



March 29, 2024

Project No. 24158

Mr. Michael Colich
566 W Palm St
Altadena, CA 91001

Subject: Preliminary Geotechnical Engineering Report
Proposed Two Single-Family Residences, Two Additional
Dwelling Units, and Two Pools
566 W Palm St, Altadena, California

Dear Mr. Colich:

In accordance with your request and authorization, we are presenting the results of our geotechnical investigation for the proposed two single-family residence, two ADUs, and two pools located at 566 W Palm St, Altadena, California. The purpose of this investigation has been to evaluate the subsurface conditions at the site and to provide geotechnical engineering recommendations for the proposed construction.

Based on our findings, the proposed project is geotechnically feasible, provided that the recommendations in this report are incorporated into the design and are implemented during construction of the project. This report was prepared in accordance with the requirements of the 2022 California Building Code and the City of Pasadena Department of Building and Safety.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding this report or if we can be of further service, please do not hesitate to contact the undersigned at (657) 888-4608 or info@ntsgeo.com.

Respectfully submitted,
NTS GEOTECHNICAL, INC.

A handwritten signature in black ink, appearing to read "Nadim Sunna".

Nadim Sunna, M.Sc., P.E., G.E. 3172
Principal Engineer



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Plate 1 – Location Map
Plate 2 – Geotechnical Map
Plate 3 – Geotechnical Section

Appendix A – Field Exploration
Appendix B – Geotechnical Laboratory Test Result

INTRODUCTION

This report presents the results of our geotechnical engineering evaluation performed for the proposed two single-family residence, two ADUs, and two pools located at 566 W Palm St, Altadena, California. See (Plate 1, Location Map). The purpose of this study has been to evaluate the subsurface conditions at the site and to provide geotechnical recommendations related to the design and construction of the proposed structures.

SITE AND PROJECT DESCRIPTION

The project site is located at 566 W Palm St, in the City of Altadena, California, and it is bound by W Palm St to the north, and existing residences to the east, south, and west. The site is currently a vacant lot with native vegetation and an existing retaining wall on the southern end. The site appears to sheet flow towards the rear side of the property.

It is our understanding that the proposed project consists of the construction of two single-family residences, two ADUs, and two pools. The structures are planned at-grade, and we anticipate that the structures will be lightly loaded wood frame buildings.

SCOPE OF WORK

As part of the preparation of this report, we have performed the following tasks:

Background Review

We reviewed readily available background data including in-house geologic maps, topographic maps, and aerial photographs relevant to the subject site in preparation of this report. The list of documents reviewed is presented in the "References" section of this report.

Field Exploration

The subsurface conditions were evaluated on March 8, 2024, by advancing three (3) hand borings. The borings were advanced to depths ranging from 7.5 to 10 feet below the existing grade. The approximate locations of the borings are shown on Plate 2, Geotechnical Map. Detailed exploration information of soils borings is presented in Appendix A, Field Exploration.

Geotechnical Laboratory Testing

Laboratory tests were performed on bulk and undisturbed samples collected during our recent field investigation by Advanced Materials Testing, LLC., a City of Los Angeles approved laboratory. NTS has reviewed their test results and accepts the

responsibility of utilizing the test data in our analysis. The following tests were performed in general accordance with ASTM standards:

- In-situ moisture and density
- Corrosion suite
- Direct shear
- Consolidation

Laboratory test results are presented within Appendix B of this report.

GEOLOGIC FINDINGS

Regional Geologic Setting

According to the Dibblee geologic map, the project site is underlain by alluvial deposits (Qof) consisting of gravel, sand, and clay.

Subsurface Materials

Earth materials encountered during our subsurface investigation consist artificial fill (Af) in the upper two to three feet followed by alluvium (Qof) extending to the total depth of the exploration. The artificial fill is composed of dark brown, medium dense, and moist sand to silty sands. In general, the alluvium consists of brown to tan, moist to very moist, medium dense to dense, sand to silty sand.

Groundwater

Groundwater was not observed during our exploration. The historical high depth to groundwater is reportedly at a depth of 50 feet below the existing grade at the project site (CDMG 1998). Groundwater conditions may vary across the site due to stratigraphic and hydrologic conditions and may change over time as a consequence of seasonal and meteorological fluctuations, or activities by humans at this site and nearby sites. However, based on the above findings, groundwater is unlikely to impact the proposed development.

GEOLOGIC HAZARDS

Faulting and Seismicity

The site is not located within an Alquist-Priolo Earthquake Fault Zone, and no known active faults are shown on the reviewed geologic maps crossing the site, however, the site is located in the seismically active region of Southern California. The nearest known active fault is the Sierra Madre fault system, which is located approximately 0.3 miles from the site.

Given the proximity of the site to these and numerous other active and potentially active faults, the site will likely be subject to earthquake ground motions in the future. A site PGAM of 0.976g was calculated for the site in conformance with the 2022 CBC. This PGAM is primarily dominated by earthquakes with a mean magnitude of 7.18 at a mean distance of 8.31 km from the site using the USGS 2014 Interactive Deaggregation website.

Liquefaction and Seismic Settlement

Liquefaction occurs when the pore pressures generated within a soil mass approach the effective overburden pressure. Liquefaction of soils may be caused by cyclic loading such as that imposed by ground shaking during earthquakes. The increase in pore pressure results in a loss of strength, and the soil then can undergo both horizontal and vertical movements, depending on the site conditions. Other phenomena associated with soil liquefaction include sand boils, ground oscillation, and loss of foundation bearing capacity. Liquefaction is generally known to occur in loose, saturated, relatively clean, fine-grained cohesionless soils at depths shallower than approximately 50 feet. Factors to consider in the evaluation of soil liquefaction potential include groundwater conditions, soil type, grain size distribution, relative density, degree of saturation, and both the intensity and duration of ground motion.

Based on our review of the state-designated Seismic Hazard Zone for liquefaction potential, the site is located within a zone of required investigation for Liquefaction. Based on the lack of shallow groundwater, the potential for liquefaction to impact the proposed development is considered low.

Landslides

Based on our review of the referenced geologic maps, literature, topographic maps, aerial photographs, and our subsurface evaluation, no landslides or related features underlie or are adjacent to the subject site. Due to the relatively level nature of the site and surrounding areas, the potential for landslides at the project site is considered negligible.

Flooding

The Federal Emergency Management Agency (FEMA) has prepared flood insurance rate maps (FIRMs) for use in administering the National Flood Insurance Program. Based on our review of the FEMA flood map, the site is located in an Area of Minimal Flood Hazard (Zone X).

Tsunami and Seiches

Tsunamis are waves generated by massive landslides near or under sea water. The site is not located on any State of California – County of Los Angeles Tsunami Inundation Map for Emergency Planning. The potential for the site to be adversely impacted by earthquake-induced tsunamis is considered to be negligible because the site is located several miles inland from the Pacific Ocean shore, at an elevation exceeding the maximum height of potential tsunami inundation.

Seiches are standing wave oscillations of an enclosed water body after the original driving force has dissipated. The potential for the site to be adversely impacted by earthquake-induced seiches is considered to be negligible due to the lack of any significant enclosed bodies of water located in the vicinity of the site.

GEOTECHNICAL ENGINEERING FINDINGS

Expansive Soil

Based on our evaluation and experience with similar material types, the soils encountered near the ground surface at the site exhibit a very low expansion potential.

Soil Corrosion

The potential for the on-site materials to corrode buried steel and concrete improvements was evaluated. Laboratory testing was performed on representative soil samples to evaluate pH, minimum resistivity, and soluble chloride and sulfate contents. The results of our corrosivity testing is presented within Appendix B of this report. General recommendations to address the corrosion potential of the on-site soils are provided below. Imported fill materials, if used, should be tested to evaluate whether their corrosion potential is more severe than those assumed.

Structural Concrete

Laboratory tests indicate that the potential of sulfate attack on concrete in contact with the on-site soils is “negligible” or “S0” exposure in accordance with ACI 318, Table 19.3.1.1. Therefore, restriction on the type of cement, water to cement ratio, and compressive strength is not required.

The aforementioned recommendations in regards to concrete are made from a soils perspective only. Final concrete mix design is beyond our purview. All applicable codes, ordinances, regulations, and guidelines should be followed in regard to the designing a durable concrete with respect to the potential for sulfate exposure from the on-site soils and/or changes in the environment.

Ferrous Metal

The results of the laboratory chemical tests performed on a sample of soil collected within the site indicate that the on-site soils are mildly corrosive to ferrous metals. Consequently, metal structures which will be in direct contact with the soil (i.e., underground metal conduits, pipelines, metal sign posts, etc.) and/or in close proximity to the soil (wrought iron fencing, etc.) may be subject to corrosion. The use of special coatings or cathodic protection around buried metal structures has been shown to be beneficial in reducing corrosion potential.

The laboratory testing program performed for this project does not address the potential for corrosion to copper piping. In this regard, a corrosion engineer should be consulted to perform more detailed testing and develop appropriate mitigation measures (if necessary).

The above discussion is provided for general guidance in regards to the corrosiveness of the on-site soils to typical metal structures used for construction. Detailed corrosion testing and recommendations for protecting buried ferrous metal and/or copper elements are beyond our purview. If detailed testing is required, a corrosion engineer should be consulted to perform the testing and develop appropriate mitigation measures.

Excavation Characteristics

The majority of the soil materials underlying the site can be excavated with excavators and other conventional grading equipment.

GEOTECHNICAL ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Based on the results of our field exploration and engineering analyses, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations in this report are incorporated into the design plans and are implemented during construction.

Based on the geologic and geotechnical findings, the following is a summary of our conclusions:

- The upper approximately 3 feet of the site soils is considered loose and compressible and will require remedial grading for foundation and slab support.
 - Due to the potential for the structures to span a cut/fill transition, we recommend that foundations that are placed within the cut portion of the pad be overexcavated to a depth

of 3 feet below the footing and recompacted to minimize differential settlement.

- There are no known active faults crossing the subject site. The site seismicity is typical for the Altadena area. Structure design should be in accordance with the current 2022 CBC.
- The potential for liquefaction to impact the proposed development is considered low.
- The proposed structures may be supported on a shallow foundation system embedded into competent firm and unyielding engineered fill.

The actual conditions of the near-surface supporting material across the site may vary. The nature and extent of variations of the surface and subsurface conditions between the exploratory excavations may not become evident until construction. If variations of the material become evident during construction of the proposed development, NTS should be notified so that the project Geotechnical Consultant can reevaluate the characteristics of the material and the conclusions and recommendations of this report, and, if needed, revise the conclusions and recommendations presented herein.

Our geotechnical engineering analyses performed for this report were based on the earth materials encountered during the subsurface exploration for the site. If the design substantially changes, then our geotechnical engineering recommendations would be subject to revision based on our evaluation of the changes. The following sections present our conclusions and recommendations pertaining to the engineering design for this project.

Los Angeles County Section 111

It is the finding of this firm that the proposed improvements will be safe and that the site will not be affected by any hazard from landslide, settlement, or slippage in compliance with the County of Los Angeles code, provided that the recommendations presented in this report are incorporated during the design and implemented during construction.

Site Preparation

Site preparation should begin with the removal of utility lines, asphalt, concrete, vegetation, and other deleterious debris from areas to be graded. Tree stumps and roots should be removed to such a depth that organic material is generally not present. Clearing and grubbing should extend to the outside edges of the proposed excavation and fill areas. We recommend that unsuitable materials such as organic matter or oversized material be selectively removed and disposed offsite. The debris and unsuitable material generated during clearing and grubbing should be removed from areas to be graded and disposed at a legal dump site away from the project area.

Remedial Grading

Remedial grading will serve to create a firm and workable platform for construction of new building pads. Due to the presence of compressible artificial fill, and in order to achieve a uniform blanket of engineered fill for support of new foundation, we recommend that the pads be excavated to a depth of 5 feet from existing grade or 3 feet below footing, whichever is deeper.

It should be noted that the recommendations provided herein are based on our subsurface exploration and knowledge of the on-site geology. Actual removals may vary in configuration and volume based on observations of geologic materials and conditions encountered during grading. The bottom of all corrective grading removals should be observed by a representative of NTS to verify the suitability of in-place soil prior to performing scarification and recompaction. Corrective grading recommendations are outlined below.

Building Pads

In order to create a firm and stable platform on which to construct the new building slab-on-grade and foundation, we recommend the following:

- The building pad should be excavated to a depth of at least 5 feet from existing grade or 3 feet below footing, whichever is deeper.
- The bottom of the over excavation should then be scarified to a depth of at least 6 inches, moisture conditioned to near optimum moisture content and recompacted to at least 90 percent relative compaction as determined in accordance with ASTM D1557.
- Following the approval of the over-excavation bottom by a representative of NTS, the onsite material may be used as fill material to achieve the planned pad grade.
- The fill material should then be placed in 6- to- 8-inch-thick lifts, moisture conditioned to near optimum moisture content and compacted to achieve 90 percent relative compaction.

Retaining Wall

New retaining wall that may be situated at the rear of the property should be supported on a shallow foundation embedded into competent native soil.

Materials for Fill

On-site soils with an organic content of less than 3 percent by volume (or 1 percent by weight) are suitable for use as fill. Soil material to be used as fill should not contain contaminated materials, rocks, or lumps over 6 inches in largest dimension, and not more than 40 percent larger than $\frac{3}{4}$ inch. Utility trench backfill material should not contain rocks or lumps over 3 inches in largest dimension.

Larger chunks, if generated during excavation, may be broken into acceptably sized pieces or may be disposed offsite.

Any imported fill material should consist of granular soil having a “very low” expansion potential (that is, expansion index of 20 or less). Import material should also have low corrosion potential (that is, chloride content less than 500 parts per million [ppm], soluble sulfate content of less than 0.1 percent, and pH of 5.5 or higher). Materials to be used as fill should be evaluated by a representative of NTS prior to importing or filling.

Compacted Fill

Prior to placement of compacted fill, the contractor should request an evaluation of the exposed excavation bottom by NTS. Unless otherwise recommended, the exposed ground surface should then be scarified to a depth of at least 8 inches and watered or dried, as needed, to achieve generally consistent moisture contents near optimum moisture content. The scarified materials should then be compacted to 90 percent relative compaction in accordance with the latest version of ASTM Test Method D1557.

Compacted fill should be placed in horizontal lifts of approximately 6 to 8 inches in loose thickness. Prior to compaction, each lift should be watered or dried as needed to achieve near optimum moisture condition, mixed, and then compacted by mechanical methods to a relative compaction of 90 percent. Successive lifts should be treated in a like manner until the desired finished grades are achieved.

Personnel from NTS should observe the excavations so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Temporary Excavations

Temporary excavations for the demolishing, earthwork, footing and utility trench are expected. We anticipate that unsurcharged excavations with vertical side slopes less than 4 feet high will generally be stable; however, sloughing of cohesionless sandy materials encountered at the site should be expected.

Where the space is available, temporary, unsurcharged excavation sides over 4 feet in height should be sloped no steeper than an inclination of 1H:1V (horizontal:vertical). Where sloped excavations are created, the tops of the slopes should be barricaded so that vehicles and storage loads do not encroach within 10 feet of the top of the excavated slopes. A greater setback may be necessary when considering heavy vehicles, such as concrete trucks and cranes. NTS should be advised of such heavy vehicle loadings so that specific setback requirements can be established. If the temporary construction slopes are to be maintained during

the rainy season, berms are recommended to be graded along the tops of the slopes in order to prevent runoff water from entering the excavation and eroding the slope faces. Where space for sloped excavations is not available, temporary shoring may be utilized.

Personnel from NTS should observe the excavation so that any necessary modifications based on variations in the encountered soil conditions can be made. All applicable safety requirements and regulations, including CalOSHA requirements, should be met.

Seismic Design

Our recommendations for seismic design parameters have been developed in accordance with 2022 CBC and ASCE 7-16 (ASCE, 2016) standards. The applicable site class is D based on the results of our field investigation. The table presents the seismic design parameters for the site that are obtained from USGS Design Ground Motions website, and are based on the ASCE 7-16 and 2022 California Building Code, and the site coordinates of N34.199891° and W118.157519°.

CBC 2022 Seismic Design Parameters

Design Parameters	Value
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, S_s	1.892
Mapped Spectral Acceleration Parameter at Period 1-Second, S_1	0.712
Site Coefficient, F_a	1.2
Site Coefficient, F_v	1.7
Adjusted MCER1 Spectral Response Acceleration Parameter at Short Period, S_{MS}	2.271
1-Second Period Adjusted MCER1 Spectral Response Acceleration Parameter, S_{M1}	1.210
Short Period Design Spectral Response Acceleration Parameter, SDS	1.514
1-Second Period Design Spectral Response Acceleration Parameter, SD_1	0.807
Peak Ground Acceleration, PGA	0.814
Peak Ground Acceleration, PGAM *	0.976
*Risk-targeted maximum considered earthquake	

Since the Site Class is designated as D and the S_1 value is greater than or equal to 0.2, the 2022 CBC requires either a site-specific seismic hazard analysis per Section 21.2 of ASCE 7-16 or the application of Exception 2 of Section 11.4.8 of ASCE 7-16. The project structural engineer should apply all requirements of

Section 11.4.8 of ASCE 7-16 to determine if increases to the seismic response coefficient (i.e. increases to the loading of the structure) are required.

It should be recognized that much of southern California is subject to some level of damaging ground shaking as a result of movement along the major active (and potentially active) fault zones that characterize this region. Design utilizing the 2022 CBC is not meant to completely protect against damage or loss of function. Therefore, the preceding parameters should be considered as minimum design criteria.

Building Foundation Design and Construction

A shallow foundation system may be used for support of the proposed buildings, provided that all the footings are placed on competent firm and unyielding engineered fill. Our geotechnical foundation design parameters are presented in the table below:

Foundation Design Parameters

Bearing Material	Competent engineered fill
Minimum Footing Size	- Width: 12 inches - Depth: 18 inches below the lowest adjacent soil grade
Allowable Bearing Capacity	2,000 psf for the minimum footing size given above. - The above value may be increased by 1/3 for temporary loads such as wind or earthquake.
Settlement	Total static settlement of 1 inch with differential settlement estimated to be approximately 1/2 inch over a span of 30 feet.
Allowable Lateral Passive Resistance	250 pcf (equivalent fluid pressure)
Allowable Coefficient of Friction	0.35

Retaining Wall Foundation Design and Construction

A shallow foundation system may be used for support of the proposed retaining walls, provided that all the footings are placed on competent firm and unyielding native soil. Our geotechnical foundation design parameters are presented in the table below:

Foundation Design Parameters

Bearing Material	Competent native soil
Minimum Footing Size	- Width: 12 inches - Depth: 24 inches below the lowest adjacent soil grade
Allowable Bearing Capacity	2,500 psf for the minimum footing size given above. - The above value may be increased by 1/3 for temporary loads such as wind or earthquake.
Settlement	Total static settlement of 1 inch with differential settlement estimated to be approximately ½ inch over a span of 30 feet.
Allowable Lateral Passive Resistance	300 pcf (equivalent fluid pressure)
Allowable Coefficient of Friction	0.35

Slab-On-Grade Design and Construction

The slab-on-grade should be designed and constructed with the minimum recommendations presented below, however, final design of the slab should be determined by the project structural engineer.

Minimum Slab Thickness: Minimum slab thickness is recommended to be 5 inches from a geotechnical standpoint. Final slab thickness per structural engineer.

Minimum Slab Reinforcement: Minimum slab reinforcement shall not be less than No. 4 bars placed at 18 inches on center. Welded wire mesh is not recommended. Care should be taken to position the reinforcement bars in the center of the slab.

Slab Subgrade:

- The upper 24 inches of the slab subgrade should be moisture conditioned to near optimum moisture content and compacted to a minimum relative compaction of compacted to 90 percent relative compaction in accordance with the latest version of ASTM D1557.
- A moisture vapor retarder below the slab-on-grade should be placed in accordance with the “Moisture Vapor Retarder” section below.

Moisture Vapor Retarder

A vapor retarder, such as a 10-mil-thick moisture vapor retarder that meets the requirements of ASTM E1745 Class C (Stego Wrap or equivalent) should be placed directly over the prepared soil subgrade to provide protection against vapor transmission through concrete floor slabs that are anticipated to receive carpet, tile or other moisture sensitive coverings. The use of moisture vapor retarder should be determined by the project architect. At minimum, the vapor retarder should be installed as follows:

- Per the manufacture's specifications as well as with the applicable recognized installation procedures such as ASTM E1643;
- Joints between the sheets and the openings for utility piping should be lapped and taped. If the barrier is not continuously placed across footings/ribs, the barrier should at minimum be lapped into the side of the footing/rib trenches down to the bottom of the trench; and,
- Punctures in the vapor retarder should be repaired prior to concrete placement.

It should be noted that the moisture retarder is intended only to reduce moisture vapor transmissions from the soil beneath the concrete and is consistent with the current standard of the industry in the building construction in Southern California. It is not intended to provide a "waterproof" or "vapor proof" barrier or reduce vapor transmission from sources above the retarder (i.e., concrete). The evaluation of water vapor from any source and its effect on any aspect of the proposed building space above the slab (i.e., floor covering applicability, mold growth, etc.) is beyond our purview and the scope of this report.

Retaining Wall Design

We recommend that the new wall be design and constructed in accordance with the following recommendations:

Foundation Recommendations

Retaining walls foundation may be sized based on the recommendations presented in "Retaining Wall Shallow Foundation Design and Construction" section of this report.

Lateral Earth Pressure

The values presented below assume surcharge loads are not applied. In addition, the recommended design lateral earth pressure is calculated assuming that a drainage system will be installed behind the retaining walls and that external hydrostatic pressure will not develop. Where adequate drainage is not provided behind the walls, further evaluation should be conducted by the project

geotechnical engineer and the lateral earth pressures will need to be adjusted accordingly.

Unrestrained Wall:	35 pcf for level backfill
Unrestrained Wall:	48 pcf for 2H:1V backfill

The unrestrained values are applicable only when the walls are designed and constructed as cantilevered walls allowing sufficient wall movement to mobilize “active” pressure conditions. This wall movement should be less than 0.01 H (H = height of wall) for the unrestrained values to be applicable.

Vertical surcharge loads within 1:1 project from the bottom of the wall distributed over retained soils should be considered as additional uniform horizontal pressure acting on the wall. All permanent surcharge loading conditions should be evaluated on a case-by-case basis by NTS.

Seismic Earth Pressure

Given the general seismicity and the fact that the basement walls are retaining more than 6 feet of earth, it is recommended that the unrestrained walls also be designed for seismic earth pressure in addition to the static earth pressures presented above. The seismic earth pressure distribution may be considered to be a triangle with the maximum pressure at the bottom. The total seismic earth pressure may be represented by an equivalent fluid pressure (EFP) of 29 pcf.

Drainage

The backdrain system should consist of 4-inch perforated pipe surrounded by at least one cubic foot of $\frac{3}{4}$ ” – 1.5” open graded gravel wrapped in Mirafi 140N fabric or equivalent. The perforated pipe should consist of SDR-35 or Schedule 40 PVC pipe or approved equivalent laid on at least 2 inch of crushed rock with the perforations laid down. The back drain gradient should not be less than 1 percent. The perforated pipe should outlet into area drains or other suitable outlet points at runs 200 feet or less, if practical. If the back drains cannot be outleted by gravity flow, a sump pump system will need to be designed and constructed. Redundant back-up pumps or components are recommended. Design of the system is outside of the purview of NTS.

Waterproofing

The back side of the retaining walls should be waterproofed prior to placement of subdrains or backfill. Waterproofing is outside of our purview and should be designed by a waterproofing consultant.

Wall Backfill

Backfill behind the wall may consist of onsite material approved by NTS. The backfill should be moisture conditioned to 3 percent above optimum moisture content and compacted to achieve at least 90 percent relative compaction in accordance with ASTM D1557.

Pool Design Criteria

The proposed shell for the swimming pool should be designed for ***low expansive*** soil conditions and be in minimum accordance with Plate 4 – Swimming Pool and Spa Design Criteria.

Pool Bottom

It is expected that the pool bottom will rest entirely on competent native material. Therefore, corrective grading is not required.

Plumbing

Leakage from the pool or from any of the appurtenant plumbing could create adverse saturated conditions of the surrounding subgrade soils. Localized areas of over-saturation can lead to differential settlement or expansion (heave) of the subgrade soils and subsequent raising and shifting of concrete flatwork. Therefore, it is essential that all plumbing fixtures be absolutely leak-free. For similar reasons, drainage from deck areas should be directed to local area drains and/or graded earth swales designed to carry runoff water to the adjacent street.

Future irrigation could result in the development of perched water zones which could affect subsurface improvements. Heavy-duty pipes and flexible couplings should be used for the pool plumbing system to minimize leaking which may produce additional pressures on the pool shell. In addition, installation of a pressure valve in the pool bottom should be used to mitigate any potential buildup of pressure.

Drainage Control

The control of surface water is essential to the satisfactory performance of the building and site improvements. Surface water should be controlled so that conditions of uniform moisture are maintained beneath the improvements, even during periods of heavy rainfall. The following recommendations are considered minimal:

- Ponding and areas of low flow gradients should be avoided.
- If bare soil within 5 feet of the structure is not avoidable, then a gradient of 5 percent or more should be provided sloping away from the improvement.

Corresponding paved surfaces should be provided with a gradient of at least 2 percent.

- The remainder of the unpaved areas should be provided with a drainage gradient of at least 2 percent.
- Positive drainage devices, such as graded swales, paved ditches, and/or catch basins should be employed to accumulate and to convey water to appropriate discharge points.
- Concrete walks and flatwork should not obstruct the free flow of surface water.
- Brick flatwork should be sealed by mortar or be placed over an impermeable membrane.
- Area drains should be recessed below grade to allow free flow of water into the basin.
- Enclosed raised planters should be sealed at the bottom and provided with an ample flow gradient to a drainage device. Recessed planters and landscaped areas should be provided with area inlet and subsurface drain pipes.
- Planters should not be located adjacent to the structures wherever possible. If planters are to be located adjacent to the structures, the planters should be positively sealed, should incorporate a subdrain, and should be provided with free discharge capacity to a drainage device.
- Planting areas at grade should be provided with positive drainage. Wherever possible, the grade of exposed soil areas should be established above adjacent paved grades. Drainage devices and curbing should be provided to prevent runoff from adjacent pavement or walks into planted areas.
- Gutter and downspout systems should be provided to capture discharge from roof areas. The accumulated roof water should be conveyed to off-site disposal areas by a pipe or concrete swale system.
- Landscape watering should be performed judiciously to preclude either soaking or desiccation of soils. The watering should be such that it just sustains plant growth without excessive watering. Sprinkler systems should be checked.

Review, Observation, and Testing

The recommendations presented in this report are contingent upon review of final plans and specifications for the project by NTS. NTS Geotechnical, Inc. should review and verify in writing the compliance of the final grading plan and the final foundation plans with the recommendations presented in this report.

It is recommended that NTS be retained to provide continuous Geotechnical Consulting services during the earthwork operations (i.e., rough grading, subgrade preparation for slabs-on-grade, finish grading, subsurface drainage installation, retaining wall backfill, pool bottom, etc.) and foundation installation process. This

is to observe compliance with the design concepts, specifications and recommendations and to allow for design changes in the event that subsurface conditions differ from those anticipated during our subsurface investigation.

LIMITATIONS

All parties reviewing or utilizing this report should recognize that the findings, conclusions, and recommendations presented represent the results of our professional geological and geotechnical engineering efforts and judgments. Due to the inexact nature of the state of the art of these professions and the possible occurrence of undetected variables in subsurface conditions, we cannot guarantee that the conditions actually encountered during grading and site construction will be identical to those observed, sampled, and interpreted during our study, or that there are no unknown subsurface conditions which could have an adverse effect on the use of the property. We have exercised a degree of care comparable to the standard of practice presently maintained by other professionals in the fields of geotechnical engineering and engineering geology, and believe that our findings present a reasonably representative description of geotechnical conditions and their probable influence on the grading and use of the property.

Our conclusions and recommendations are based on the assumption that our firm will act as the geotechnical engineer of record during construction and grading of the project to observe the actual conditions exposed, to verify our design concepts and the grading contractor's general compliance with the project geotechnical specifications, and to provide our revised conclusions and recommendations should subsurface conditions differ significantly from those used as the basis for our conclusions and recommendations presented in this report. Since our conclusions and recommendations are based on a limited amount of current and previous geotechnical exploration and analysis, all parties should recognize the need for possible revisions to our conclusions and recommendations during grading of the project.

It should be further noted that the recommendations presented herein are intended solely to minimize the effects of post-construction soil movements. Consequently, minor cracking and/or distortion of all on-site improvements should be anticipated.

This report has not been prepared for the use by other parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes.

REFERENCES

California Department of Conservation, California Geological Survey, 2008, Guidelines for Evaluation and Mitigation of Seismic Hazards in California: Special Publication 117A, 98 pp.

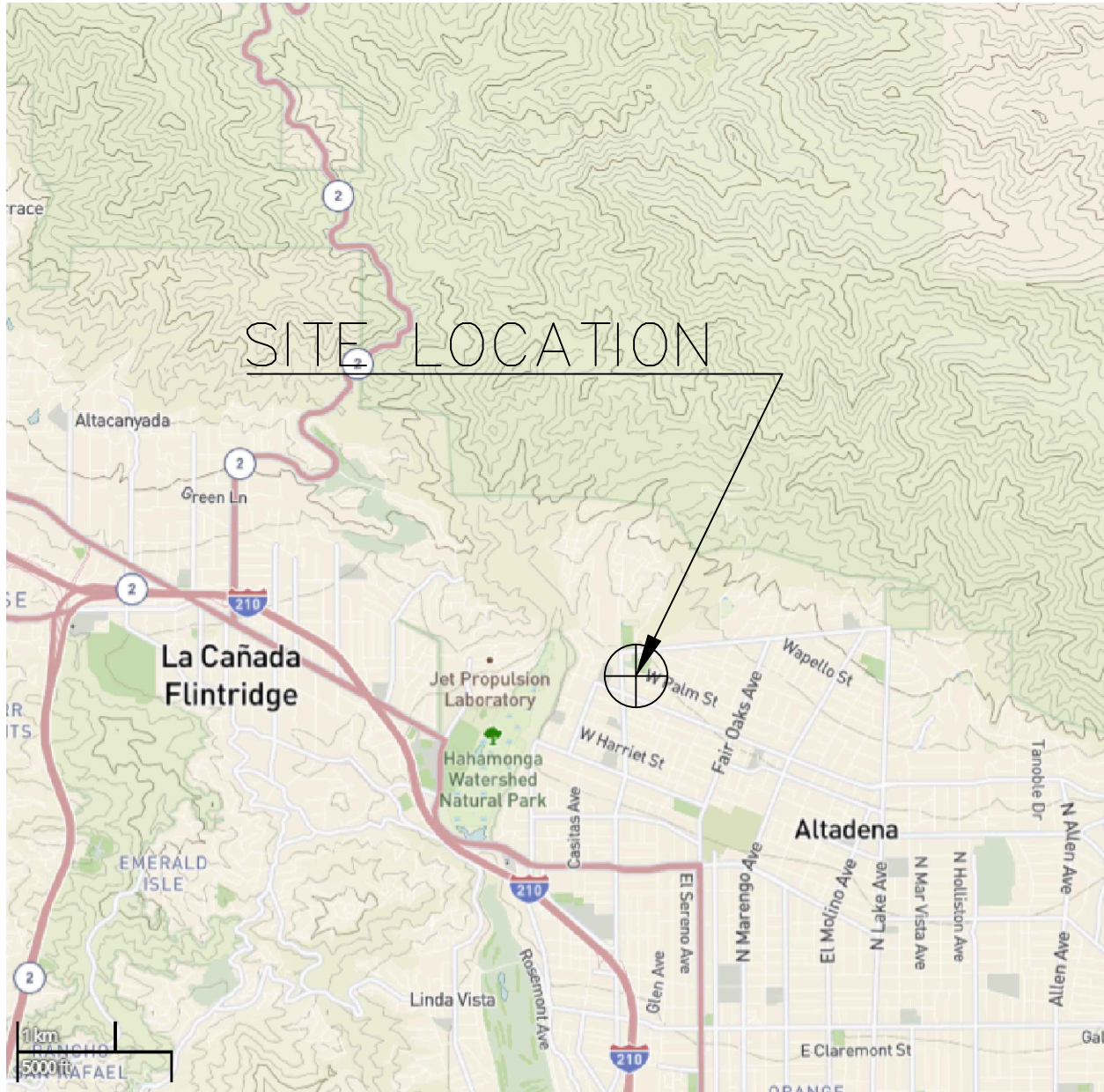
California Department of Conservation, Division of Mines and Geology, 1998, Seismic Hazard Zone Report for the Pasadena 7.5-Minute Quadrangle, Los Angeles County, California: Seismic Hazard Zone Report 014.

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Dibblee, T.W., and Ehrenspeck, H.E., ed., Geologic map of the Pasadena quadrangle, Los Angeles County, California, Dibblee Foundation Map DF-23, dated 1989.

Naval Facilities Engineering Command, 1986, NAVFAC Design Manual.



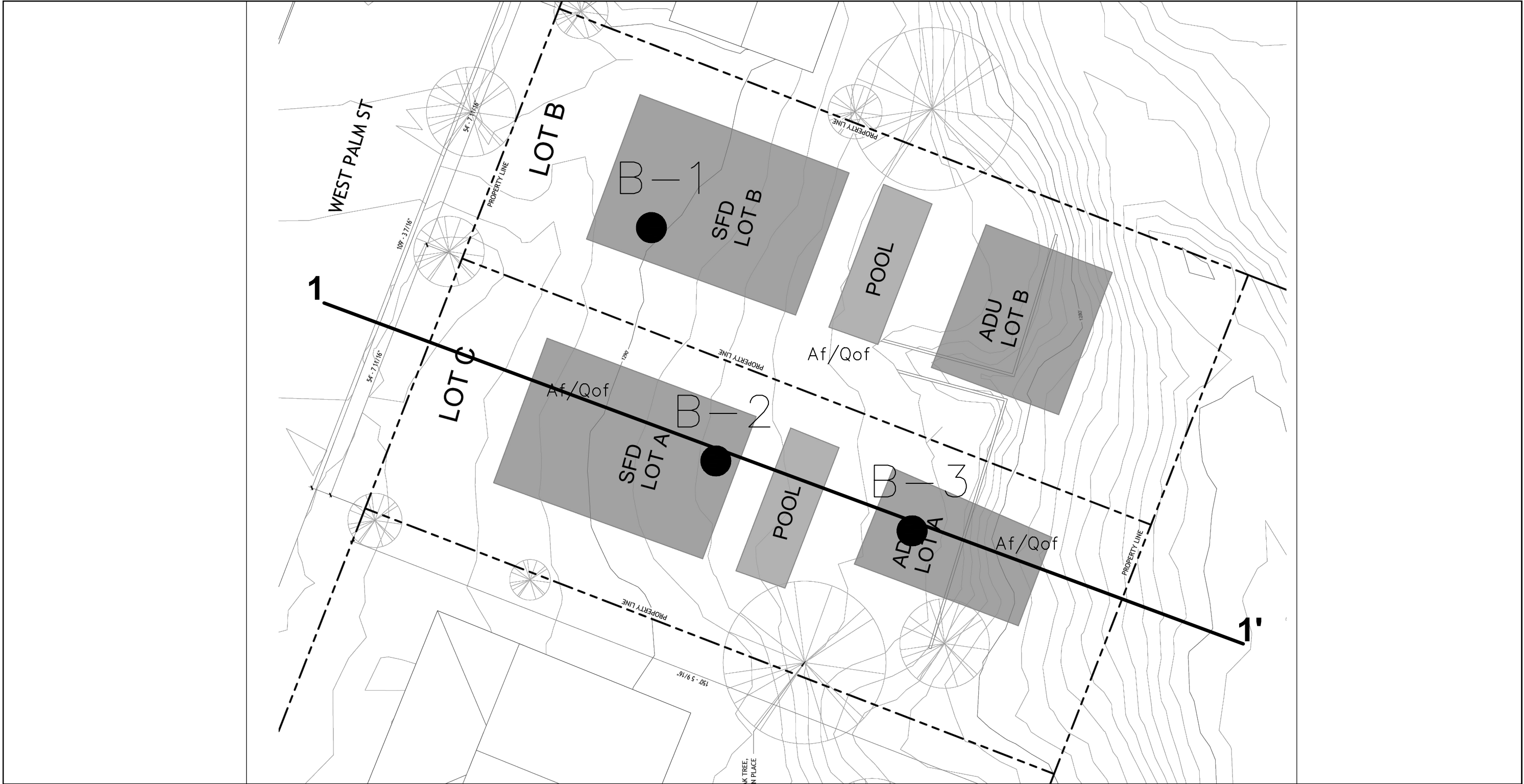
LOCATION MAP

NTS
GEOTECHNICAL

Date: April 2, 2024

Project No.: 24158

Plate
1







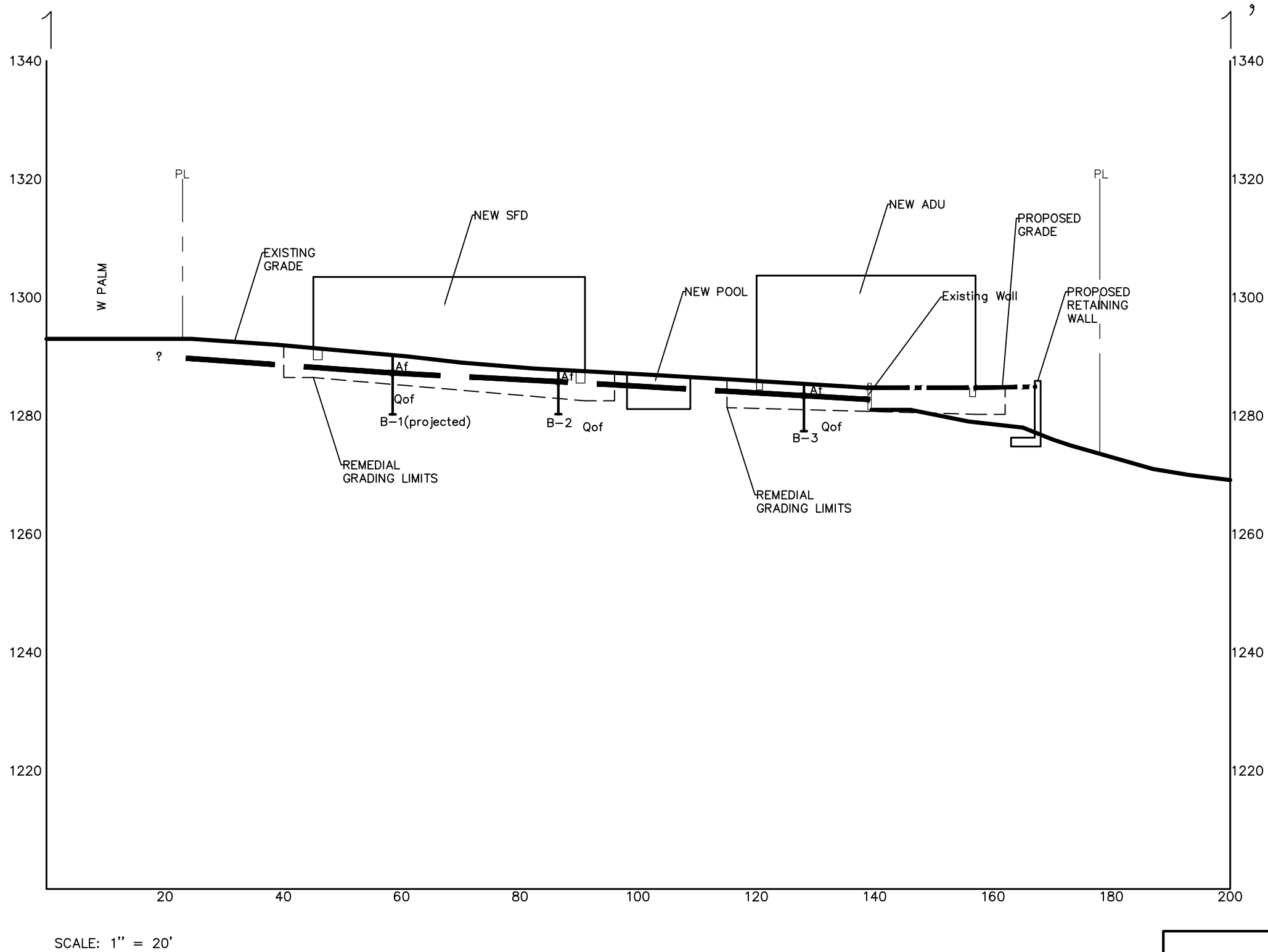

GEOTECHNICAL LEGEND

	APPROXIMATE LOCATION OF BORING		ARTIFICIAL FILL
	GEOTECHNICAL SECTION		ALLUVIUM

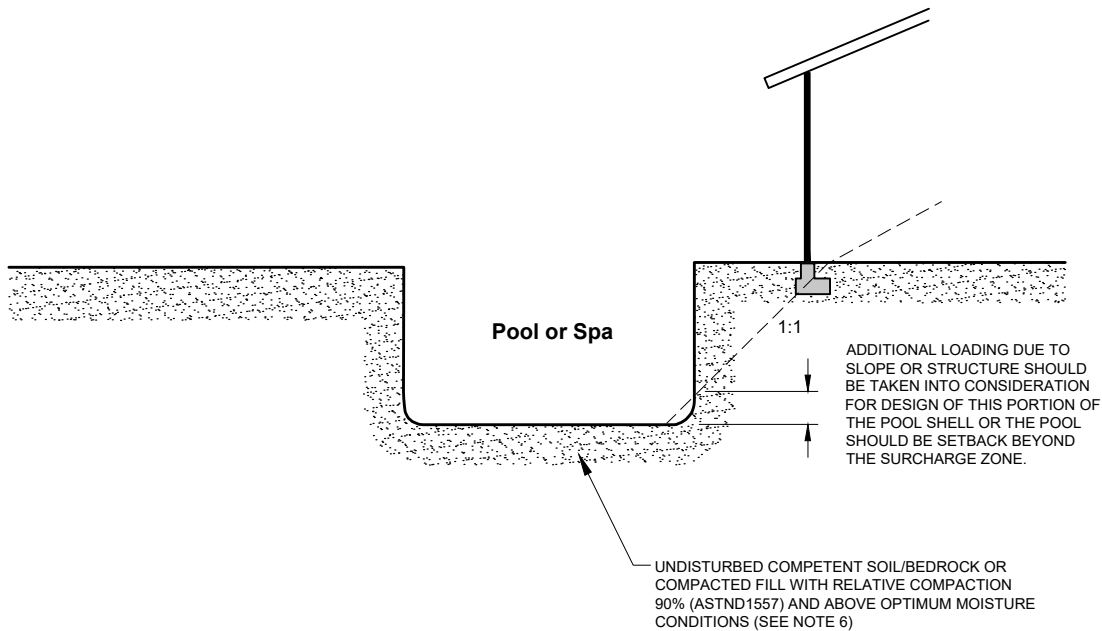
GEOTECHNICAL MAP

Date: 4/2/2024	Project No.: 24158	Plate: 2
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DRAWING: c:\users\info\nts\geotechnical\projects - general\2024\24158 - 566 w palm st - atlodena\reports\plates\plate 3 - geologic section.dwg PLOTTED: 4/2/2024 8:08 PM BY: Nadim Sunna



Geotechnical Section		
	Date:	MARCH 29, 2024
	Project No.:	24158
		Plate 3



1. THE POOL WALLS SHOULD BE DESIGNED TO ACCOUNT FOR THE FOLLOWING SOIL EXPANSION FORCES;
 - VERY LOW EXPANSION – EFP = 40 psf/ft
 - LOW EXPANSION – EFP = 50psf/ft
 - MEDIUM EXPANSION – EFP = 75psf/ft
 - HIGH TO VERY HIGH EXPANSION – EFP = 125psf/ft
 THE ACTUAL EXPANSIVENESS OF SOILS EXPOSED IN POOL EXCAVATION SHOULD BE EVALUATED UPON COMPLETION OF THE EXCAVATION AS POOL SUBGRADE SOILS ARE EXPOSED.
2. WHERE POOLS OR SPAS ARE PLANNED NEAR STRUCTURES, APPROPRIATE SURCHARGE LOADS SHOULD BE INCORPORATED INTO THE DESIGN AND CONSTRUCTION.
3. IN ORDER TO PROVIDE UNIFORM CONDITIONS, THE BOTTOM OF THE POOL EXCAVATION MAY NEED TO BE OVER-EXCAVATED AND REPLACED TO POOL SUBGRADE WITH COMPACTED FILL. AS AN ALTERNATIVE, THE REINFORCING STEEL IN THE AREA OF A TRANSITION AREA MAY BE INCREASED TO ACCOUNT FOR THE DIFFERENCES IN ENGINEERING PROPERTIES AND THE POTENTIAL DIFFERENTIAL BEHAVIOR.
4. WHEREAS POOL EXCAVATION MAY BE FREE OF WATER AT A TIME OF CONSTRUCTION, FUTURE IRRIGATION COULD RESULT IN THE DEVELOPMENT OF PERCHED WATER ZONES WHICH COULD AFFECT SUBSURFACE IMPROVEMENTS. HEAVY-DUTY PIPES AND FLEXIBLE COUPLINGS SHOULD BE USED FOR THE POOL PLUMBING SYSTEM TO MINIMIZE LEAKING WHICH MAY PRODUCE ADDITIONAL PRESSURES ON THE POOL SHELL. IN ADDITION, INSTALLATION OF A PRESSURE VALVE IN THE POOL BOTTOM SHOULD BE USED TO MITIGATE POTENTIAL BUILD-UP OF PRESSURE.
5. IN GENERAL, ALL BELOW GRADE IMPROVEMENTS MUST BE CONSTRUCTED BY QUALIFIED PROFESSIONALS UTILIZING APPROPRIATE DESIGNS WHICH ACCOUNT FOR THE ON-SITE (LOT) GEOTECHNICAL CONDITIONS. OBSERVATION/TESTING SHOULD BE PERFORMED BY NTS DURING POOL/SPA EXCAVATION TO VERIFY EXPOSED SOIL CONDITIONS ARE CONSISTENT WITH THE ASSUMED DESIGN CONDITIONS.
6. FOR HIGHLY/SEVERELY CORROSIVE SOILS, CEMENT SHALL BE TYPE V AND CONCRETE SHALL HAVE A MINIMUM WATER TO CEMENT RATIO OF 0.45 AND MINIMUM COMPRESSIVE STRENGTH OF 4,500 PSI. FOR MODERATELY CORROSIVE SOILS, CEMENT SHALL BE TYPE II/V, AND CONCRETE SHALL HAVE A MINIMUM WATER TO CEMENT RATIO OF 0.50 AND MINIMUM COMPRESSIVE STRENGTH OF 4,000 PSI. SPECIAL RECOMMENDATIONS MAY BE REQUIRED FOR VERY SEVERE LEVELS OF SULFATES. FINAL CONCRETE MIX DESIGN IS OUTSIDE OUR PURVIEW.

APPENDIX A

Field Exploration

Appendix A

Field Exploration

The subsurface exploration program for the proposed project consisted of advancing three (3) 4-inch-diameter hand tool borings. The borings were advanced to depths ranging from 7.5 to 10 feet below the existing grade.

The Boring Logs are presented as Figures A-2 to A-4. The Boring Logs describe the earth materials encountered, samples obtained, and show the field and laboratory tests performed. The log also shows the boring number, drilling date, and the name of the logger and drilling subcontractor. The borings were logged by an engineer using the Unified Soil Classification System. The boundaries between soil types shown on the logs are approximate because the transition between different soil layers may be gradual. Drive samples of representative earth materials were obtained from the borings.

A California modified sampler was used to obtain drive samples of the soil encountered. This sampler consists of a 3-inch outside diameter (O.D.), 2.4-inch inside diameter (I.D.) split barrel shaft that was driven a total of 6-inches into the soil at the bottom of the boring by a safety hammer. The soil was retained in brass rings for laboratory testing. Additional soil from each drive remaining in the cutting shoe was usually discarded after visually classifying the soil.

Upon completion of the borings, the borings were backfilled with soil from the cuttings.

Project: **566 W Palm St**
 Project Location: **566 W Palm St,
 Altadena**
 Project Number: **24158**



Key to Log of Boring Sheet 1 of 1

Depth (feet)	Sample Type	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

COLUMN DESCRIPTIONS

- | | |
|--|---|
| <p>1 Depth (feet): Depth in feet below the ground surface.</p> <p>2 Sample Type: Type of soil sample collected at the depth interval shown.</p> <p>3 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>4 Material Type: Type of material encountered.</p> <p>5 Graphic Log: Graphic depiction of the subsurface material encountered.</p> | <p>6 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.</p> <p>7 Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.</p> <p>8 Dry Unit Weight, pcf: Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.</p> <p>9 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



Poorly graded SAND with Silt (SP-SM)

TYPICAL SAMPLER GRAPHIC SYMBOLS

	Auger sampler		CME Sampler
	Bulk Sample		Grab Sample
	3-inch-OD California w/ brass rings		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, AW)
	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 A-1

Project: 566 W Palm St Project Location: 566 W Palm St, Altadena Project Number: 24158		Log of Boring B-1 Sheet 1 of 1
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Date(s) Drilled 3/8/2024	Logged By ERL	Checked By NS
Drilling Method Hand Tools	Drill Bit Size/Type 4"	Total Depth of Borehole 10 feet
Drill Rig Type Hand Tools	Drilling Contractor Juan Garcia	Approximate Surface Elevation N/A
Groundwater Level and Date Measured Not Encountered	Sampling Method(s) Modified California	Hammer Data N/A
Borehole Backfill Native	Location 566 W Palm St, Altadena	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SP-SM		ARTIFICIAL FILL (Af): SAND to SILTY SAND, dark brown, fine to coarse-grained sand, abundance of cobbles, some debris, some organics, moist, medium dense	13	100	
5			SP-SM		ALLUVIUM (Qof): SAND to SILTY SAND, brown to tan, fine to coarse-grained sand, some gravel, medium dense	7	118	
			SP-SM		moist, dense			
			SP-SM		abundance of cobbles			
10			SP-SM		moist	9	116	
					Total Depth = 10 feet Groundwater not encountered Backfilled with native			
15								
20								
25								
30								

Figure A-2

Project: 566 W Palm St Project Location: 566 W Palm St, Altadena Project Number: 24158		Log of Boring B-2 Sheet 1 of 1
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Date(s) Drilled 3/8/2024	Logged By ERL	Checked By NS
Drilling Method Hand Tools	Drill Bit Size/Type 4"	Total Depth of Borehole 7.5 feet
Drill Rig Type Hand Tools	Drilling Contractor Juan Garcia	Approximate Surface Elevation N/A
Groundwater Level and Date Measured Not Encountered	Sampling Method(s) Modified California	Hammer Data N/A
Borehole Backfill Native	Location 566 W Palm St, Altadena	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SP-SM		ARTIFICIAL FILL (Af): SAND to SILTY SAND, dark brown, fine to coarse-grained sand, abundance of cobbles, some debris, some organics, medium dense	12	99	
5			SP-SM		ALLUVIUM (Qof): SAND to SILTY SAND, brown to tan, fine to coarse-grained sand, some gravel, moist, medium dense	10	103	
			SP-SM		moist			
			SP-SM		abundance of cobbles			
			SP-SM		Refusal at 7.5 feet			
10					Total Depth = 7.5 feet Groundwater not encountered Backfilled with native			
15								
20								
25								
30								

Figure A-3

Project: 566 W Palm St Project Location: 566 W Palm St, Altadena Project Number: 24158		Log of Boring B-3 Sheet 1 of 1
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Date(s) Drilled 3/8/2024	Logged By ERL	Checked By NS
Drilling Method Hand Tools	Drill Bit Size/Type 4"	Total Depth of Borehole 8 feet
Drill Rig Type Hand Tools	Drilling Contractor Juan Garcia	Approximate Surface Elevation N/A
Groundwater Level and Date Measured Not Encountered	Sampling Method(s) Modified California	Hammer Data N/A
Borehole Backfill Native	Location 566 W Palm St, Altadena	

Depth (feet)	Sample Type	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, pcf	REMARKS AND OTHER TESTS
0			SP-SM		ARTIFICIAL FILL (Af): SAND to SILTY SAND, dark brown, fine to coarse-grained sand, abundance of cobbles, some debris, some organics, medium dense	18	102	
5			SP-SM		ALLUVIUM (Qof): SAND to SILTY SAND, brown to tan, fine to coarse-grained sand, some gravel, very moist, medium dense	10	106	
			SP-SM		moist			
			SP-SM		abundance of cobbles			
			SP-SM		Refusal at 8 feet Total Depth = 8 feet Groundwater not encountered Backfilled with native			
10								
15								
20								
25								
30								

Figure A-4

APPENDIX B

Laboratory Testing Data



Advanced Materials Testing, LLC

March 19, 2024

Project 24158

Mr. Nadim Sunna
NTS Geotechnical, Inc.
15333 Culver Drive, Suite 340
Irvine, California 92604

Subject:

RESULTS OF LABORATORY TESTING

566 W. Palm Street
Altadena, California

Mr. Sunna:

Pursuant to your request, this is a letter to certify that Advanced Materials Testing, LLC has performed laboratory soil tests for the subject project under the supervision of the undersigned engineer. Services performed by this facility were conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other warranties are expressed nor implied. Interpretation of the laboratory test results and applications of the results on the design and construction of the project are beyond the scope of our services.

Moisture and Density Tests

The dry unit weight and moisture content of the undisturbed samples were determined. The results are tabulated in the Laboratory Recapitulation - Table 1.

Shear Tests

Direct single-shear tests were performed with a direct shear machine. The desired normal load is applied to the specimen and allowed to come to equilibrium. The rate of deflection on the sample is approximately 0.005 inches per minute. The samples are tested at higher and/or lower normal loads in order to determine the angle of internal friction and the cohesion. The results are plotted on the Shear Test Diagrams and the results tabulated in the Laboratory Recapitulation - Table 1. The samples were observed prior to and after shearing to ensure the particle size of the sample did not exceed 10% of the diameter of the test specimen in accordance with ASTM standards. Although the soil was described to include gravels they were not included within the samples tested, therefore, the results provide a conservative estimate of the shear strength of the soil.

Consolidation

Consolidation tests were performed on samples, within the brass ring, to predict the soils behavior under a specific load. Porous stones are placed in contact with top and bottom of the samples to permit to allow the addition or release of water. Loads are applied in several increments and the results are recorded at selected time intervals. Samples are tested at field and increased moisture content. The results are plotted on the Consolidation Test Curve and the load at which the water is added as noted on the drawing.

pH (CTM 643)

A sample of dry soil and distilled water are placed in a flask and allowed to stand for approximately an hour to stabilize. The pH is measured using a pH meter that has been compensated for temperature. The results are tabulated in the Laboratory Recapitulation - Table 2.

Minimum Resistivity (CTM 643)

The electrical resistivity of each soil specimen is conducted in a two-stage process using the soil box method. The first stage measures the resistivity of the soil in its as-received condition and the second stage records the value after saturation with distilled water. The results are tabulated in the Laboratory Recapitulation - Table 2.

Chloride Content (CTM 422)

A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot of the sample is mixed with chloride indicator and titrated over silver nitrate solution. The chloride content is determined by the difference of the volumes required to complete titration. The results are tabulated in the Laboratory Recapitulation - Table 2.

Sulfate Content (CTM 417)

A sample of dry soil is mixed with distilled water and allowed to stand overnight. The top aliquot is mixed with distilled water and a conditioning agent. The solution is then placed in a photometer and the value recorded. The process is repeated with the addition of barium chloride. The sulfate content is determined by the difference of the photometer readings. The results are tabulated in the Laboratory Recapitulation - Table 2.

Should you have any questions regarding these laboratory test results, please do not hesitate to contact the undersigned at your convenience.

Respectfully submitted,
Advanced Materials Testing, LLC



Raymond Haddad
President
RMH-1

Attachments: Laboratory Test Results

PROJECT NO.: 24158

PROJECT ADDRESS: 566 W. Palm Street

LABORATORY RECAPITULATION 1

Explorations	Depth (ft)	Material	Dry Density (p.c.f.)	Moisture Content (%)
B-1	2.0	Af	100	13
	5.0	Qoa	118	7
	10.0	Qoa	116	9
B-2	2.0	Qoa	99	12
	5.0	Qoa	103	10
B-3	2.0	Qoa	102	18
	5.0	Qoa	106	10

LABORATORY RECAPITULATION 2

Explorations	Depth (ft)	pH	As-Is Soil Resistivity (ohm-cm)	Minimum Soil Resistivity (ohm-cm)	Chloride (ppm)	Sulfate (ppm)
B-3	2.0	7.31	35,000	11,000	50	70

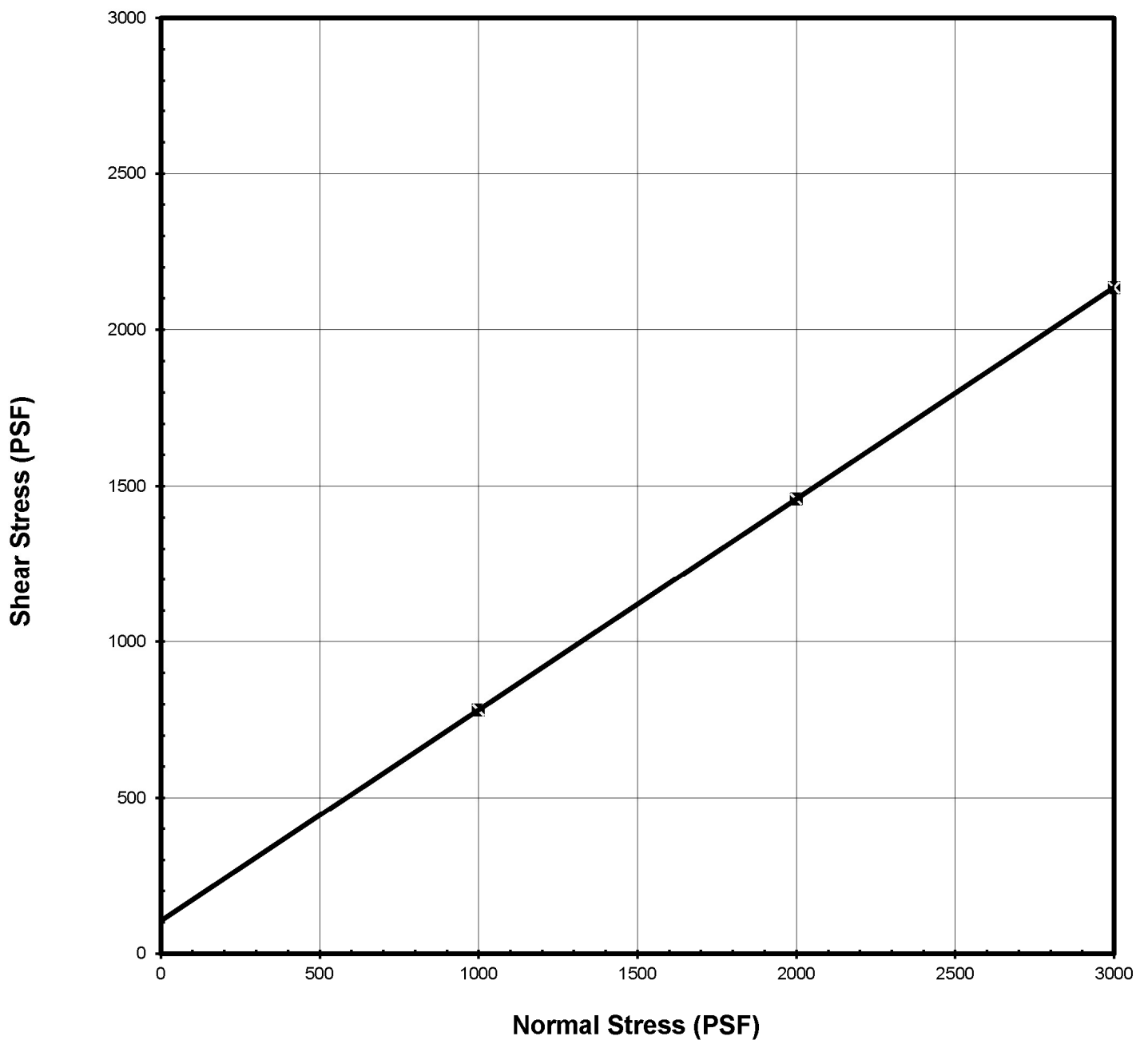
Direct Shear Test Diagram (D-3080)

PLATE: S-1

P.N. 24158

Sample Description	Sample Identification	Test Type	Sample Test State	Number of Passes
Qoa	B-1 @ 5.0'	Ultimate	Saturated	1

Soil Dry Density (PCF)	118	Shear Strength Values:	
Soil Moisture Content (%)	15	Phi (Degrees)	34.1
Soil Saturation (%)	99	Cohesion (PSF)	105.0



Consolidation Pressure Curve (D-2435)

Sample Identification	Sample Description
B-2 @ 5.0'	Qoa

PLATE: C-1 P.N. 24158

