or 2 feet below footing bottom (whichever is greater) within the building pad should be over excavated processed and recompacted to 92%. 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.
- Groundwater was not encountered during field exploration on August 11, 2020 to the depths explored. Ground water levels will fluctuate with seasonal climatic variations and changes in the land use.

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

1.0 INTRODUCTION

Terradyne Engineering Inc., (TEI) conducted an onsite field exploration on August 11, 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 (referenced as B-1 through B-8 Appendix B) for the proposed building development located at approximately 600 feet west of the intersection of El Evado Road along the north side of Mojave Drive in the City of Victorville San Bernardino County, California .

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

2.0 PROPOSED CONSTRUCTION

Based on the available plans and information, the proposed construction will consist of a commercial single story AutoZone retail store structure and related improvements (trash enclosure, asphalted drive, underground utilities and parking areas and landscaping. The construction is proposed to take place in the western portion of an 11 acre parcel. The area of study consists of an approximately 150 feet frontage along the northern side of Mojave Drive at approximately 600 feet west of the intersection with El Evado Road. The area of study extends for approximately 250 feet to the north of Mojave Drive. The proposed building will be located generally in the western portion of the area of study. Access is planned from the southeast, and northeast of the area of study. Figure 5, depicts the proposed improvements for the site.

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

The Scope of Services does not include an 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 and aerial photographs of the site, the parcel under investigation consists of a undeveloped property located at approximately 600 feet to the west of the intersection of El Evado Road along the north side of Mojave Drive in the City of Victorville, San Bernardino County, California (western portion of APN Number 0394-031-36). The area of study extends for approximately 150 feet to the west and 250 feet north for an area of approximately 37,500 square feet. Site Topography is generally flat with site elevations ranging from approximately +2946 to 2938 feet above mean sea level with a generally south to north gradient. 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 2018 Victorville California 7.5-minute topographic quadrangle (Figure D, Appendix A) and the Google Earth Pro®, database indicates the subject property is located on an alluvial valley. The subject property is approximately situated at 34.529069° north latitude and 117.349098° west longitude (Google Earth Pro®, 2020).

5.0 GEOTECHNICAL INVESTIGATION

5.1 Field Exploration

The field exploration by Terradyne Engineering Inc., was completed on August 11, 2020. Eight (8) hollow-stem auger borings were advanced to a maximum depth of 16.5 feet below ground surface in the vicinity of the proposed building structure and parking area. The locations of these exploratory borings (referenced as Boring B-1 through Boring B-8) are shown on the Approximate Boring Locations Map (Figure 4, Appendix A).

5.1.1 Engineering Borings

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.

Conditions between boring 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. Stratification lines, as indicated on the Boring Logs, represent approximate changes in soil and rock composition, moisture and color, as approximated by field personnel logging the drilling operation and by the engineer in the laboratory from sample recovery data and by observation of the samples. Actual depths to changes in the field may differ from those indicated on the logs, or transitions may occur in a gradual manner and may not be sharply defined by a readily obvious line of demarcation.

All eight borings were backfilled with the removed soil cuttings on August 11, 2020. Earth materials encountered in this investigation consisted of fill and alluvial sediments, silty sands (see Figure C, Appendix A).

5.2 Site Geology

Regional Geologic maps of the area (USGS, Dibblee, T.W. 1960, Preliminary Geologic Map of The Victorville Quadrangle, California Map MF-229, Map Scale: 1:62,500), indicate that the subject site is located in an area underlain by Quaternary Recent Alluvium (Qa). These units are described as unconsolidated deposits of alluvial fans consisting predominately of gravel, sand, and silt. Exploration of the subject site reveals conformity with this description. Figure 3 (Appendix A), reproduces geologic mapping of the site vicinity showing the site layout and the mapped location of the alluvium (Qa).

5.3 Faulting and Seismicity

Our review of the available references indicate that the mapped active fault nearest to the site is the western section of the North Frontal Thrust Fault system, which is an Alquist-Priolo zoned fault, this fault zone is mapped at approximately 11.5 miles to the southeast at the closest point to a fault strand, and described as capable of a Magnitude M_w 6.0 – 7.1 earthquake (SCEDC, 2013). Other mapped active faults near the subject site include the Helendale-South Lockhart fault zone which lies at approximately 13.0 miles to the northeast and east of the site; the Mojave Section of the San Andreas Fault zone is the closest known historically active fault zone (1857 Fort Tejon Earthquake) located at approximately 18.2 miles to the southwest. According to the Southern California Earthquake Data Center - the Maximum Magnitude earthquake on the San Andreas Fault Zone is MW 6.8 to 8.0. other nearby fault is the northern portion of the San Jacinto Fault Zone (San Bernardino Valley Section), and the eastern portion of the Sierra Madre Fault Zone (Cucamonga Section), located at approximately 22 miles to the south southwest of the site at their closest point to a strand.

All these faults have shown signs of Pleistocene (11,000 years) and Historic seismic activity and are all classified as “Active”. According to the Official Map of Alquist-Priolo Earthquake Fault Zones of California, by the California Division of Mines and Geology (currently California Geological Survey) (CDMG, 1991) the site IS NOT located an Alquist-Priolo Earthquake Fault Zone map.

5.4 General Subsurface Conditions

A field log was prepared for each of the borings. The logs include information concerning the boring method, samples attempted and recovered, and the presence of various materials (such as silt, clay, sand or gravel) and groundwater observations. It also includes an interpretation of the subsurface conditions between samples. Therefore, the log includes both factual and interpretive information. The final log and key to classification terms and symbols are included in Appendix B.

The soils underlying the site to the full depth explored may be grouped into two generalized strata each with similar physical and engineering properties. The lines on the log designating the interface between soil strata represent approximate boundaries. The transition between materials may be gradual. The soil stratigraphy at the boring location is presented in the Boring Logs.

The soils underlying the site were noted to consist mainly of 6-inches of undifferentiated topsoil/fill mantling the natural soils that consisted of (from youngest to oldest):

Topsoil/surficial soils undifferentiated: The area of study was noted to be mantled by a layer of topsoil/surficial soils, that was noted to extend to approximately 1.0 foot below the surface in vicinity of our exploratory excavations. These encountered surficial soils were observed to generally consist of light-brown silty sand (SM), this material was observed to have a loose consistency and was noted to be dry to moist and have some fine gravel.

Alluvium (Qa): Underlying the artificial fill, we encountered alluvium deposits consisting of silty sand. This material was observed to be light-brown, medium dense to dense and dry to moist. This material was noted to extend beyond the bottoms of our exploratory excavations at 16.5 feet. Table 2 below (following page), presents the main soils stratum encountered during our field exploration and the approximate depth range of each strata.

Table 1

Stratum	Depth Range (feet)	Remarks
<u>Topsoil/surficial soil undifferentiated (Qa)</u>	0 to 1.0'	No groundwater encountered
<u>Alluvial Fan Deposits (Qa)</u>	1.0' to >16.5'	

The above description generally highlights the major soil stratification features and soil characteristics. The boring log should be consulted for specific information at the boring location. An excerpt from a regional geologic map is included in Appendix A, as Figure C.

5.5 Regional Groundwater

Based on our review of the available references (CDWR), there are several state wells located in the vicinity of the subject site with three wells located within a 1 mile from the site. The following Table 2 presents groundwater information from those wells.

Table 2

State Well No.	Ground Elev. (ft. amsl)	Highest GW Depth. (bgs)	Date	Latest GW Depth. (bgs)	Date	Distance from Subject Site (mi.)	Direction from the Subject Site
05N05W12R001S	+ 2941.09	+143.1	03/18/17	+143.1	03/18/17	0.11	N
05N04W07N002S	+ 2937.69	+211	03/01/06	+214	4/22/10	0.29	NE
05N05W13H002S	+ 2978.81	+220	03/01/06	+220	03/01/06	0.52	SSE

Groundwater was not encountered during our field exploration on August 11, 2020.

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.

5.6. 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) Maximum Dry Density-Optimum Moisture Content (ASTM D1557)
- 3) Grain Size Distribution (ASTM D422)
- 4) One-Dimensional Consolidation (ASTM D2435)
- 5) Corrosion Potential (CT-417, CT-422, CT-532(643))
- 6) R-Value (Cal 301)

5.6.1 Moisture Content / In-Situ Density

The relationship between the moisture and density of undisturbed soil samples give qualitative information regarding the in-place soil strength characteristics and soil conditions. Results of our in-place moisture and density testing are presented on boring logs, (Appendix B).

The in-place moisture contents of the samples obtained from the upper 5 feet of soils in the vicinity of the proposed building pad areas at the subject site, were observed to range from 0.9 to 9.6 percent. Optimum moisture content was determined to be 8.5 percent. These results indicate a variability of moisture content of the upper soils throughout the site but generally significantly below optimum moisture content (see Appendix C, Laboratory Testing), and will require moisture conditioning during grading operations.

5.6.2 Maximum Dry Density/Optimum Moisture Content

The maximum dry density and optimum moisture content was obtained in the laboratory from a representative sample of the site soils. Results of our testing indicate that the tested soils yielded a maximum dry density of 128.2 at an optimum moisture content of 8.5 percent.

5.6.3 Grain Size Distribution Analysis

Representative samples of the subsurface materials were subjected to mechanical grain-size analysis by wet-sieving with U.S. Standard brass screens. The results of our grain size distribution analysis indicate that the sample tested contains 0.1 percent of gravel; 79.7 percent sand and 20.1 percent passing the 200 sieve. The percent passing the 200 sieve is presented in Appendix B (Laboratory Testing Results).

5.6.4 Consolidation Test

The consolidation test is used to estimate the consolidation/settlement or expansion that could potentially occur within a soil under specific loadings (such as may be imposed by buildings, walls, piers, etc.) and after saturation. The tested soils were generally loose sandy soils that are typically susceptible to collapse. The results of our testing indicate that the tested soils are susceptible to moderate collapse when moisture is introduced. Results of our laboratory testing are presented in Appendix B (Laboratory Testing Results).

5.6.5 Expansion Potential

Expansive soils change in volume with change in moisture content. Shrinking and swelling of the clays can cause heaving and cracking on retaining wall, slab-on-grade and structures founded on

shallow foundations. The onsite natural alluvial fan deposits soils are mainly sands and silty sands. We did not test for expansivity, our experience with these types of soils suggest that these soils will have a low to very low expansion potential. We recommend that an expansion test be performed on a representative sample when grading starts, and removals take place if significant signs of clays are encountered. Terradyne may provide additional recommendations if expansive soils are encountered during grading construction.

5.6.6 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 No. 3.

Table No. 4

Sample Location/ Depth, (ft)	pH	Soil Resistivity (Ohm-cm)	Soluble Sulfate (PPM)	Soluble Chloride (PPM)
B-1/ 1.0 - 5.0	6.09	1,400	95	11

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 (0.0095) 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. 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.

In general, soils are considered deleterious to foundation elements when the pH is less than 5.5 and considered to be corrosive and deleterious to metals. A pH of 7 is considered neutral; a pH <7 is considered acidic, a pH >7 is considered to be alkaline. Results of our testing yielded a pH of 6.09 which indicates that the tested soils are slightly acidic, and that pH is not a significant factor in corrosivity to metals.

Soil with a chloride concentration greater than or equal to 500 ppm or more is considered corrosive to ferrous metals. The Chloride content of the sampled soils measured at approximately 11 ppm, which indicates that Chloride is not a major factor in corrosion to ferrous metals.

The soil resistivity measurement of the sample was approximately 1,400 ohm-cm, which indicates a **severely corrosive** soil to ferrous metals. Therefore, the corrosion protection measures are advisable to be considered in the design. It should be noted that Terradyne Engineering Inc. does not practice corrosion engineering and our assessment here should be construed as an aid to the owner or owner's representative. A corrosion specialist should be consulted for any specific design requirement.

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 a minimum of 2500 psi at 28 days and maximum slump during placement shall be five inches, or as recommended by the structural engineer. 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 CONCLUSIONS

6.1 General

Based on the results of our study, it is Terradyne's opinion that the proposed buildings can be constructed as planned, provided that the recommendations presented herein are implemented. It is our opinion that the on-site soils (when properly processed and recompact as recommended herein) should provide adequate foundation support for the proposed structure.

6.2 Regional Groundwater

Review of the available references (CADWR, 2020), indicate that three state wells located at less than 1 mile from the site located to the north, northeast and south-southeast had groundwater measured at deeper than 100 feet from ground elevations with groundwater depths ranging from 143 to 220 feet below ground surface elevations. Well information including ground elevations are presented in Table 2 (page 8 above).

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.

6.3 Moisture Content

The in-place moisture contents of the samples obtained from the upper 5 feet of soils in the vicinity of the proposed building pad areas at the subject site, were observed to range from 0.9 to 9.6 percent. Optimum moisture content was determined to be 8.5 percent. These results indicate a variability of moisture content of the upper soils throughout the site but generally well under optimum moisture content and will require moisture conditioning during grading operations.

6.4 Soil Compressibility

The encountered artificial fills and upper alluvial deposits were noted to be compressible from an engineering standpoint. As such, they are not recommended for foundation or slab support in their current condition. The natural soils were observed to be denser at depth, have a superior bearing

capacity and may be used to support future secondary compacted fills.

6.5 Regional and Local Faulting

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.

Our review of the available references indicate that the mapped active fault nearest to the site is the western section of North Frontal Thrust Fault system, which is an Alquist-Priolo zoned fault, this fault zone is mapped at approximately 11.5 miles to the southeast at the closest point to a fault strand, and described as capable of a Magnitude M_w 6.0 – 7.1 earthquake (SCEDC, 2013). Other nearby active faults are described in Section 5.3 above. As previously the subject property is not within a State of California Fault Zone (CGS, 2018).

6.6 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 2019 California Building Code (CBC) and ASCE 7-16 are presented in Table 5.

Table 5

CBC DESIGN RESPONSE SPECTRUM PARAMETERS	
Latitude	34.529069 degrees north
Longitude	-117.349098 degrees west
Site Class	D – Stiff Soil
MCE_R Ground Motion, S_s (period=0.2s)	1.154 g
MCE_R Ground Motion, S_1 (period=1.0s)	0.448 g
Site Amplification Factor at 0.2s, F_a	1.038

Site Amplification Factor at 1.0s, F_v	N/A
Site-modified Spectral Acceleration Value, S_{MS}	1.198 g
Site-modified Spectral Acceleration Value, S_{M1}	N/A
Numeric Seismic Design Value at 0.2s SA, S_{DS}	0.799g
Numeric Seismic Design Value at 1.0s SA, S_{D1}	N/A
Peak Ground Acceleration	0.496 g
Site Modification Peak Ground Acceleration, PGA_M	0.548 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.*

6.7 Seismic Hazards and Other Considerations

Earthquakes or aftershocks may cause secondary ground failures. Ground failures are caused by soil losing its structural integrity. Examples of seismically-induced ground failures are liquefaction, lateral spreading, ground lurching, and subsidence. *Liquefaction* (the rapid transformation of soil to a fluid-like state) affects loose saturated sands. *Lateral spreading* is the horizontal movement of loose, unconfined sedimentary and fill deposits during seismic activity. *Ground-lurching* is the horizontal movement of soil, sediments, or fill located on relatively steep embankments or scarps as a result of seismic activity, forming irregular ground surface cracks. The potential for lateral spreading or lurching is highest in areas underlain by soft, saturated materials, especially where bordered by steep banks or adjacent hard ground. *Subsidence* is vertical downward movement of the ground surface. The review of the available references indicates that the subject site is located in an area underlain by granular soils. The seismic hazard most likely to impact the site is ground shaking due to a large earthquake on one of the major active regional faults. Because of the proximity to the subject site and the maximum credible event, it appears that the western section of North Frontal Thrust Fault system, located at approximately 11.5 miles to the southeast of the site is most likely to affect the site with severe ground shaking should a significant earthquake occur along this fault.

6.8.1 Liquefaction

Based on a review the liquefaction study by the San Bernardino County Land Use Plan GENERAL PLAN Geologic Hazard Overlays Victorville-San Bernardino (EHFH C, 2010) the subject property is located outside a suspected area of liquefaction and landslide susceptibility. Due to the relatively flat topography, the site is not within a zone of possible earthquake induced landslides.

Liquefaction of soils can be caused by strong vibratory motion in response to earthquakes. Both research and historical data indicate that loose mostly fine sands or predominantly granular soils are susceptible to liquefaction, while the stability of rock is not as adversely affected by vibratory motion. Liquefaction is generally known to occur primarily in cohesionless silt, sand, and fine-grained gravel deposits of Holocene to late Pleistocene age in areas where the groundwater is shallower than about 50 feet (DMG Special Publication 117A). Is also a function of relative density, soil type and probable intensity and duration of ground shaking. Due to the relatively deep groundwater in the general area (>100 feet bgs), the potential for liquefaction at the site is negligible.

6.8.2 Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. The subject site is generally flat and because of the site not being mapped in a liquefaction zone, deep groundwater, it is our opinion that the potential for liquefaction induced lateral spreading is also low.

6.8.3 Ground Lurching

As noted previously, ground-lurching is the horizontal movement of soil, sediments, or fill located on relatively steep embankments or scarps as a result of seismic activity, forming irregular ground surface cracks. The subject site is relatively flat, and, as such, the potential for ground lurching is considered to be very low.

6.8.4 Seismic Settlement

Seismic settlement occurs when loose to medium-dense, granular soils consolidate during ground shaking. The materials which underlie the subject site were observed to be primarily loose silty sands. As such, it appears that the soils underlying the subject site possess a relatively **low to moderate potential** for seismically induced settlement in their present condition.

6.8.5 Seismic Induced Landslides

The site topography and the general topography of the area is relatively flat, as such the potential for seismic induced landslides is none.

6.8.6 Design Earthquake Magnitude

The review of readily available references pertinent to the subject site indicates that structures should be designed to resist moderate earthquakes with a low probability of structural damage. Such design shall resist major or severe earthquakes with some structural damage, but with a low probability of collapse.

The moderate and major earthquakes have been interpreted to represent the maximum probable and maximum credible earthquakes, respectively. The maximum credible earthquake is defined as the largest event that a specific fault is theoretically capable of producing within the presently known tectonic framework and is established based on mechanical relationships of the fault and fault mechanisms and does not consider rate of recurrence or probability of occurrence. The seismic design parameters at the site were obtained using the USGS seismic design maps site. The subject site is located at latitude of 34.529069° north and longitude 117.349098°. The peak horizontal ground acceleration at the site was calculated to be 0.496g.

6.9 Other Potential Site Hazards

6.9.1 Flood

The project site is located within FEMA Map Number 06071C5815H, effective on 08/28/2008. This map shows that the project site is located within FEMA-designated Flood “Zone X” described as “zone of minimal risk of flood hazard” (FEMA, 2016). Zone X is designated as Areas determined to be outside the 0.2% annual chance floodplain. This statement should be verified with the City of Victorville and/or County of San Bernardino.

6.9.2 Hydroconsolidation

Commonly referred to as soil collapse, typically occurs when loose, dry, sandy soils become saturated and settle. These types of soils are commonly termed 'collapsible'. Collapsible soils are moisture sensitive in that an increase in moisture content is the primary triggering mechanism for their volume reduction (compression). These soils are characterized by showing in-situ high void ratios and low unit weights, they are typically granular or only slightly cohesive. The encountered soils consisted mainly of loose to medium dense silty sands. The sampled soils at 6 feet presented hydroconsolidation, as such, it is our opinion that the subgrade soils are potentially collapsible in their current condition and should be processed prior to using them as bearing material.

7.0 RECOMMENDATIONS

7.1 General

Based on our geotechnical study at the site, our review of readily available reports and literature pertinent to the site (Attached), and our understanding of the proposed final grades, it is our opinion that development and/or improvement of the site is feasible from a geotechnical standpoint, provided the conclusions and recommendations included in this report are properly incorporated into the design and construction of any proposed structures. There appear to be no significant geotechnical constraints on-site that cannot be mitigated by proper planning, design, and utilization of sound construction practices. The engineering properties of the underlying materials, surface drainage, and anticipated degree of seismic risk offer conditions comparable to the other sites surrounding the subject project. The following sections provide geotechnical recommendations that should be incorporated into the design of the proposed improvements at the site.

7.2 Construction Monitoring

As Geotechnical Engineer of Record for this project, Terradyne Engineering Inc., should be involved in monitoring the earthwork activities and foundation installation 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

7.3 Earthwork

Grading and earthwork should be performed in accordance with the following recommendations and the. In case of conflict, the following recommendations shall supersede those presented in the 2019 California Building Code (CBC, 2019).

7.3.1 General

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

During earthwork construction, removals and reprocessing of fill materials, as well as general grading procedures of the contractor should be observed, and the fill placed selectively tested by representatives of the geotechnical engineer. If any unusual or unexpected conditions are exposed in the field, they should be reviewed by the geotechnical engineer and if warranted, modified and/or additional remedial recommendations will be offered. Specific guidelines and comments pertinent to the planned development are provided herein.

The recommendations presented herein have been completed using the information provided to us regarding site development. If information concerning the proposed development is revised, or any changes in the design and location of the proposed property modified or approved in writing by this office.

7.3.2. Site Preparation

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 92 percent relative compaction (based on ASTM Test Method D1557).

7.3.3. Removal of Unsuitable Soils

As noted above, the existing fill soils and upper alluvium soils are considered to be potentially compressible 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, and because of the potential for hydroconsolidation of the tested soils, it is anticipated that the removal depths in the area of the proposed building 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; and due to the potential for hydroconsolidation of the subsurface soils, all areas to receive fill and/or other surface improvements, shall be scarified to a minimum depth of 8 inches below removal grade elevations, be moisture conditioned to **2 percent over optimum moisture content** and compacted to minimum **92 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 2 percent over optimum moisture content and recompaction of these soils to a minimum **92 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 **2 percent over optimum moisture content** and be recompacted to a minimum **92 percent** relative compaction (based on ASTM Test Method D1557). This earthwork should extend a minimum of 5 feet beyond the proposed footing limits.

7.3.4. 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, 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.

We recommend that if encountered, oversize materials (materials greater than 6 inches in maximum dimension) be removed from the upper 4 feet of fill.

7.3.5. Trench Excavations and Backfill

Trenches are anticipated to be excavated with moderate effort using conventional construction equipment in good operating condition. Deep trenches may require the use of heavy equipment operations. The encountered soils at the site consisted of 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).

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).

7.3.6 Temporary Drainage and Excavation 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 OSHA and other applicable building codes. Temporary excavations that could potential be a safety hazard are not anticipated for this project. However, the following recommendations should be followed based on anticipated and/or exposed conditions for continuous foundation and trench excavations:

- Vertical cuts (if proposed) exposing artificial fill shall have a maximum height of 4 feet. Upper portions of excavations that are deeper than 4 feet shall be laid back at a 1.5:1 (horizontal: vertical) slope gradient.
- Excavations above these maximum allowable heights and excavations that expose creep-prone soils or unsupported bedding planes should be trimmed back to the bedding plane / slip angle or shored.
- Excavation walls in sands and dry soils should always be kept moist (but not saturated).

All confined excavations deeper than 5 feet should conform to safety requirements for excavations as set forth in the State Construction Safety Orders enforced by the State Division of Industrial Safety, CAL OSHA.

7.3.7 Shrinkage and Bulking

Several factors will impact earthwork balancing on the site, including shrinkage, bulking, subsidence, trench spoils from utilities and footing excavations, and final pavement section thickness as well as the accuracy of topography.

Shrinkage, bulking and subsidence are primarily dependent upon the degree of compaction effort achieved during construction. For planning purposes, the shrinkage factor is estimated to be on the order of 10 to 15 percent for the onsite natural soils to be utilized as fill. This shrinkage factor may vary with methods employed by the contractor. Subsidence is estimated to be on the order of 0.1 feet. Losses from site clearing and removal of existing site improvements may affect earthwork quantity calculation and should be considered.

The previous estimates are intended as an aid for the project engineers in estimating earthwork quantities. It is recommended that the site development be planned to include an area that could be raised or lowered to accommodate final site balancing.

7.3.8 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.

7.3.9 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, Inc. Location and frequency of tests shall be at our field representative(s) discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction. Any areas not meeting the required compaction should be re-compacted and retested until compliance is met.

7.4 Foundations and Slab Design

Foundations and slabs should be designed in accordance with structural considerations and the following recommendations. These recommendations assume that soils exposed at finish pad grade will have a low potential for expansion. These recommendations may be verified by performing additional expansion tests after grading is completed. Localized areas of higher expansion may be possible.

7.4.1 Foundation Design

All proposed building and non-building improvements that are anticipated to constitute a structural load may be supported by an appropriate foundation system designed by the project structural engineer in accordance with the guidelines of the Uniform Building Code and/or all applicable

local building codes. Footings adequately founded in firm natural soils or properly compacted fill soils as recommended in Section 7.3 above should be a minimum 15 inches wide by 18 inches below the finished grade elevation for one story, and 18 inches wide by 24 inches deep below the finished grade elevation for a two-story structure, or in accordance with the project structural engineer requirements. Greater embedment may be necessary to resist lateral loads due to wind and seismic forces of the requirements of 2019 CBC. A coefficient of friction of 0.35 of dead load may be used. At these dimensions, footings adequately founded in properly compacted fill soil may be designed for an allowable soil bearing value of **2000** pounds per square foot. These values may be increased by one-third for loads of short duration including wind or seismic forces. The allowable bearing value may be **increased by 250** pounds per square foot per foot increase in depth or width to a maximum of 4000 psf. Foundations should be properly reinforced in accordance with the project structural engineer's recommendations. Minimum reinforcement shall consist of two No. 4 rebar at the top and two No. 4 rebar at the bottom of the footing or in accordance with the structural engineers' requirements, whichever is greater. We estimate that the total and differential settlement for the proposed improvements will be on the order of 1-inch and approximately ½ -inch between structural elements.

All foundation excavations should be observed and tested by a representative of Terradyne Engineering Inc., prior to placement of steel and concrete.

Table 6		
Earth Material and Foundation Design Parameters		
Earth Material Parameters	Foundation Bearing Material	Certified Fill/Approved Soil
	Foundation Bearing Pressures ³	2,000 psf
	Coefficient of Friction ¹	0.35
	Passive Earth Pressure (EFP) ³	200 pcf
	Maximum Passive Earth Pressure	4,000 psf
Continuous Footing Design	Minimum Width	15-inches one-story structure 18-inches two-story structure
	Min. Embedment Depth into Bearing Material ²	18-inches one-story structure 24-inches two-story structure
	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	24-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.		

7.4.2 Concrete Slabs

Interior concrete slabs should have a minimum thickness of 4.5 inches and be underlain by a 10-mil visqueen moisture barrier, underlain with a 2-inch layer of clean sand (sand equivalent of at least 30). The visqueen moisture barrier should be overlain by a 2-inch layer of clean sand to aid in concrete curing. All slabs should be constructed with preferred minimum reinforcement consisting of No. 3 bars placed mid-height in the slab and spaced on 18-inch centers in both directions. Welded wire mesh is not an acceptable alternative. Crack control joints should be provided in accordance with the recommendations of the project structural engineer. For the proposed site, a modulus of subgrade reaction k_1 of 100 psi/in is recommended.

Exterior concrete flatwork (sidewalks, etc.) should have a minimum thickness of 4 inches, be underlain by a 2-inch layer of clean sand and reinforced with a minimum. No. 3 bars placed mid-height in the slab and spaced on 18-inch centers in both directions. Care should be taken by the contractor to ensure that the reinforcement is placed and maintained at slab midheight. We recommend that crack control joints for exterior flatwork be provided with a minimum spacing of 12 feet and a maximum of 15 feet, or in accordance with the structural engineer's recommendations. We also recommend that every third control joint be converted to an expansion joint.

Some slab cracking due to shrinkage should be anticipated. The potential for this slab cracking may be reduced by careful control of water/cement ratios. The contractor should take appropriate curing precautions during the pouring of concrete in hot weather to minimize cracking of slabs. We recommend that a slipsheet (or equivalent) be utilized if crack-sensitive flooring is planned directly on concrete slabs. All slabs should be designed in accordance with structural considerations.

7.4.3 Moistening of Foundation Soils

Footing excavations and slab subgrades should be thoroughly moistened prior to placement of concrete.

7.4.4 Cement Type

Our laboratory testing of a representative sample of the near surface indicated a **negligible** concentration of soluble sulfates. Based on the guidelines presented in the current edition of the Uniform Building Code, a minimum Type II cement may be utilized in concrete that will be in direct contact with the near-surface soils. Based on the guidelines presented in the current edition of the International Building Code (IBC 2018, CBC 2019). Terradyne Engineering Inc. can provide additional recommendations.

7.5 Retaining Walls Lateral Earth Pressures (if proposed)

For design purposes, the following lateral earth pressure values for level and free-draining backfill are recommended for retaining walls (**if proposed**) backfilled with on-site soils, and for those backfilled with select soils (possessing an internal friction angle of at least 30 degrees and extending at least 0.5H from the upslope face of the wall, where H is the wall height).

Table 7 Equivalent Fluid Weight (pcf)

<u>Conditions</u>	<u>On-Site Backfill</u>	<u>Select Backfill</u> ($\text{PHI} \geq 30$ Degrees)
Active	33	35
At-Rest	70	55
Passive (Fill Soils)	250	350

Unrestrained (yielding) cantilever walls should be designed for an active equivalent pressure value provided above. In the design of walls restrained from movement at the top (nonyielding), such as basement walls or re-entrant corners, the at-rest pressures should be used. For areas of re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall laterally from the corner. The above values assume backfill soils will have a low expansion potential and free-draining condition. If conditions other than those covered herein are anticipated, the equivalent fluid pressures should be provided on an individual basis by the geotechnical engineer. Retaining wall structures should be provided with appropriate drainage. Typical drainage design is illustrated in Appendix A Figure 6. Wall backfill should be compacted by mechanical methods to at least 90 percent relative compaction (based on ASTM Test Method D1557). Wall footings should be designed in accordance with the foundation design recommendations and reinforced in accordance with structural considerations. For all retaining walls, we recommend a minimum horizontal distance from the outside base of the footing to daylight of 8 feet.

Lateral soil resistance developed against lateral structural movement can be obtained from the passive pressure value provided above. Further, for sliding resistance, a friction coefficient of 0.35 may be used at the concrete and soil interface. These values may be increased by one-third when considering loads of short duration including wind or seismic loads. The total resistance may be taken as the sum of the frictional and passive resistance provided that the passive portion does not exceed two-thirds of the total resistance.

7.6 Wall Backdrain and Waterproofing

In order to reduce the potential for water build-up and an increase in hydrostatic pressure behind a retaining wall (if proposed), a wall backdrain shall be installed (see attached Figure 1). The wall backdrain shall consist of a 4-inch minimum diameter Schedule 40 PVC perforated pipe (perforations oriented down) inclined at a minimum 1-percent gradient. The backdrain pipe shall be encased in a 1-foot wide by 1-foot tall envelope (minimum) of 3/4" to 1-1/2 inch crushed rock, wrapped in a filter fabric envelope consisting of Mirafi 140N or an approved equivalent with a minimum 6-inch fabric overlap. The new wall backdrain shall either be discharged via 4-inch diameter Schedule 40 PVC pipes. The water should be directed into a suitable surface drainage system or catch basin. If a catch basin is used the collected water should be pumped out by means of a sump pump to a suitable drainage system. The wall backdrain system construction (clean bottom, subdrain pipe installation gravel wrap and backfill), shall also be observed and confirmed by a representative of this office to document compliance with these recommendations.

In order to reduce the infiltration of water through the wall face, we recommend the back of the new retaining wall be cleaned, dried, prepared, and waterproof sealed (with products such as Vulkem 201, or BT Type-2 by Pacific Polymer, and Amaco PB-4 (green foam board) or approved equivalent) installed in accordance with the manufacturer's recommendations. A minimum of a two-foot-thick compacted fill cap shall be placed over the gravel backfill to reduce the potential for infiltration of moisture into the subsurface. For below grade walls, a concrete swale may be constructed to direct flow of water away from the surface and prevent ponding and soil saturation.

One of the most common post-construction problems is moisture affecting below grade walls. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Special care should be taken in the design and installation of waterproofing to avoid these types of moisture problems, or actual water seepage into the structure through any shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints.

The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

The backfill behind the wall should be drained properly. The drainage system should consist of a 4-inch PVC down perforated drainpipe located near the bottom of the wall. The drain collects the water that enters the backfill and this may be disposed of through solid pipe outlets along the base of the wall (See Appendix A, Figure 6).

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 a design R-value of 31. The design R-value was chosen based on laboratory testing (Appendix C) 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. 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 8 Flexible Pavement Sections

Traffic Index (TI)	Minimum Section Thickness (inches)		
	Asphalt Concrete (AC)	Class II Aggregate Base* (AB)	Compacted Subgrade to 95%
5 or less (auto parking)	3.0	4.0	12.0-inches
6 (truck access)	4.0	6.0	12.0-inches

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

In areas where rigid concrete pavement is planned, at a minimum, concrete should be 3000 psi with fiber mesh. Concrete thickness should be a minimum 5 inches thick in parking areas (light duty) and 6 inches thick (heavy duty) in truck drive and loading areas, trash enclosure pad and driveways. We recommend installing all concrete paving over a minimum 4-inch thick granular Caltrans Class II aggregate base compacted to a minimum 95 percent relative compaction on prepared subgrade soil also compacted to a minimum 95 percent relative compaction. Reinforcement should be specified by the structural engineer but at a minimum should consist 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. Table 9 below presents a summary of recommendations for rigid pavement at the site.

Table 9 Rigid Pavement Sections

Traffic Index (TI)	Minimum Section Thickness (inches)			Concrete Strength	Minimum Reinforcement
	Rigid Concrete Pavement	Class II Aggregate Base* (AB)	Compacted Subgrade to 95 %		
Light duty (auto parking)	5.0-Inches	4.0-inches	12.0-inches	4000 psi at 28 days	#3 rebar at 18- inches on center
Heavy duty (truck access, driveways)	6.0-inches	4.0-inches	12.0-inches	4000 psi at 28 days	#3 rebar at 18- inches on center

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

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 if final grades differ significantly from existing grades. The minimum required compaction of aggregate base and the subgrade is 95% of maximum dry density based on ASTM D1557.

8.0 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.

9.0 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.

9.1 Plan Review

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

9.2 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.

10.0 LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from eight (8) borings drilled at the site.

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 Autozone Store #4499 west of the intersection of El Evado Road. & Mojave Drive, in the City of Victorville, San Bernardino County, California.

REFERENCES

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

California Institute of Technology, 2020, Southern California Earthquake Data Center. <https://scedc.caltech.edu/significant/fault-index.html>

California Department of Water Resources (CDWR), 2020 <http://wdl.water.ca.gov/waterdatalibrary/>

USGS, Dibblee, T.W. 1960, Preliminary Geologic Map of The Victorville Quadrangle, California Map MF-229, Map Scale: 1:62,500

FEMA Flood Map Service Center:

<https://msc.fema.gov/portal/search?AddressQuery=-117.253368%2C%2034.53881#searchresultsanchor>

Google Earth Pro®, 2020.

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

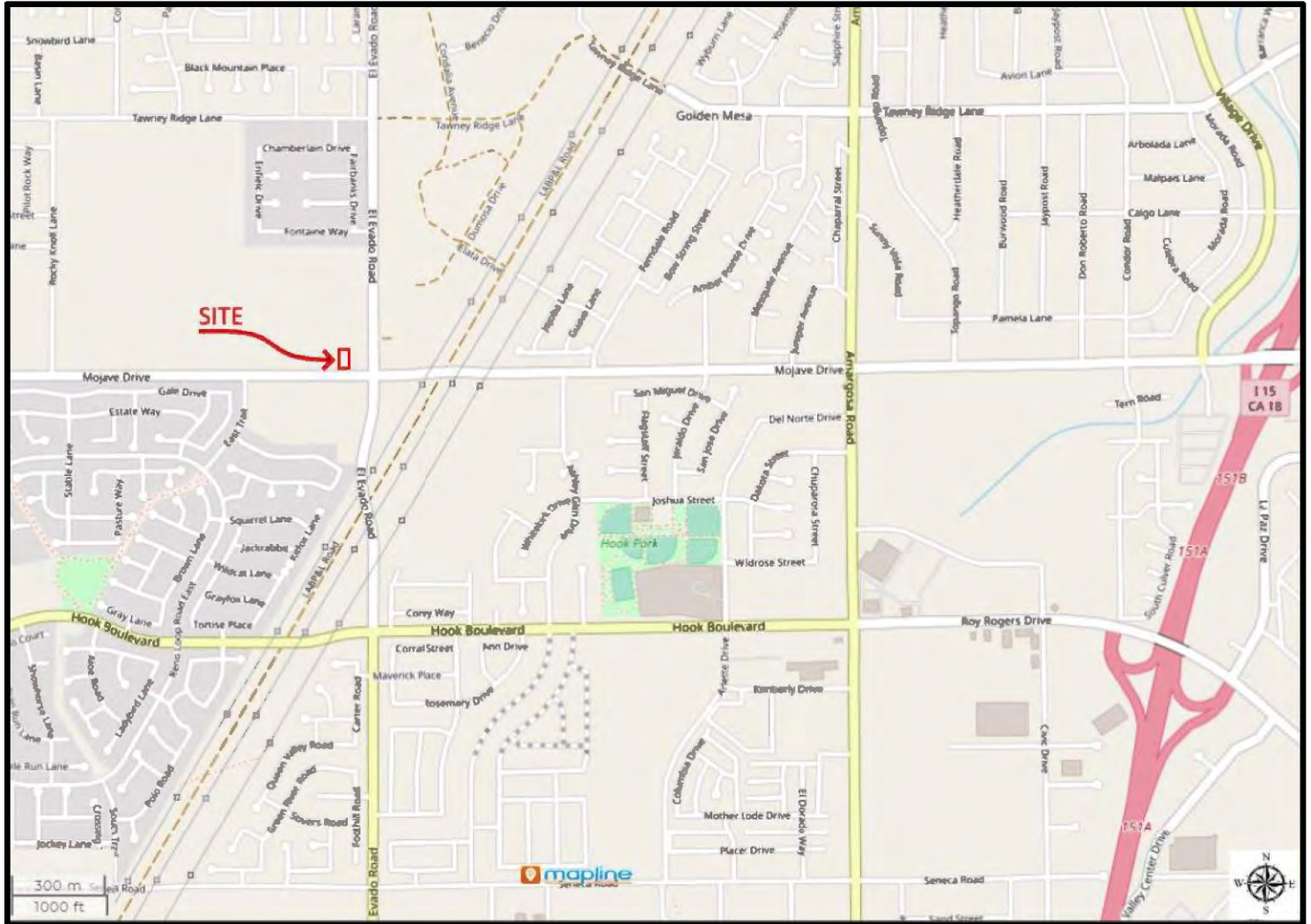
San Bernardino County Land Use Services, 2016

<http://cms.sbcounty.gov/lus/Planning/ZoningOverlayMaps/GeologicHazardMaps.aspx>

United States Geological Survey (USGS), 2018 edition, 7.5' Minute Topographic Map of the Victorville Quadrangle, San Bernardino County, California, Scale 1:24,000

APPENDIX A

VICINITY MAP



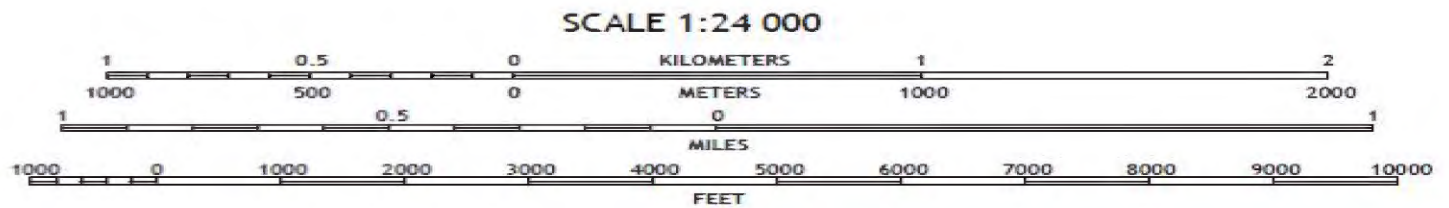
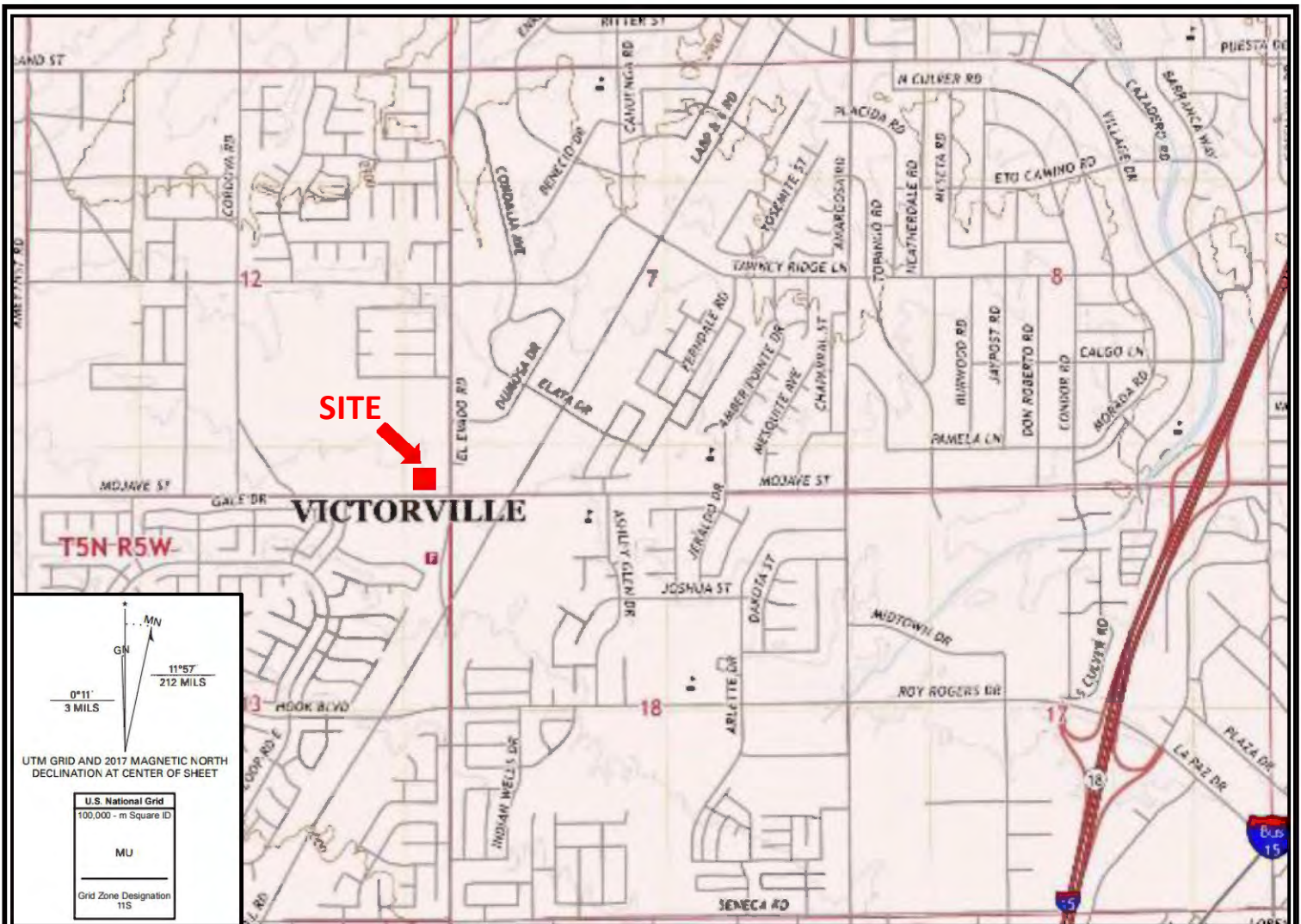
Proposed New Autozone
Mojave Drive and El Evado Road
Victorville, CA 91387

Terradyne, Inc.

Regional Topographic Map

Terradyne Project No: L201046

Figure: 1



CONTOUR INTERVAL 40 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.18

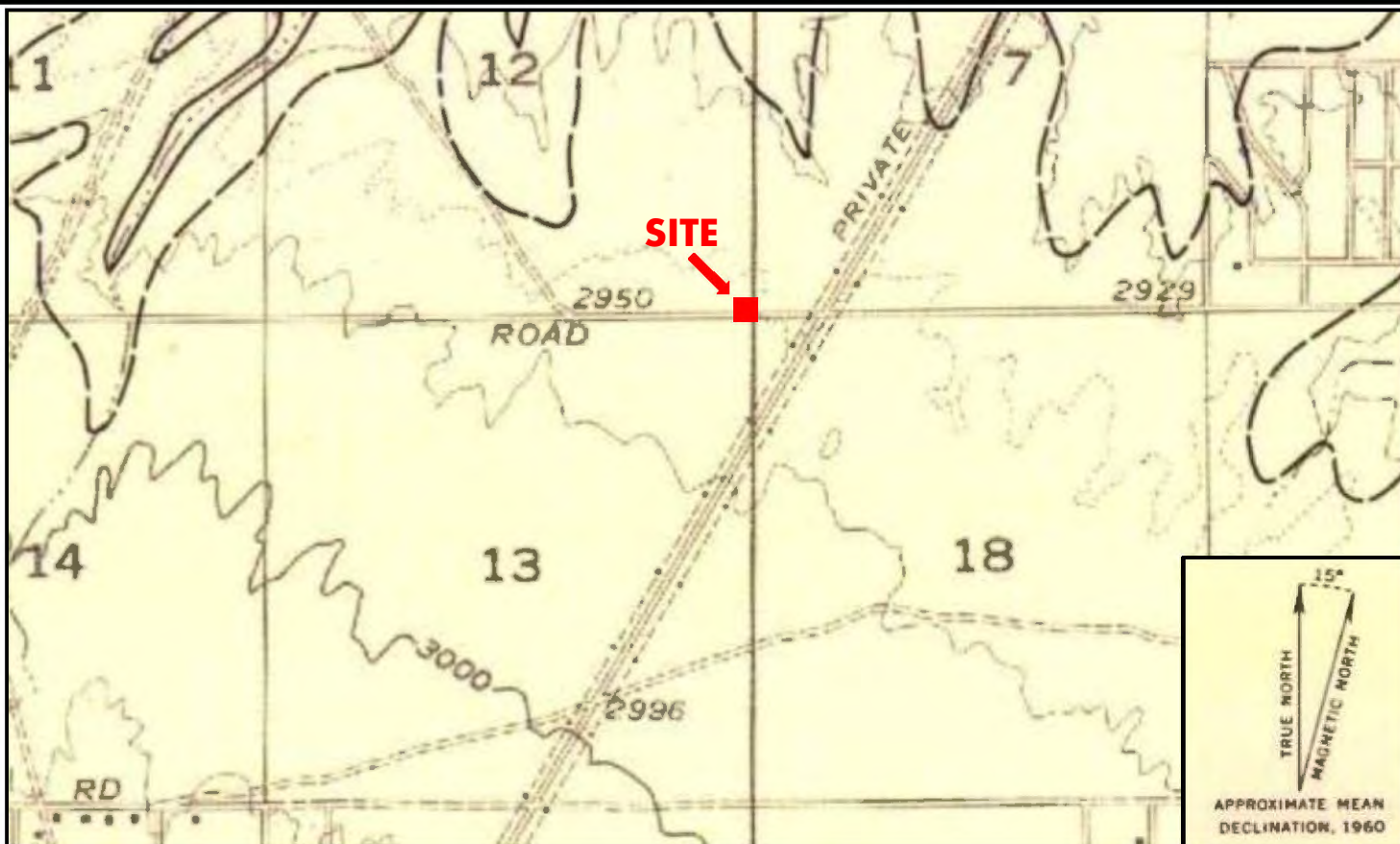
Map Reference: United States Geological Survey (USGS), 2018 edition, 7.5' Minute Topographic Map of the Victorville Quadrangle, San Bernardino County, California, Scale 1:24,000

Terradyne, Inc.

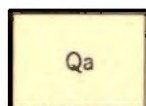
Regional Topographic Map

Terradyne Project No: L201046

Figure: 2

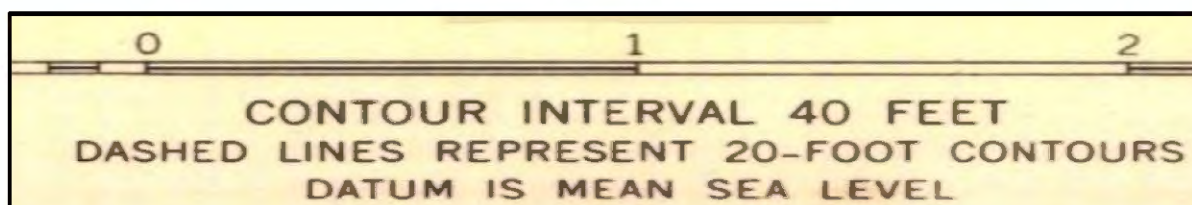


Unit Explanation



Alluvium and Associated Sediments (Holocene)—Unconsolidated sediments
Composed of alluvial silt, sand and gravel derived from
adjacent higher ground.

Scale:



Map Reference: • USGS, Dibblee, T.W. 1960, Preliminary Geologic Map Of The Victorville Quadrangle, California Map MF-229, Map Scale: 1:62,500

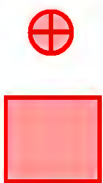
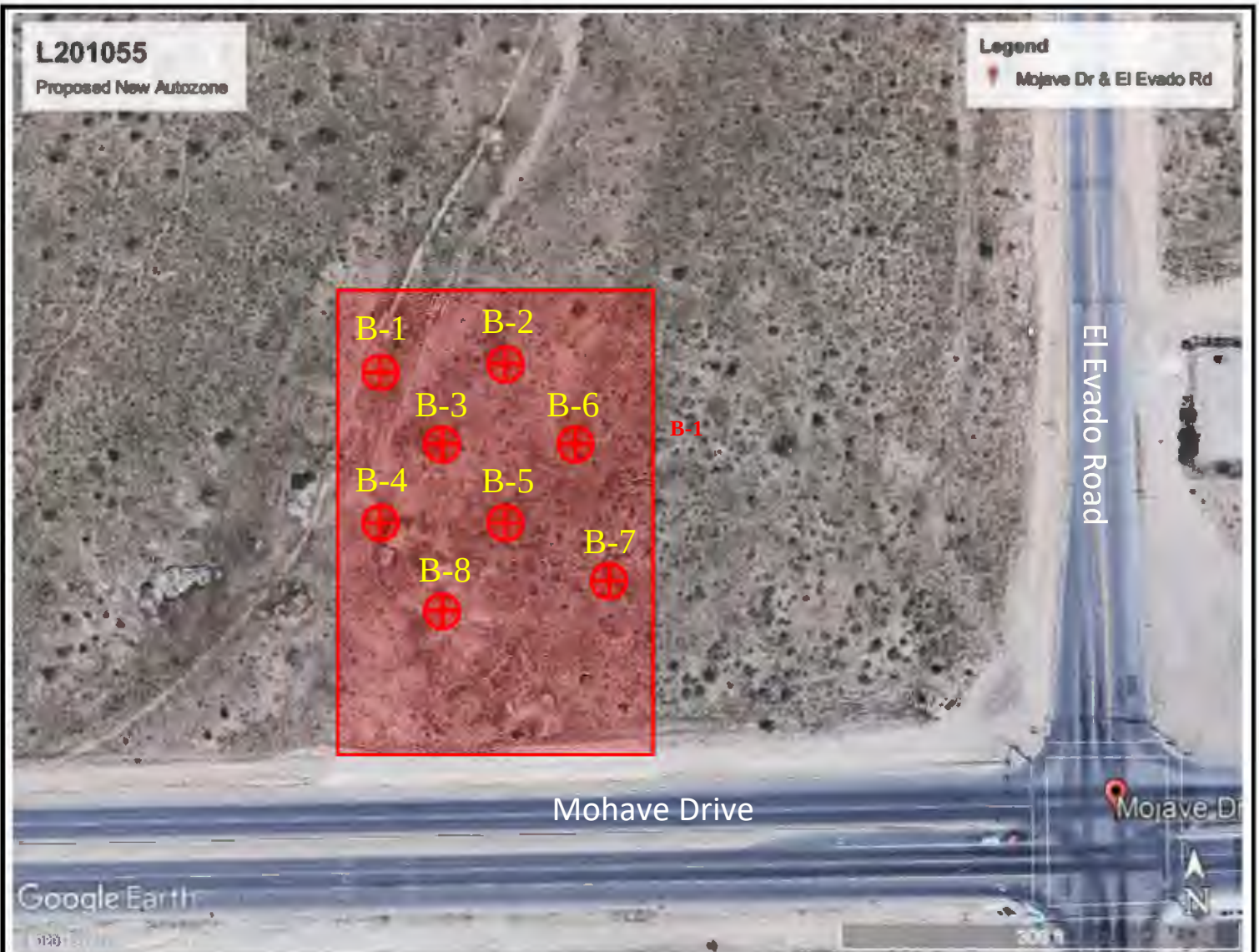
**Proposed Autozone #4499 Near
El Evado Road. & Mojave Drive,
Victorville, CA**

Terradyne, Inc.

Regional Geologic Map

Terradyne Project No: L201055

Figure: 3



Approximate Hand Boring Location

Approximate Subject Lot Boundary

Map Reference: Google Earth Pro®, 2020

Proposed New Autozone Mojave Drive and El Evado Road Victorville, CA 91387	Terradyne, Inc.	
	Google Earth Pro®, 2020	
	Terradyne Project No: L201055	Figure: 4



TYPICAL RETAINING WALL SECTION

(No Scale)

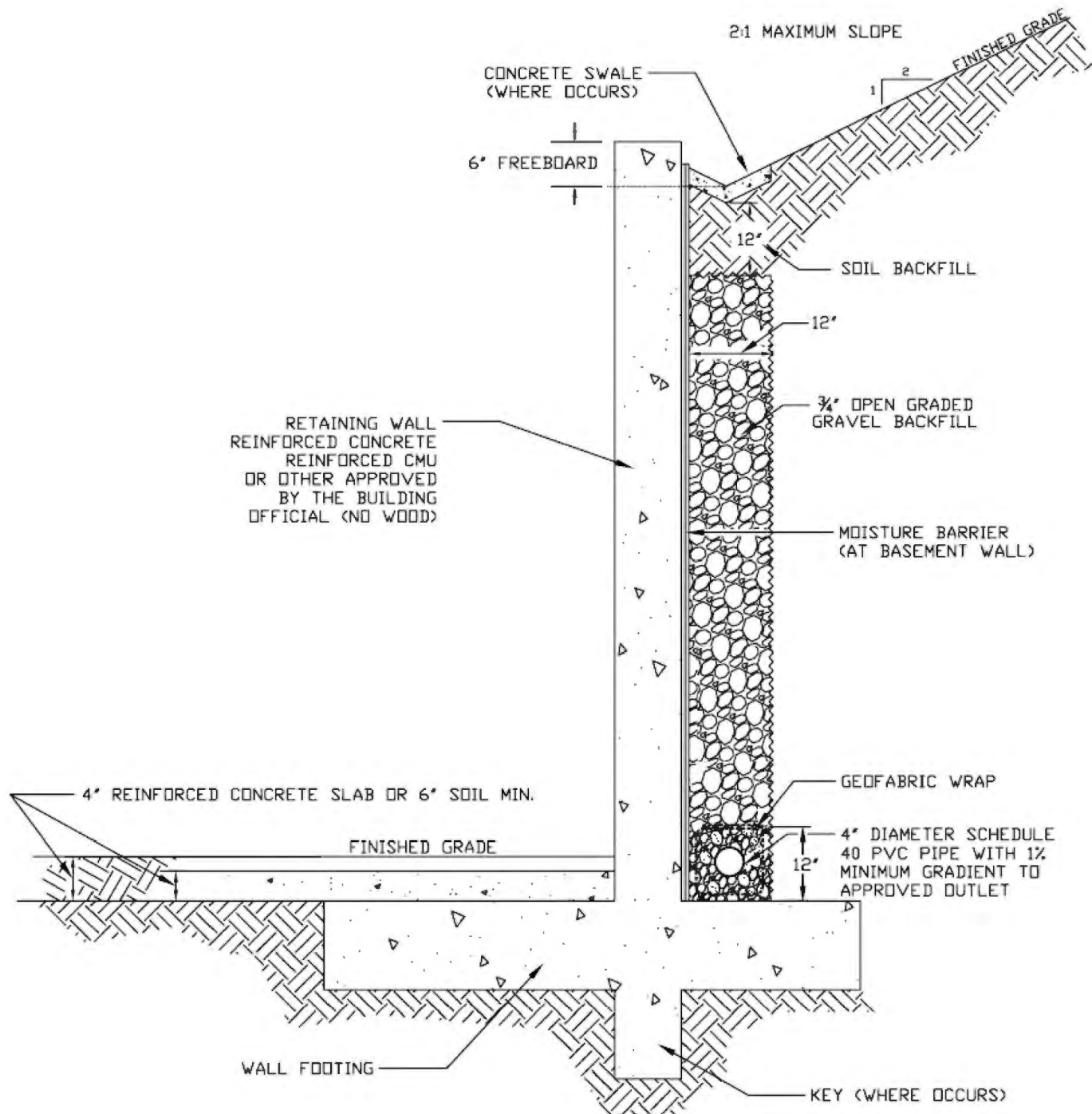


Figure 6

APPENDIX B

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 1

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Bulk, Modified California, SPT	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
			@1-5'		SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained	1.6		
			@2-2.5'	12/25/50	SM		1'-16.5' ALLUVIUM (Qa)			
			@3-3.5'	17/22/38	SM		Silty SAND, light brown, medium dense to very dense, dry to slightly moist, fine to medium grained	1.7	120.0	
			@5-5.5'	19/33/43	SM		Silty SAND, light brown, very dense, dry to slightly moist, fine to medium grained			
					SM		Consistency changes to dense	1.1		
			@8-8.5'	10/23/32	SM		Consistency changes to very dense			
					SM		Consistency changes to dense	1.0		
					SM		Consistency changes to medium dense	0.9		
			15-16.5'	10/16/22	SM			0.8		
							End of boring at 16.5 ft			
							No groundwater			
							No caving			
							Backfilled with native soil			

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 2

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Modified California, SPT	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
	0				SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-16.5' ALLUVIUM (Qa)			
		@2-2.5'	10/35/50		SM		Silty SAND, light brown, medium dense to very dense, dry to slightly moist, fine to medium grained	5.7	112.2	
					SM		Silty SAND, light brown, very dense, dry to slightly moist, fine to medium grained			
	5	@5-5.5'	12/19/32		SM		Consistency changes to medium dense	1.4		
		@8-8.5'	14/25/27		SM		Consistency changes to dense	1.0		
	10									
					SM					
	15		15-16.5'	12/14/26	SM			1.7		
							End of boring at 16.5 ft No groundwater No caving Backfilled with native soil			
	20									

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 3

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Modified California, SPT	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
							1'-16.5' ALLUVIUM (Qa)			
					SM		Silty SAND, light brown, dense, dry to slightly moist, fine to medium grained			
	3-3.5'		@3-3.5'	9/25/40	SM		Silty SAND, light brown, dense, dry to slightly moist, fine to medium grained	2.4	119.3	
5										
	6-6.5'		@6-6.5'	12/30/34	SM			6.1	114.6	
	9-9.5'		@9-9.5'	12/26/35	SM			1.2		
10										
				11/25/24	SM					
15					SM					
	15-16.5'			13/17/23						
							End of boring at 16.5 ft			
							No groundwater			
							No caving			
							Backfilled with native soil			
20										

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 4

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Modified California, SPT	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
	0				SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to meidum grained			
		@1.5-2'	13/19/23		SM		1'-16.5' ALLUVIUM (Qa)	2.7	117.0	
					SM		Silty SAND, light brown, medium dense to dense, dry to slightly moist, fine to meidum grained			
		@3-3.5'	12/14/40		SM		Silty SAND, light brown, medium dense, dry to slightly moist, fine to meidum grained	1.7	119.4	
					SM		Consistency changes to dense			
	5				SM		Consistency changes to medium dense	2.5	114.1	
		@5-5.5'	30/15/24		SM					
					SM		Consistency changes to dense			
		@8-8.5'	9/23/32		SM					
	10				SM					
				10/16/18	SM					
					SM					
	15				SM					
		15-16.5'	5/10/22		SM					
							End of boring at 16.5 ft No groundwater No caving Backfilled with native soil			
	20									

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 5

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Modified California	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
	0				SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
		@2-2.5'	10/12/17		SM		1'-16.5' ALLUVIUM (Qa)	1.1		
							Silty SAND, light brown, medium dense, dry to slightly moist, fine to medium grained			
	5	@5-5.5'	4/10/17		SM			1.7		
	10		7/11/12		SM					
	15	15-15.5'	5/12/12		SM					
							End of boring at 16.5 ft			
							No groundwater			
							No caving			
							Backfilled with native soil			
	20									

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 6

Sheet 1 of 1

Date(s) Drilled	8/11/2020	Logged By	CR	Checked By	HE
Drilling Method	Standard Penetration Test	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	Sampling Method(s)	Modified California	Hammer Data	140 lbs 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	REMARKS AND OTHER TESTS
	0				SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-11.5' ALLUVIUM (Qa)			
		@2-2.5'	12/11/17		SM		Silty SAND, light brown, medium dense to dense, dry to slightly moist, fine to medium grained	1.7		
	5	@5-5.5'	8/14/23		SM					
	10		7/24/24		SM		Consistency becomes dense			
							End of boring at 11.5 ft No groundwater No caving Backfilled with native soil			
	15									
	20									

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 7

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Modified California	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-11.5' ALLUVIUM (Qa)			
		@2.5-3'	8/18/27		SM		Silty SAND, light brown, medium dense to dense, dry to slightly moist, fine to medium grained	9.6	125.1	
5		@5-5.5'	6/12/19		SM					
10			10/20/25		SM					
							End of boring at 11.5 ft No groundwater No caving Backfilled with native soil			
15										
20										

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 8

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Modified California	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-11.5' ALLUVIUM (Qa)			
		@2-2.5'	9/10/27		SM		Silty SAND, light brown, medium dense to dense, dry to slightly moist, fine to medium grained	2.7		
5		@5-5.5'	10/12/22		SM					
					SM					
10			10/20/27		SM		Consistency becomes dense			
							End of boring at 11.5 ft			
							No groundwater			
							No caving			
							Backfilled with native soil			
15										
20										

APPENDIX C



CLIENT:
Sweetgum Environmental

Plant City, FL

PROJECT: Proposed New AutoZone Store #4499

Near El Evado & Mojave Dr.,
Victorville, San Bernardino, CA 92315

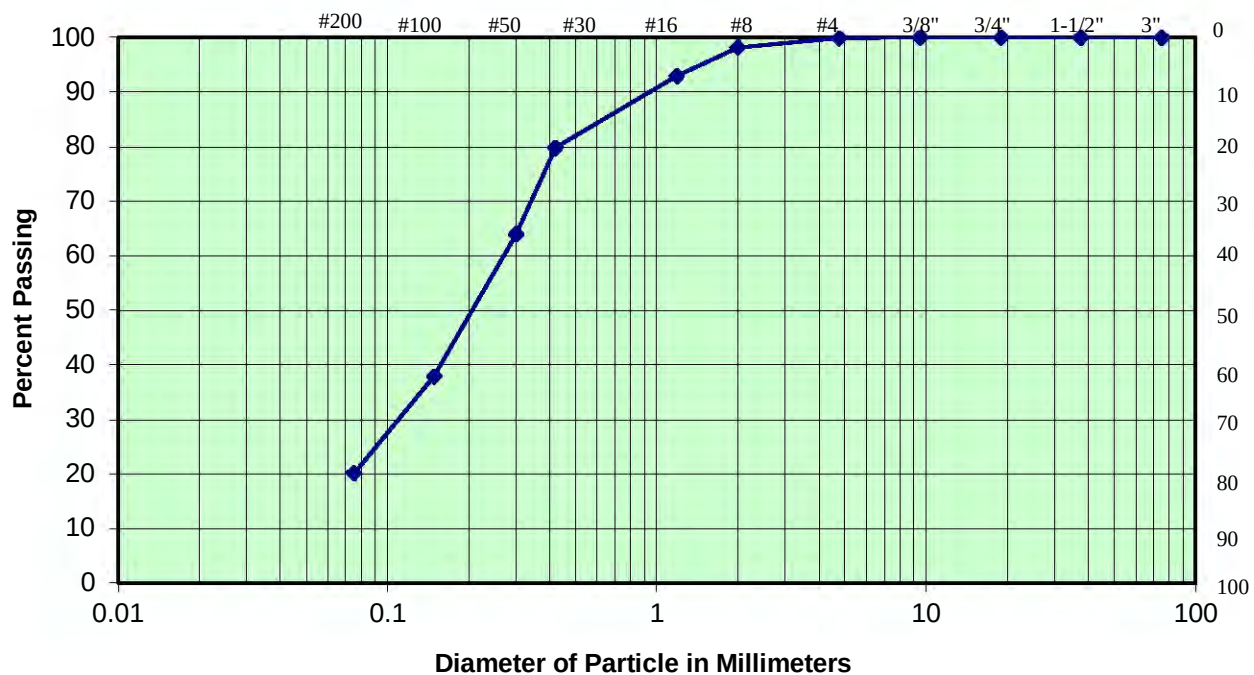
Terradyne Project #: L201055

TEST DATA

BORING #: B-1

DEPTH: 1-5 ft

Gradation Test Results



DESCRIPTION:	Silty SAND
---------------------	------------

Gravel	0.1%
Sand	79.7%
Fines	20.1%
Moisture	1.6%

Classification	
USCS:	SM
AASHTO:	--



Laboratory Compaction Test Results

(Proctor # 1 :)

Gradation:		Correction for oversize rock:		
Sieve Size:	Cumulative % Retained	(using assumed values for bulk specific gravity and absorption of oversize particles)		
1 3/4"		% oversize	Max D.D.	Opt M.C.
1 1/4"				
7/8"		5	130.2	8.3
3/4"		10	132.4	8.1
3/8"		15	134.5	7.9
#4		20	136.8	7.7
#40		25	139.2	7.5
#200		30	141.6	7.2

PROJECT:	Mojave Dr and El Evado Rd, Victorville, CA
PROJECT #:	L201055
PROCTOR #:	1
SAMPLE #:	1
DATE COMPLETED:	8/19/2020
MAXIMUM DRY DENSITY:	128.2
OPTIMUM MOISTURE CONTENT	8.5 %
CLIENT:	



Sample Description: USCS: SM
Silty SAND, light brown

Other Test Procedures:
ASTM D4318

Location: _____

LIQUID LIMIT (LL) _____

PLASTI. INDEX (PI) _____

Compaction Test Procedure: ASTM D 1557 Method A

GRAVEL _____ %

SAND _____ %

SILT AND CLAY _____ %

Lab and QC by: FS/YS

Evado and Mojave Dr., Victorville

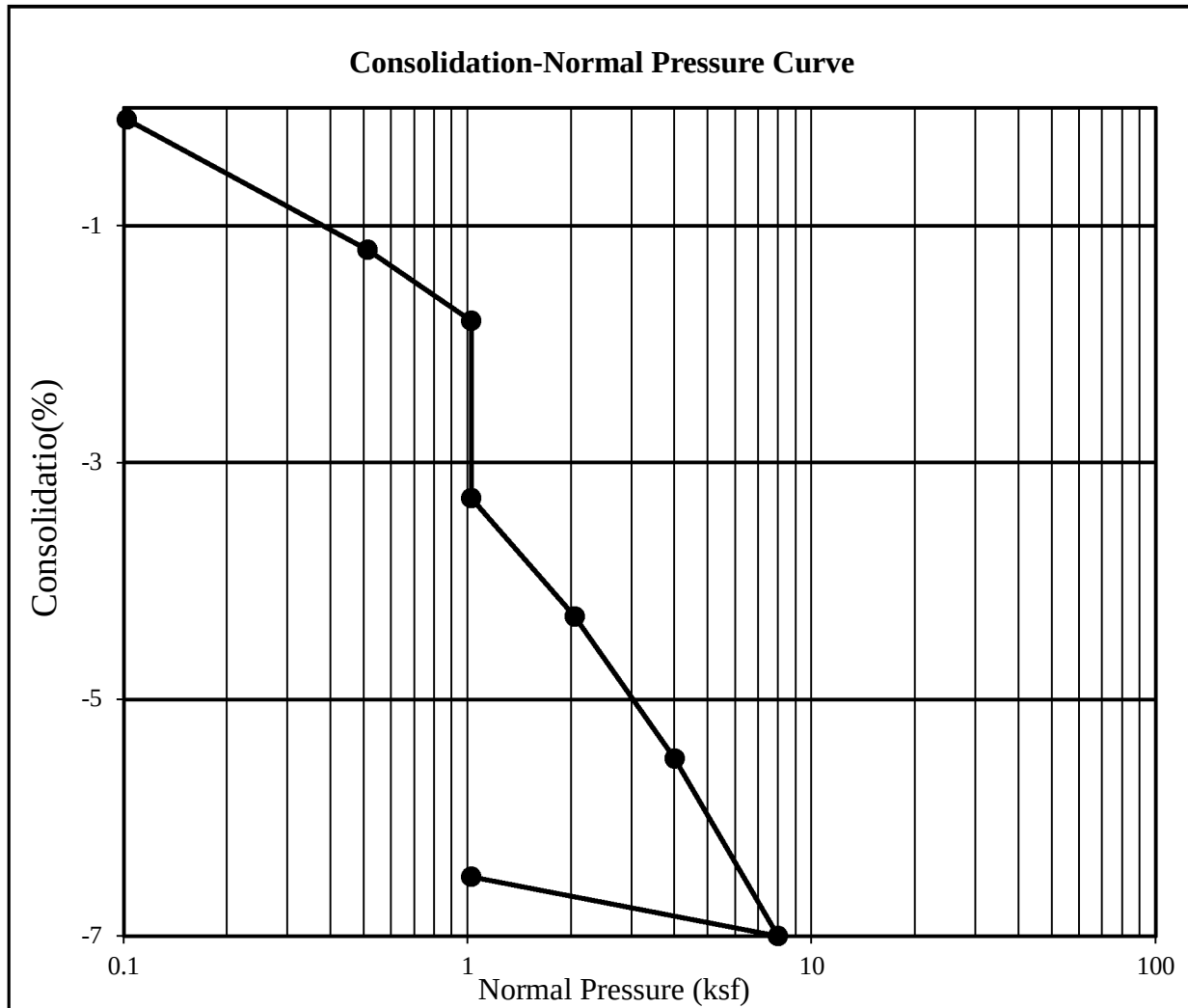
PH Measured	6.09		Sulfate Content	95	ppm
Resistivity p	1400		Chloride Content	11	ppm
Resistivity Rg			Nitrate Content		ppm

Date Tested: 8 / 18 / 2020

Evado and Mojave Dr., Victorville

PH Measured	6.09	
Resistivity p	1400	
Resistivity Rg		
Sulfate Content	95	ppm
Chloride Content	11	ppm
Nitrate Content		ppm

Notes:



Boring Info		Before Test		After Test		Record	
Boring No.	B-3	Moisture (%)	6.1	Moisture (%)	16.6	Test by	ZJ
Depth	6'	Total Weight (g)	181	Total Weight (g)	198.3	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	44.6	Ring Weight (g)	44.6	Start Date	8/14/2020
		Wet Density (pcf)	113.3	Wet Density (pcf)	127.7	End Date	8/17/2020
Geotechnical Investigation Report: Evado and Mojave Dr., Victorville				Terradyne Engineering, Inc.			
				Consolidation Test Diagram			
				Terradyne Project No: L201055		Plate:	

APPENDIX D

ASCE 7 Hazards Report

Address:

No Address at This
Location

Standard: ASCE/SEI 7-16

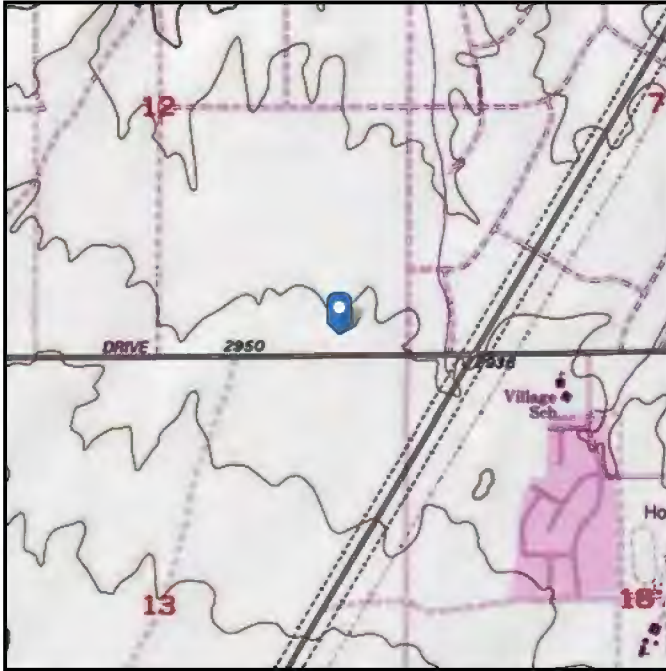
Risk Category: II

Soil Class: D - Stiff Soil

Elevation: 2946.46 ft (NAVD 88)

Latitude: 34.529069

Longitude: -117.349098



Site Soil Class: D - Stiff Soil

Results:

S_S :	1.154	S_{D1} :	N/A
S_1 :	0.448	T_L :	12
F_a :	1.038	PGA :	0.496
F_v :	N/A	PGA_M :	0.548
S_{MS} :	1.198	F_{PGA} :	1.104
S_{M1} :	N/A	I_e :	1
S_{DS} :	0.799	C_v :	1.331

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

Data Accessed: Mon Aug 24 2020

Date Source: [USGS Seismic Design Maps](#)



TERRADYNE ENGINEERING, INC.
2691 Dow Ave, Suite F
Tustin, California 92780
Phone: 657-212-5800
www.terradyne.com

November 3, 2021

Mr. Rob DeGraaf, LEP, PWS
Sweetgum Environmental
Plant City, Florida
Phone: 813-365-2411
Email: robdegraaf@verizon.com

Subject: **Report of Subsurface Exploration & Geotechnical Investigation Comments**
Application No.: AutoZone Victorville
Submittal Number: 2nd Submittal, 30150021.0130, BLDC21-00096
Terradyne Project No.: L201055

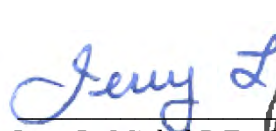
Reference: *See Attached*

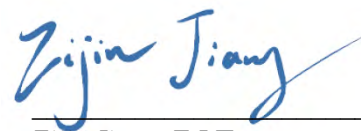
Dear Mr. DeGraaf,

In response to the referenced geotechnical report review comments, we have prepared this document to address geotechnical review comments made by City of Victorville, dated on October 6, 2021. Recommendations in the referenced geotechnical reports (dated August 24, 2020) remain valid unless amended herein.

Should you have any questions, please do not hesitate to contact the undersigned.

Respectfully Submitted, **Terradyne Engineering, Inc.**


Jerry L. Michal P.E., G.E.
Senior Project Engineer/ G.E. 2515
Registration Exp. Date 03/31/2022



Zijin Jiang, E.I.T.
Staff Engineer

Attachment:

Figure 1 – Vicinity Map
Figure 2 – Site Plan
Figure 3 – Geotechnical Map
Boring Log and Lab Test
Percolation Test Report
City Comments Letter
ATC Seismic Hazard Parameters

Note: For convenience, we have rewritten the comments in italics. Our response is written directly below each comment.

1. Provide a clear and simple vicinity map with a small-scale showing streets and nearby properties. The other three (3) maps shown the site in two different locations; at the corner or west of the corner of an intersection.

Please see attached updated vicinity map in Figure 1.

2. The site plan is showing AM/PM C-Store and not the Auto Zone. Update site plan showing Auto Zone the subject of this report.

Please see attached site plan for the proposed AutoZone store in Figure 2.

3. The Introduction of the report describe drilling logging and sampling 8 hollow stem auger holes, but the site plan of holes shows hand boring of 8 holes location. Update site plan or the introduction.

Please see updated geotechnical map in figure 3, which shows all geotechnical borings drilled by hollow stem auger.

4. The Introduction of the report describe drilling logging and sampling 8 hollow stem auger holes to a depth of only 16.5 feet. Deeper drilled holes shall be carried out to a depth of at least 50 feet for the type of the proposed building.

Terradyne drilled and sampled a 50-foot boring for the proposed building. The 50-foot boring log, boring B-9 is attached.

We did not encountered groundwater in our 50 foot boring, and the consistency of the soil is considered dense to very dense according to standard penetration testing (SPT). For liquefaction to occur, the following four factors are required: 1) saturated soil or soil situated below the groundwater table; 2) undrained loading (strong ground shaking), such as by an earthquake; 3) contractive soil response during shear loading, which is often the case for a soil which is initially in a loose or uncompacted state; and 4) susceptible soil type; such as clean, uniformly graded sands, non-plastic silts, or gravels. Based on our online research, the historical high groundwater has been recorded at 196.70 feet below ground surface at 1 mile to the east of the subject site (State Well Number: 05N04W08N001S). Therefore, the liquefaction potential at the site is considered minimal.

5. Provide a percolation/infiltration test report.

Please see attached percolation test report.

6. Provide the soil classifications (A, B, C or D) of the site based on the field tests.

Based on field test and lab test, the soil we have encountered are mostly dense silty sand (USCS Classification: SM). The soil type by OSHA is identified as Type C.

7. Reference all Geological Hazards and the Seismic design parameter according to latest CBC Code of 2019. Provide Seismic Info/data that reflect 2019 California Building Code which was Effective January 1, 2020.

The updated seismic design acceleration parameters in accordance with the 2019 CBC and ASCE/SEI 7-16 are presented in Table below.

CBC DESIGN RESPONSE SPECTRUM PARAMETERS	
Latitude	34.528887°
Longitude	-117.3485614°
Site Class	D – Default
Risk Category	II
Seismic Design Category (SDC)	D
MCE _R Ground Motion, S _s (period=0.2s)	1.154 g
MCE _R Ground Motion, S ₁ (period=1.0s)	0.448 g
Site-modified Spectral Acceleration Value, S _{MS}	1.385 g
Site-modified Spectral Acceleration Value, S _{M1}	0.830 g
Numeric Seismic Design Value at 0.2s SA, S _{DS}	0.923 g
Numeric Seismic Design Value at 1.0s SA, S _{D1}	0.553 g
Site Amplification Factor at 0.2s, F _a	1.2
Site Amplification Factor at 1.0s, F _v	1.852
Site Modification Peak Ground Acceleration, PGA _M	0.595 g

Note: ATC-127 - Applied Technology Councils/USGS Site Specific Seismic Hazard information is attached in Appendix E. 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.

REFERENCES

Report of Subsurface Exploration & Geotechnical Investigation: Proposed New AutoZone Store #4499, Near El Evado & Mojave Drive, Victorville, San Bernardino County, CA 92394, Terradyne Engineering, Inc., Project No. L201055, dated August 24, 2020.

Report Of Subsurface Exploration & Geotechnical Investigation Comments, Application No.: AutoZone Victorville, Submittal Number: 2nd Submittal, 30150021.0130, BLDC21-00096, dated October 6, 2021

Sheet 9 of 12, Grading Plans Grading and Drainage Plan, prepared by Kimley-Horn and Associates, Inc., dated on October 15, 2021



Not to Scale

Source: Google Maps, 2020



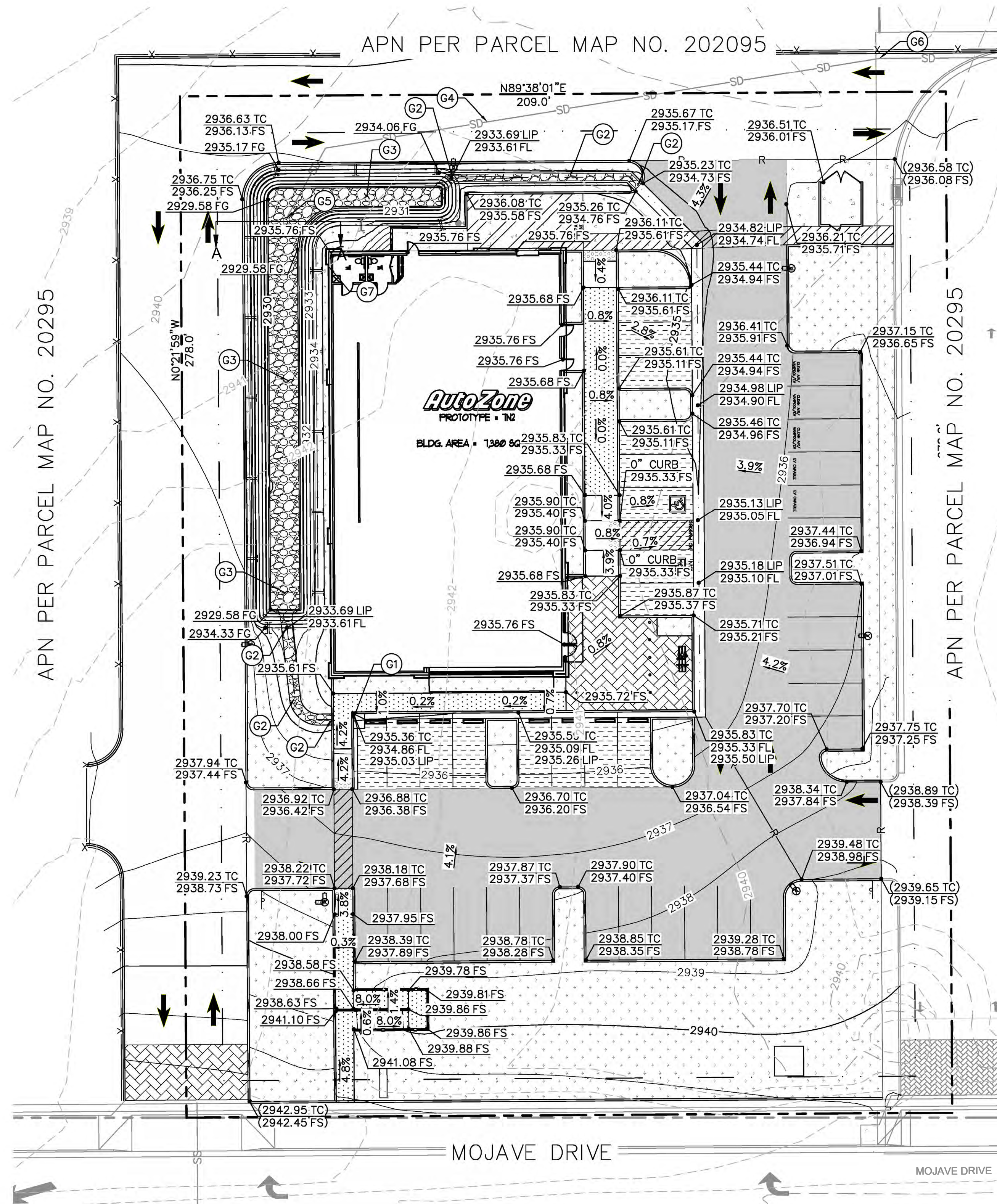
Limited Geotechnical Investigation Report
Proposed AutoZone Store at:
Mojave Drive & El Evado Road,
Victorville, CA 91387

Terradyne Engineering, Inc.

Vicinity Map

Terradyne Project No.: L201055

Figure: 1



GRADING LEGEND

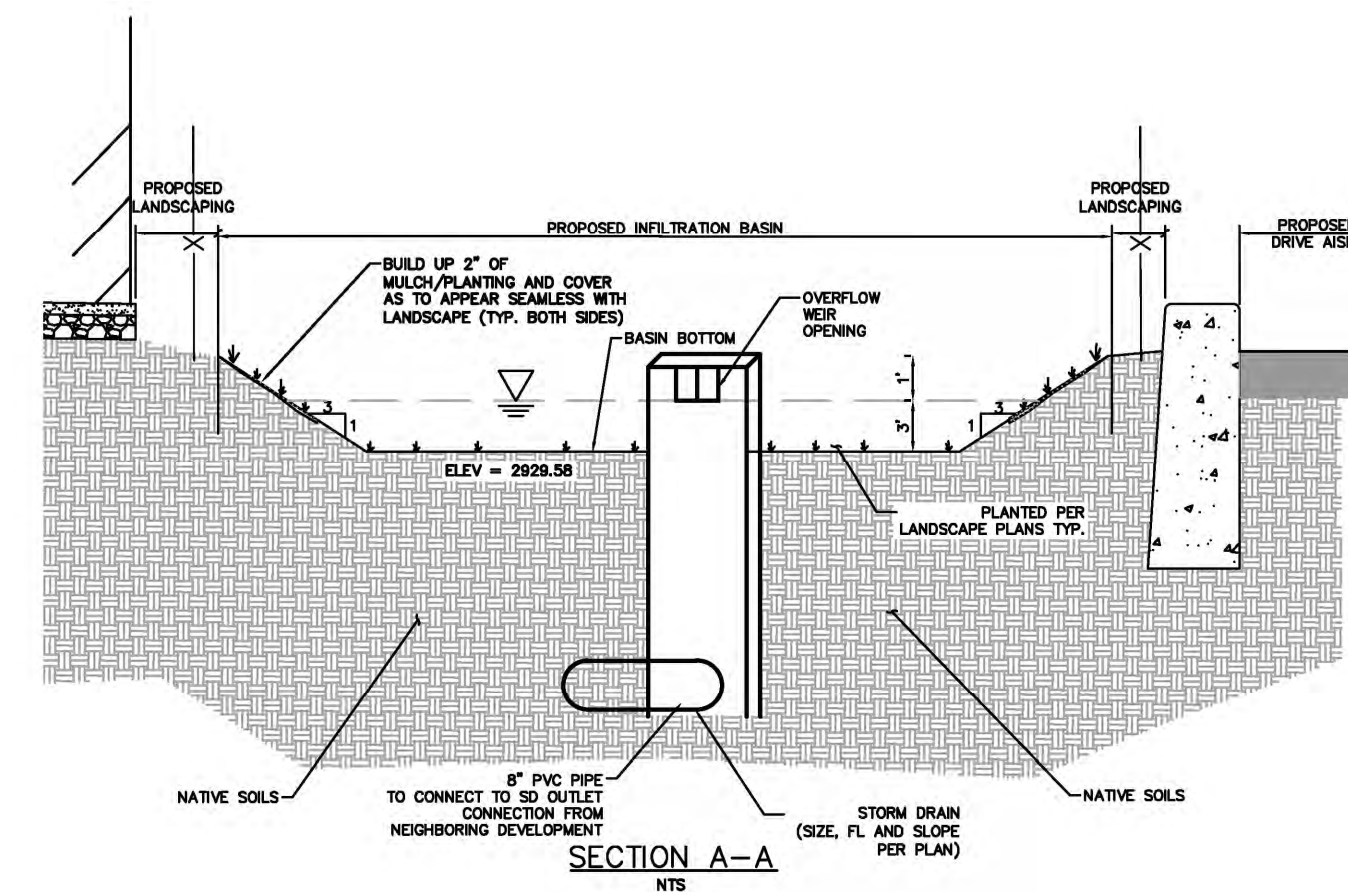
---	PROPERTY LINE
1585	PROPOSED CONTOUR
1585	EXISTING CONTOUR
---	EXISTING EASEMENT
---	FLOW LINE
R	RIDGE LINE
SD	PROPOSED STORM DRAIN LINE
F.F.	FINISH FLOOR ELEVATION
FL	FLOWLINE
LIP	LIP OF GUTTER
TC	TOP OF CURB
FS	FINISH SURFACE
TOP	TOP OF BASIN
BOT	BOTTOM OF BASIN
(1202.50 TC) (1202.00 FS)	EXISTING GRADE
1202.50 TC 1202.00 FS	PROPOSED GRADE
	PROPOSED LANDSCAPING SEE LANDSCAPE PLANS FOR MORE INFORMATION
	CLEAN STONE GRAVEL RIP RAP
X.XX	DIRECTION OF FLOW

NOTES

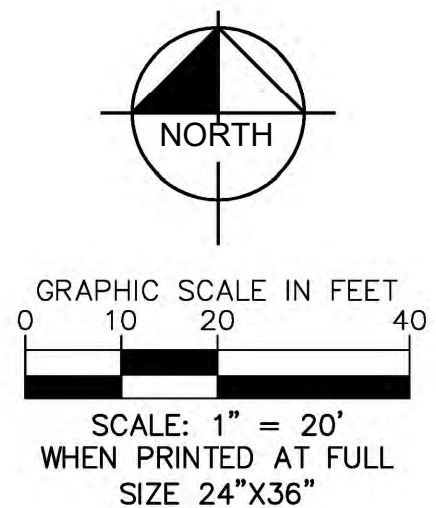
ALL GRADING WORK TO COMPLY WITH THE RECOMMENDATIONS SET FORTH IN THE GEOTECHNICAL REPORT.

GRADING NOTES

- (G1) PROPOSED PARKWAY CULVERT TO VEGETATED SWALE.
- (G2) PROPOSED VEGETATED SWALE.
- (G3) PROPOSED INFILTRATION BASIN, REFER TO SECTION A-A HERON.
- (G4) PROPOSED 8" HDPE STORM DRAIN PIPE.
- (G5) PROPOSED OVERFLOW WEIR STRUCTURE.
- (G6) PROPOSED CONNECTION TO 12" STORM DRAIN STUB.
- (G7) PROPOSED ROOF DRAIN DOWNSPOUT. REFER TO ARCHITECTURAL PLANS FOR MORE INFORMATION.



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Se l



BLDC21-00096

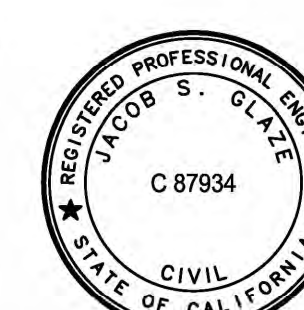
Kimley»Horn

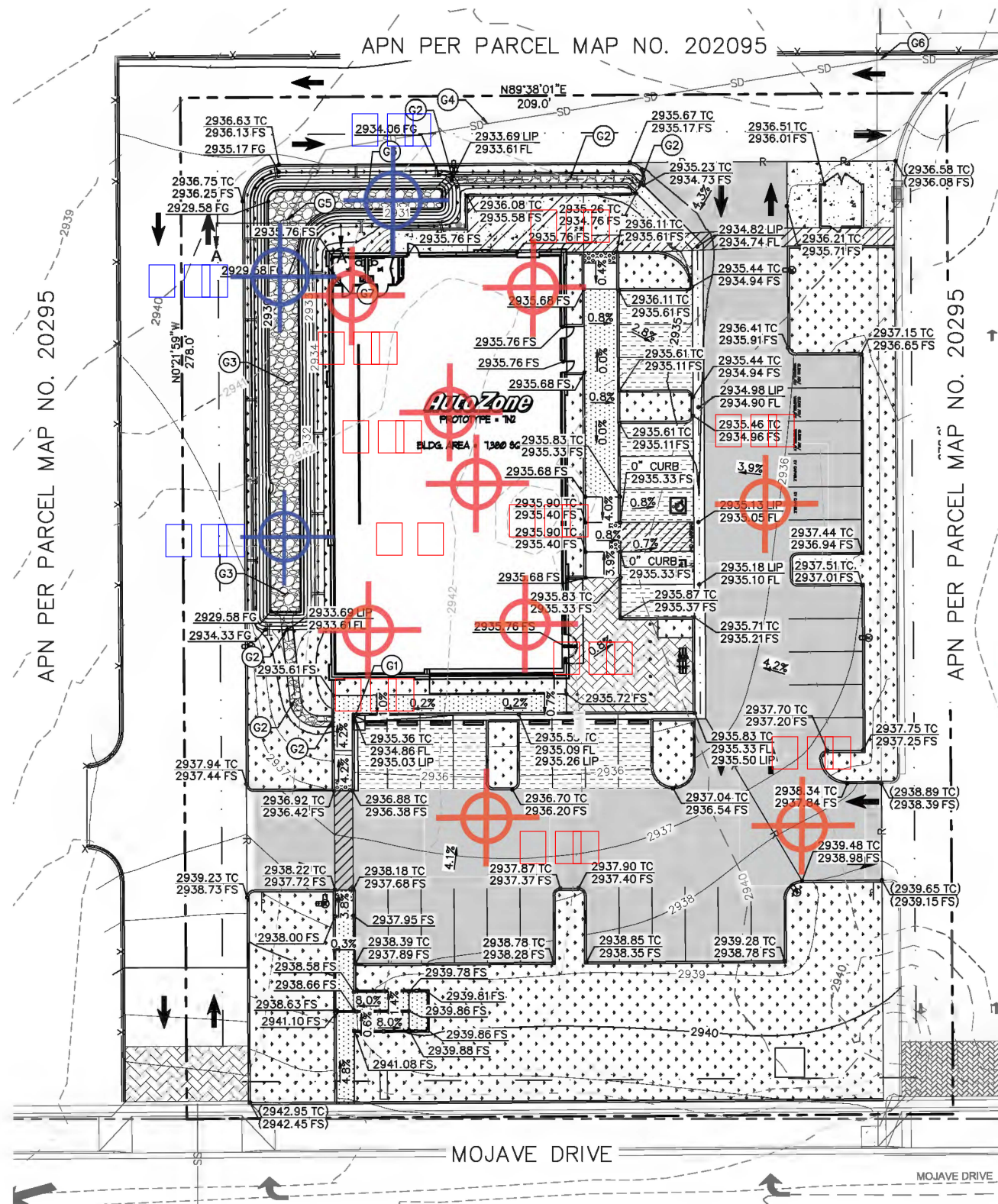
© 2021 KIMLEY-HORN AND ASSOCIATES, INC.
1100 TOWN AND COUNTRY RD., SUITE 700, ORANGE, CA 92668
PHONE: 714-939-1030 FAX: 714-938-9488
WWW.KIMLEY-HORN.COM



CITY OF VICTORVILLE
ENGINEERING DEPARTMENT
14343 Civic Drive, Victorville, Ca. 92392 (760) 955-5158

NO.	REVISION	BY	DATE
GRADING PLANS			
GRADING AND DRAINAGE PLAN			
FIELD BOOK NO. (S)			
BENCH MARK: CITY BENCHMARK: #V-213; DESCRIPTION: "Mojave Dr. @ El Evado Rd., TC 2' West of SW BCR". ELEVATION = 2937.86' COV CONTROL #V-213		DESIGN BY: X.X DRAWN BY: X.X CHECKED BY: J.G. DATE: 10/15/2021	SHEET NO. 9 OF 12
APPROVED BY: CITY ENGINEER		R.C.E. C44730 EXP. 03-31-22	DRAWING No. XX-00 PROJECT NO. TBD





GRADING LEGEND

---	PROPERTY LINE
1585	PROPOSED CONTOUR
1585	EXISTING CONTOUR
- - - -	EXISTING EASEMENT
---	FLOW LINE
R	RIDGE LINE
SD	PROPOSED STORM DRAIN LINE
F.F.	FINISH FLOOR ELEVATION
FL	FLOWLINE
LIP	LIP OF GUTTER
TC	TOP OF CURB
FS	FINISH SURFACE
TOP	TOP OF BASIN
BOT	BOTTOM OF BASIN
(1202.50 TC) (1202.00 FS)	EXISTING GRADE
1202.50 TC 1202.00 FS	PROPOSED GRADE
[Pattern]	PROPOSED LANDSCAPING SEE LANDSCAPE PLANS FOR MORE INFORMATION
[Pattern]	CLEAN STONE GRAVEL RIP RAP
X.XX	DIRECTION OF FLOW

NOTES

ALL GRADING WORK TO COMPLY WITH THE RECOMMENDATIONS SET FORTH IN THE GEOTECHNICAL REPORT.

GRADING NOTES

- (G1) PROPOSED PARKWAY CULVERT TO VEGETATED SWALE.
- (G2) PROPOSED VEGETATED SWALE.
- (G3) PROPOSED INFILTRATION BASIN, REFER TO SECTION A-A HERON.
- (G4) PROPOSED 8" HDPE STORM DRAIN PIPE.
- (G5) PROPOSED OVERFLOW WEIR STRUCTURE.
- (G6) PROPOSED CONNECTION TO 12" STORM DRAIN STUB.
- (G7) PROPOSED ROOF DRAIN DOWNSPOUT. REFER TO ARCHITECTURAL FOR MORE INFORMATION.

Grading notes and symbols including red and blue crosshair symbols, and text like "ro or Lo o s", "ro er ol o Lo o s", and "Sed e s olo e e".

OR

Scale 1" = 100'

or Load Lines

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 1

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Bulk, Modified California, SPT	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
			@1-5'		SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained	1.6		
			@2-2.5'	12/25/50	SM		1'-16.5' ALLUVIUM (Qa)			
			@3-3.5'	17/22/38	SM		Silty SAND, light brown, medium dense to very dense, dry to slightly moist, fine to medium grained	1.7	120.0	
			@5-5.5'	19/33/43	SM		Silty SAND, light brown, very dense, dry to slightly moist, fine to medium grained	1.1		
			@8-8.5'	10/23/32	SM		Consistency changes to dense	1.0		
					SM		Consistency changes to medium dense	0.9		
			15-16.5'	10/16/22	SM			0.8		
							End of boring at 16.5 ft No groundwater No caving Backfilled with native soil			
20										

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 3

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Modified California, SPT	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
							1'-16.5' ALLUVIUM (Qa)			
							Silty SAND, light brown, dense, dry to slightly moist, fine to medium grained			
			@3-3.5'	9/25/40	SM		Silty SAND, light brown, dense, dry to slightly moist, fine to medium grained	2.4	119.3	
5			@6-6.5'	12/30/34	SM			6.1	114.6	
			@9-9.5'	12/26/35	SM			1.2		
10				11/25/24	SM					
			15-16.5'	13/17/23	SM					
15							End of boring at 16.5 ft No groundwater No caving Backfilled with native soil			
20										

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 5

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Modified California	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-16.5' ALLUVIUM (Qa)			
		@2-2.5'	10/12/17		SM		Silty SAND, light brown, medium dense, dry to slightly moist, fine to medium grained	1.1		
5		@5-5.5'	4/10/17		SM			1.7		
10			7/11/12		SM					
15		15-15.5'	5/12/12		SM					
20							End of boring at 16.5 ft No groundwater No caving Backfilled with native soil			

Project: **Proposed New AutoZone Store #4499**Project Location: **Near El Evado & Mojave Dr., Victorville, San Bernardino, CA 92315**

Project Number:

Log of Boring 7

Sheet 1 of 1

Date(s) Drilled 8/11/2020	Logged By CR	Checked By HE
Drilling Method Standard Penetration Test	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	Sampling Method(s) Modified California	Hammer Data 140 lbs 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	REMARKS AND OTHER TESTS
0					SM		0-1' TOPSOIL			
					SM		Silty SAND, light brown, loose, dry to slightly moist, fine to medium grained			
					SM		1'-11.5' ALLUVIUM (Qa)			
			@2.5-3'	8/18/27	SM		Silty SAND, light brown, medium dense to dense, dry to slightly moist, fine to medium grained	9.6	125.1	
5			@5-5.5'	6/12/19	SM					
10				10/20/25	SM					
							End of boring at 11.5 ft No groundwater No caving Backfilled with native soil			
15										
20										

Project: **Proposed AutoZone Store #4499**Project Location: **Near Mojave Drive & El Evado Road,
Victorville, CA 92394**Project Number: **L201055****Log of Boring B-9****Sheet 1 of 2**

Date(s) Drilled	10/26/2021	Logged By	ZJ	Checked By	JM
Drilling Method	Standard Penetration Test using Hollow Stem Auger	Drill Bit Size/Type	8"	Total Depth of Borehole	51.5 feet bgs
Drill Rig Type	GT8	Drilling Contractor	2R Drilling	Approximate Surface Elevation	
Groundwater Level and Date Measured	Not encountered	Sampling Method(s)	Bulk, Modified California	Hammer Data	140 lbs 30" drop
Borehole Backfill	Cuttings	Location	See Figure-3 Geotechnical 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	REMARKS AND OTHER TESTS
0					SM		0.0 - 2.0 Topsoil			
					SM		Silty SAND with gravel, reddish brown, medium dense, slightly moist, fine grained sand, medium grained gravel			
5			5-6.5'	23 43 50 for 6"	SM		2.0 -51.5 Alluvium (Qa) Silty SAND with gravel, reddish brown, medium dense, slightly moist, fine grained sand, medium grained gravel Consistency become very dense			
			5-10'							
10			10-11.5'	18 34 50 for 3"	SM					
15			15-16.5'	19 30 37	SP		SAND, light brown, dense, slightly moist, fine-medium grained sand			
20			20-21.5'	12 19 31	CL		CLAY, dark brown, hard, slightly moist, medium plasticity			
25			25-26.5'	15 35 50 for 6"	CL		Color becomes pale to light brown			
30										

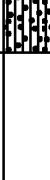
Project: **Proposed AutoZone Store #4499**

Project Location: **Near Mojave Drive & El Evado Road,
Victorville, CA 92394**

Project Number: **L201055**

Log of Boring B-9

Sheet 2 of 2

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
	30		30-31.5	13 34 50 for 5"	CL					
	35		35-36.5	50 for 6"	SM		Silty SAND, light brown, very dense, slightly moist, fine grained sand			
	40		40-41.5	16 50 for 5"	SP		SAND, light brown, very dense, slightly moist, fine to coarse grained sand			
	45		45-46.5	27 50 for 6"	SM		Silty SAND, brown, very dense, slightly moist, fine grained sand			
	50		50-51.5	20 45 50 for 5"	SM					
	55						End of boring at 51.5 feet No groundwater No caving Backfilled with cuttings			
	60									
	65									

Project: **Proposed AutoZone Store #4499**

Project Location: **Near Mojave Drive & El Evado Road,
Victorville, CA 92394**

Project Number: **L201055**

Key to Log of Boring

Sheet 1 of 1

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
1	2	3	4	5	6	7	8	9	10	11

COLUMN DESCRIPTIONS

- | | |
|---|--|
| <p>1 Elevation (feet): Elevation (MSL, feet).</p> <p>2 Depth (feet): Depth in feet below the ground surface.</p> <p>3 Sample Type: Type of soil sample collected at the depth interval shown.</p> <p>4 Sample Number: Sample identification number.</p> <p>5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.</p> <p>6 Material Type: Type of material encountered.</p> | <p>7 Graphic Log: Graphic depiction of the subsurface material encountered.</p> <p>8 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.</p> <p>9 Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.</p> <p>10 Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.</p> <p>11 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.</p> |
|---|--|

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
 COMP: Compaction test
 CONS: One-dimensional consolidation test
 LL: Liquid Limit, percent

PI: Plasticity Index, percent
 SA: Sieve analysis (percent passing No. 200 Sieve)
 UC: Unconfined compressive strength test, Qu, in ksf
 WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

 Lean CLAY, CLAY w/SAND, SANDY CLAY (CL)

 Silty SAND (SM)

 Poorly graded SAND (SP)

TYPICAL SAMPLER GRAPHIC SYMBOLS

 Auger sampler  Bulk Sample  3-inch-OD California w/ brass rings	 CME Sampler  Grab Sample  2.5-inch-OD Modified California w/ brass liners
--	--

 Pitcher Sample

 2-inch-OD unlined split spoon (SPT)

 Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

 Water level (at time of drilling, ATD)

 Water level (after waiting)

 Minor change in material properties within a stratum

 Inferred/gradational contact between strata

 Queried contact between strata

GENERAL NOTES

- Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
- Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure B-1

Do the same as in the previous example, but now the error is

S ☐ **L** ☐ ☐ ☐ **D** ☐ **L** ☐ ☐

Project No.: L201008

Evado and Mojave Dr., Victorville

PH Measured	6.09				
Resistivity p	1400		Ωm		
Resistivity Rg			k Ω		
				Sulfate Content	95 ppm
				Chloride Content	11 ppm
				Nitrate Content	ppm

12

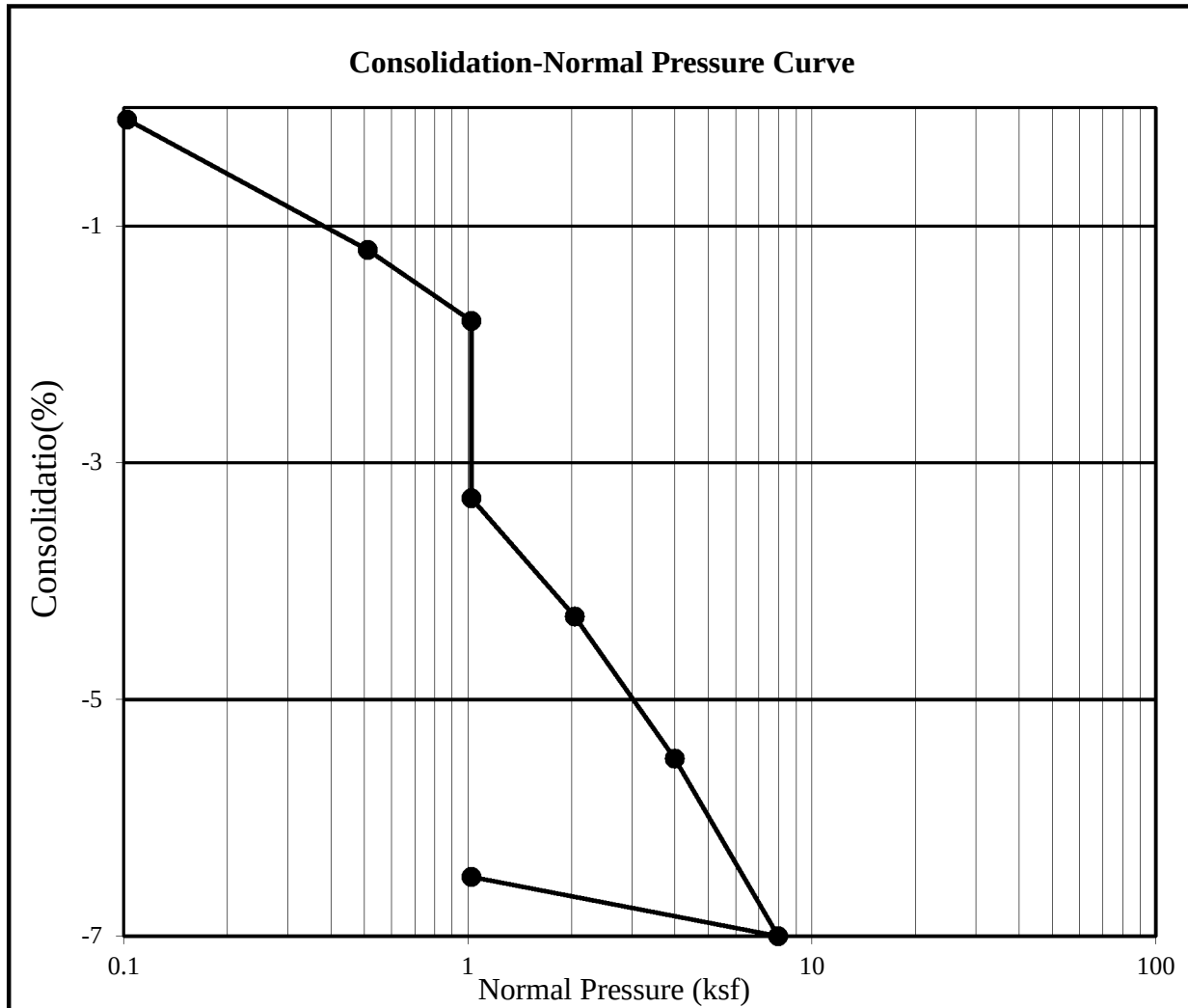
Notes:

Notes:

Evado and Mojave Dr., Victorville

PH Measured	6.09			
Resistivity p	1400	Ωm		
Resistivity Rg		k Ω		
			Sulfate Content	95
			Chloride Content	11
			Nitrate Content	

Notes:



Boring Info		Before Test		After Test		Record	
Boring No.	B-3	Moisture (%)	6.1	Moisture (%)	16.6	Test by	ZJ
Depth	6'	Total Weight (g)	181	Total Weight (g)	198.3	Check by	
Soil Classification	Silty Sand	Ring Weight (g)	44.6	Ring Weight (g)	44.6	Start Date	8/14/2020
		Wet Density (pcf)	113.3	Wet Density (pcf)	127.7	End Date	8/17/2020
Geotechnical Investigation Report: Evado and Mojave Dr., Victorville				Terradyne Engineering, Inc.			
				Consolidation Test Diagram			
				Terradyne Project No: L201055		Plate:	

Merolito Reor



**Percolation Tests Report
Proposed AutoZone Store #4499
Near Mojave Drive & El Evado Road,
Victorville, CA 91387**

Terradyne Project No.: L201055

November 3, 2021

*Terradyne Engineering, Inc.
2691 Dow Avenue, Suite F, Tustin, CA 92780
Office: 657-212-5800 • Website: www.terradyne.com*



November 3, 2021

Mr. Rob DeGraaf, LEP, PWS
Sweetgum Environmental
Plant City, Florida
Phone: 813-365-2411
Email: robdegraaf@verizon.com

Re: Subsurface Explorations & Geotechnical Investigation
Proposed New AutoZone Store #4499
Near El Evado Road & Mojave Drive,
Victorville, San Bernardino County, CA 92394
Terradyne Project No.: L201055

Reference: See Attachment

Dear Mr. DeGraaf:

In accordance with your request, we have completed our soil percolation testing at the subject site. The purpose of our investigation was to provide preliminary data for the construction of a WQMP/BMP design for the AutoZone Store #4499 at Near El Evado Road and Mojave Drive, Victorville, San Bernardino County, California.

Percolation Test Procedure

Percolation testing for design of stormwater infiltration BMPs was completed after guidance of the Technical Guidance Document for Water Quality Management Plans (BMP Design Manual, 2013).

Boring Percolation Testing Method

The three test holes were drilled using an 8" hollow-stem auger drill rig (GT8) to a depth of up to 13.0 feet. Approximately 2-inches of pea gravel was placed at the bottom of the test holes. A 3" perforated PVC pipe was installed, and the sidewalls were filled with pea gravel. Prior to field testing, the hole was pre-saturated. Testing was performed and observations were recorded over a minimum 10-minutes test period following the test procedures outlined by the referenced standard. Measurements were taken to the nearest 1/4 of an inch using a measuring tape with 1/16-inch divisions.

Soil Characteristics

In accordance with the Unified Soil Classification System (USCS), the underlying materials are classified as medium dense to dense silty SAND (SM) and clayey SAND (SC). Generally, granular sandy material can be considered favorable with respect to the soil infiltration characteristics.

Percolation Rate

The grain size distribution affects soil permeability. Coarse-grained soils with large median particle sizes will yield higher infiltration rates. Finer grained soils will yield lower infiltration rates. Percolation rate (Inch/Hour) from the field testing are as follows:

Test No.	Location	Depth (Feet)	Initial Design Percolation Rate (Inch/Hour)	Percolation Rate (in/hr, F=3)(In/hr)
P-1	See Figure 3	13	63.0	21.0
P-2	See Figure 3	12	19.5	6.5
P-3	See Figure 3	12	24.0	8.0

Long-term sustainable infiltration rates may be affected by several factors including the degree of saturation of the adjacent ground and the infiltration of finer grained soils into the system. To account for these factors, the application of these rates should therefore consider the use of an appropriate factor of safety. The development of the factor of safety should be based upon the more conservative rate obtained and include consideration of the impacts of deteriorated performance, life/health safety issues and should anticipate that the rates established in these tests will be reduced over time. Final selection of the appropriate reduction coefficients & factors of safety should be made by the designer based on the local laws and ordinances, and desired level of conservatism.

Suitability of the Site for Stormwater Infiltration

It is TEI's opinion based on the results of the field study, that the area of the proposed infiltration system **is suitable** for stormwater infiltration BMPs. This judgment is based upon the factors listed below.

1. Infiltration Rate. The design infiltration rate determined from the site-specific percolation testing in the property is above 0.5 inches per hour in the site tested.
2. Historic Groundwater Conditions. Review of the available references (SGMA Data Viewer, 2021), the historic high groundwater has been recorded at 196.70 feet below ground surface at 1 mile to the east of the subject site (State Well Number: 05N04W08N001S). Groundwater was not encountered in our 50-foot boring during field exploration. As such, there is enough distance (minimum 10 feet) between the base of the proposed BMP system to the possible high historic groundwater to meet the requirements of the San Bernardino County BMP Manual.
3. Relatively Homogeneous Soil Conditions. Our field investigation in the area of study indicates that the soils in the entire proposed BMP area is a relatively homogeneous mostly sandy soil with suitable infiltration capabilities that extend to depth.

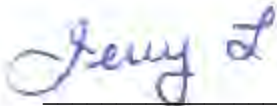
In consideration of the site evaluation- it is TEI's opinion that the site **is suitable** for application of full stormwater infiltration BMP's.

Closure

The findings and conclusions in this report were prepared in accordance with generally accepted engineering principles and practices. No other warranty, either expressed or implied, is made as to the future performance of the project. Conclusions, recommendations, and other information contained in this report are based upon the assumption that the subsurface conditions do not vary appreciably between and adjacent to the observation points. Although no significant variation is anticipated, it must be recognized that variations can occur. This report has been prepared for our client, to be used solely initial design purposes. Anyone using this report for any other purpose must draw their own conclusions regarding the infiltration characteristics and soil conditions at the site.

We appreciate this opportunity to be of continued service to you. Should you have any questions regarding the information contained herein, please contact us at your earliest convenience.

Respectfully submitted,
Terradyne Engineering, Inc.



Jerry Michal P.E.
Senior Geotechnical Engineer



Zijin Jiang, E.I.T.
Staff Engineer

Percolation-Infiltration Test Diagram

TERRADYNE
Engineers, Geologists & Environmental Scientists

Testing Date: 10/26/2021

Boring/Test No.: P-1

Tested By: ZJ

Depth of Boring: 13 ft

Depth to Invert of BMP: 13 ft

Depth of Water Table: N/A

Time Interval Standard

Water Remaining in Boring (Y/N) Y

Standard Time Interval Between Readings: 10 min

[illegible]

Boring Percolation Testing Field Log



Project Number:	<u>L201055</u>	Testing Date:	<u>10/26/2021</u>
Project Location:	<u>Near Mojave Dr. & El Evado Rd.</u>	Boring/Test No.:	<u>P-2</u>
Earth Description:	<u>Silty SAND and Clayey SAND</u>	Tested By:	<u>ZJ</u>
Diameter of Boring:	<u>8 in</u>	Diameter of Casing:	<u> </u>
Liquid Description:	<u>Tap water</u>	Depth of Boring:	<u>12 ft</u>
Measurement Method:	<u>Sounder/Tape</u>	Depth to Invert of BMP:	<u>12 ft</u>
Depth of Initial Water Depth (d1):	<u>0</u>	Depth of Water Table:	<u>N/A</u>

Time Interval Standard

Start Time for Pre-Soak:	<u>10:15</u>	Water Remaining in Boring (Y/N)	<u>Y</u>
Start Time for Standard:	<u>10:34</u>	Standard Time Interval Between Readings:	<u>10 min</u>

Reading Number	Time (Start/End) (hh:mm)	Elapsed Time (Δt)	Water Drop During Standard Time Interval Δd (inches)	Percolation Rate for Reading (in/hr)	Soil Description/ Notes/Comments
1	10:34	10	4.25	25.5	SM
	10:44				
2	10:45	10	4.500	27.0	SM
	10:55				
3	10:56	11	5.500	30.0	SM
	11:07				
4	11:08	16	6.500	24.4	SC
	11:24				
5	11:25	10	3.125	18.8	SC
	11:35				
6	11:35	10	3.250	19.5	SC
	11:45				

Boring Percolation Testing Field Log



Project Number:	<u>L201055</u>	Testing Date:	<u>10/26/2021</u>
Project Location:	<u>Near Mojave Dr. & El Evado Rd.</u>	Boring/Test No.:	<u>P-3</u>
Earth Description:	<u>Silty SAND and Clayey SAND</u>	Tested By:	<u>ZJ</u>
Diameter of Boring:	<u>8 in</u>	Diameter of Casing:	<u> </u>
Liquid Description:	<u>Tap water</u>	Depth of Boring:	<u>12 ft</u>
Measurement Method:	<u>Sounder/Tape</u>	Depth to Invert of BMP:	<u>12 ft</u>
Depth of Initial Water Depth (d1):	<u>0</u>	Depth of Water Table:	<u>N/A</u>

Time Interval Standard

Start Time for Pre-Soak:	<u>11:35</u>	Water Remaining in Boring (Y/N)	<u>Y</u>
Start Time for Standard:	<u>11:48</u>	Standard Time Interval Between Readings:	<u>10 min</u>

Reading Number	Time (Start/End) (hh:mm)	Elapsed Time (Δt)	Water Drop During Standard Time Interval Δd (inches)	Percolation Rate for Reading (in/hr)	Soil Description/ Notes/Comments
1	11:49	13	6.625	30.6	SM
	12:02				
2	12:06	10	4.000	24.0	SM
	12:16				
3	12:17	10	3.500	21.0	SM
	12:27				
4	12:27	10	4.125	24.8	SC
	12:37				
5	12:38	10	3.875	23.3	SC
	12:48				
6	12:48	10	4.000	24.0	SC
	12:58				

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2nd Submittal Comments
AutoZone Victorville
**REPORT OF SUBSURFACE
EXPLORATION & GEOTECHNICAL**

REPORT OF SUBSURFACE EXPLORATION & GEOTECHNICAL INVESTIGATION COMMENTS	
Application No.	AutoZone Victorville
Submittal Number	2nd Submittal, 30150021.0130 BLDC21-00096
Comments Date	October 6, 2021

Item #	COMMENTS By: Mohamed Worayeth, Senior Civil Engineer mworayeth@hrgreen.com	Satisfied	Not Satisfied	Applicant Response
		✓	✗	
	General Geotechnical Comments			
1.	Provide a clear and simple vicinity map with a small-scale showing streets and nearby properties. The other three (3) maps shown the site in two different locations; at the corner or west of the corner of an intersection.		✗	
2.	The site plan is showing AM/PM C-Store and not the Auto Zone. Update site plan showing Auto Zone the subject of this report.		✗	
3.	The Introduction of the report describe drilling logging and sampling 8 hollow stem auger holes, but the site plan of holes shows hand boring of 8 holes location. Update site plan or the introduction.		✗	
4.	The Introduction of the report describe drilling logging and sampling 8 hollow stem auger holes to a depth of only 16.5 feet. Deeper drilled holes shall be carried out to a depth of at least 50 feet for the type of the proposed building.		✗	



2nd Submittal Comments
AutoZone Victorville
**REPORT OF SUBSURFACE
EXPLORATION & GEOTECHNICAL**

Item #	COMMENTS By: Mohamed Worayeth, Senior Civil Engineer mworayeth@hrgreen.com	Satisfied	Not Satisfied	Applicant Response
		✓	✗	
5.	Provide a percolation/infiltration test report.		✗	
6.	Provide the soil classifications (A, B, C or D) of the site based on the field tests.		✗	
7.	Reference all Geological Hazards and the Seismic design parameter according to latest CBC Code of 2019. Provide Seismic Info/data that reflect 2019 California Building Code which was Effective January 1, 2020.	✓		

END OF COMMENTS

Please provide applicant's response with next submittal.

□□□ Ses □□ Des □□□ □□r □□e □er



Hazards by Location

Search Information

Coordinates: 34.52888725724356, -117.3485614537201

Elevation: 2947 ft

Timestamp: 2021-11-03T20:35:05.163Z

Hazard Type: Seismic

Reference Document: ASCE7-16

Risk Category: II

Site Class: D-default



Map data ©2021 Imagery ©2021, County of San Bernardino, Maxar Technologies, USDA Farm Service Agency

Basic Parameters

Name	Value	Description
S_S	1.154	MCE_R ground motion (period=0.2s)
S_1	0.448	MCE_R ground motion (period=1.0s)
S_{MS}	1.385	Site-modified spectral acceleration value
S_{M1}	* null	Site-modified spectral acceleration value
S_{DS}	0.923	Numeric seismic design value at 0.2s SA
S_{D1}	* null	Numeric seismic design value at 1.0s SA

* See Section 11.4.8

▼Additional Information

Name	Value	Description
SDC	* null	Seismic design category
F_a	1.2	Site amplification factor at 0.2s
F_v	* null	Site amplification factor at 1.0s
CR_S	0.936	Coefficient of risk (0.2s)
CR_1	0.92	Coefficient of risk (1.0s)
PGA	0.496	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.595	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)

SsRT	1.154	Probabilistic risk-targeted ground motion (0.2s)
SsUH	1.234	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.448	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.487	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

* See Section 11.4.8

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey [Seismic Design Web Services](#).

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