Appendix D-1

# Geotechnical Investigation Report, General Pump Expansion Yard, Southwest Corner of I Avenue and Hercules Street, Hesperia, California 92345

TGR Geotechnical, Inc

May 10, 2024

Geotechnical
Environmental
Hydrogeology
Material Testing
Construction Inspection

May 10, 2024 Project No. 24-7867

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14467 Park Ave.
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Subject: Geotechnical Investigation Report, General Pump Expansion Yard, Southwest Corner of I Avenue and Hercules Street, Hesperia, California 92345.

Robert,

In accordance with your request and authorization, TGR Geotechnical, Inc. (TGR) has completed our geotechnical investigation for the proposed new pump yard in Hesperia, California. This report presents the findings of our geotechnical investigation, including site seismicity and provides geotechnical design recommendations for the proposed development. The work was performed in general accordance with our proposal dated December 26, 2023.

Based on our investigation the proposed development is feasible from a geotechnical viewpoint provided the recommendations presented in this report are implemented during design and construction.

If you have any questions regarding this report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Respectfully submitted,

***TGR GEOTECHNICAL, INC.***

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**ATTACHMENTS**

Figure 1 – Site Location Map
Figure 2 – Boring Location Map
Figure 3 – Regional Geology Map
Figure 4 – Regional Fault Map
Figure 5 – Seismic Hazard Zone Map

Table 1 – Percolation Test Worksheet

Appendix A – References
Appendix B – Log of Borings
Appendix C – Laboratory Test Results
Appendix D – Site Seismic Design Parameters
Appendix E – Standard Grading Guidelines

## INTRODUCTION

### Site Description and Proposed Project Development

The subject site is located on the southwest corner of I avenue and Hercules Street (Figure 1) in the city of Hesperia, California. It is our understanding that the existing property consists of a vacant, undeveloped 4.53-acre parcel of land. It is also our understanding that the proposed development consists of a truck yard, metal machine building shop for the maintenance of pumps, pipes and casings with the capability for crane installations and office building.

### Scope of Work

The scope of work for this geotechnical investigation included the following:

- Site reconnaissance to assess current site conditions, mark boring locations and call Dig-Alert.
- Sampling and logging nine (9) hollow stem auger borings utilizing a hollow stem drill rig to approximate depths ranging from 10 to 15 feet below existing grade at the subject site to evaluate subsurface soil conditions. All borings encountered refusal in hard material or gravel. The borings were backfilled with soil cuttings and any excess soil was disposed onsite.
- Percolation testing in the upper 5 feet at two (2) locations. The testing was conducted in accordance with the San Bernardino County guidelines. The borings were backfilled with soil cuttings and any excess soil was disposed onsite.
- Laboratory testing of selected samples for in-situ moisture and dry density, maximum dry density and optimum moisture content, shear, passing No. 200 sieve, corrosion series and R-value.
- Engineering analysis, including site seismicity, foundation and slab-on grade design, earthworks recommendations, settlement potential and infiltration rates.
- Preparation of this report summarizing current subsurface soil conditions, findings, and presenting our recommendations for the proposed improvements.

### Field Investigation

Field exploration was performed on March 8, 2024 by members from our firm who performed percolation testing, logged the borings and obtained representative samples, which were subsequently transported to the laboratory for further review and testing. The approximate locations of the borings are indicated on the enclosed Boring Location Map (Figure 2).

The subsurface conditions were explored by drilling, sampling, and logging nine (9) borings with a truck mounted hollow stem drill rig to depths ranging from approximately 10 to 15 feet below existing grade. All borings were terminated early due to encountering refusal in hard material or gravel. Two (2) additional borings, P-1 and P-2, were advanced to five (5) feet and utilized for percolation testing. The logs of borings presenting soil conditions and descriptions are presented in Appendix B.

The drill rig was equipped with a sampling apparatus to allow for recovery of driven modified California Ring Sampler (CRS), 3-inch outside diameter, and 2.42-inch inside diameter and SPT samples. Driven samples and bulk samples of the earth materials encountered at selected intervals were recovered from the borings.

The samples were driven using an automatic 140-pound hammer falling freely from a height of 30 inches. The blow counts for CRS were converted to equivalent SPT blow counts. Soil descriptions were entered on the logs in general accordance with the Unified Soil Classification System (USCS). The locations and depths of the soil samples recovered are indicated on the logs in Appendix B.

Percolation Testing Procedures and Results

Field percolation testing was performed in general accordance with the with the San Bernardino Technical Guidance WQMP for sandy soils.

Borings P-1 and P-2 were converted to field percolation test wells by placing approximately two inches of gravel at the bottom of the borehole, installation of two-inch diameter PVC pipes and placement of gravel in the annulus between the borehole and the PVC pipe to hold it securely in place. The borings were presoaked for 1 hour prior to percolation testing. Infiltration test rates were determined utilizing the referenced County of San Bernardino guidelines. A gravel factor of 0.54 was used in the calculations to account for the volume of water reduction from the gravel in the annular space of the boring. Results of the infiltration testing are presented in Table 1 - Percolation Test Worksheet and in the table below:

| Test Location | Test Depth (feet) | Infiltration Rate (Inches/hour) |
|---|---|---|
| P-1 | 0 - 5 | 0.60 |
| P-2 | 0 - 5 | 2.01 |

Suitability Assessment Safety Factor

Factor values (v), for Factor Category A, were assigned according to the San Bernardino Technical Guidance Document for WQMP, VII.4.

Table 3 (below) presents assigned factor values and the calculated Suitability Assessment Safety Factor (Σp) in Worksheet H from the San Bernardino Technical Guidance Document for WQMP Appendix VII.

| Factor Category | | Factor Description | Assigned Weight (w) | Factor Value (v) | Product (p) p = w * v |
|---|---|---|---|---|---|
| A | Suitability Assessment | Soil assessment methods | 0.25 | 2 | 0.5 |
| | | Predominant soil texture | 0.25 | 1 | 0.25 |
| | | Site soil variability | 0.25 | 1 | 0.25 |
| | | Depth to groundwater / impervious layer | 0.25 | 1 | 0.25 |
| | | Suitability Assessment Safety Factor, $S_A$ = Σp | | | 1.25 |

The above values should be used in conjunction with Factor Category B parameters (to be determined by others) as specified in Worksheet H of the San Bernardino Technical Guidance Document for WQMP Appendix VII.

Laboratory Testing

Laboratory tests were performed on representative samples to verify the field classification of the recovered samples and to evaluate the geotechnical properties of the subsurface soils. The following tests were performed:

- In-situ Moisture Content (ASTM D2216) and Dry Density (ASTM D7263);
- Maximum Dry Density and Optimum Moisture Content (ASTM D1557);
- Direct Shear Strength (ASTM D3080);
- Passing No. 200 Sieve (ASTM 1140);
- R-value (CAL 301); and
- Corrosion series:
    1. Soluble Sulfate (CAL.417A);
    2. Soluble Chlorides (CAL.422);
    3. Minimum Resistivity (CAL.643); and
    4. pH (CAL 747)

Laboratory tests for geotechnical characteristics were performed in general accordance with the ASTM procedures. The results of the in-situ moisture content and density tests are shown on the borings logs in Appendix B. The results of other laboratory tests are presented in Appendix C.

## GEOTECHNICAL FINDINGS

### Geology

#### Regional Geologic Setting

The project site is located in the northeast portion of the Hesperia 15-minute Quadrangle, California. Per the Geologic Map of the 15-minute Hesperia quadrangle, San Bernardino County, California (Dibblee, 2003), the subject site is underlain by Quaternary older alluvium (Qoa). Figure 3 presents the Regional Geology Map.

#### Earth Units

Based on our subsurface investigation, the subject area is underlain by approximately 2 to 5 feet of very fine to fine grained brown silty sand in a moist condition in the vicinity of Borings B-2, B-3 and B-5. The silty sand is underlain by fine to coarse grained orange brown clayey sand with varying amounts of gravel and cobbles to approximately 15 feet below existing grade, the maximum depth explored. The clayey sand is interbedded with layers of sand, gravel and cobbles. Detailed descriptions of the earth units encountered are presented in the Boring Logs in Appendix B.

#### Groundwater

Subsurface water was not encountered to a depth of approximately 15 feet below existing grade during the subsurface exploration.

USGS groundwater data from wells nearest to the subject site indicate a groundwater high of approximately 300 feet below existing grade (USGS 342608117171201 004N004W15F001S). The groundwater well is located approximately 0.2 miles to the northwest of the subject site.

Seasonal and long-term fluctuations in the groundwater may occur as a result of variations in subsurface conditions, rainfall, run-off conditions and other factors. Therefore, variations from our observations may occur. Static groundwater is not anticipated to impact the proposed development.

Static groundwater is not anticipated to impact the proposed development.

#### Expansive Soil

Onsite soils are granular in nature, which correlates to a “very low to low” expansion potential.

### Seismic Review

#### Faulting and Seismicity

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. The principal source of seismic activity is movement along the northwest-trending regional faults such as the San Andreas, San Jacinto and Elsinore fault zones. These fault systems produce approximately 5 to 35 millimeters per year of slip between the plates.

We consider the most significant geologic hazard to be the potential for moderate to strong seismic shaking that is likely to occur at the subject site. The subject site is located in the highly

seismic Southern California region within the influence of several faults that are considered to be Holocene-active, pre-Holocene or age-undetermined faults. A Holocene-active fault is defined by the State of California as a fault that has exhibited surface displacement within the Holocene time (about the last 11,700 years). A pre-Holocene fault is defined by the State as a fault whose history of past movement is older than 11,700 years ago and does not meet the criteria for a Holocene-active fault. An age-undetermined fault is defined by the State as a fault where the recency of fault movement has not been determined.

These Holocene-active, pre-Holocene and age-undetermined faults are capable of producing potentially damaging seismic shaking at the site. It is anticipated that the subject site will periodically experience ground acceleration as the result of small to moderate magnitude earthquakes. Other Holocene-active, pre-Holocene and age-undetermined faults without surface expression (blind faults) that are not currently zoned and may be capable of generating an earthquake are known to be present in the region.

Based on a review of the San Bernardino County Land Use Plan, Geologic Hazard Overlay Map EHFHC, the subject site is not located within a fault hazard zone (Figure 5). Our review of geologic literature pertaining to the site area indicates that there are no Holocene-active, pre-Holocene or age-undetermined faults located within or immediately adjacent to the subject property.

The nearest fault to the subject site is the Ord Mountains fault zone mapped approximately 4.9 miles southeast of the site. Other faults nearby include the North Frontal thrust system mapped approximately 5.4 miles east of the site, the Cleghorn fault zone mapped approximately 7.6 miles south of the site, the Bowen Ranch fault mapped approximately 8.3 miles southeast of the site and the Tunnel Ridge fault mapped approximately 8.6 miles southeast of the site. The regional fault map shows the location of the subject site in respect to the regional faults (Figure 4).

## Secondary Seismic Hazards

### Surface Fault Rupture and Ground Shaking

Since no known faults are located within the site, surface fault rupture is not anticipated. However, due to the close proximity of known active and potentially active faults, severe ground shaking should be expected during the life of the proposed structures.

### Liquefaction

Liquefaction is a seismic phenomenon in which loose, saturated, fine-grained granular soils behave similarly to a fluid when subjected to high-intensity ground shaking. Liquefaction occurs when these ground conditions exist: 1) Shallow groundwater; 2) Low density, fine, clean sandy soils; and 3) High-intensity ground motion. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below foundations.

A review of the San Bernardino County Land Use Plan, Geologic Hazard Overlay Map EHFHC (Figure 5) indicates the subject site is not located in a liquefaction hazard zone.

Based on the above, absence of shallow groundwater and relatively dense nature of site soils, it is our opinion that the potential for liquefaction is negligible.

Seismically Induced Settlement

Ground accelerations generated from a seismic event can produce settlements in sands or in granular earth materials both above and below the groundwater table. This phenomenon is often referred to as seismic settlement and is most common in relatively clean, loose sands, although it can also occur in other soil materials. The potential for seismic settlement is considered to be low due to the relatively high SPT blow counts recorded during drilling (medium dense to very dense subsurface soils).

Lateral Spreading

Seismically induced lateral spreading involves primarily movement of earth materials due to earth shaking. Lateral spreading is demonstrated by near-vertical cracks with predominantly horizontal movement of the soil mass involved. The topography in the vicinity of the subject site is relatively flat. Therefore, the potential for lateral spreading at the subject site is considered very low.

Earthquake Induced Landsliding

Earthquake induced landsliding involves downhill motion of earth materials during or subsequent to earth shaking. Historically, landslides triggered by earthquakes have been a significant cause of damage. Areas that are most susceptible to earthquake induced landslides are areas with steep slopes in poorly cemented or highly fractured bedrock, areas underlain by loose, weak soils, and areas on or adjacent to existing landslide deposits.

The subject site is not located within a landslide hazard zone and adjacent areas are situated on relatively flat topography. Based on the above, the potential for earthquake induced landsliding is considered negligible.

Subsidence

Moderate soil settlement associated with wetting of the site soil is anticipated. However, the potential for damage to the proposed buildings as a result of subsidence is considered very low provided the grading and recommendations presented in this report are implemented during design and construction of the proposed improvements.

## DISCUSSIONS AND CONCLUSIONS

### General

Based on our review of previous investigations, field exploration, laboratory testing and engineering analysis, it is our opinion that the proposed structure and proposed grading will be safe against hazard from landslide, settlement, or slippage and the proposed construction will have no adverse effect on the geologic stability of the adjacent properties provided our recommendations presented in this report are followed.

### Conclusions

Based on our findings and analyses, the subject site is likely to be subjected to moderate to severe ground shaking due to the proximity of known active and potentially active faults. This may reasonably be expected during the life of the structure and should be designed accordingly.

The engineering evaluation performed concerning site preparation and the recommendations presented are based on information provided to us and obtained by us during our office and fieldwork. This report is prepared for the development of the proposed street improvements and 4,800 square foot lightly loaded service building with associated onsite parking and landscaping at the subject site. In the event that any significant changes are made to the proposed development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the recommendations of this report are verified or modified in writing by TGR.

## RECOMMENDATIONS

Seismic Design Parameters

When reviewing the 2022 CBC the following parameters should be incorporated into the design. The Site Class is based on site soil conditions per Section 11.4.3 of the ASCE 7-16. It is our opinion Site Class D – Stiff Soil is the most appropriate based on-site soil conditions.

| Parameter | Value |
|---|---|
| Latitude (degree) | 34.4296 |
| Longitude (degree) | -117.2820 |
| Site Class (CBC Section 1613.2.2) | D – Stiff |
| Site Coefficient, $F_a$ (CBC Table 1613.2.3 (1)) | 1.0 |
| Site Coefficient, $F_v$ (CBC Table 1613.2.3 (2)) | 1.780 |
| Mapped Spectral Acceleration at 0.2-sec, $S_s$ (CBC Section 1613.2.1) | 1.352 g |
| Mapped Spectral Acceleration at 1.0-sec, $S_1$ (CBC Section 1613.2.1) | 0.520 g |
| Spectral Acceleration at 0.2-sec Adjusted for Site Class, $S_{MS}$ (CBC Section 1613.2.3) | 1.352 g |
| Spectral Acceleration at 1.0-sec Adjusted for Site Class, $S_{M1}$ (CBC Section 1613.2.3) | 0.926 g |
| Design Spectral Acceleration at 0.2-sec, $S_{DS}$ (CBC Section 1613.2.4) | 0.901 g |
| Design Spectral Acceleration at 1.0-sec, $S_{D1}$ (CBC Section 1613.2.4) | 0.617 g |
| Seismic Response Coefficient ($C_s$) ASCE 7-16 | Per 12.8-6 |
| Mapped $MCE_G$, Peak Ground Acceleration, PGA | 0.568 g |
| Site Coefficient for Mapped $MCE_G$, $F_{PGA}$ | 1.1 |
| Site Modified Peak Ground Acceleration, $PGA_M$ | 0.625 g |

* Based on Equivalent Lateral Force Design Procedure Being Used.

In general, ASCE 7-16 Section 11.4.8 requires site-specific hazard analysis for structures on Site Class D for values of $S_1$ greater than or equal to 0.2 g. When using Equivalent lateral Force (ELF) and Modal Response Spectrum Analysis (MRSA), the ASCE 7-16 Section 11.4.8 Item 1 exception shall be utilized. Increasing $S_{M1}$ by 50% in Eq. (11.4-2) results in an increase in the value of $S_{D1}$ determined by Eq. (11.4-4) by 50%. These increased values of $S_{M1}$ and $S_{D1}$ are to be used for all applications of these parameters throughout the Standard, including for the formulation of the design response spectrum where a design response spectrum is needed per this standard. It should be noted that the 50% increase in $S_{D1}$ also increases *Ts* by 50% resulting in an extension of the acceleration-controlled plateau of the design response spectrum. *Cs* is determined in accordance with Eq. (12.8-6).

The structural consultant should review the above parameters and the 2022 California Building Code to evaluate the seismic design.

Conformance to the criteria presented in the above table for seismic design does not constitute any type of guarantee or assurance that significant structural damage or ground failure will not

occur during a large earthquake event. The intent of the code is “life safety” and not to completely prevent damage of the structure, since such design may be economically prohibitive.

Foundation Design Recommendations

The proposed maintenance yard building may be supported on continuous and/or spread footings. Bearing capacity recommendations for shallow foundations are presented below. These recommendations assume that the footings will be supported on a minimum of three (3) feet of engineered fill.

For foundations supported on three (3) feet of engineered fill with minimum ninety (90) percent relative compaction, an allowable bearing pressure of 2,500 pounds per square foot may be used in design for a minimum embedment depth of twenty-four (24) inches.

The building foundations should extend a minimum of twenty-four (24) inches below the lowest adjacent grade. The minimum recommended footing width is eighteen (18) inches for continuous footing and twenty-four (24) inches for pad footing. A minimum reinforcement of two (2) No. 4 steel bar top and two (2) No. 4 steel bar bottom is required for continuous footings from a geotechnical viewpoint. Foundation design details such as concrete strength, reinforcements, etc. should be established by the Structural Engineer.

A one-third (1/3) increase on the aforementioned bearing pressure may be used in design for short-term wind or seismic loads.

The total and differential static settlement is anticipated to be 1-inch and 0.5-inch or less over 30 feet.

Resistance to lateral loads including wind and seismic forces may be provided by frictional resistance between the bottom of concrete and the underlying fill soils and by passive pressure against the sides of the foundations. A coefficient of friction of 0.43 may be used between concrete foundation and underlying soil. The recommended passive pressure of the engineered fill may be taken as an equivalent fluid pressure of 300 pounds per cubic foot (3,000 psf max).

Footings located near property lines or existing structures where the lateral removal cannot be achieved shall be designed for a reduced bearing capacity of 1,500 pounds per square foot and the passive resistance shall be ignored.

Slab-On-Grade Recommendations

Slab-on-grade should be a minimum of 5-inches thick and reinforced with a minimum of No. 4 reinforcing bar on 16-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel.

The subgrade material should be compacted to a minimum of ninety (90) percent of the maximum laboratory dry density (ASTM D1557) to a minimum depth of three (3) feet. Prior to placement of concrete, the subgrade soil should be moistened to near optimum moisture content and verified by our field representative. The actual thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition, the anticipated use of the building and thermal impacts due to extreme temperature variations.

For moisture sensitive flooring, the floor slab should be underlain by minimum 15-mil impermeable polyethylene membrane (Stego Wrap, Moistop Plus, or any equivalent meeting the requirements of ASTM E1745, Class A rating) as a capillary break. The placement of sand above and below the impermeable polyethylene membrane is at the discretion of the project structural engineer/concrete contractor and is considered outside the scope of geotechnical engineering.

Flatwork Recommendations

Flatwork for pedestrian traffic should be a minimum of 4-inches thick and should be reinforced with a minimum of No. 3 reinforcing bar on 16-inch centers in two horizontally perpendicular directions. Reinforcing should be properly supported to ensure placement near the vertical midpoint of the slab. "Hooking" of the reinforcement is not considered an acceptable method of positioning the steel. The subgrade material should be compacted to a minimum of ninety (90) percent of the maximum laboratory dry density (ASTM D1557) to a minimum depth of two (2) feet. Prior to placement of concrete, the subgrade soils should be moistened to near optimum moisture content and verified by our field representative. The actual thickness and reinforcement of the slab shall be designed by the structural engineer and should include the anticipated loading condition.

Preliminary Pavement Design

The Caltrans method of design was utilized to develop the following asphalt pavement section. The section was developed based on an a tested “R-Value” for compacted site subgrade soils of 40.

Traffic indices of 4.5, 5, 6, 7 and 8 were assumed for use in the evaluation of automobile parking stalls, drive isles and driveways, fire lanes/medium truck and heavy truck traffic, respectively. The traffic indices are subject to approval by controlling authorities and shall be approved by the project civil engineer.

| **ASPHALT PAVEMENT SECTION** | | | | | **PCC PAVEMENT SECTION** | | |
|---|---|---|---|---|---|---|---|
| Pavement Utilization | Traffic Index | Asphalt (Inch) | Aggregate Base (Inch) | Total (Inch) | *PCC | Aggregate Base (Inch) | Total (Inch) |
| Auto Driveways | 6.0 | 4.0 | 5.0 | 9.0 | 7.0 | -- | 7.0 |
| Medium Truck Traffic | 7.0 | 4.0 | 7.5 | 11.5 | 7.0 | 4.0 | 11.0 |

*Minimum concrete compressive strength of 3,500 psi.

Aggregate base material should consist of CAB/CMB complying with the specifications in Section 200-2.2/200-2.4 of the current “Standard Specifications for Public Works Construction” and should be compacted to at least ninety-five (95) percent of the maximum dry density (ASTM D1557). The surface of the aggregate base should exhibit a firm and unyielding condition just prior to the placement of asphalt concrete paving.

The pavement subgrade should be constructed in accordance with the recommendations presented in the grading section of this report.

The R-value and the associated pavement section should be confirmed at the completion of site grading.

An increase in the PCC pavement slab thickness, placement of steel reinforcement (or other alternatives such as Fibermesh) and joint spacing due to loading conditions including shrinkage and thermal effects may be necessary and should be incorporated by the structural engineer as necessary to prevent adverse impact on pavement performance and maintenance.

Cement Type and Corrosion

Based on laboratory testing concrete used should be designed in accordance with the provisions of ACI 318-19, Chapter 19 for Exposure Class S0 with a minimum unconfined compressive strength of 2,500 psi and for Exposure Class C1 (Moderate) – Concrete exposed to moisture but not a significant source of chlorides, per ACI 318-19 Table 19.3.1.1.

Corrosion tests indicate onsite soils are moderately corrosive for ferrous metals exposed to site soils.

TGR does not practice corrosion engineering. If needed, a qualified specialist should review the site conditions and evaluate the corrosion potential of the site soil to the proposed improvements and to provide the appropriate corrosion mitigations for the project.

Shrinkage/Subsidence

Removal and recompaction of the near surface soils is estimated to result in shrinkage ranging from 5 to 10 percent. Minor ground subsidence is expected to occur in the soils below the zone of removal, due to settlement and machinery working. The subsidence is estimated to be between one and two tenths of a foot.

Site Development Recommendations

General

During earthwork construction, all site preparation and the general procedures of the contractor should be observed, and the fill selectively tested by a representative of TGR. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and if warranted, modified and/or additional recommendations will be offered.

Grading

All grading should conform to the guidelines presented in the California Building Code (2022 edition), except where specifically superseded in the text of this report. Prior to grading, TGR's representative should be present at the pre-construction meeting to provide grading guidelines, if needed, and review any earthwork. Although no fill was encountered in the locations drilled, any undocumented fill, if encountered within the building footprint and five (5) feet outside laterally should be removed and replaced with engineered fill. Oversize particles may be encountered during grading. All particles greater than 4-inches shall be removed and disposed off site.

A minimum of three (3) feet of engineered fill is recommended under footings and slab-on-grade, and two (2) feet under flatwork and pavement.

Site soils may be reused as engineered fill provided the recommendations presented in this report are implemented. Exposed bottoms should be scarified a minimum of 4-inches, moisture conditioned and compacted to a minimum ninety (90) percent relative compaction. Subsequently, site fill soils should be re-compacted to a minimum of ninety (90) percent relative compaction at a minimum of optimum moisture content. The lateral extent of removals beyond the building/structure/footing limits should be equal to at least five (5) feet.

The depth of over-excavation should be reviewed by the Geotechnical Consultant during the actual construction. Any subsurface obstruction buried structural elements, and unsuitable material encountered during grading, should be immediately brought to the attention of the Geotechnical Consultant for proper exposure, removal and processing, as recommended.

Fill Placement

Prior to any fill placement TGR should observe the exposed surface soils. The site soil may be re-used as engineered fill provided, they are free of organic content and particle size greater than 4-inches. All particles greater than 4-inches shall be removed and disposed offsite. Fill shall be moisture conditioned to near optimum and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D1557. Any import soil shall be non-expansive and approved by TGR Geotechnical Inc.

Compaction

Prior to fill placement, the exposed surface should be scarified to a minimum depth of six (6) inches, fill placed in six (6) inch loose lifts moisture conditioned to near optimum and compacted to a minimum relative compaction of ninety (90) percent in accordance with ASTM D1557.

Temporary Excavation and Shoring

Soils may be cut vertically to a maximum depth of 4 feet. Some sloughing may be anticipated due to the granular nature of site soils. For deeper cuts, entire excavations shall be properly shored or sloped back to at least 1H:1V (Horizontal: Vertical) or flatter. The exposed slope face should be kept moist (but not saturated) during construction to reduce local sloughing. No surcharge loads should be permitted within a horizontal distance equal to the height of cut from the toe of excavation unless the cut is properly shored. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any nearby adjacent footings or public right of way should be properly shored to maintain support at the adjacent structures and public right of way.

Drainage

Positive site drainage should be maintained at all times. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. Pad drainage should be directed towards street/parking or other approved areas.

Trenching

All excavations should conform to CAL-OSHA and local safety codes. Open or backfilled trenches parallel with a footing shall not be below a plane having a downward slope of 1 unit vertical to 2 units horizontal (50 percent slope) from a line 9 inches above the bottom edge of the footing and not closer than 18 inches from the face of such footing, per CBC section 1809.14.

Utility Trench Backfill

All utility trench backfills in structural areas and beneath hardscape features should be brought to near optimum moisture content and compacted to a minimum relative compaction of ninety (90) percent of the laboratory standard. Flooding/jetting is not recommended.

Sand backfill, (unless trench excavation material), should not be allowed in parallel exterior trenches adjacent to and within an area extending below a 1:1 plane projected from the outside bottom edge of the footing. All trench excavations should minimally conform to CAL-OSHA and local safety codes. Soils generated from utility trench excavations may be used provided it is moisture conditioned and compacted to ninety (90) percent minimum relative compaction.

Imported Soils

Any imported soil required to complete grading operations should consist of predominantly granular material which exhibits an expansion index less than 30 when tested in accordance with ASTM D4829, and should be free of debris, particles greater than 4 inches in maximum dimension, organic matter or other deleterious materials, and should be approved by the Geotechnical Consultant or his representative. Final acceptance of any imported soil will be based upon review and testing of the soil actually delivered to the site.

Geotechnical Review of Plans

All grading and foundation plans should be reviewed and accepted by the geotechnical consultant prior to construction. If significant time elapses since preparation of this report, the geotechnical consultant should verify the current site conditions, and provide any additional recommendations (if necessary) prior to construction.

Geotechnical Observation/Testing During Construction

Per sections 1705.6 and table 1705.6 of the 2022 California Building Code, periodic geotechnical inspection shall be performed to:

- Verify materials below shallow foundations are adequate to achieve the design bearing capacity;
- Verify excavations are extended to the proper depth and have reached proper material;
- Verify classification and test compacted materials; and
- Prior to placement of compacted fill, inspect subgrade and verify that the site has been prepared properly.

Per sections 1705.6 and table 1705.6 of the 2022 California Building Code, continuous geotechnical inspection shall be performed to:

- Verify use of proper materials, densities and lift thickness during placement and compaction of compacted fill.

The geotechnical consultant should also perform observation and/or testing at the following stages:

- During any grading and fill placement;
- After foundation excavation and prior to placing concrete;

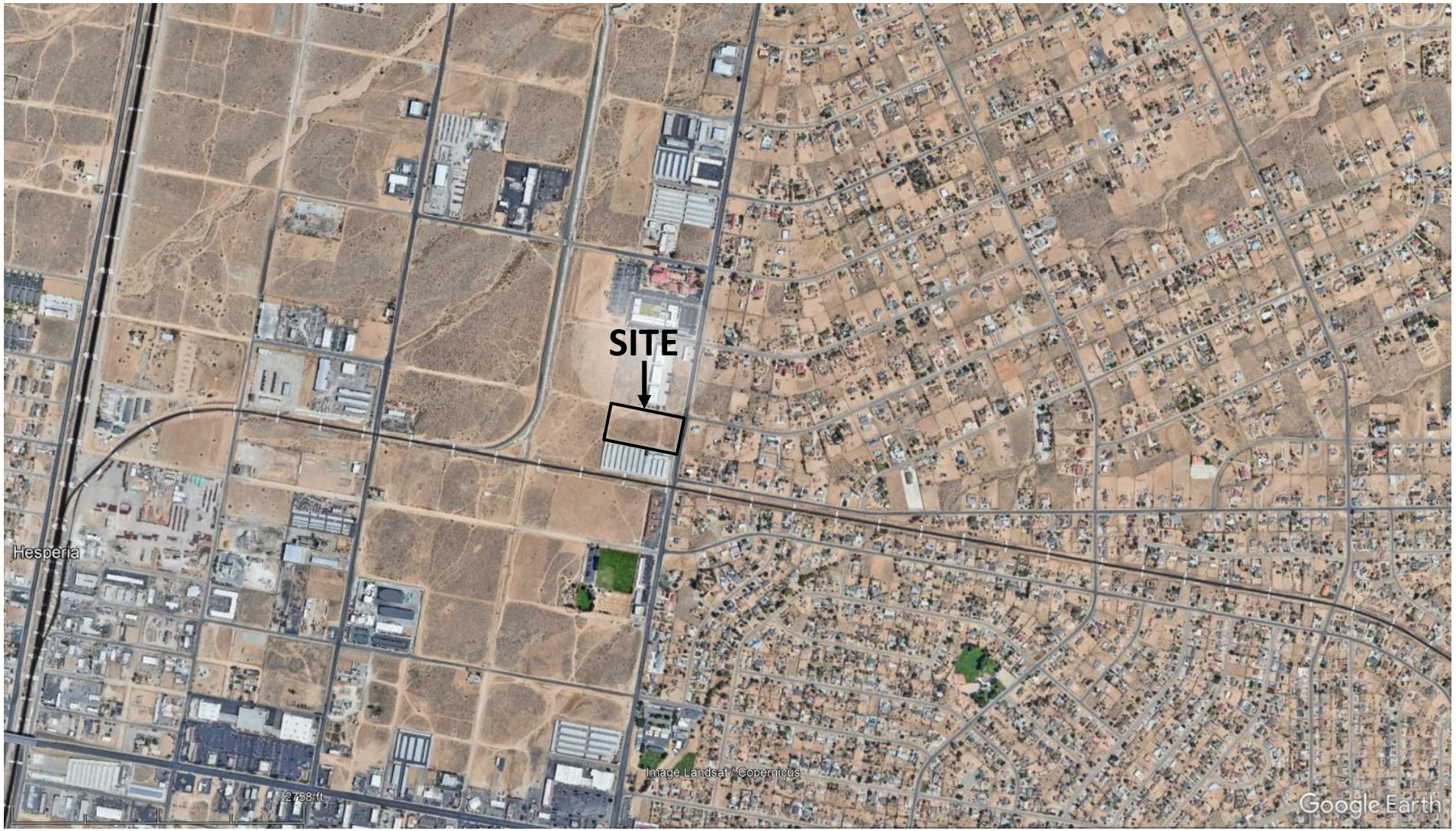
- Prior to placing slab and flatwork concrete;
- Trench excavation, bottom, bedding and fill placement;
- During placement of aggregate base and asphalt or Portland cement concrete; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

Limitations

This report was prepared for a specific client and a specific project, based on the client's needs, directions and requirements at the time.

This report was necessarily based upon data obtained from a limited number of observances, site visits, soil and/or other samples, tests, analyses, histories of occurrences, spaced subsurface exploration and limited information on historical events and observations. Such information is necessarily incomplete. Variations can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time.

This report is not authorized for use by and is not to be relied upon by any party except the client with whom TGR contracted for the work. Use or reliance on this report by any other party is that party's sole risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify TGR from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of TGR.

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# SITE LOCATION MAP
# SW CORNER OF I AVENUE AND HERCULES STREET, HESPERIA, CALIFORNIA

PROJECT NO. 24-7867

FIGURE 1


**B-9** ⊕ APPROXIMATE LOCATION OF EXPLORATORY BORING

**P-2** ○ APPROXIMATE LOCATION OF PERCOLATION BORING

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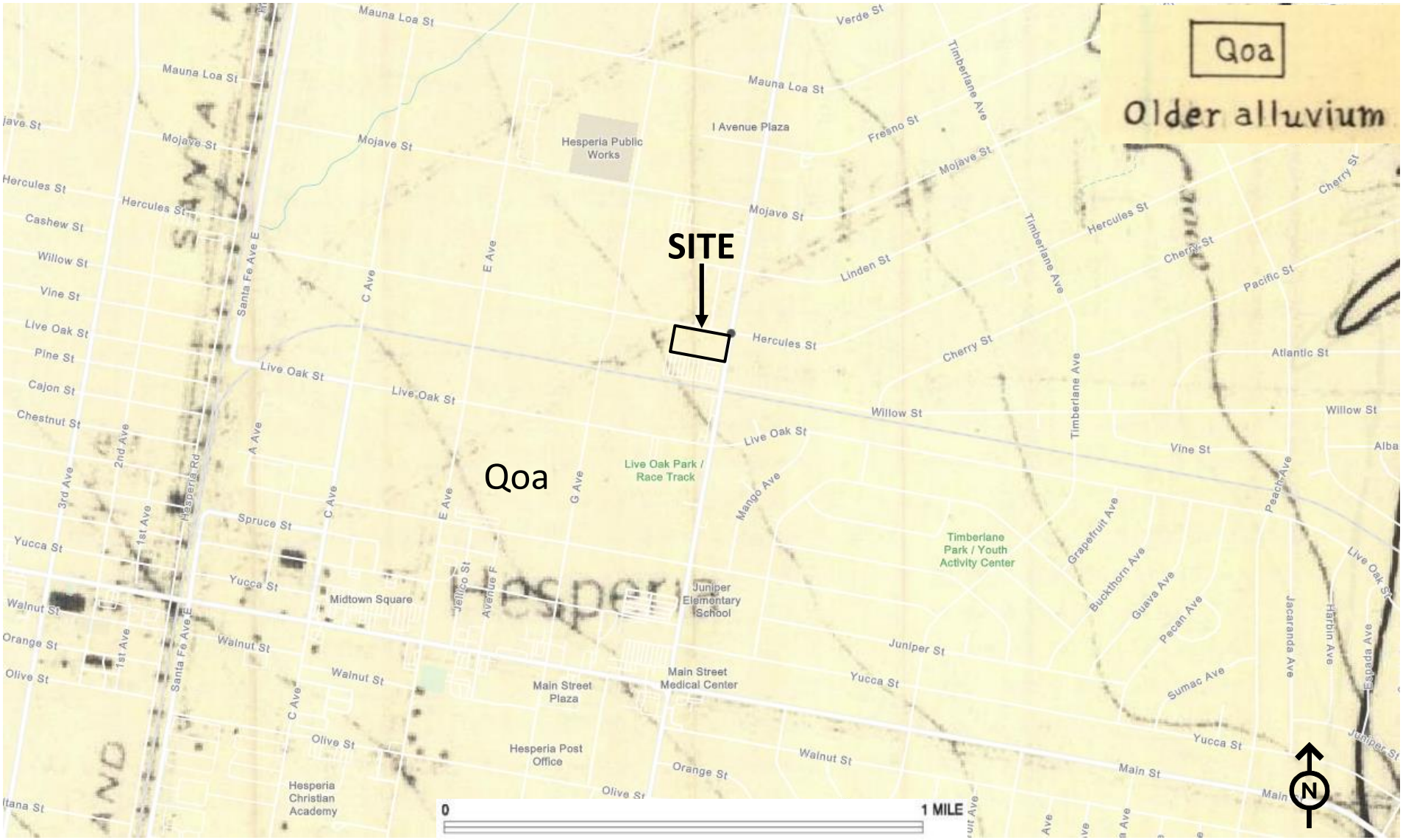
# BORING LOCATION MAP
# SW CORNER OF I AVENUE AND HERCULES STREET, HESPERIA, CALIFORNIA

PROJECT NO. 24-7867

FIGURE 2




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

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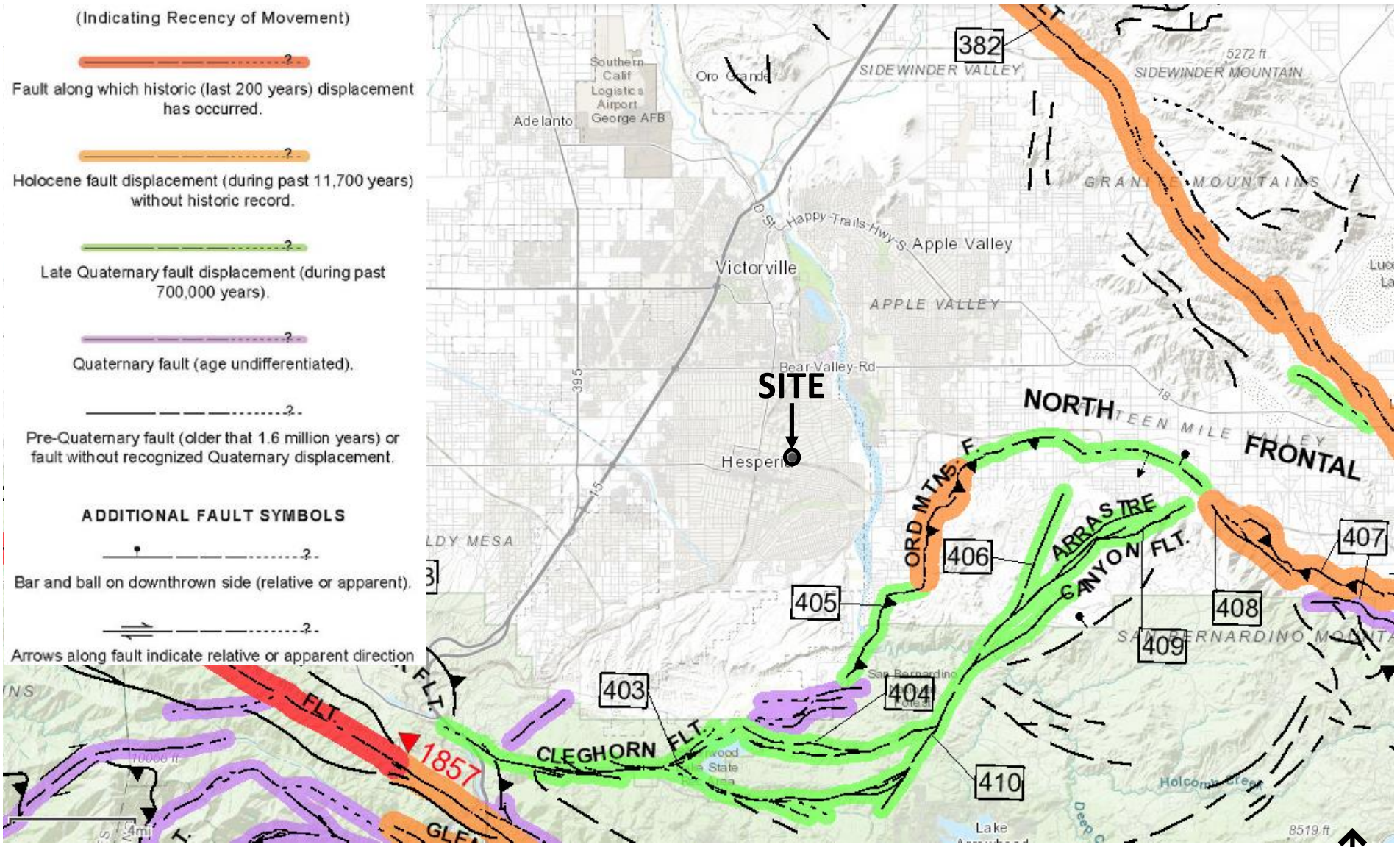
# REGIONAL GEOLOGY MAP
# SW CORNER OF I AVENUE AND HERCULES STREET, HESPERIA, CALIFORNIA

PROJECT NO. 24-7867

FIGURE 3




Modified From: Jennings, C. W., 2010, Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology, Geologic Data Map Series, No. 6, Scale 1:750,000.

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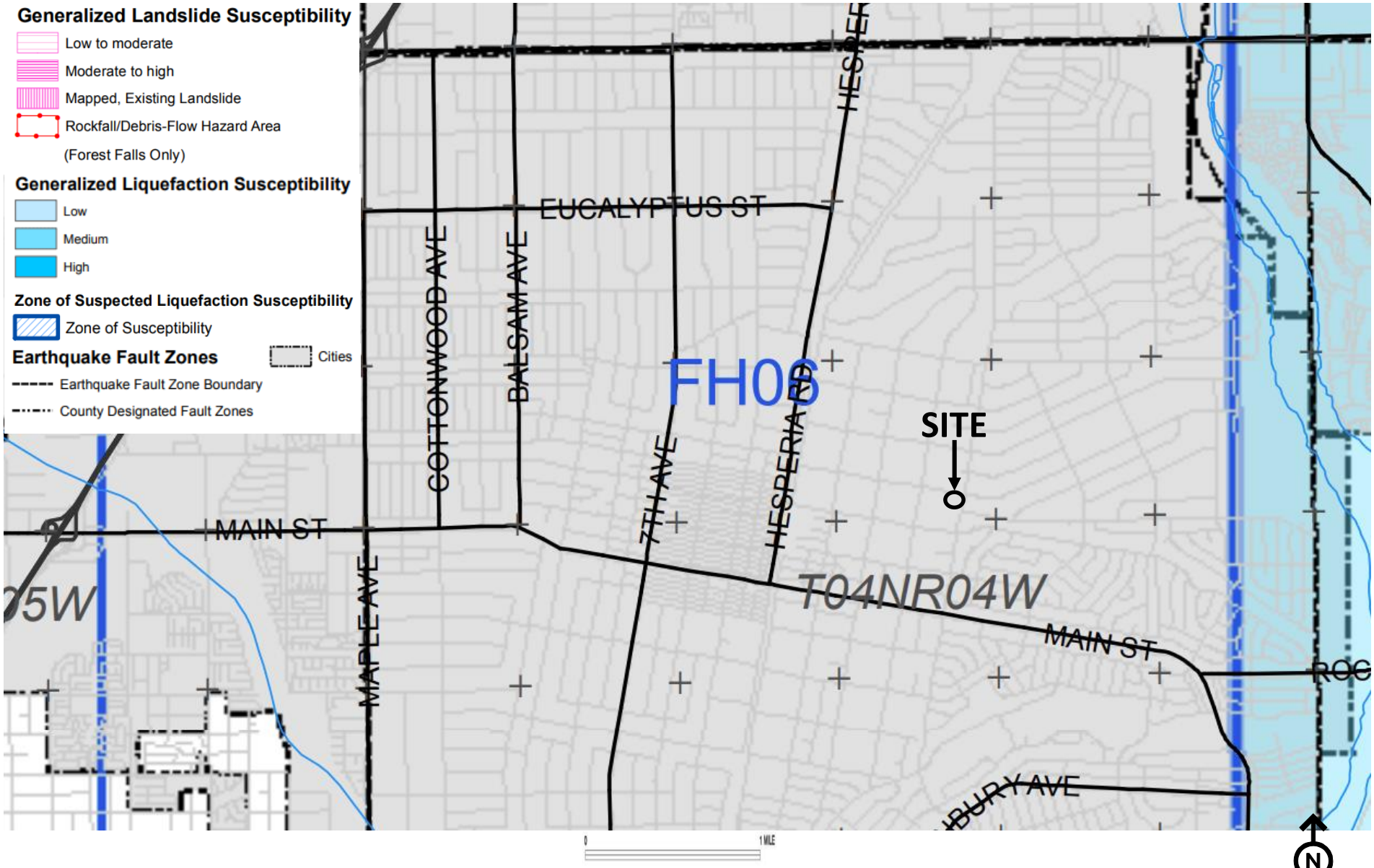
# REGIONAL FAULT MAP
# SW CORNER OF I AVENUE AND HERCULES STREET, HESPERIA, CALIFORNIA

PROJECT NO. 24-7867

FIGURE 4




Modified From: San Bernardino County Land Use Plan, 2007, General Plan, Geologic Hazard Overlay, Map No. EHFHC.

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SEISMIC HAZARD ZONE MAP
SW CORNER OF I AVENUE AND HERCULES STREET,
HESPERIA, CALIFORNIA

PROJECT NO. 24-7867

FIGURE 5

## Table 1: Percolation Test Worksheet

| Test Hole | Total Depth (in) | Initial Depth (in) | Final Depth (in) | ΔWater Level (in) | Initial Time (min) | Final Time (min) | Δ Time (min) | Initial Height of Water (in) | Final Height of Water (in) | Average Height of Water (in) | Gravel Factor | Infiltration Rate (in/hr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| P-1 | 60 | 2.8 | 7.0 | 4.3 | 0.0 | 10.0 | 10.0 | 57.3 | 53.0 | 55.1 | 0.54 | 0.60 |
| | 60 | 0.0 | 5.0 | 5.0 | 0.0 | 10.0 | 10.0 | 60.0 | 55.0 | 57.5 | 0.54 | 0.68 |
| | 60 | 0.0 | 4.5 | 4.5 | 0.0 | 10.0 | 10.0 | 60.0 | 55.5 | 57.8 | 0.54 | 0.60 |
| | 60 | 0.3 | 4.7 | 4.5 | 0.0 | 10.0 | 10.0 | 59.8 | 55.3 | 57.5 | 0.54 | 0.60 |
| | 60 | 0.0 | 4.8 | 4.8 | 0.0 | 10.0 | 10.0 | 60.0 | 55.3 | 57.6 | 0.54 | 0.64 |
| | 60 | 0.0 | 4.5 | 4.5 | 0.0 | 10.0 | 10.0 | 60.0 | 55.5 | 57.8 | 0.54 | 0.60 |
| | | | | | | | | | | | | |
| P-2 | 60 | 2.0 | 23.5 | 21.5 | 0.0 | 10.0 | 10.0 | 58.0 | 36.5 | 47.3 | 0.54 | 3.50 |
| | 60 | 2.5 | 16.5 | 14.0 | 0.0 | 10.0 | 10.0 | 57.5 | 43.5 | 50.5 | 0.54 | 2.14 |
| | 60 | 2.8 | 17.3 | 14.5 | 0.0 | 10.0 | 10.0 | 57.3 | 42.8 | 50.0 | 0.54 | 2.24 |
| | 60 | 2.0 | 16.3 | 14.3 | 0.0 | 10.0 | 10.0 | 58.0 | 43.8 | 50.9 | 0.54 | 2.16 |
| | 60 | 2.0 | 16.0 | 14.0 | 0.0 | 10.0 | 10.0 | 58.0 | 44.0 | 51.0 | 0.54 | 2.12 |
| | 60 | 2.5 | 15.8 | 13.3 | 0.0 | 10.0 | 10.0 | 57.5 | 44.3 | 50.9 | 0.54 | 2.01 |
| | | | | | | | | | | | | |

$$I_t = \frac{\Delta H(60r)}{\Delta t(r + 2H_{avg})}$$

$\Delta H$ = Change in height

$\Delta t$ = Time interval

r = Radius

$I_t$ Infiltration Rate

$H_{ave}$ Average Head Height over the time interval

# APPENDIX A
# REFERENCES

TGR GEOTECHNICAL
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www.tgrgeotech.com

# APPENDIX A

## References

American Concrete Institute, 2001, ACI 330R-01, Guide for Design and Construction of Concrete Parking Lots, Reported by ACI Committee 330, dated October 1, 2001.

California Department of Conservation – California Geological Survey, 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers and Geoscience Practitioners for Assessing Fault Rupture Hazards in California.

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

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Jennings, C. W., 2010, Fault Activity Map of California and Adjacent Areas, California Division of Mines and Geology, Geologic Data Map Series, No. 6, Scale 1:750,000.

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San Bernardino County Technical Guidance Document Appendix VII, Infiltration Rate Evaluation and Factor of Safety Recommendations, dated May 19, 2011.

# APPENDIX B
# LOG OF BORINGS

TGR GEOTECHNICAL
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THE FOLLOWING DESCRIBES THE TERMS AND SYMBOLS USED ON THE LOG OF BORINGS TO SUMMARIZE THE RESULTS OBTAINED IN THE FIELD INVESTIGATION AND SUBSEQUENT LABORATORY TESTING

## DENSITY AND CONSISTENCY

The consistency of fine grained soils and the density of coarse grained soils are described on the basis of the Standard Penetration Test as follows:

| COARSE GRAINED SOILS | | ESTIMATED UNCONFINED COMPRESSIVE STRENGTH (Tsf) | FINE GRAINED SOILS | |
|---|---|---|---|---|
| Very Loose | < 4 | < 0.25 | Very Soft | < 2 |
| Loose | 4 – 10 | 0.35 – 0.50 | Soft | 2 – 4 |
| Medium | 10 – 30 | 0.50 – 1.0 | Firm (Medium) | 4 – 8 |
| Dense | 30 – 50 | 1.0 – 2.0 | Stiff | 8 – 15 |
| Very Dense | > 50 | 2.0 – 4.0 | Very Stiff | 15 – 30 |
| | | > 4.0 | Hard | > 30 |

## PARTICLE SIZE DEFINITION (As per ASTM D2487 and D422)

| | | | |
|---|---|---|---|
| Boulder | ⇒ Larger than 12 inches | Coarse Sands | ⇒ No. 10 to No. 4 sieve |
| Cobbles | ⇒ 3 to 12 inches | Medium Sands | ⇒ No. 40 to No. 10 sieve |
| Coarse Gravel | ⇒ 3/4 to 3 inches | Fine Sands | ⇒ No. 200 to 40 sieve |
| Fine Gravel | ⇒ No. 4 to 3/4 inches | Silt | ⇒ 5µm to No. 200 sieve |
| | | Clay | ⇒ Smaller than 5µm |

## SOIL CLASSIFICATION

Soils and bedrock are classified and described based on their engineering properties and characteristics using ASTM D2487 and D2488.

Percentage description of minor components:

| | | | |
|---|---|---|---|
| Trace | 1 – 10% | Some | 20 – 35% |
| Little | 10 – 20% | And or y | 25 – 50% |

Stratified soils description:

| | | | |
|---|---|---|---|
| Parting | 0 to 1/16 inch thick | Layer | ½ to 12 inches thick |
| Seam | 1/16 to ½ inch thick | Stratum | > 12 inches thick |

# SOIL CLASSIFICATION CHART

## UNIFIED SOIL CLASSIFICATION AND SYMBOL CHART

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

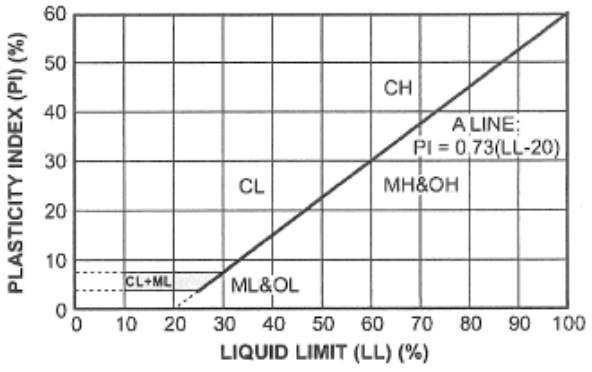
## LABORATORY CLASSIFICATION CRITERIA

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

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

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

## PLASTICITY CHART




## PARTICLE SIZE LIMITS

| COBBLES | GRAVEL | | SAND | | | SILT OR CLAY |
|---|---|---|---|---|---|---|
| | coarse | fine | coarse | medium | fine | |
| | 3" | ¾" | NO. 4 | NO. 10 | NO. 40 | NO. 200 |

TGR Geotechnical Environmental Hydrogeology Material Testing Construction Inspection

# LOG OF BORING EXPLANATION

# LOG OF EXPLORATORY BORING B-1

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **24-7867** | Logged By: | **RA** |
| Project Name: | **Hesperia Pump Yard** | Project Engineer: | **SG** |
| Date Drilled: | **3/8/24 - 3/8/24** | Drill Type: | **Hollow Stem** |
| Ground Elev: | **3110** | Drive Wt & Drop: | **140lbs / 30in** |

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is grass and dry vegetation. | | | |
| | | | | | | | | Clayey SAND- orange brown, moist, medium dense, fine to coarse grained sand, trace gravel. | | | |
| 3105 | 5 | | | | >50 | | SC | ...Same as above, very dense, some fine to medium grained gravel. | 5 | 104 | |
| 3100 | 10 | | | | 32 | | SC | ...Same as above, dense, abundant corase gravel and some cobbles. | 4 | 102 | |
| | | | | | | | | Total depth: 11.5 feet due to refusal in gravel. | | | |
| 3095 | 15 | | | | | | | No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion. | | | |
| | | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3090 | 20 | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

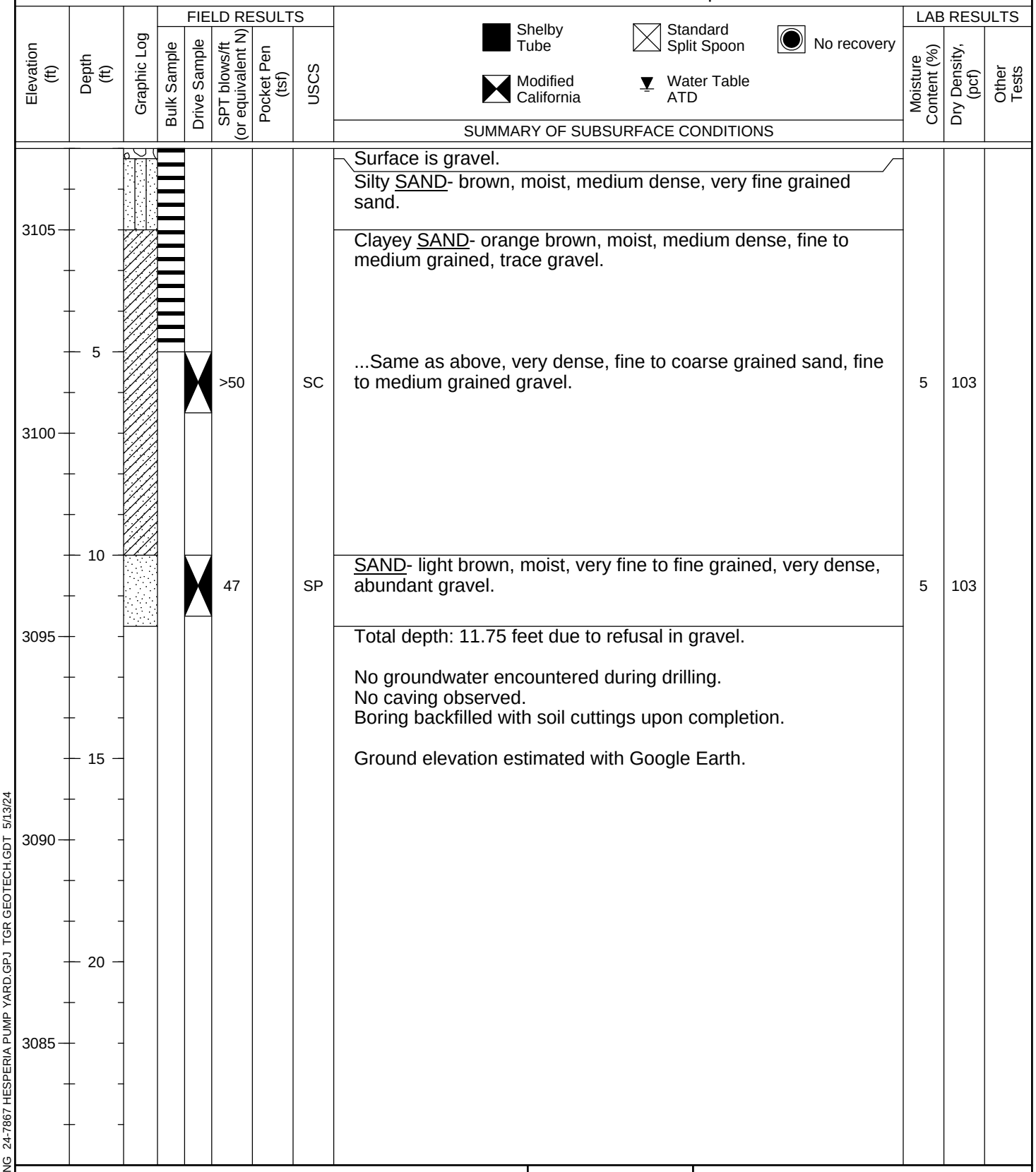
**PLATE 1**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-2

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **24-7867** | Logged By: | **RA** |
| Project Name: | **Hesperia Pump Yard** | Project Engineer: | **SG** |
| Date Drilled: | **3/8/24 - 3/8/24** | Drill Type: | **Hollow Stem** |
| Ground Elev: | **3107** | Drive Wt & Drop: | **140lbs / 30in** |




This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 2**

TGR GEOTECHNICAL, INC.

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

# LOG OF EXPLORATORY BORING B-3



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3104**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3104 | 0 | | | | | | | Surface is gravel.<br>Silty SAND- brown, moist, medium dense, very fine grained. | | | |
| 3100 | 5 | | | ■ | 49 | | SC | Clayey SAND- orange brown, moist, very dense, fine to coarse grained, some fine to medium grained gravel. | 10 | 108 | |
| 3095 | 10 | | | ■ | >50 | | SPG | Gravelly SAND- orange brown, slightly moist to dry, fine to coarse grained sand, fine to medium grained gravel. | 2 | 115 | |
| 3090 | 14 | | | | | | | Total depth: 14 feet due to refusal in gravel.<br><br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation estimated with Google Earth. | | | |
| 3085 | 15 | | | | | | | | | | |
| 3080 | 20 | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 3**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-4



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3110**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt and dry vegetation. | | | |
| | | | | | | | | Clayey SAND- brown, moist, medium dense, fine to coarse grained sand, some fine to medium grained gravel. | | | Corrosion, R-Value |
| 3105 | 5 | | | ■ | >50 | | SC | ...Same as above, very dense. | 4 | 94 | |
| 3100 | 10 | | | ■ | >50 | | SC | ...Same as above, abundant gravel. | 4 | 105 | |
| | | | | | | | | Total depth: 12 feet due to refusal in gravel. | | | |
| | | | | | | | | No groundwater encountered during drilling. No caving observed. Boring backfilled with soil cuttings upon completion. | | | |
| 3095 | 15 | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3090 | 20 | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 4**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-5



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3109**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt and dry vegetation. | | | |
| | | | | | | | | Silty SAND- brown, moist, medium dense, very fine to fine grained. | | | |
| | | | | | | | | Clayey SAND- orange brown, moist, medium dense, fine to medium grained. | | | |
| 3105 | 5 | | | ■ | 43 | | SP | SAND- orange brown, slightly moist, very dense, fine to coarse grained, some silt. | 3 | 105 | |
| 3100 | 10 | | | ■ | >50 | | | Total depth: 10 feet due to refusal in hard material. | | | |
| | | | | | | | | No groundwater encountered during drilling. No caving observed. Boring backfilled with soil cuttings upon completion. | | | |
| | | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3095 | 15 | | | | | | | | | | |
| 3090 | 20 | | | | | | | | | | |
| 3085 | | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 5**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-6



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3105**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt and dry vegetation. | | | |
| | | | | | | | | Clayey SAND- orange brown, moist, medium dense, fine grained. | | | |
| | | | | | | | SC | | | | Max, Shear |
| 3100 | 5 | | | | 50 | | SC | ...Same as above, very dense, fine to coarse grained. | 3 | 103 | |
| | | | | | | | | ...Becomes light brown. | | | |
| 3095 | 10 | | | | >50 | | | Total depth: 10 feet due to refusal in hard material. | | | |
| | | | | | | | | No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion. | | | |
| | | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3090 | 15 | | | | | | | | | | |
| 3085 | 20 | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 6**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-7



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3111**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3110 | 0 | | | | | | | Surface is dirt.<br>Clayey SAND- brown, moist, medium dense, fine grained, trace gravel. | | | |
| | 5 | | | ■ | >50 | | SC | ...Same as above, orange brown. | 7 | 107 | |
| 3105 | | | | | | | | Total depth: 7 feet due to refusal on a large cobble. | | | |
| | | | | | | | | No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion. | | | |
| | 10 | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3100 | | | | | | | | | | | |
| | 15 | | | | | | | | | | |
| 3095 | | | | | | | | | | | |
| | 20 | | | | | | | | | | |
| 3090 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 7**

TGR GEOTECHNICAL, INC.

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

# LOG OF EXPLORATORY BORING B-8



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3110**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt. | | | |
| | | | | | | | | Clayey SAND- brown, moist, medium dense, fine grained, trace gravel. | | | |
| 3105 | 5 | | | ■ | 20 | | SC | ...Same as above, orange brown, fine to coarse grained. | 7 | 112 | |
| 3100 | 10 | | | ■ | >50 | | SC | ...Same as above, very dense, abundant gravel. | 6 | 113 | |
| | | | | | | | | Total depth: 13 feet due to refusal in gravel. | | | |
| 3095 | 15 | | | | >50 | | | No groundwater encountered during drilling.<br>No caving observed.<br>Boring backfilled with soil cuttings upon completion. | | | |
| 3090 | 20 | | | | | | | Ground elevation estimated with Google Earth. | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 8**

TGR GEOTECHNICAL, INC.

# LOG OF EXPLORATORY BORING B-9



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3105**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt. | | | |
| | | | | | | | | Silty SAND- brown, moist, medium dense, fine grained. | | | |
| 3100 | 5 | | | ■ | 14 | | SC | Clayey SAND- orange brown, moist, medium dense, fine to coarse grained sand, trace fine to medium grained gravel. | 7 | 115 | |
| 3095 | 10 | | | ■ | 39 | | SC | ...Same as above, dense, abundant gravel. | 7 | 106 | |
| 3090 | 15 | | | | | | | Total depth: 15 feet due to refusal in gravel. | | | |
| | | | | | | | | No groundwater encountered during drilling. | | | |
| | | | | | | | | No caving observed. | | | |
| | | | | | | | | Boring backfilled with soil cuttings upon completion. | | | |
| | | | | | | | | Ground elevation estimated with Google Earth. | | | |
| 3085 | 20 | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 9**

TGR GEOTECHNICAL, INC.

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

# LOG OF EXPLORATORY BORING P-1

Sheet **1** of **1**

| | | | |
|---|---|---|---|
| Project Number: | **24-7867** | Logged By: | **RA** |
| Project Name: | **Hesperia Pump Yard** | Project Engineer: | **SG** |
| Date Drilled: | **3/8/24 - 3/8/24** | Drill Type: | **Hollow Stem** |
| Ground Elev: | **3107** | Drive Wt & Drop: | **140lbs / 30in** |

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Surface is dirt and dry vegetation. | | | |
| | | | | | | | | Clayey SAND- brown to orange brown, moist, medium dense, very fine to fine grained sand, trace gravel. | | | |
| 3105 | | | | | | | SC | ...More gravel encountered. | 6 | | -200= 22.0% |
| | 5 | | | | | | | Total depth: 5 feet. | | | |
| | | | | | | | | No groundwater encountered during drilling. | | | |
| | | | | | | | | No caving observed. | | | |
| | | | | | | | | Boring utilized for percolation testing. | | | |
| | | | | | | | | Boring backfilled with soil cuttings upon completion. | | | |
| 3100 | | | | | | | | Ground elevation estimated with Google Earth. | | | |
| | 10 | | | | | | | | | | |
| 3095 | | | | | | | | | | | |

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 10**

TGR GEOTECHNICAL, INC.

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

# LOG OF EXPLORATORY BORING P-2



Project Number: **24-7867**
Project Name: **Hesperia Pump Yard**
Date Drilled: **3/8/24 - 3/8/24**
Ground Elev: **3106**

Logged By: **RA**
Project Engineer: **SG**
Drill Type: **Hollow Stem**
Drive Wt & Drop: **140lbs / 30in**

Shelby Tube | Standard Split Spoon | No recovery | Modified California | Water Table ATD

| Elevation (ft) | Depth (ft) | Graphic Log | FIELD RESULTS: Bulk Sample | Drive Sample | SPT blows/ft (or equivalent N) | Pocket Pen (tsf) | USCS | SUMMARY OF SUBSURFACE CONDITIONS | LAB RESULTS: Moisture Content (%) | Dry Density, (pcf) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3105 | 0 | | | | | | SM | Surface is dirt and dry vegetitation.<br>Silty SAND- brown, moist, medium dense, fine to coarse grained. | 5 | | -200= 20.5% |
| | 5 | | | | | | | Total depth: 5 feet.<br><br>No groundwater encountered during drilling.<br>No caving observed.<br>Boring utilized for percolation testing.<br>Boring backfilled with soil cuttings upon completion.<br><br>Ground elevation estimated with Google Earth. | | | |
| 3100 | | | | | | | | | | | |
| | 10 | | | | | | | | | | |
| 3095 | | | | | | | | | | | |

LOG OF BORING 24-7867 HESPERIA PUMP YARD.GPJ TGR GEOTECH.GDT 5/13/24

This Boring Log should be evaluated in conjunction with the complete geotechnical report. This Boring Log represents conditions observed at the specific location and date indicated, it is not warranted to be representative of subsurface conditions at other locations and times.

**PLATE 11**

TGR GEOTECHNICAL, INC.

# APPENDIX C
# LABORATORY TEST RESULTS

TGR GEOTECHNICAL
DBE, MBE & SBE firm
3037 S. HARBOR BLVD
SANTA ANA, CA 92704
P 714.641.7189 F 714.641.7190
www.tgrgeotech.com

## APPENDIX C

Laboratory Testing Procedures and Results

In-Situ Moisture and Dry Density Determination (ASTM D2216 and D7263): Moisture content and dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The results of these tests are presented in the boring logs. Where applicable, only moisture content was determined from "undisturbed" or disturbed samples.

Maximum Density and Optimum Moisture Content (ASTM D1557): The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM Test Method D1557. The results of these tests are presented in the table below:

| Sample Location | Sample Description | Maximum Dry Density (Pcf) | Optimum Moisture Content (%) |
|---|---|---|---|
| B-6 @ 0-5 feet | Clayey Sand | 142.5 | 7.0% |

Direct Shear Strength (ASTM D3080): Direct shear test was performed on selected remolded samples, which were soaked for a minimum of 24 hours under a surcharge equal to the applied normal force during testing. After transfer of the sample to the shear box, and reloading the sample, pore pressures set up in the sample due to the transfer were allowed to dissipate for a period of approximately 1-hour prior to application of shearing force. The sample was tested under various normal loads, a motor-driven, strain-controlled, direct-shear testing apparatus at a strain rate of less than 0.001 to 0.5 inches per minute (depending upon the soil type). The test results are presented in the test data and in the table below:

| Sample Location | Sample Description | Friction Angle (degrees) | Apparent Cohesion (psf) |
|---|---|---|---|
| B-6 @ 0-5 feet | Clayey Sand (Remolded) | 33 | 96 |

Corrosivity Tests (CAL 422, CAL 643 and CAL 747): Electrical conductivity, pH, and soluble chloride tests were conducted on representative samples and the results are provided in the test data and in the table below:

| Sample Location | Sample Description | Soluble Chloride (CAL 422) (ppm) | Electrical Resistivity (CAL 643) (ohm-cm) | pH (CAL 747) | Potential Degree of Attack on Steel |
|---|---|---|---|---|---|
| B-4 @ 0-5 feet | Clayey Sand | 54 | 5,350 | 7.8 | Moderate |

Soluble Sulfate (CAL 417A): The soluble sulfate content of selected sample was determined by standard geochemical methods. The test results are presented in the test data and in the table below:

| Sample Location | Sample Description | Water Soluble Sulfate in Soil, (% by Weight) | Sulfate Content (ppm) | Exposure Class* |
|---|---|---|---|---|
| B-4 0-5 feet | Clayey Sand | 0.078 | 78 | S0 |

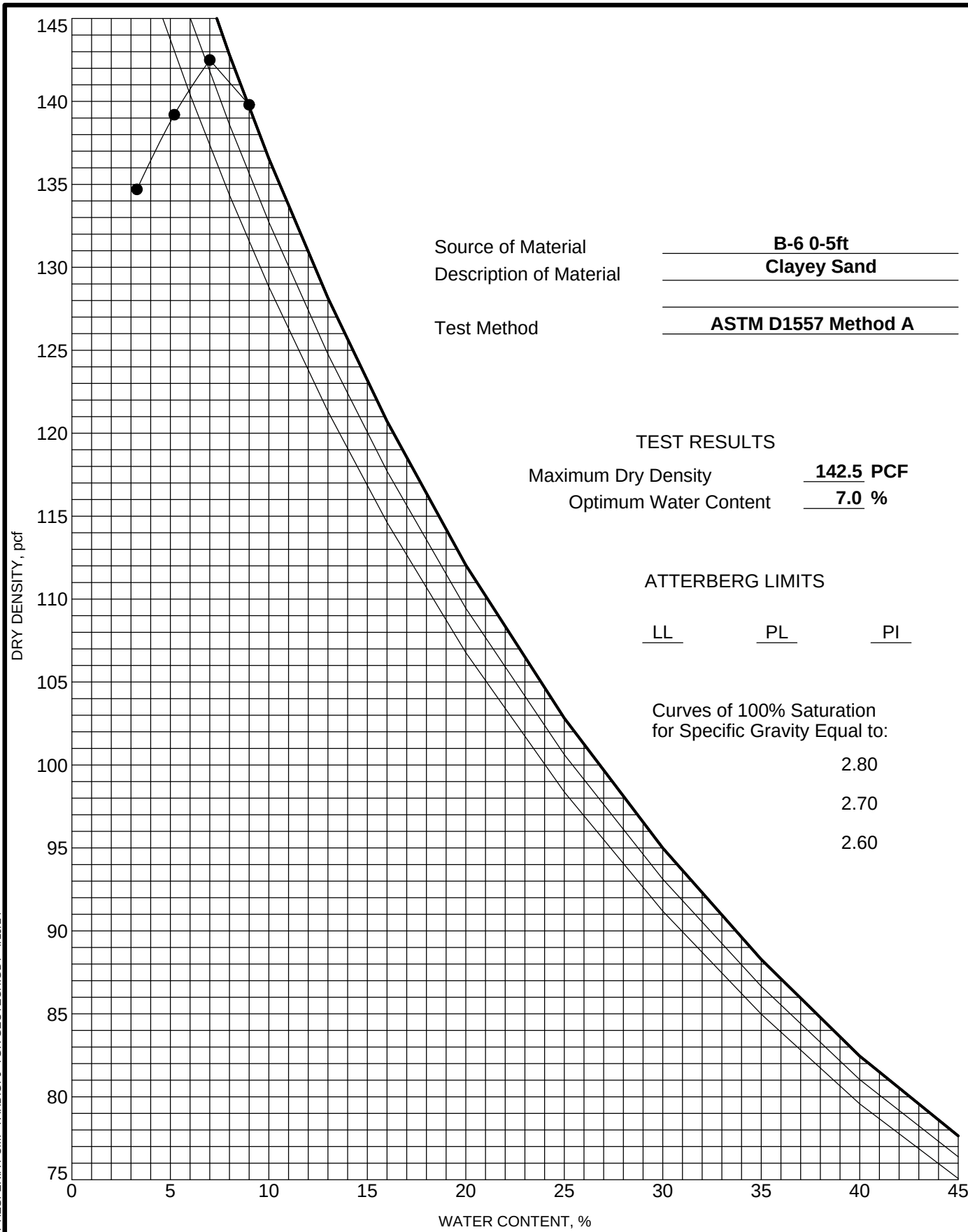
* Based on the current version of ACI 318-19 Building Code, Table No. 19.3.1.1; Exposure Categories and Classes.

Passing No. 200 Sieve (ASTM D1140): Typical materials were washed over No. 200 sieve. The test results are presented in the Log of Borings and in the table below:

| Sample Location | % Passing No. 200 Sieve |
|---|---|
| P-1 @ 0-5 feet | 22.0% |
| P-2 @ 0-5 feet | 20.5% |

R-Value (CAL 301): The resistance “R”-Value was determined by the California Materials Method No. 301 for subgrade soils. One sample was prepared, and exudation pressure and “R”-Value determined. The graphically determined “R”-Value at exudation pressure of 300 psi is summarized in the table below:

| Sample Location | Sample Description | R-Value |
|---|---|---|
| B-4 @ 0-5 feet | Clayey Sand | 40 |




Source of Material: **B-6 0-5ft**

Description of Material: **Clayey Sand**

Test Method: **ASTM D1557 Method A**

TEST RESULTS

Maximum Dry Density: **142.5 PCF**

Optimum Water Content: **7.0 %**

ATTERBERG LIMITS

LL PL PI

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

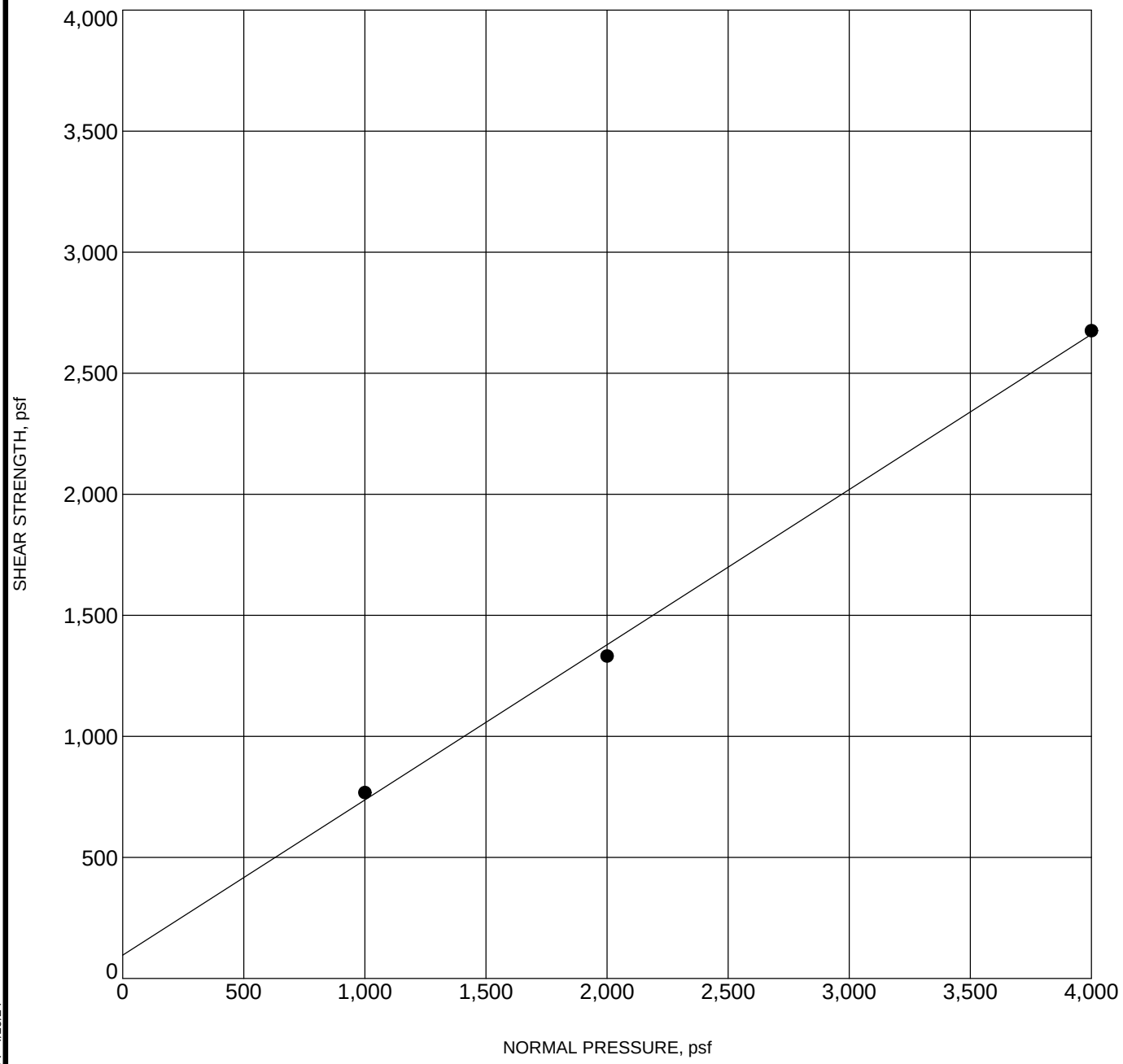
2.60

TGR GEOTECHNICAL, INC.
3037 S. Harbor Blvd
Santa Ana, CA 92704
Telephone: 714-641-7189
Fax: 714-641-7190

# MOISTURE-DENSITY RELATIONSHIP

Project Number: 24-7867

Project Name: Hesperia Pump Yard




| Specimen Identification | | Classification | $\gamma_d$ | MC% | c | $\phi$ |
|---|---|---|---|---|---|---|
| ● **B-6** | **0-5** | **Clayey Sand - Remolded - 90% RC** | **128** | **7** | **96** | **33** |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

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Fax: 714-641-7190

# DIRECT SHEAR TEST

Project Number: 24-7867

Project Name: Hesperia Pump Yard

# ANAHEIM TEST LAB, INC

196 Technology Dr., Unit D
Irvine, CA 92618
Phone (949) 336-6544

TO:

TGR GEOTECHNICAL
3037 S. HARBOR BLVD.
SANTA ANA, CA 92704

DATE: 3/27/2024

P.O. NO.: Verbal

LAB NO.: C-7784

SPECIFICATION: CTM-643/417/422

MATERIAL: Soil

---

Project No.: 24-7867
Project: Hesperia Pumpyard
Sample ID: B-4 @ 0-5'

## ANALYTICAL REPORT

CORROSION SERIES

SUMMARY OF DATA

| pH | MIN. RESISTIVITY per CT. 643 ohm-cm | SOLUBLE SULFATES per CT. 417 ppm | SOLUBLE CHLORIDES per CT. 422 ppm |
|---|---|---|---|
| 7.8 | 5,350 | 78 | 54 |

RESPECTFULLY SUBMITTED

WES BRIDGER LAB MANAGER

# ANAHEIM TEST LAB, INC

196 Technology Drive, Unit D
Irvine, CA 92618
Phone (949) 336-6544

TO:

TGR GEOTECHNICAL
3037 S. HARBOR BLVD.
SANTA ANA, CA 92704

DATE: 3/28/2024

P.O. NO.: Verbal

LAB NO.: C-7784

SPECIFICATION: CA- 301

MATERIAL: Brown, Clayey Sand

---

Project No.: 24-7867
Project: Hesperia Pumpyard
Sample ID: B-4 @ 0-5'

## ANALYTICAL REPORT

"R" VALUE

| BY EXUDATION | BY EXPANSION |
|---|---|
| 40 | N/A |

RESPECTFULLY SUBMITTED

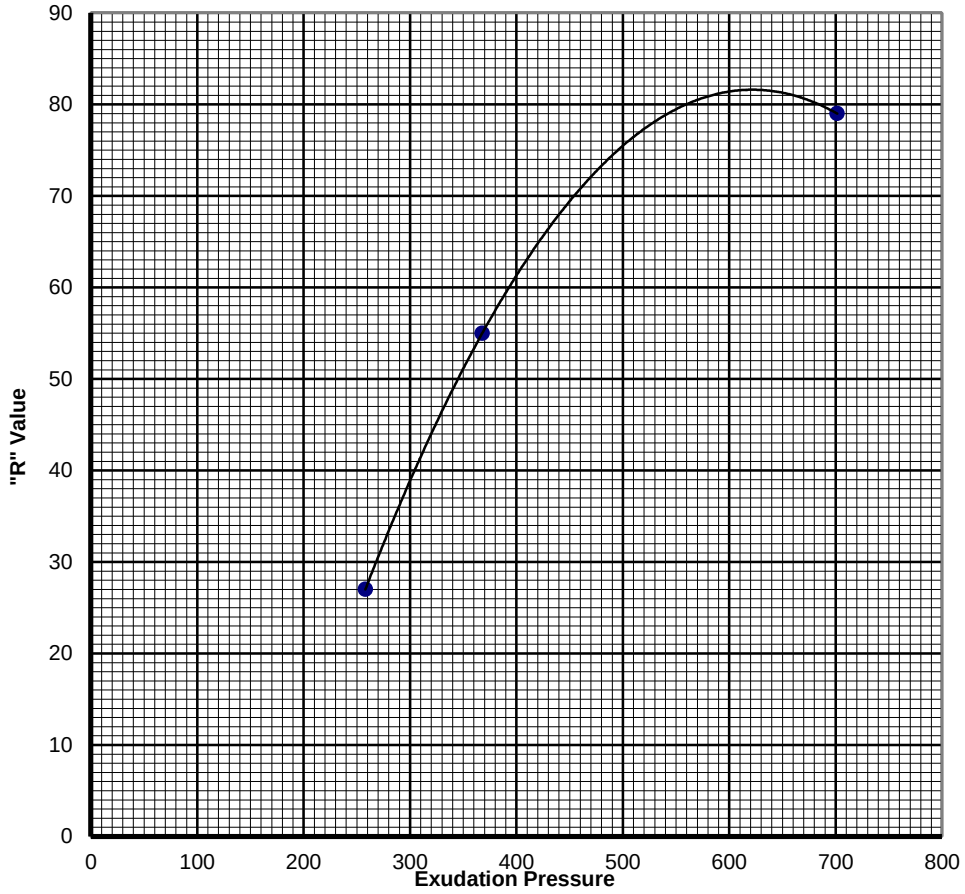
WES BRIDGER LAB MANAGER

# "R" VALUE CA 301

**Client: TGR Geotechnical** **ATL No.:** C 7784 **Date:** 3/28/2024
**Client Reference No.: 24-7867**
**Sample: B-4 @ 0-5'** **Soil Type:** Brown, Clayey Sand

| TEST SPECIMEN | | A | B | C | D |
|---|---|---|---|---|---|
| Compactor Air Pressure | psi | 350 | 150 | 60 | |
| Initial Moisture Content | % | 6.6 | 6.6 | 6.6 | |
| Moisture at Compaction | % | 7.5 | 8.4 | 9.3 | |
| Briquette Height | in. | 2.46 | 2.48 | 2.55 | |
| Dry Density | pcf | 133.5 | 132.1 | 130.7 | |
| EXUDATION PRESSURE | psi | 701 | 368 | 258 | |
| EXPANSION PRESSURE | psf | 43 | 0 | 0 | |
| Ph at 1000 pounds | psi | 13 | 27 | 45 | |
| Ph at 2000 pounds | psi | 23 | 55 | 100 | |
| Displacement | turns | 3.9 | 3.95 | 4.15 | |
| "R" Value | | 79 | 55 | 27 | |
| CORRECTED "R" VALUE | | 79 | 55 | 27 | |

| **Final "R" Value** | |
|---|---|
| BY EXUDATION: @ 300 psi | **40** |
| BY EXPANSION: TI = 5.0 | **N/A** |



# APPENDIX D
# SITE SEISMIC DESIGN PARAMETERS

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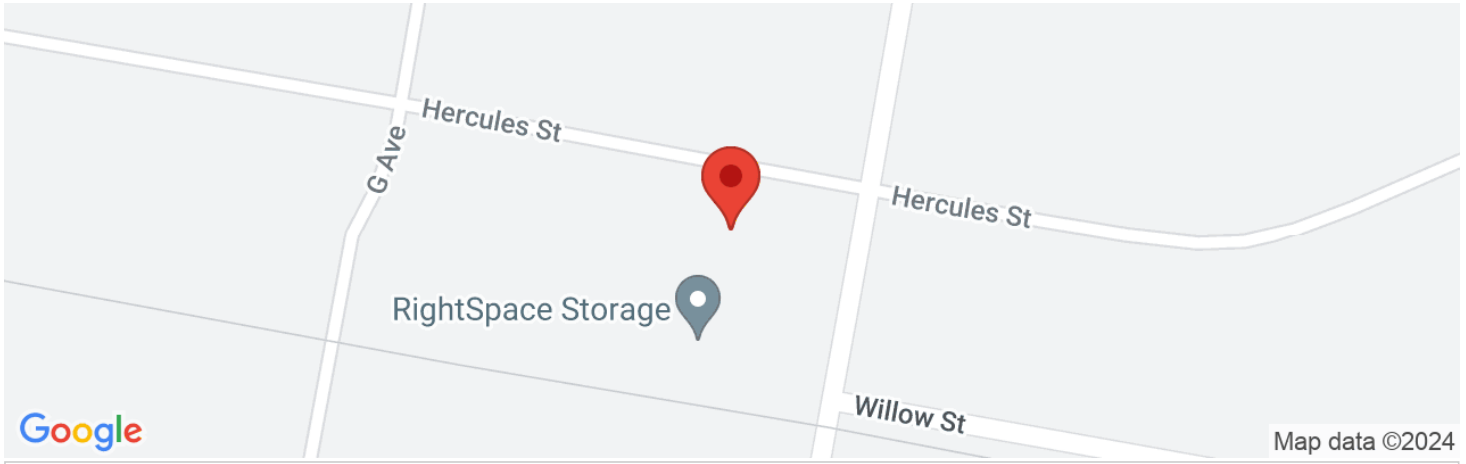
USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

OSHPD

# Hesperia Pump Yard

**Latitude, Longitude: 34.4296, -117.2820**




| | |
|---|---|
| **Date** | 5/3/2024, 9:05:01 AM |
| **Design Code Reference Document** | ASCE7-16 |
| **Risk Category** | II |
| **Site Class** | D - Stiff Soil |

| Type | Value | Description |
|---|---|---|
| $S_S$ | 1.352 | $MCE_R$ ground motion. (for 0.2 second period) |
| $S_1$ | 0.52 | $MCE_R$ ground motion. (for 1.0s period) |
| $S_{MS}$ | 1.352 | Site-modified spectral acceleration value |
| $S_{M1}$ | null -See Section 11.4.8 | Site-modified spectral acceleration value |
| $S_{DS}$ | 0.901 | Numeric seismic design value at 0.2 second SA |
| $S_{D1}$ | null -See Section 11.4.8 | Numeric seismic design value at 1.0 second SA |

| Type | Value | Description |
|---|---|---|
| SDC | null -See Section 11.4.8 | Seismic design category |
| $F_a$ | 1 | Site amplification factor at 0.2 second |
| $F_v$ | null -See Section 11.4.8 | Site amplification factor at 1.0 second |
| PGA | 0.568 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1.1 | Site amplification factor at PGA |
| $PGA_M$ | 0.625 | Site modified peak ground acceleration |
| $T_L$ | 12 | Long-period transition period in seconds |
| SsRT | 1.352 | Probabilistic risk-targeted ground motion. (0.2 second) |
| SsUH | 1.452 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration |
| SsD | 1.5 | Factored deterministic acceleration value. (0.2 second) |
| S1RT | 0.52 | Probabilistic risk-targeted ground motion. (1.0 second) |
| S1UH | 0.57 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D | 0.6 | Factored deterministic acceleration value. (1.0 second) |
| PGAd | 0.568 | Factored deterministic acceleration value. (Peak Ground Acceleration) |
| $PGA_{UH}$ | 0.58 | Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration |
| $C_{RS}$ | 0.931 | Mapped value of the risk coefficient at short periods |
| $C_{R1}$ | 0.911 | Mapped value of the risk coefficient at a period of 1 s |
| $C_V$ | 1.37 | Vertical coefficient |

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# APPENDIX E
# STANDARD GRADING GUIDELINES

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# STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for grading operations performed under the observation and testing of TGR Geotechnical, Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the Preliminary Geotechnical Investigation report, or in other written communication signed by the Soils Engineer or Engineering Geologist.

## 1.0 GENERAL

- The Soils Engineer and Engineering Geologist are the Owner's or Builder's representatives on the project. For the purpose of these specifications, observation and testing by the Soils Engineer includes that observation and testing performed by any person or persons employed by, and responsible to, the licensed Geotechnical Engineer or Geologist signing the grading report.

- All clearing, site preparation or earthwork performed on the project shall be conducted by the Contractor under the observation of the Geotechnical Engineer.

- It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Geotechnical Engineer and to place, spread, mix, water and compact the fill in accordance with the specifications of the Geotechnical Engineer. The Contractor shall also remove all material considered unsatisfactory by the Geotechnical Engineer.

- It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of Compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement and time of year.

- A final report will be issued by the Geotechnical Engineer and Engineering Geologist attesting to the Contractor's conformance with these specifications.

## 2.0 SITE PREPARATION

- All vegetation and deleterious material such as rubbish shall be disposed of off-site. The removal must be concluded prior to placing fill.

- The Civil Engineer shall locate all houses, sheds, sewage disposal systems, large trees or structures on the site, or on the grading plan to the best of his knowledge prior to preparing the ground surface.

- Soil, alluvium or rock materials determined by the Geotechnical Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as part of a compacted fill must be approved by the Geotechnical Engineer.

- After the ground surface to receive fill has been cleared, it shall be scarified, disced or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks or other uneven features which may prevent uniform compaction.

  The scarified ground surface shall then be brought to optimum moisture content, mixed as required, and compacted as specified. If the scarified zone is greater than twelve inches in depth, the excess shall be removed and placed in lifts restricted to six inches. Prior to placing fill, the ground surface to receive fill shall be inspected, tested and approved by the Geotechnical Engineer.

- Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines or others not located prior to grading are to be removed or treated in a manner prescribed by the Geotechnical Engineer.

## 3.0 COMPACTED FILLS

- Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Engineer. Roots, tree branches and other matter missed during clearing shall be removed from the fill as directed by the Geotechnical Engineer.
- Rock fragments less than six inches in diameter may be utilized in the fill, provided:

- They are not placed in concentrated pockets.
- There is a sufficient percentage of fine-grained material to surround the rocks.
- The distribution of the rocks is observed by the Geotechnical Engineer.

- Rocks greater than six inches in diameter shall be taken off-site, or placed in accordance with the recommendations of the Geotechnical Engineer in areas designated as suitable for rock disposal. Details for rock disposal such as location, moisture control, percentage of the rock placed, etc., will be referred to in the "Conclusions and Recommendations" section of the Geotechnical Report, if applicable.

  If rocks greater than six inches in diameter were not anticipated in the Preliminary Geotechnical report, rock disposal recommendations may not have been made in the "Conclusions and Recommendations" section. In this case, the Contractor shall notify the Geotechnical Engineer if rocks greater than six inches in diameter are encountered. The Geotechnical Engineer will then prepare a rock disposal recommendation or request that such rocks be taken off-site.

- Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

- Representative samples of materials to be utilized as compacted fill shall be analyzed in the laboratory by the Geotechnical Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Geotechnical Engineer as soon as possible.

- Material used in the compacting process shall be evenly spread, watered or dried, processed and compacted in thin lifts not to exceed six inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Geotechnical Engineer.

- If the moisture content or relative compaction varies from that required by the Geotechnical Engineer, the Contractor shall rework the fill until it is approved by the Geotechnical Engineer.

- Each layer shall be compacted to 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency; (in general, ASTM D1557 will be used.)

  If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use of expansive soil conditions, the area to receive fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the grading report.

- All fill shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of five horizontal to one vertical, in accordance with the recommendations of the Geotechnical Engineer.

- The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the Preliminary report. (See details)

- Drainage terraces and subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendation of the Geotechnical Engineer and Engineer Geologist.

- The Contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

The Contractor shall prepare a written detailed description of the method or methods he will employ to obtain the required slope compaction. Such documents shall be submitted to the Geotechnical Engineer for review and comments prior to the start of grading.

If a method other than overbuilding and cutting back to the compacted core is to be employed, slope tests will be made by the Geotechnical Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the contractor will be notified by the Geotechnical Engineer.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no additional cost to the Owner or Geotechnical Engineer.

- All fill slopes should be planted or protected from erosion by methods specified in the preliminary report or by means approved by the governing authorities.

- Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials; and the transition shall be stripped of all soil prior to placing fill. (See detail)

## 4.0 CUT SLOPES

- The Engineering Geologist shall inspect all cut slopes excavated in rock, lithified or formation material at vertical intervals not exceeding ten feet.

- If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these

conditions shall be analyzed by the Engineering Geologist and Geotechnical Engineer; and recommendations shall be made to treat these problems.

- Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a non-erosive interceptor swale placed at the top of the slope.

- Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

- Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Engineer or Engineering Geologist.

## 5.0 GRADING CONTROL

- Inspection of the fill placement shall be provided by the Geotechnical Engineer during the progress of grading.

- In general, density tests should be made at intervals not exceeding two feet of fill height or every 500 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction of being achieved.
- Density tests should be made on the surface material to receive fill as required by the Geotechnical Engineer.

- All cleanout, processed ground to receive fill, key excavations, subdrains and rock disposal must be inspected and approved by the Geotechnical Engineer (and often by the governing authorities) prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Engineer and governing authorities when such areas are ready for inspection.

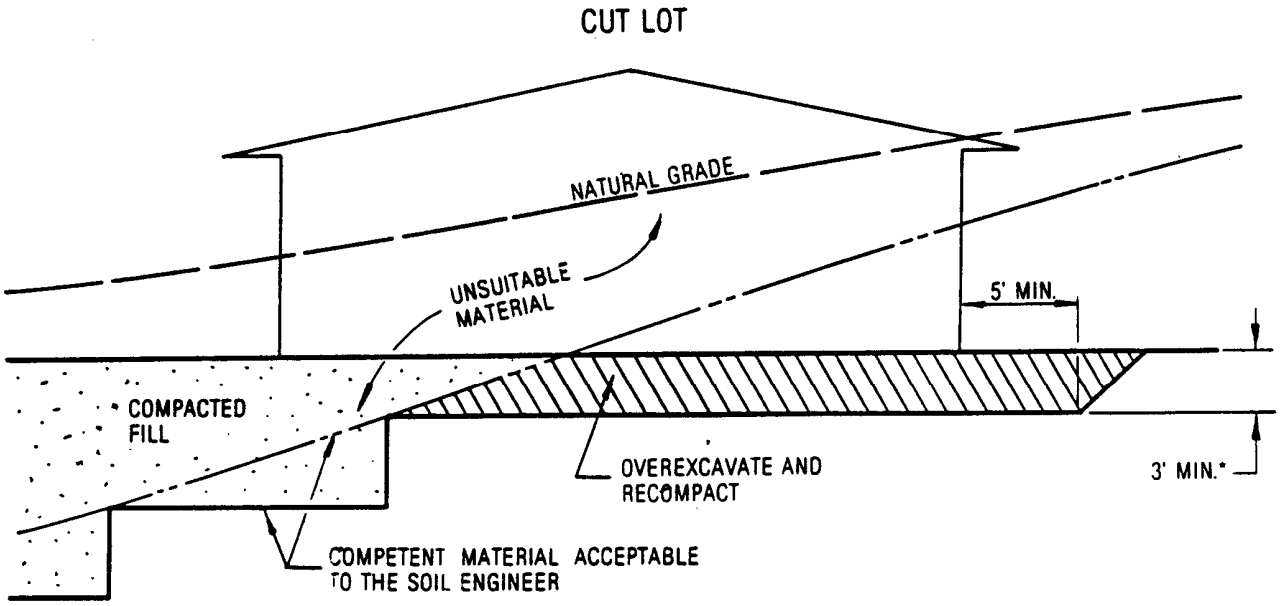
## 6.0 CONSTRUCTION CONSIDERATIONS

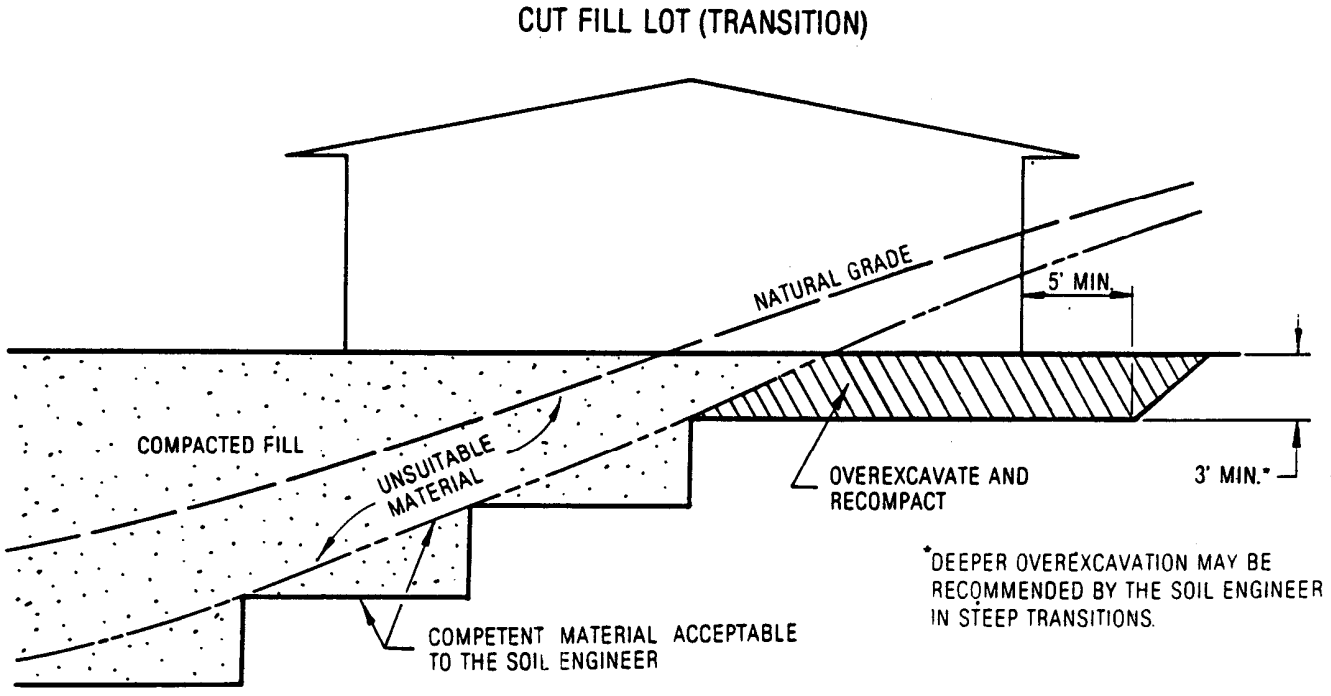
- Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

- Upon completion of grading and termination of observations by the Geotechnical Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Geotechnical Engineer or Engineering Geologist.

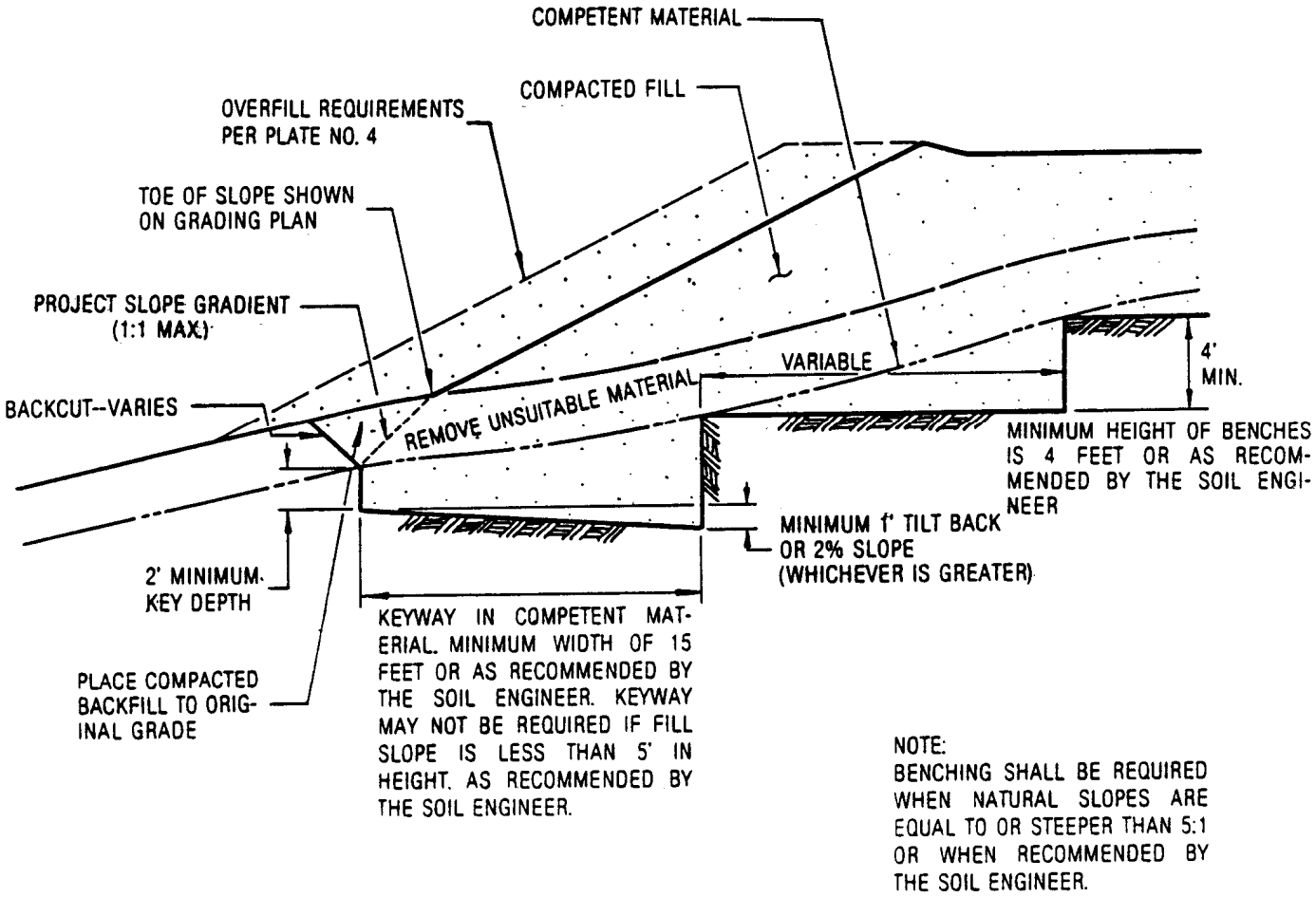
- Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of a permanent nature on or adjacent to the property.

# TYPICAL OVEREXCAVATION OF DAYLIGHT LINE



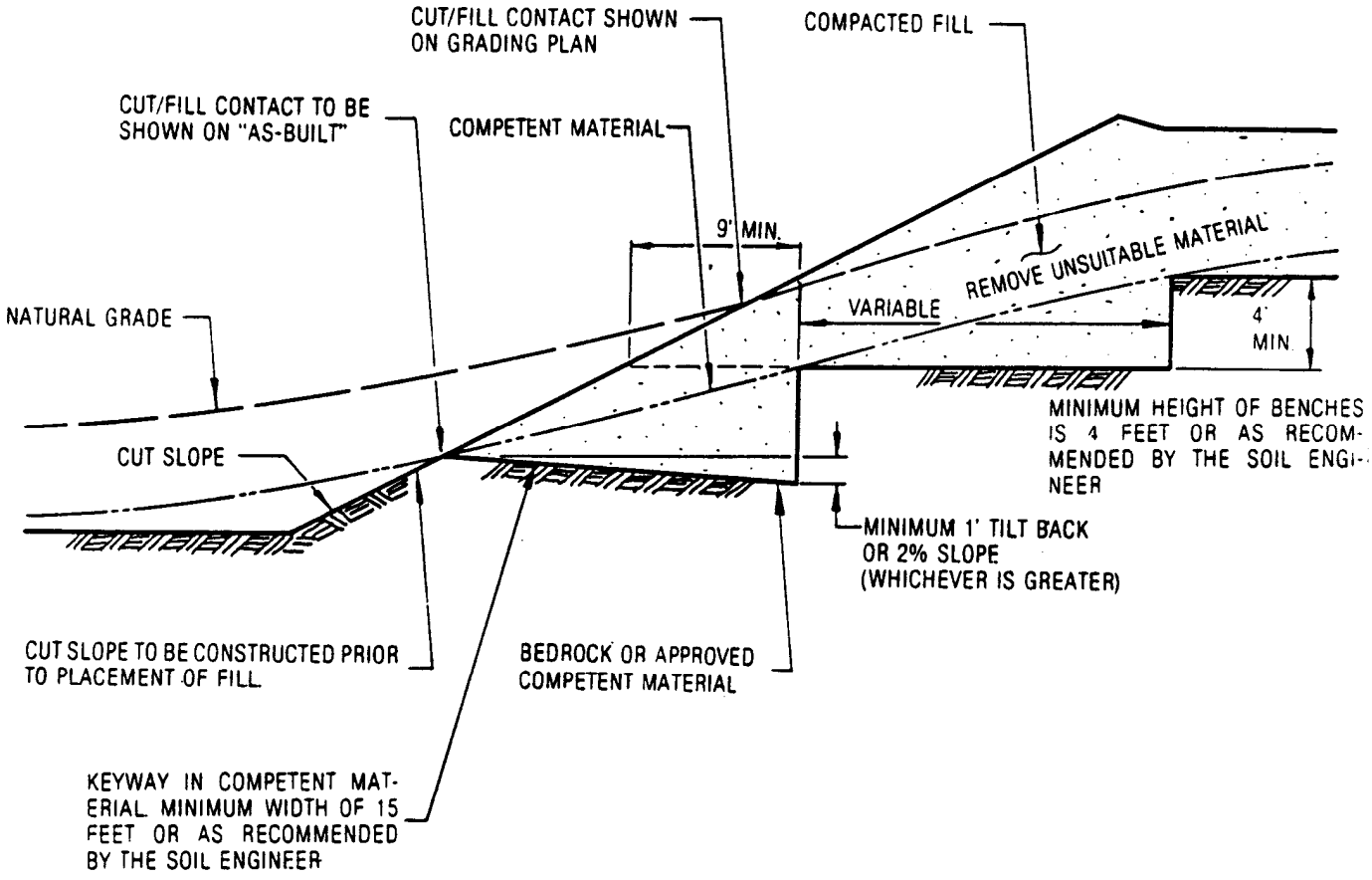



# TYPICAL FILL OVER NATURAL SLOPE

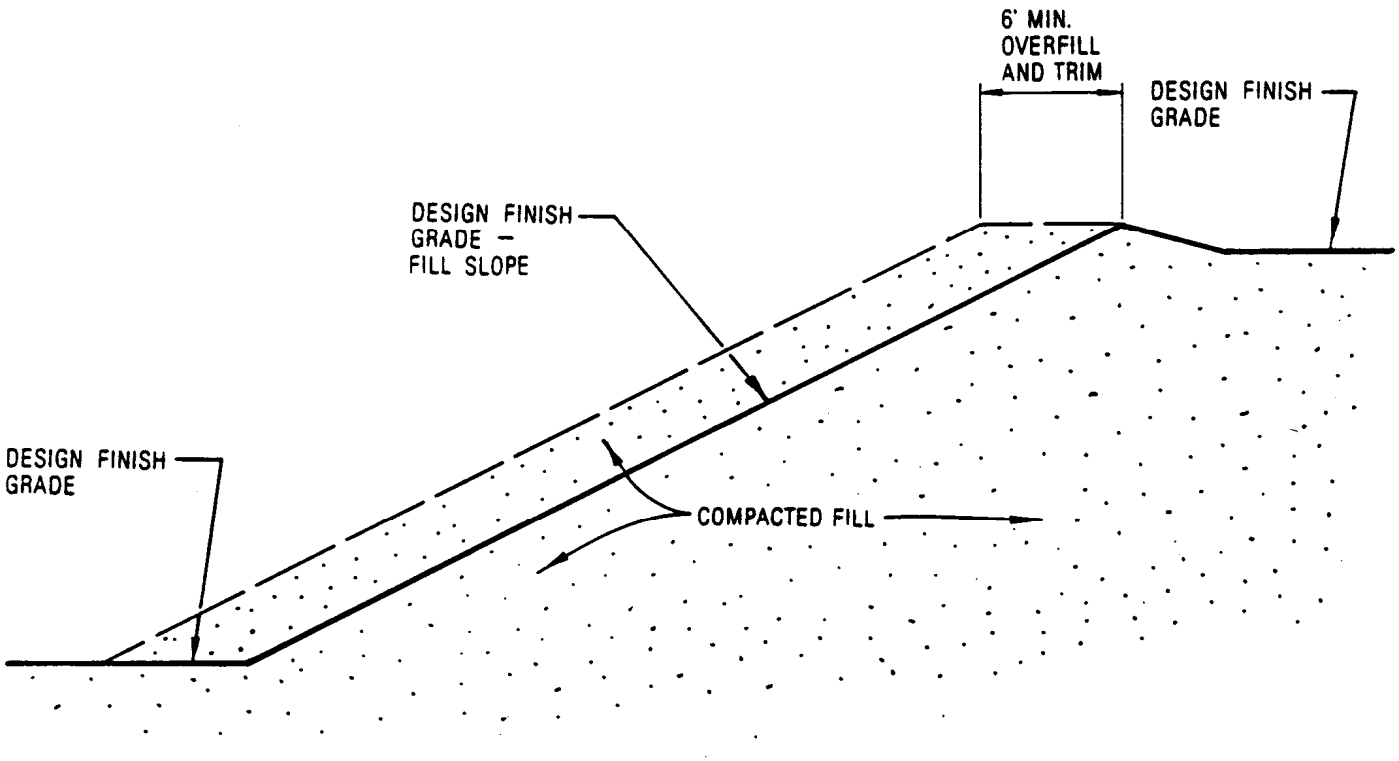



NOTE:
BENCHING SHALL BE REQUIRED WHEN NATURAL SLOPES ARE EQUAL TO OR STEEPER THAN 5:1 OR WHEN RECOMMENDED BY THE SOIL ENGINEER.

# TYPICAL FILL-OVER-CUT SLOPE



# TYPICAL FILL SLOPE CONSTRUCTION




NOTES:

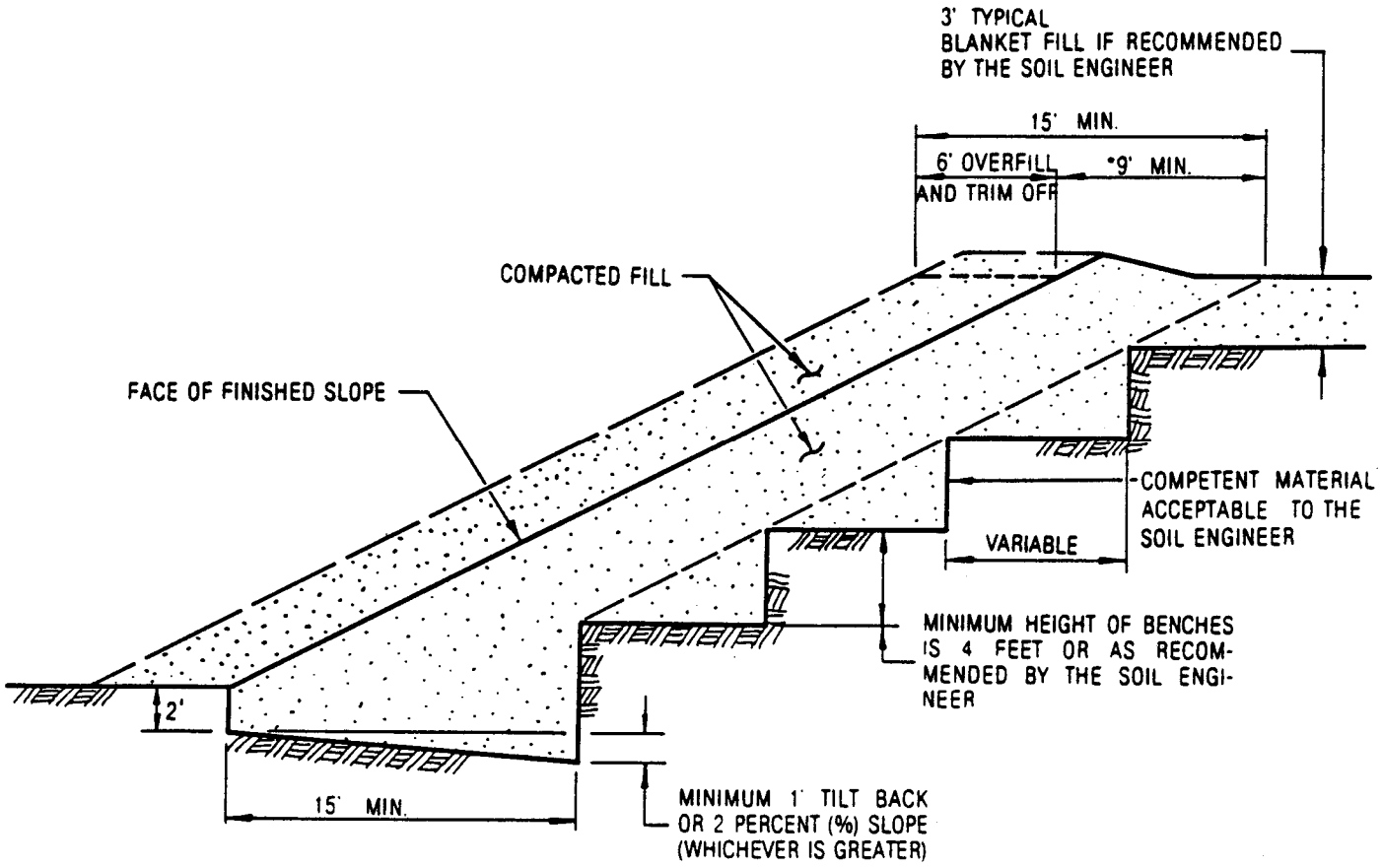
1. ALL FILL SLOPES, INCLUDING BUTTRESS AND STABILIZATION FILLS, SHALL BE OVERFILLED A MINIMUM OF SIX FEET HORIZONTALLY WITH COMPACTED FILL AND TRIMMED TO THE DESIGN FINISH GRADE.

   EXCEPTIONS:

   A. FILL SLOPE OVER CUT SLOPE.
   B. FILL SLOPE ADJACENT TO EXISTING IMPROVEMENTS.

2. THE EXCEPTIONS ABOVE WHICH DO NOT HAVE THE 6 FOOT SLOPE OVERFILL AND TRIM SHALL BE COMPACTED AS STATED IN THE PROJECT SPECIFICATIONS.

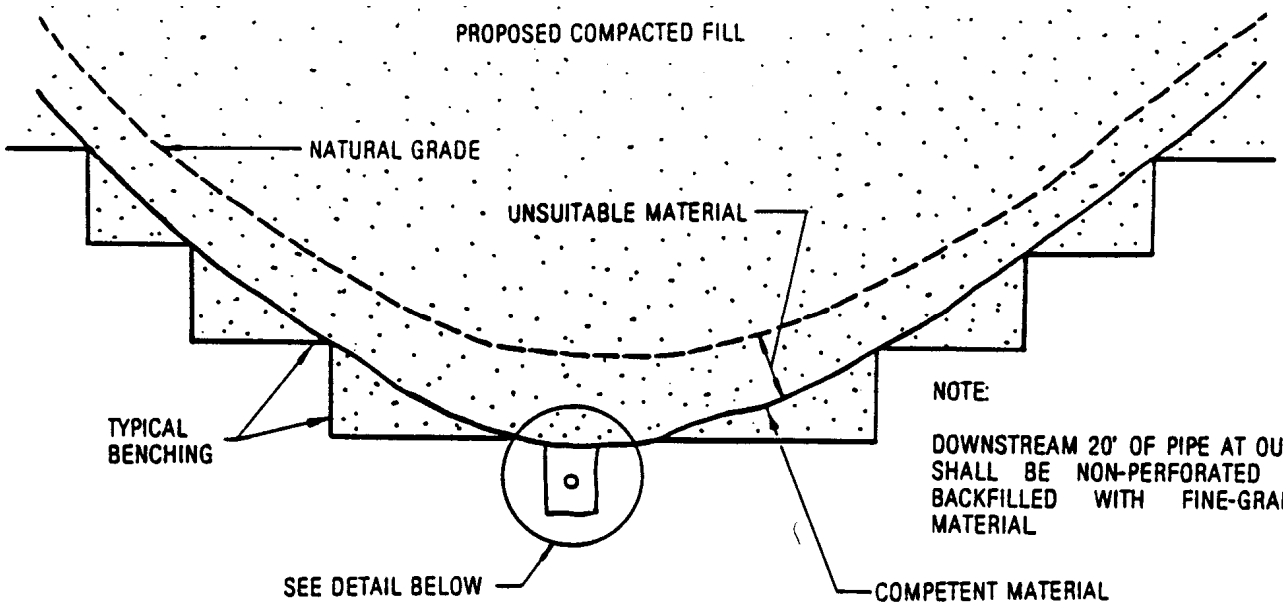
# TYPICAL STABILIZATION FILL




NOTE:
SEE PLATE 6 FOR TYPICAL SUBDRAIN DETAILS FOR STABILIZATION FILLS. IF RECOMMENDED BY THE SOIL ENGINEER.

*GREATER THAN 9' IF RECOMMENDED BY THE SOIL ENGINEER: 15' WHERE NO 6' OVERFILL

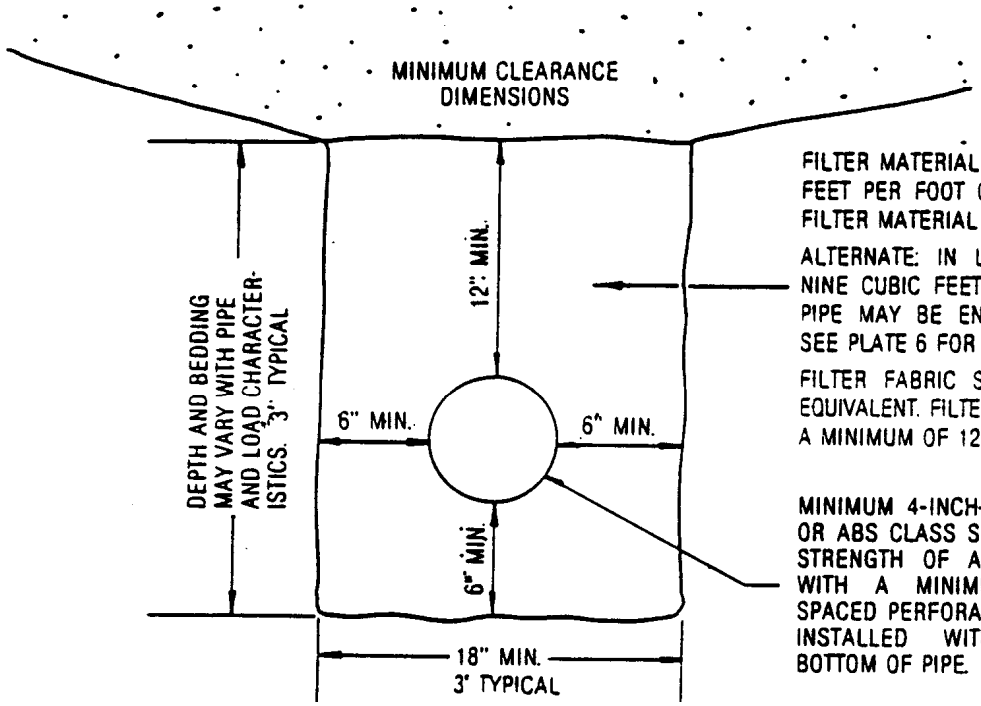
# TYPICAL CANYON SUBDRAIN




NOTE:

DOWNSTREAM 20' OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL

NOTES:
PIPE SHALL BE A MINIMUM OF 4 INCHES DIAMETER AND RUNS OF 500 FEET OR MORE USE 6-INCH DIAMETER PIPE, OR AS RECOMMENDED BY THE SOIL ENGINEER



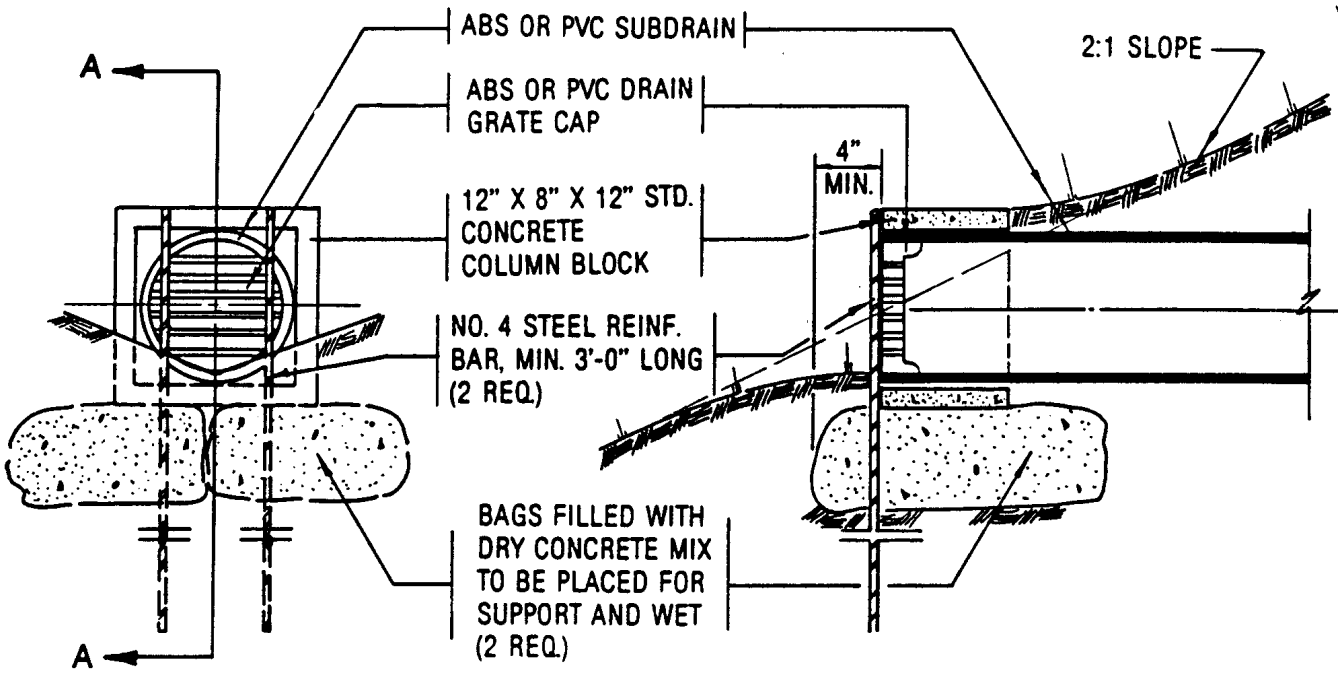

FILTER MATERIAL – MINIMUM OF NINE CUBIC FEET PER FOOT OF PIPE. SEE PLATE 6 FOR FILTER MATERIAL SPECIFICATION.

ALTERNATE: IN LIEU OF FILTER MATERIAL NINE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE PLATE 6 FOR GRAVEL SPECIFICATIONS.

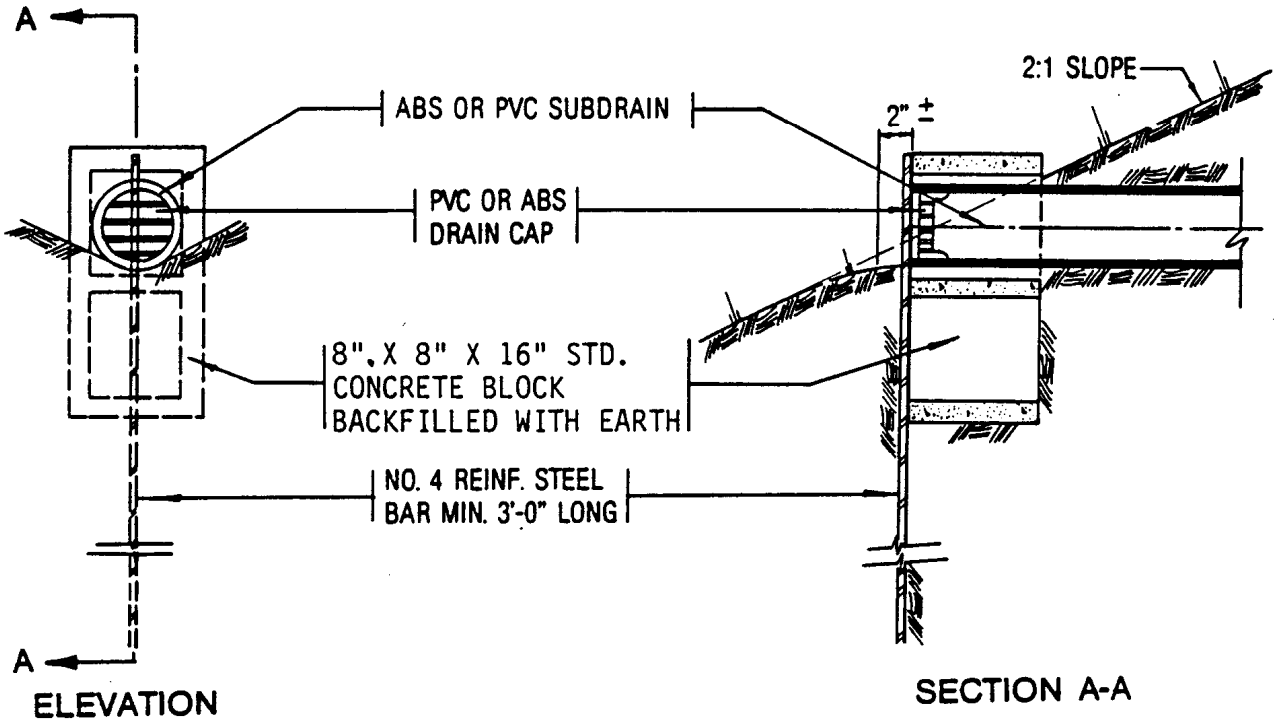
FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

MINIMUM 4-INCH-DIAMETER, PVC SCH. 40 OR ABS CLASS SDR-35 WITH A CRUSHING STRENGTH OF AT LEAST 1000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE, INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE.

# SUBDRAIN OUTLET MARKER

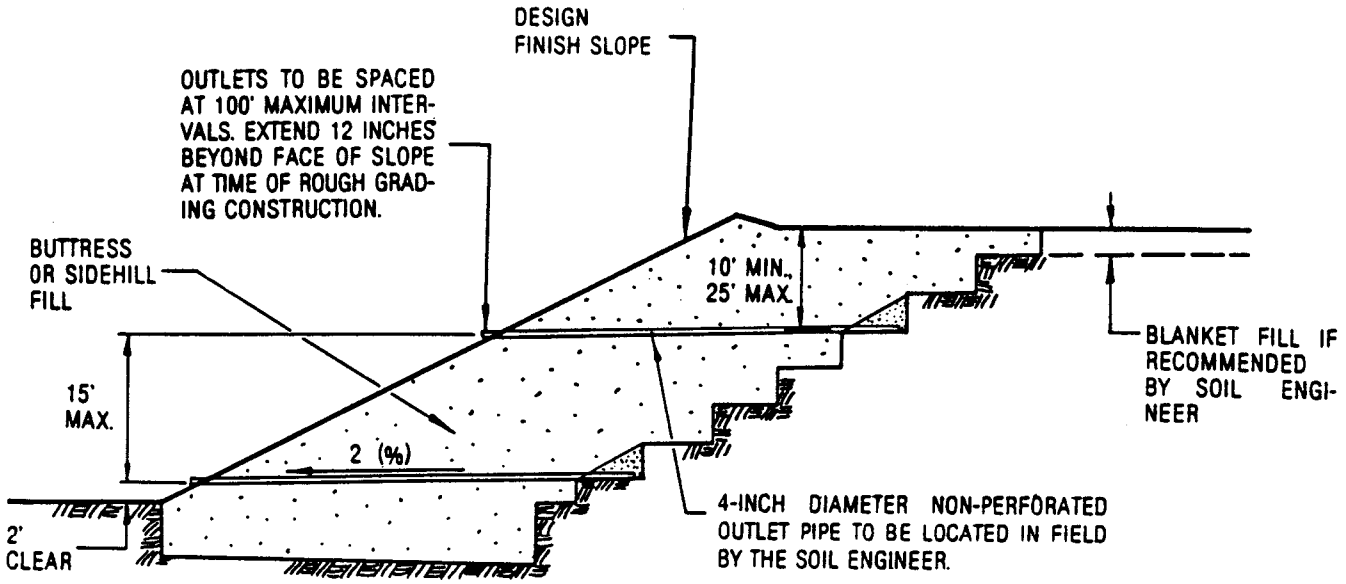



## SUBDRAIN OUTLET MARKER FOR 6" AND 8" PIPES




## SUBDRAIN OUTLET MARKER – 4" PIPE

# TYPICAL STABILIZATION AND BUTTRESS FILL SUBDRAIN




FILTER MATERIAL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT: (CONFORMS TO MA STD. PLAN 323)

| SIEVE SIZE | PERCENTAGE PASSING |
|---|---|
| 1" | 100 |
| 3/4" | 90-100 |
| 3/8" | 40-100 |
| NO. 4 | 25-40 |
| NO. 8 | 18-33 |
| NO. 30 | 5-15 |
| NO. 50 | 0-7 |
| NO. 200 | 0-3 |

"GRAVEL" TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUIVALENT:

| SIEVE SIZE | MAXIMUM PERCENTAGE PASSING |
|---|---|
| 1½" | 100 |
| NO. 4 | 50 |
| NO. 200 | 8 |

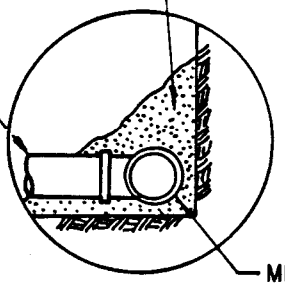
SAND EQUIVALENT = MINIMUM OF 50

FILTER MATERIAL – MINIMUM OF FIVE CUBIC FEET PER FOOT OF PIPE. SEE ABOVE FOR FILTER MATERIAL SPECIFICATION.

ALTERNATIVE: IN LIEU OF FILTER MATERIAL, FIVE CUBIC FEET OF GRAVEL PER FOOT OF PIPE MAY BE ENCASED IN FILTER FABRIC. SEE ABOVE FOR GRAVEL SPECIFICATION.

FILTER FABRIC SHALL BE MIRAFI 140 OR EQUIVALENT. FILTER FABRIC SHALL BE LAPPED A MINIMUM OF 12 INCHES ON ALL JOINTS.

OUTLET PIPE TO BE CONNECTED TO SUBDRAIN PIPE WITH TEE OR ELBOW



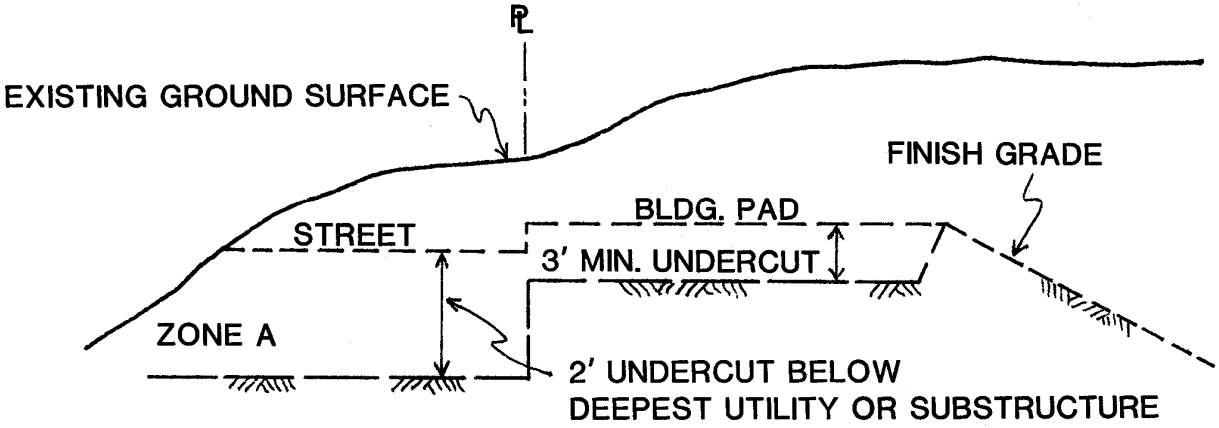
MINIMUM 4-INCH DIAMETER PVC SCH 40 OR ABS CLASS SDR 35 WITH A CRUSHING STRENGTH OF AT LEASE 1,000 POUNDS, WITH A MINIMUM OF 8 UNIFORMLY SPACED PERFORATIONS PER FOOT OF PIPE INSTALLED WITH PERFORATIONS ON BOTTOM OF PIPE. PROVIDE CAP AT UPSTREAM END OF PIPE. SLOPE AT 2 PERCENT TO OUTLET PIPE.

NOTES:

1. TRENCH FOR OUTLET PIPES TO BE BACKFILLED WITH ON-SITE SOIL.

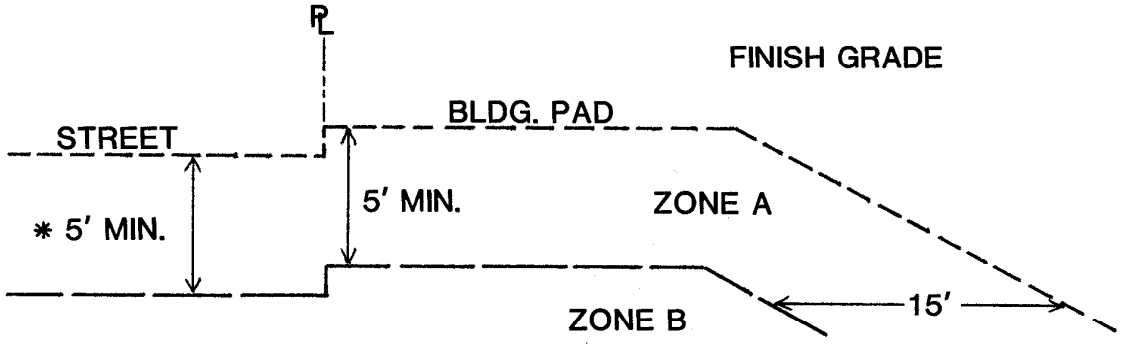
# TYPICAL CUT AND FILL GRADING DETAILS

TYPICAL GRADING WITHIN PROPOSED DEEP BEDROCK CUT AREAS




NO SCALE

TYPICAL GRADING WITHIN PROPOSED FILL AREAS



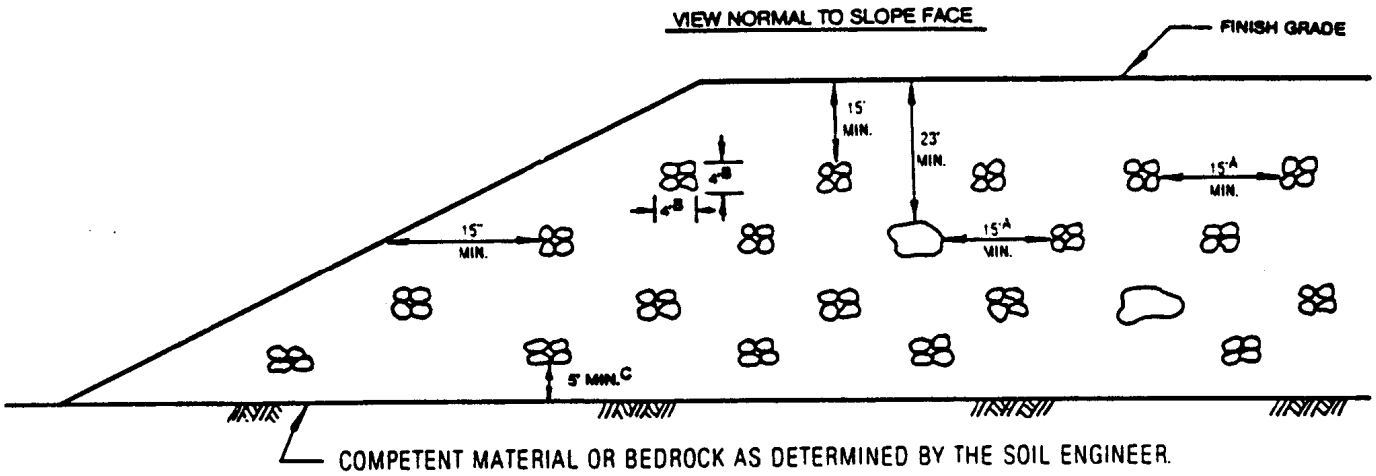

LEGEND

ZONE A ....."SOIL" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

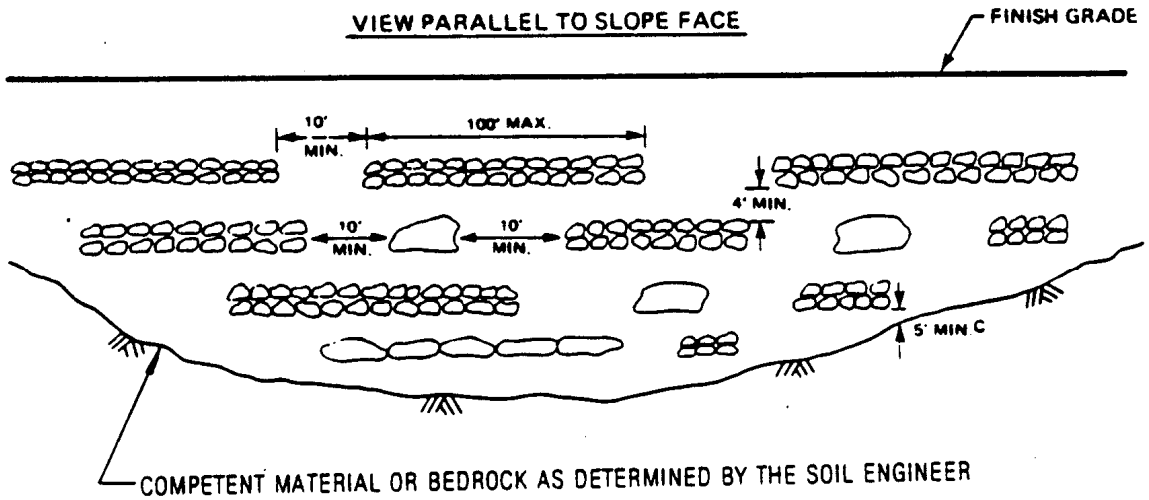
ZONE B ....."SOIL-ROCK" AND/OR "ROCK" FILL PLACED IN ACCORDANCE WITH THE RECOMMENDATIONS PRESENTED IN SECTION 11.2.3 OF THIS REPORT

* 5′ OR 1′ BELOW DEEPEST UTILITY, WHICHEVER IS GREATER

# TYPICAL OVERSIZE ROCK DISPOSAL – "SOIL-ROCK" FILL




NOTE:
ORIENTATION OF WINDROWS MAY VARY BUT SHALL BE AS RECOMMENDED BY SOIL ENGINEER.




NOTES:

A. ONE EQUIPMENT WIDTH OR A MINIMUM OF 15 FEET.
B. HEIGHT AND WIDTH MAY VARY DEPENDING ON ROCK SIZE AND TYPE OF EQUIPMENT.
C. IF APPROVED BY THE SOIL ENGINEER, WINDROWS MAY BE PLACED DIRECTLY ON COMPETENT MATERIALS OR BEDROCK PROVIDING ADEQUATE SPACE IS AVAILABLE FOR COMPACTION.
D. VOIDS IN WINDROW TO BE FILLED BY FLOODING GRANULAR SOIL INTO PLACE. GRANULAR SOIL SHALL MEAN ANY SOIL WHICH HAS A UNIFIED SOIL CLASSIFICATION SYSTEM (UBC 29-1) DESIGNATION OF SM, SP, SW, GM, GP, OR GW.
E. AFTER FILL BETWEEN WINDROWS IS PLACED AND COMPACTED WITH THE LIFT OF FILL COVERING WINDROW, WINDROW SHALL BE PROOF-ROLLED WITH D-9 DOZER OR EQUIVALENT.
F. OVERSIZED ROCK IS DEFINED AS LARGER THAN 12" IN SIZE.