

**UPDATED GEOTECHNICAL REPORT
PROPOSED SINGLE-FAMILY RESIDENTIAL DEVELOPMENT
TRACT No. 20707
VERDEMONT DRIVE AND NORTH ANTIQUE STREET
SAN BERNARDINO, SAN BERNARDINO COUNTY, CALIFORNIA**

PREPARED FOR

**VERDEMONT HEIGHTS I, LLC
434 NORTH 2ND AVENUE
UPLAND, CALIFORNIA 91783**

PREPARED BY

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October 1, 2024
Project No. 4044-CR

Verdemont Heights I, LLC

434 North 2nd Avenue

Upland, California 91783

Attention: Ms. Arlene Anaya

Subject: Updated Geotechnical Report

Proposed Single-Family Residential Development

Tract No. 20707

Verdemont Drive and North Antique Street

San Bernardino, San Bernardino County, California

Dear Ms. Anaya:

GeoTek, Inc. (GeoTek) is pleased to provide the results of this Updated Geotechnical Report for the subject project located northeast of the intersection of Verdemont Drive and North Antique Street, in the City of San Bernardino, San Bernardino County, California. This report presents the results of GeoTek's evaluation and discussion of the findings.

Based on the results of this evaluation, development of the property appears feasible from a geotechnical viewpoint provided that the recommendations presented in this report and in future reports are incorporated into design and construction.

GeoTek has reviewed the recommendations provided within the referenced reports prepared by Lawson & Associates Geotechnical Consulting, Inc. (Lawson & Associates Geotechnical Consulting, Inc., 2004) and LGC Inland, Inc. (LGC Inland, Inc., 2005) and generally concurs with the recommendations provided in their reports. GeoTek accepts the previous data, findings, conclusions and geotechnical recommendations provided in the referenced documents, except as amended in this report. GeoTek is now assuming the status of Geotechnical Engineer of Record for the proposed development.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call GeoTek.

Respectfully submitted,
GeoTek, Inc.



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Appendix B – General Earthwork Grading Guidelines

I. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical engineering and geologic conditions of the subject site as related to the currently proposed development. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data and general information pertinent to the site,
- Review of geotechnical reports previously prepared for this site by Lawson & Associates Geotechnical Consulting, Inc. (Lawson & Associates Geotechnical Consulting, Inc., 2004) and LGC Inland, Inc. (LGC Inland, Inc., 2005),
- Performance of a site reconnaissance,
- Review and evaluation of site seismicity and geologic hazards, and
- Compilation of this Updated Geotechnical Report which presents GeoTek's findings and a general summary of pertinent geotechnical conditions relevant for site development.

The intent of this report is to aid in the evaluation of the site for future development from a geotechnical perspective. The professional opinions and geotechnical information contained in this report will likely need to be updated based on review of final site development plans. These should be provided to GeoTek for review when available.

2. SITE DESCRIPTION, PROPOSED DEVELOPMENT AND PRIOR REPORT REVIEW

2.1 SITE DESCRIPTION

Tract No. 20707 is located northeast of the intersection of Verdмонт Drive and North Antique Street, in the City of San Bernardino, San Bernardino County, California (see Figure I, Site Location and Topography Map). Based on review of aerial images and a recent site reconnaissance, an existing storm water facility basin occupies the southwestern corner of the site; the remainder of the site is currently vacant land.

The irregular shaped project site is currently comprised of a portion of six (6) parcels of land (San Bernardino County Assessor's Parcel Numbers (APNs) 0348-121-14, -27 and -28; 0261-011-02, -03 and -10) and encompasses a total of approximately 108 acres. The site can generally be accessed from Verdemont Drive from the southeast, an unimproved roadway. Several dirt trails transect the site.

The subject tract and site area can be considered as having sloping terrain. Based on the topographic map for the area and other documents reviewed for this report, the elevation of the subject site ranges from approximately 1,965 above msl (mean sea level) to 2,168 feet above msl, with surface drainage generally directed to the southwest.

The site is in an area largely characterized by residential development and vacant land. The site is bound by vacant land to the west, north and east. An existing debris basin is located adjacent to the northeast corner of the site while a water storage tank is located adjacent to the northwest corner of the site. Verdemont Drive, followed by single-family residences, bounds the site to the south.

2.2 PROPOSED DEVELOPMENT

Based upon review of a *Tentative Tract Map*, prepared by Bonadiman (undated), site development for the project will consist of 115 lots for the future accommodation of single-family residential structures (see Figure 2). Other tract improvements are anticipated to include a debris basin, storm water disposal facilities, underground utilities, interior street/parking/drive areas and landscape/hardscape improvements. Perimeter/interior walls are anticipated as part of the tract development.

It is anticipated that the residential structures will be up to two stories in height. Conventional shallow (isolated spread and continuous wall) foundations and slabs-on-grade are anticipated. Maximum anticipated structural loads of 2.5 kips per lineal foot for continuous foundations and 50 kips for columns are anticipated. Sewage disposal will be by a public sewer.

Design cuts and fills of up to approximately 60 and 20 feet, respectively, are anticipated to be required to bring the site to design grades. Cut and fill slopes up to 60 feet in height are depicted on the *Tentative Tract Map* (see Figure 2).

As site development planning progresses and plans become available, the plans should be provided to GeoTek for review and comments, if warranted. Additional engineering analyses may be necessary in order to provide specific earthwork recommendations and geotechnical design parameters for actual site development.

2.3 PRIOR REPORT REVIEW

GeoTek's review of the reports and documents provided to this firm (Lawson & Associates Geotechnical Consulting, Inc., 2004 and LGC Inland, Inc., 2005) is summarized below in chronological order.

Preliminary Geotechnical and Fault Investigation (Lawson & Associates Geotechnical Consulting, Inc., 2004)

Lawson & Associates Geotechnical Consulting, Inc. (Lawson) issued a *Preliminary Geotechnical and Fault Investigation* report for the subject project on July 20, 2004.

Lawson stated that the scope of work included drilling, logging and selective sampling of five (5) hollow-stem auger borings to depths between 14 and 50.5 feet; seven (7) test pits to depths of six (6) to 12 feet; and one (1) 300-foot-long fault trench to approximately seven (7) feet deep; and laboratory testing.

Lawson stated that the proposed development consisted of single-family homes.

Lawson reported that no strong geomorphic lineaments were interpreted to project through the site during the review of aerial photographs. However, strong geomorphic evidence was present just north of the site, coinciding with the San Andreas fault. Geomorphic evidence of active landsliding was not observed on the site by Lawson.

Lawson reported that the laboratory testing included maximum dry density/optimum moisture content, expansion index, R-value, consolidation, corrosivity and in-situ density/moisture content.

Lawson reported that the earth materials on the site were comprised of undocumented artificial fill and alluvial fan deposits. The undocumented fill materials were reported to have been encountered within two test pits and one boring, up to 7.5 feet in thickness and covering an area approximately 300 feet wide and 700 feet long. The undocumented fill materials were reported to generally consist of loose layers of sandy clay, clayey sand and silty sand (CL, SC and SM soil types based on the Unified Soil Classification System) with varying amounts of gravel, cobbles and boulders. The undocumented fill materials were assumed to have been derived from the construction of the debris basin located northeast of the site.

Lawson reported that alluvial fan deposits were encountered from the surface to the maximum depth explored of 50.5 feet. The alluvial fan deposits consisted of light brown to dark brown, silty sand, sand and silty gravel with sand, cobbles and boulders (SM, SP and GM soil types).

Lawson reported that very old alluvial fan deposits were encountered in the fault trench located in the northwest corner of the site. The very old alluvial fan deposits consisted of red to yellow red, clayey sand (SC soil type) and occasional silty sand (SM soil type) with various amounts of gravel, cobbles and boulders.

Lawson reported that groundwater was not encountered to the maximum depth explored of about 50.5 feet.

Lawson reported that the closest known active fault to the site is the San Andreas fault, located approximately 300 feet to the north. The presence of the fault was reported by Lawson to be interpreted from aerial photographs or by direct observation of the offset drainage, aligned vegetation, incised hills, etc. Lawson further reported that a splay of the San Andreas fault is mapped within the *Alquist-Priolo* Earthquake Fault Zone. Lawson reported that no evidence to support the existence of this splay or any other splay was observed in their fault trench or during the site reconnaissance and aerial photographic interpretations. Lawson stated that based on interpretation, the splay is older than 11,000 years as evidenced by the lack of right-lateral offsets within the alluvial fan deposits or very old alluvial fan deposits and by the apparent lack of expression within the younger alluvial materials. Lawson stated that as a result of this accumulation of data, the splay is not interpreted as being active and therefore, no structural setbacks were required or recommended.

Lawson stated that based on their exploration, anticipated removal depths would vary from four (4) to 14 feet, with the deepest removals being within the undocumented artificial fill areas.

Lawson reported that oversize rock (i.e., rock exceeding a maximum dimension of 12 inches) was expected to be encountered during construction and would require special handling, such as rock blanket fills, windrows, offsite disposal or stockpiled onsite and crushed for future use.

Lawson provided typical earthwork recommendations for overexcavation of cut and cut/fill transition lots.

Lawson provided a shrinkage value of 10 to 15 percent for the removal and recompaction of both the undocumented artificial fill soils and the young alluvial fan deposits. Subsidence was expected to vary from negligible to approximately 0.1 foot.

Lawson provided seismic design parameters for the project based on a Site Class “D” and the 1997 Uniform Building code (UBC).

Lawson reported that the potential for earthquake induced liquefaction at the site was considered very low to remote due the relatively deep groundwater and the dense nature of the deeper on-site soils. Lawson did not provide an estimate of anticipated seismic (“dry sand”) settlement potentials.

Lawson provided geotechnical recommendations for a conventional slab-on-grade foundation system for the project structures.

Lawson stated that based on laboratory testing, the on-site earth materials have a “Very Low” (0-20) expansion index. Lawson also reported that based on laboratory testing, the on-site earth materials can be classified as having a “negligible” sulfate exposure condition and can be considered “mildly corrosive” to buried metals.

Lawson provided preliminary geotechnical recommendations for site retaining walls, concrete flatwork and pavement design recommendations for the project.

Second Response to the City of San Bernardino Review Comments (LGC Inland, Inc., 2005)

LGC Inland, Inc. (LGC) issued a *Second Response to the City of San Bernardino Review Comments* report for the subject project on December 5, 2005. It should be noted that Lawson is now doing business as LGC.

LGC stated that they issued a revised version of the referenced report (Lawson, 2004) on December 20, 2004 that included a revised Geotechnical Map, which included a revised Tentative Tract Map. LGC stated that the report remained applicable; however, the revised plates included in the response report should supersede the previous versions. GeoTek was not provided with the stated report dated December 20, 2004 for this evaluation; nor was GeoTek provided the *First Response* report for the project for this evaluation.

Mr. Floyd J. Williams, a geotechnical consultant to the City of San Bernardino, provided two (2) “recommendations” based on review of the December 20, 2004 report. LGC provided the two (2) recommendations along with a response to each recommendation, as follows:

Recommendation No. 1: Excavate another exploratory fault trench in a direction normal to the Alquist-Priolo zone boundary across the area between the boundary and the limit line to the

northeast that defines the area to be developed. Mr. Williams suggested that the trench be located approximately 600 feet southeast of Trenches FT-1 and FT-2.

LGC Response to Recommendations No. 1: An additional trench 255 feet long fault trench was excavated normal to the *Alquist-Priolo* zone boundary roughly 600 feet southeast of Trenches FT-1 and FT-2. This trench was labeled FT-3. Mr. Floyd J. Williams was stated to have been contacted to observe the additional trench excavation. No evidence of active faulting was observed within the trench. In addition, three trenches on the order of 500± feet long were recently excavated and logged by LGC within the *Alquist-Priolo* zone on an adjacent property to the southeast. No evidence of active faulting was observed in these trenches as well.

Recommendation No. 2: Submit a supplementary report including an updated geotechnical map displaying the additional trench location and the logs of the new trench to Mr. Ben Steckler, Associate Planner, City of San Bernardino.

LGC Response to Recommendations No. 2: A revised Geotechnical Map and the trench logs were enclosed in the report to supplement the previous report. LGC stated that strong geomorphic evidence of lineaments was present just north of the site, coinciding with the mapped location of the San Andreas fault. However, no evidence of active faulting was observed in FT-1 through FT-3 excavated on the site. LGC further stated that the conclusions and recommendations of the referenced reports remain applicable.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 PREVIOUS FIELD EXPLORATION

Field explorations were previously performed at this site by Lawson (2004) and LGC (2005), as discussed in Section 2.3 of this report.

The approximate locations of the prior excavations for the project (Lawson, 2004) are presented on the Geotechnical Map (dated July 2004) prepared by Lawson which is included in Appendix A of this report. The logs of the exploratory borings and trenches for the explorations performed by Lawson (2004) are also included in Appendix A of this report. The subsurface exploration program conducted by Lawson (2004) occurred on January 8 and 12, 2004, and included the excavation of five (5) exploratory hollow-stem auger borings (B-1 through B-5), to depths ranging from approximately 14 and 50.5 feet below existing grades; seven (7) exploratory trenches (TP-1 through TP-7) to depths ranging from

approximately six (6) to 12 feet below existing grades; and one (1) 300-foot long fault trench (FT-1) to approximately seven (7) feet deep.

The approximate locations of the prior excavations for the project (LGC, 2005) are presented on the Geotechnical Map prepared by LGC which is also included in Appendix A of this report. The logs of the exploratory trenches for the explorations performed by LGC (2005) are also included in Appendix A of this report. The subsurface exploration program conducted by LGC (2005) occurred December 2005 and included the excavation of two (2) additional fault trenches (FT-2 and FT-3).

No additional field exploration was performed for this Updated Geotechnical Report.

3.3 PREVIOUS LABORATORY TESTING

Laboratory testing was previously performed by Lawson (2004) for soil samples collected from the site during their prior field exploration program. Laboratory testing included maximum dry density/optimum moisture content, expansion index, R-value, consolidation, corrosivity, sulfate content and in-situ density/moisture content. The results of the prior laboratory testing are presented in Appendix A of this report.

No additional laboratory testing was performed for this Updated Geotechnical Report.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is situated in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. Basically, it extends approximately 975 miles from the Transverse Ranges geomorphic province southerly to the tip of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zone trend northwest-southeast and are found near the middle of the province.

The Newport-Inglewood Fault zone is located in the western portion of the province and the San Andreas Fault zone borders the northeasterly margin of the province.

More specific to the subject property, the site is located in an area geologically mapped to be underlain by alluvium (Dibblee, T.W. and Minch, J.A., 2004).

The site parcels are partially located within an “*Alquist-Priolo*” fault hazard zone. The site has not yet been mapped to be located within a California Geological Survey identified liquefaction or seismic-induced landslide zone.

No evidence of active faulting was identified in the proposed residential development area of the site by LGC (2005) within the limits of their Fault Trenches 1, 2 and 3. GeoTek concurs with this conclusion provided by LGC (2005).

4.2 GEOLOGIC MATERIALS

A brief description of the earth materials encountered is presented in the following section. Based on the site reconnaissance, previous exploratory excavations and review of published geologic maps, the site is locally underlain by undocumented artificial fill and alluvial fan deposits.

4.2.1 Undocumented Artificial Fill (Map Symbol - Afu)

Lawson (2004) reported that the undocumented fill materials were encountered within two test pits and one boring, up the 7.5 feet in thickness and covering an area approximately 300 feet wide and 700 feet long. The undocumented fill materials were reported to generally consist of loose layers of sandy clay, clayey sand and silty sand (CL, SC and SM soil types based on the Unified Soil Classification System) with varying amounts of gravel, cobbles and boulders. The undocumented fill materials were assumed to have been derived from the construction of the debris basin located northeast of the site.

Expansion index testing (ASTM D 4829) performed by Lawson (2004) indicated the near surface soils have a “Very Low” (0-20) expansion index (EI). Based on the laboratory test results, the near surface materials have a soluble sulfate content of less than 0.1 percent (ASTM D 4327). The test results are provided in Appendix A of this report.

4.2.2 Alluvial Fan Deposits (Map Symbol – Qyf)

Lawson reported that alluvial fan deposits were encountered from the surface to the maximum depth explored of 50.5 feet. The alluvial fan deposits consisted of light brown to dark brown, silty sand, sand and silty gravel with sand, cobbles and boulders (SM, SP and GM soil types).

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

If encountered during earthwork construction, surface water on this site will likely be the result of precipitation or possibly some minor surface run-off from immediately surrounding properties. Overall site area drainage is to the southwest, as directed by site topography. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

Lawson (2004) reported that groundwater was not encountered to the maximum depth explored of about 50.5 feet. Groundwater is anticipated to be greater than 50 feet below the ground surface. It is possible that seepage may be encountered following periods of heavy and/or prolonged precipitation.

Based on the results of the field exploration, review of site area geomorphology and geology, groundwater/seepage will likely not be encountered during excavation and grading operations. If groundwater/seepage is encountered during construction, it is anticipated that the water can be effectively managed within shallow excavations with the use of lined sump pumps placed in the bottom of excavations or other drainage devices.

4.4 FAULTING AND SEISMICITY

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is in a seismically active region.

The site parcels are partially located within an “Alquist-Priolo” fault hazard zone. No evidence of active faulting was identified in the proposed residential development area of the site by LGC (2005) within the limits of their Fault Trenches 1, 2 and 3. GeoTek concurs with this conclusion provided by LGC (2005). GeoTek does recommend the implementation of restricted use setback zones for habitable structures at this time.

4.4.1 Seismic Design Parameters

The site is located at approximately 34.2107 Latitude and -117.3610 West Longitude. Based on the relatively dense soil conditions encountered across the site, a Site Class “D” is considered appropriate for this project. Site spectral accelerations (S_a and S_1), for 0.2 and 1.0 second periods for a Class “D” site, was determined from the SEAOC/OSHPD web interface

that utilizes the USGS web services and retrieves the seismic design data and presents that information in a report format.

The following seismic design parameters, based on the 2015 National Earthquake Hazards Reduction Program (NEHRP)/ASCE 7-16/2022 CBC, are presented below:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_s	2.48g
Mapped 1.0 sec Period Spectral Acceleration, S_1	1.056g
Site Coefficient for Site Class "D", F_a	1.0
Site Coefficient for Site Class "D", F_v	1.7**
Maximum Considered Earthquake Spectral Response Acceleration for 0.2 Second, S_{MS}	2.48g
Maximum Considered Earthquake Spectral Response Acceleration for 1.0 Second, S_{M1}	2.694g*
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	1.653g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	1.796g*
Site Modified Peak Ground Acceleration, PGA_M	1.172g
Seismic Design Category	E

*ASCE 7-16 Supplement 3 Section 11.4.8 requires a ground motion hazard analysis for structures on Site Class "D" for values of S_1 greater than or equal to 0.2g. However, a ground motion hazard analysis is not required where the values of S_{M1} and S_{D1} are increased by 50%. The S_{M1} and S_{D1} values shown above already include the 50% increase, so that exception can be obtained.

**ASCE 7-16 Supplement 3 Section 11.4.8 indicates that the value of F_v should only be used for calculation of T_s , determination of Seismic Design Category, linear interpolation for intermediate values of S_1 , and when taking the exceptions under Items 1 and 2 of Section 11.4.8 for the calculation of S_{D1} .

Final selection of the appropriate seismic design coefficients should be made by the project structural engineer based upon the local practices and ordinances, expected building response and desired level of conservatism.

4.4.2 Liquefaction & Seismic Settlements

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

The site is not mapped within an area identified by the County of San Bernardino for liquefaction ([FH22C_20100309.pdf \(sbcounty.gov\)](#)). Due to the relative dense nature of the alluvial materials underlying the site and lack of shallow groundwater, it is GeoTek's opinion that the potential for liquefaction and seismic induced ("dry sand") settlement at this site is very low.

4.4.3 Other Seismic Hazards

The potential for secondary seismic hazards such as seiche and tsunami is considered to be remote due to site elevation and distance from an open body of water. Due to the absence of a nearby free-face and the very low liquefaction hazard, the potential for lateral spreading is considered to be nil.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Development of the site appears feasible from a geotechnical viewpoint. The specific recommendations for site development provided in this report will need to be further evaluated when development plans are provided for review. The following sections present general recommendations. More specific geotechnical recommendations for site development can be provided when more finalized site development plans are available for review.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of San Bernardino, the 2022 California Building Code (CBC) and recommendations contained in this report. The General Grading Guidelines included in Appendix B outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix B.

5.2.2 Site Clearing and Demolition

Initial site preparation should commence with removal of debris, pavements, underground utilities, deleterious materials and vegetation within the limits of the planned improvements. Existing utilities, not planned for re-use, should be capped off at the property boundaries and removed. All materials generated by demolition and site clearing operations should be properly disposed of off-site. Voids resulting from removing any materials should be replaced with engineered fill materials with expansion characteristics similar to the onsite materials.

5.2.3 Remedial Grading

All existing undocumented fill and the upper five (5) feet of the alluvial fan deposits should be removed to expose competent materials for all areas to receive new fill and/or surface improvements. Competent materials are considered to be undisturbed alluvial fan deposits with a minimum of 85 percent relative compaction (ASTM D1557) and little to no visible porosity. Removal depths are anticipated to range from about five (5) to 14 feet across the majority of the site (Lawson, 2004).

The actual depths of removals should be determined by a GeoTek representative during site grading based on actual soil conditions encountered. Remedial excavations should be taken to a relatively level bottom across individual building pads. The bottoms of all remedial excavations should be reviewed and approved by a GeoTek representative.

Following approval of excavation bottoms, the exposed subgrade soils should be scarified to a depth of about twelve (12) inches, be moisture treated to slightly above the soil's optimum moisture content (ASTM D1557) and then be compacted to at least 90% of the soil's maximum dry density (ASTM D1557).

Testing by GeoTek is recommended to document that the engineered fill soils have been properly moisture conditioned and compacted as recommended.

Lawson (2004) and LGC (2005) previously excavated approximately 1,000 linear feet of fault trenches to depths up to seven (7) feet below existing grades without properly engineering backfill soils. These previous fault trenches should be completely identified, followed by the removal and replacement of all fault trench excavation backfill soil as properly compacted engineered fill.

5.2.4 Pavement Areas

Undocumented fill should be removed below proposed pavement areas. If no undocumented fill is encountered or is relatively shallow, the natural soils should be overexcavated to a depth

of 12 inches below existing grade or 12 inches below proposed finished grade, whichever is deeper. Finished grade is defined as the top of the subgrade. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 95 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.5 Hardscape Areas

Undocumented fill should be removed below hardscape areas. The exposed soils in these areas and in cut areas should be scarified to a depth of approximately eight inches, moistened to at least the optimum moisture content and compacted to a minimum relative compaction of at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

5.2.6 Slope Construction

Grading details for slope construction are presented as details B-2 and B-3 in Appendix B. Cut slopes in the alluvial fan deposits constructed at maximum gradients of 2:1 (horizontal: vertical) or flatter, in accordance with industry standards, are anticipated to be grossly stable. Surficial stability should be assessed during grading by an engineering geologist. An engineering geologist should observe all cut slopes. Cut slopes should expose competent native alluvial fan deposits. If adverse structure or incompetent materials are exposed and identified in the cut slopes, stabilization fills may be recommended.

Swales should be constructed at the top of all slopes to collect and divert drainage away from the slope face. Drainage should be directed to an approved drainage discharge location. Swales should be constructed with concrete, shotcrete or approved non-erosive material. Swales should be cleaned of loose soil and debris on an on-going basis.

Fill slopes constructed at maximum gradients of 2:1 (horizontal: vertical), in accordance with industry standards, are anticipated to be both grossly and surficially stable. Where fill is to be placed against sloping terrain with gradients of 5:1 (horizontal: vertical) or steeper, the sloping ground surface should be benched to remove loose and disturbed surface soil to assure that the new fill is placed in direct contact with competent bedrock and to provide horizontal surfaces for fill placement. A minimum 10- to 15-foot-wide keyway should be constructed at the toe of the fill slope areas extending at least 2 to 3 feet vertically into competent natural material.

The base of the keyways and benches should be sloped back into the hillside at a gradient of at least two percent. The base of the benches should be evaluated by a representative of GeoTek prior to processing. Upon approval, the exposed materials should be moistened to at least the optimum moisture content and densified to a relative compaction of at least 90 percent of maximum dry density as determined by ASTM D 1557 test procedures.

Fill slopes should also be overbuilt and cut-back to their design grade or the slopes should be back-rolled with a sheepsfoot roller or similar compaction equipment at vertical heights not exceeding four (4) feet. The finished graded slope surface should be compacted to at least 90 percent of the soil's maximum dry density per ASTM D1557. A suitable alternative would be to compact the slopes during construction and then roll the final slope to provide a dense, erosion resistant surface.

Berms should be constructed and maintained at the top of all fill slopes to divert drainage away from the slope faces. An abatement program to control ground-burrowing rodents should be implemented and maintained. Burrowing rodents can decrease the long-term performance of slopes.

5.2.7 Canyon Subdrains

Canyon subdrains should be installed in major drainage swales that will be filled with at least 10 feet of fill. A typical canyon subdrain detail is provided as Figure B-1 in Appendix B. The actual locations of subdrains should be determined by a GeoTek representative during grading based on the conditions encountered. The canyon subdrains should be tied into the project storm drain system (where possible) or daylighted as appropriate. The final 20-foot segment of the subdrain should consist of a non-perforated pipe. Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

5.2.8 Transition Lots and Cut Lots

Rough grading will create cut, cut/fill transition and shallow fill lots. All lots should be overexcavated such that all building pads are underlain by at least five (5) feet of compacted engineered fill and overexcavation bottoms should slope to drain to the adjacent street or suitable direction so ponding of water is not likely to occur. The lateral extent of this recommendation should include the area extending at least five (5) feet beyond the building limits.

Transition (i.e., cut/fill) lots should be overexcavated a minimum of five (5) feet below proposed grades or to a depth of 1/3 the maximum fill thickness.

All cut lots should be overexcavated to a depth of five (5) feet below proposed grade and replaced with engineered fill.

5.2.9 Engineered Fill

The on-site soils are generally considered suitable for reuse as engineered fill provided they are free from vegetation, debris and other deleterious material. The alluvial materials are anticipated to contain significant quantities of oversized rocks (i.e., greater than six (6) inches

maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

Any undercut areas should be brought to final subgrade elevations with fill materials that are placed and compacted in general accordance with minimum project standards. Engineered fill should be placed in six-inch to eight-inch loose lifts, moisture conditioned to at least the optimum moisture content and compacted to a minimum relative compaction of 90 percent as determined by ASTM D1557 test procedures.

5.2.10 Excavation Characteristics

Excavations in the on-site earth materials should be readily accomplished with heavy-duty earthmoving or excavating equipment in good operating condition.

Oversized rocks (>6 inches) should be anticipated on this site. The alluvial fan materials are anticipated to contain significant quantities of oversize (i.e., greater than six inches maximum size). Special excavation techniques and/or equipment (screens) may be required to create acceptable fill.

Overexcavation of drive/street areas during rough grading should be considered due to the anticipated oversized materials to prevent significant trenching difficulties associated with utility installations. The overexcavation should extend to a depth of at least two (2) feet below the deepest planned utility and then be backfilled with properly compacted fill.

5.2.11 Trench Excavations and Backfill

Temporary trench excavations within the on-site materials should be stable at 1.5:1 inclinations for short durations during construction and where cuts do not exceed 15 feet in height. It is anticipated that temporary cuts to a maximum height of four (4) feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90 percent relative compaction (as determined by ASTM D 1557 test procedures). Under-slab trenches should also be compacted to project specifications. Where applicable, based on jurisdictional requirements, the top 12 inches of backfill below subgrade for road pavements should be compacted to at least 95 percent relative compaction. On-site materials may not be suitable for use as bedding

material but should be suitable as backfill provided particles larger than six (6) inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be properly moisture conditioned prior to placement in trenches.

5.2.12 Shrinkage and Subsidence

For planning purposes, a shrinkage factor of about 10 to 15 percent may be considered for removal of any undocumented fill and alluvial materials that are removed and replaced as engineered fill.

It should be noted that the volume associated with the possible removal of oversize rocks greater than 12-inches in diameter from the site during grading, overexcavations or utility trenching should be accounted for in determining final earthwork quantities.

A subsidence loss of up to approximately 0.1 foot is estimated for the project.

Site balance areas should be available in order to adjust project grades, depending on actual field conditions at the conclusion of earthwork construction.

5.2.13 Oversize Rock Materials

Excavations within the alluvial materials will most likely generate oversize materials (greater than 6 inches in maximum dimension). Oversize rocks (exceeding 12 inches in maximum dimension) are anticipated to be encountered during grading. Rocks up to six (6) inches in diameter may be placed within the upper three (3) feet of the building pads. Rocks greater than six (6) inches, and less than 12-inches in diameter, may be placed in fills three (3) to five (5) feet below finish grade if no improvements are planned for those areas than could be adversely impacted (i.e., utilities, pools, etc.). Rocks greater than 12- inches and less than 24-inches in diameter may be placed in fills five (5) to 10 feet below finish grade. Rocks greater than 24-inches can be incorporated in the fills provided they comply with the Rock Burial Details presented on Plate B-4 in Appendix B. Alternatively, oversized materials can be used as slope protection, riprap, crushed or exported from the site.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Foundation and Building Slab Design Criteria

Foundation design criteria for a conventional foundation system, in general conformance with the 2022 CBC, are presented below for the proposed residential structures associated with the project. The graded site soils are anticipated to have a “Very Low” (0-20) expansion index (EI) in accordance with ASTM D 4829. Typical design criteria for the site based upon a “Very Low” expansion index are tabulated below. These are minimal recommendations and are not intended to supersede the design by the project structural engineer.

The conventional foundation elements for the proposed buildings should bear entirely in engineered fill soils or competent native alluvial fan materials (not a combination of the two). Foundations should be designed in accordance with the 2022 CBC.

Expansion index and soluble sulfate testing of the soils should be performed during construction to evaluate the as-graded conditions. Final recommendations should be based upon the actual as-graded soils conditions.

A summary of the foundation design recommendations is presented in the following table:

GEOTECHNICAL RECOMMENDATIONS FOR FOUNDATION DESIGN

Design Parameter	“Very Low” Expansion Index
Minimum Foundation Depth (inches below lowest adjacent grade)	12
Minimum Foundation Width (Inches)*	12
Minimum Slab Thickness (actual) ¹	4 – Actual
Minimum Slab Reinforcing	6” x 6” – W1.4 x W1.4 welded wire fabric placed in middle of slab or No. 3 bars at 24-inch centers placed in middle of slab
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one placed near the top and one near the bottom
Presaturation of Subgrade Soil (Percent of Optimum)	Minimum of 100% of the optimum moisture content to a depth of at least 12 inches prior to placing concrete

*Code minimums per Table 1809.7 of the 2022 CBC should be complied with.

5.3.1.1 An allowable soil bearing capacity of 2,000 pounds per square foot (psf) may be used for design of continuous and perimeter footings 12 inches deep and 12 inches wide, and pad footings 24 inches square and 12 inches deep. Additionally, an increase of

one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). This bearing capacity contains a minimum factor of safety of three (3).

- 5.3.1.2 Based on the recommended site grading, it is estimated a total static settlement of less than one (1) inch will occur. A differential static settlement of about 1/2 inch over a 40-foot span is also estimated.
- 5.3.1.3 The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 3,500 psf for footings founded on engineered fill. The allowable passive earth pressure contains a factor of safety of 1.5. An allowable coefficient of friction between soil and concrete of 0.40 may be used with dead load forces. The coefficient of friction contains a reduction value of one-third. Passive pressure and frictional resistance can be combined without reduction. The upper one (1) foot of soil should be ignored in the passive pressure calculations unless the surface is covered with pavement.
- 5.3.1.4 A grade beam, a minimum of 12 inches wide and 12 inches deep, should be utilized across large entrances. The base of the grade beam should be at the same elevation as the bottom of the adjoining footings.
- 5.3.1.5 GeoTek recommends that control joints in slabs be placed in two directions spaced approximately 24 to 36 times the thickness of the slab in inches. These joints are a widely accepted means to control cracks and should be reviewed by the project structural engineer.

5.3.2 Moisture and Vapor Retarding System

- 5.3.2.1 A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2022 California Green Building Standards Code (CALGreen) Section 4.505.2, the 2022 CBC Section 1907.1 and ACI 360R-10. The vapor retarder design and construction should also meet the requirements of ASTM E 1643. A portion of the vapor retarder design should be the implementation of a moisture vapor retardant membrane.

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to

accidental puncture than thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil thick membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional. The membrane should consist of Stego wrap or the equivalent.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e. thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, ASTM, CALGreen and California Building Code requirements and guidelines.

GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate.

In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention; since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

5.3.3 Miscellaneous Foundation Recommendations

- 5.3.3.1 To minimize moisture penetration beneath the slab-on-grade areas, utility trenches should be backfilled with engineered fill, lean concrete or concrete slurry where they intercept the perimeter footing or thickened slab edge.
- 5.3.3.2 Soils from the footing excavations should not be placed in the slab-on-grade areas unless properly compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.4 Foundation Setbacks

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of $H/3$ (where H is the slope height) from the face of any descending slope. The setback should be at least seven (7) feet and need not exceed 40 feet.
- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem.
- The bottom of any proposed foundations for structures should be deepened so as to extend below a 1:1 projection upward from the bottom of the nearest excavation.

5.4 RETAINING WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Retaining wall foundations embedded a minimum of 12 inches into engineered fill or competent bedrock should be designed using an allowable bearing capacity of 2,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 3,500 psf. A coefficient of friction between soil and concrete of 0.40 may be used with dead load forces. Passive pressure and frictional resistance can be combined without reduction.

An equivalent fluid pressure approach may be used to compute the horizontal active pressure against the wall. The appropriate fluid unit weights are given in the table below for specific slope gradients of retained materials.

Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF)
Level	35
2:1	55

For walls with a retained height greater than six (6) feet, an incremental seismic pressure should be included into the wall design. Where needed, it is recommended that an incremental seismic load for unrestrained walls with level backfill of $18H^2$ [Units: pounds per lineal foot of wall] should be included into the wall design to account for seismic loading conditions, where H is the retained height of the wall. For unrestrained walls with a retained height greater than six (6) feet with backfill of a 2:1 [horizontal: vertical] gradient, a dynamic load increment of $29H^2$ should be included in the wall design. These incremental seismic loads may be assumed to be applied at a point $1/3H$ above the base of the wall.

5.4.2 Restrained Retaining Walls

Any retaining wall that will be restrained prior to placing backfill or walls that have male or reentrant corners should be designed for at-rest soil conditions using an equivalent fluid pressure of 55 pcf (select backfill), plus any applicable surcharge loading. For areas having male or reentrant corners, the restrained wall design should extend a minimum distance equal to twice the height of the wall laterally from the corner, or as otherwise determined by the structural engineer.

5.4.2.1 Other Design Considerations

- Retaining and garden wall foundation elements should be designed in accordance with building code setback requirements. A minimum horizontal setback distance of five (5) feet as measured from the bottom outside edge of the footing to a sloped face is recommended.

- Wall design should consider the additional surcharge loads from superjacent slopes and/or footings, where appropriate.
- No backfill should be placed against concrete until minimum design strengths are evident by compression tests of cylinders.
- The retaining wall footing excavations, backcuts and backfill materials should be approved by the project geotechnical engineer or their authorized representative.
- Positive separations should be provided in garden walls at horizontal distances not exceeding 20 feet.

5.4.3 Soil Corrosivity

The soil resistivity at this site was tested in the laboratory on one (1) sample collected during the previous field investigation conducted (Lawson, 2004). The results of the testing indicate that the on-site soils are considered “mildly corrosive” (15,000 ohm-cm) (Roberge, 2000) to buried ferrous metal in accordance with current standards used by corrosion engineers. Recommendations for protection of buried ferrous metal should be provided by a corrosion engineer. Additional corrosion testing should be performed at the time of site grading to review the corrosion potential of the as-graded soils.

5.4.4 Soil Sulfate Content

The sulfate content was determined in the laboratory on one (1) sample collected during the previous field investigation conducted (Lawson, 2004). The results indicate that the water-soluble sulfate result is less than 0.1 percent by weight, which is considered “negligible” as per Table 19.3.1.1 of ACI 318-19. Based on the test results and Table 19.3.1.1 of ACI 318-19, no special recommendations for concrete are required for this project due to soil sulfate exposure. Additional soil sulfate content testing should be performed at the time of site grading to review the soil sulfate exposure potential of the as-graded soils.

5.4.5 Import Soils

Import soils should have expansion characteristics similar to the on-site soils. GeoTek also recommends that the proposed import soils be tested for expansion and sulfate potential. GeoTek should be notified a minimum of 72 hours prior to importing so that appropriate sampling and laboratory testing can be performed.

5.5 PAVEMENT DESIGN CONSIDERATIONS

Pavement design for proposed on-site pavement (i.e., local and collector) improvements was conducted per Caltrans *Highway Design Manual* guidelines for flexible pavements. An R-value of 40 is being estimated for the post-graded roadway subgrade soils. For preliminary pavement

design, assumed Traffic Indexes (TI) of 5.5 and 7.0 were used. Final pavement design should be based on R-value testing of the graded street subgrades and the assigned TI values. Based on the assumptions noted, the following preliminary pavement design recommendations are provided.

TI	Thickness of Asphalt Concrete (inches)	Thickness of Aggregate Base (inches)
5.5 (Local)	4.0	4.0
7.0 (Collector)	4.0	7.0

The TIs used in the pavement design are typically considered reasonable values for the proposed project street areas and should provide a pavement life of approximately 20 years with a normal amount of flexible pavement maintenance. Irrigation adjacent to pavements, without a deep curb or other cutoff to separate landscaping from the paving may result in premature pavement failure. Traffic parameters used for design were selected based upon engineering judgment and not upon information furnished to us such as an equivalent wheel load analysis or a traffic study.

The recommended pavement sections provided are intended as a minimum guideline and final selection of pavement cross section parameters should be made by the project civil engineer, based upon the local laws and ordinances, expected subgrade and pavement response, and desired level of conservatism. If thinner or highly variable pavement sections are constructed, increased maintenance and repair could be expected. Final pavement design should be checked by testing of soils exposed at subgrade (the upper 12 inches) after final grading has been completed.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base should conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density (modified proctor).

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement, rolling and compaction of asphaltic concrete, should be performed in accordance with the City of San Bernardino specifications, and under the observation and testing of GeoTek and a City Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.



Deleterious material, excessive wet or dry pockets, oversized rock fragments, and other unsuitable yielding materials encountered during grading should be removed. Once existing compacted fills are brought to the proposed pavement subgrade elevations, the subgrade should be proof rolled in order to check for a uniform and unyielding surface. The upper 12 inches of pavement subgrade soils should be scarified, moisture conditioned at or near optimum moisture content, and recompact to at least 95 percent of the laboratory maximum dry density (ASTM D1557). If loose or yielding materials are encountered during construction, additional evaluation of these areas should be carried out by GeoTek. All pavement section changes should be properly transitioned.

5.6 CONCRETE CONSTRUCTION

5.6.1 General

Concrete construction should follow the 2022 CBC and ACI guidelines regarding design, mix placement and curing of the concrete. If desired, GeoTek could provide quality control testing of the concrete during construction.

5.6.2 Concrete Flatwork

Exterior concrete slabs and sidewalks should be designed using a four-inch minimum thickness. No specific reinforcement is required from a geotechnical perspective. However, some shrinkage and cracking of the concrete should be anticipated as a result of typical mix designs and curing practices commonly utilized in industrial construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. should be pre-saturated to a minimum of 100% of the optimum moisture content to a depth of 12 inches for soils having a "Very Low" expansion index.

All concrete installation, including preparation and compaction of subgrade, should be performed in accordance with the City of San Bernardino specifications, and under the observation and testing of GeoTek and a City inspector, if necessary.

5.6.3 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are “hairline” to more than 1/8 inch in width. Most cracks in concrete while unsightly do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek suggests that control joints be placed in two directions and located a distance approximately equal to 24 to 36 times the slab thickness.

Exterior concrete flatwork (patios, walkways, driveways, etc.) is often some of the most visible aspects of site development. They are typically given the least level of quality control, being considered “non-structural” components. It is suggested that the same standards of care be applied to these features as to the structures themselves.

5.7 POST CONSTRUCTION CONSIDERATIONS

5.7.1 Landscape Maintenance and Planting

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be

implemented and maintained. This is critical as burrowing rodents can decrease the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundations. This type of landscaping should be avoided. Planters within 30 feet of the buildings should be above ground and underlain by a concrete slab. Waterproofing of the foundation and/or subdrains may be warranted and advisable. GeoTek could discuss these issues, if desired, when plans are made available.

5.7.2 Drainage

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond or seep into the ground adjacent to the footings and floor-slabs. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

It is the owner's responsibility to maintain and clean drainage devices on or contiguous to their lot. In order to be effective, maintenance should be conducted on a regular and routine schedule and necessary corrections made prior to each rainy season.

5.8 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

GeoTek recommends that site grading, specifications, retaining wall/shoring plans and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations may be necessary based on these reviews. GeoTek also recommends that representatives from this firm be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and test bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing when necessary.

- Observe the fill for uniformity during placement including utility trenches.
- Test the fill for field density and relative compaction.
- Test the near-surface soils to verify proper moisture content.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. GeoTek recommends that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

6. LIMITATIONS

This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. Further, no evaluation of any existing site improvements is included. The scope is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0902124-CR) dated September 6, 2024, and geotechnical engineering standards normally used on similar projects in this region.

The materials observed on the project site appear to be representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since GeoTek's recommendations are based on the site conditions observed and encountered, and laboratory testing, GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

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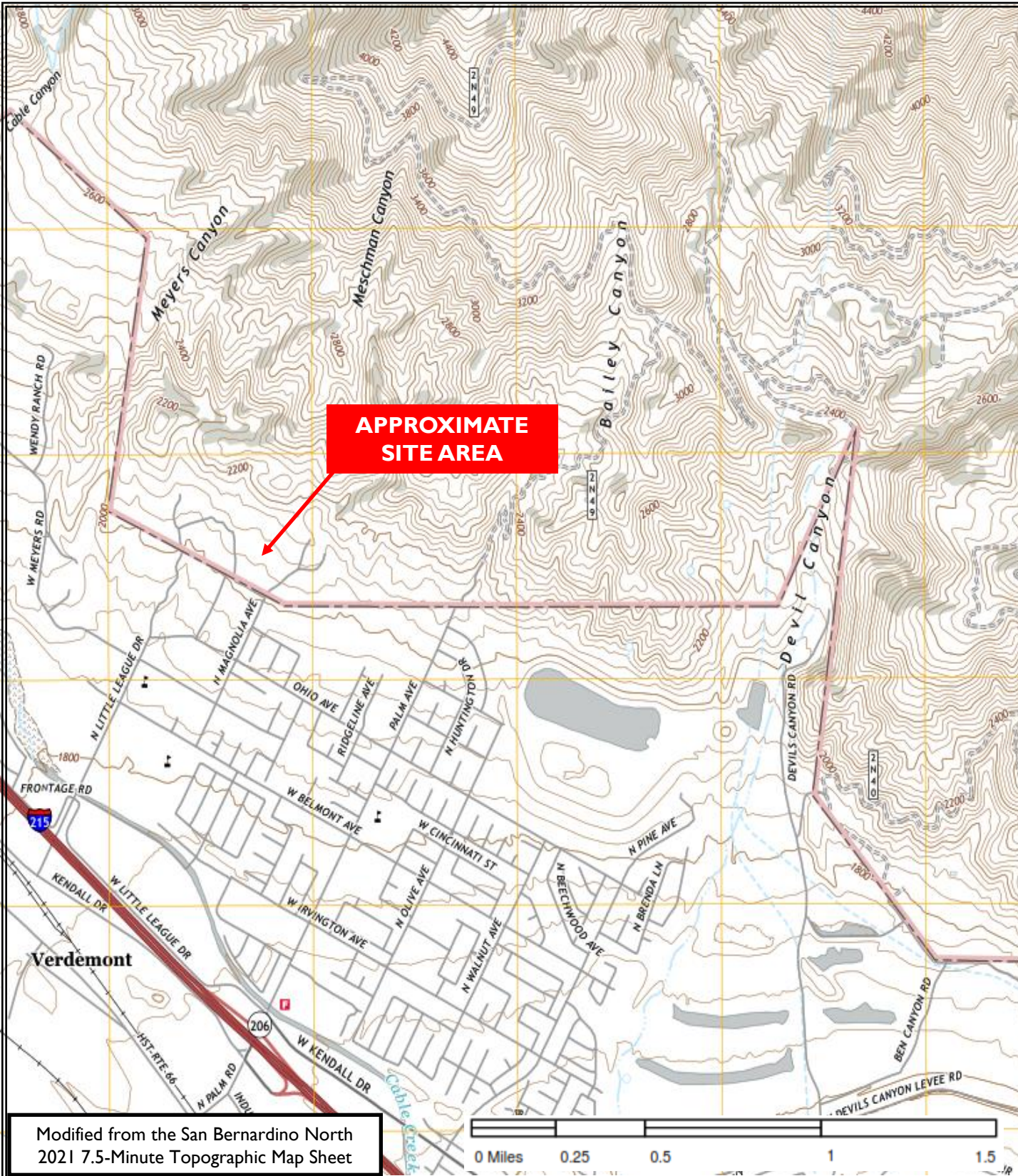
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GFR Homes Tract No. 20707 San Bernardino, San Bernardino County, California Project No. 4044-CR	 NORTH	Figure I Site Location and Topography Map	
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APPENDIX A

**GEOTECHNICAL MAP AND TRENCH LOG (LAWSON, 2004);
GEOTECHNICAL MAP AND TRENCH LOGS (LGC, 2005); LOGS OF
EXPLORATORY BORINGS AND TRENCHES (LAWSON, 2004); AND
LABORATORY TEST RESULTS (LAWSON, 2004)**

Proposed Single-Family Residential Development

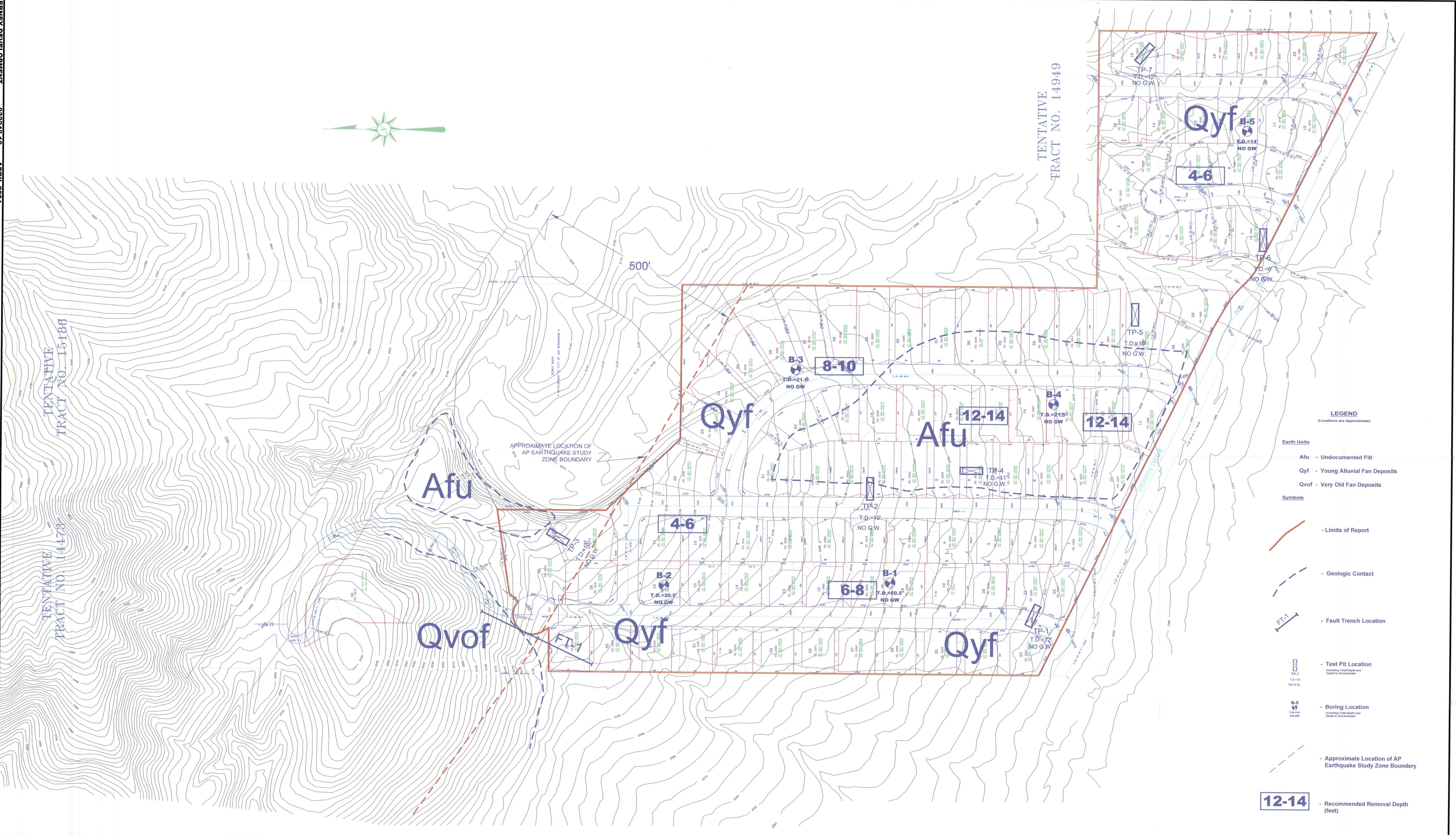
Tract No. 20707

Verdemont Drive and North Antique Street

San Bernardino, San Bernardino County, California

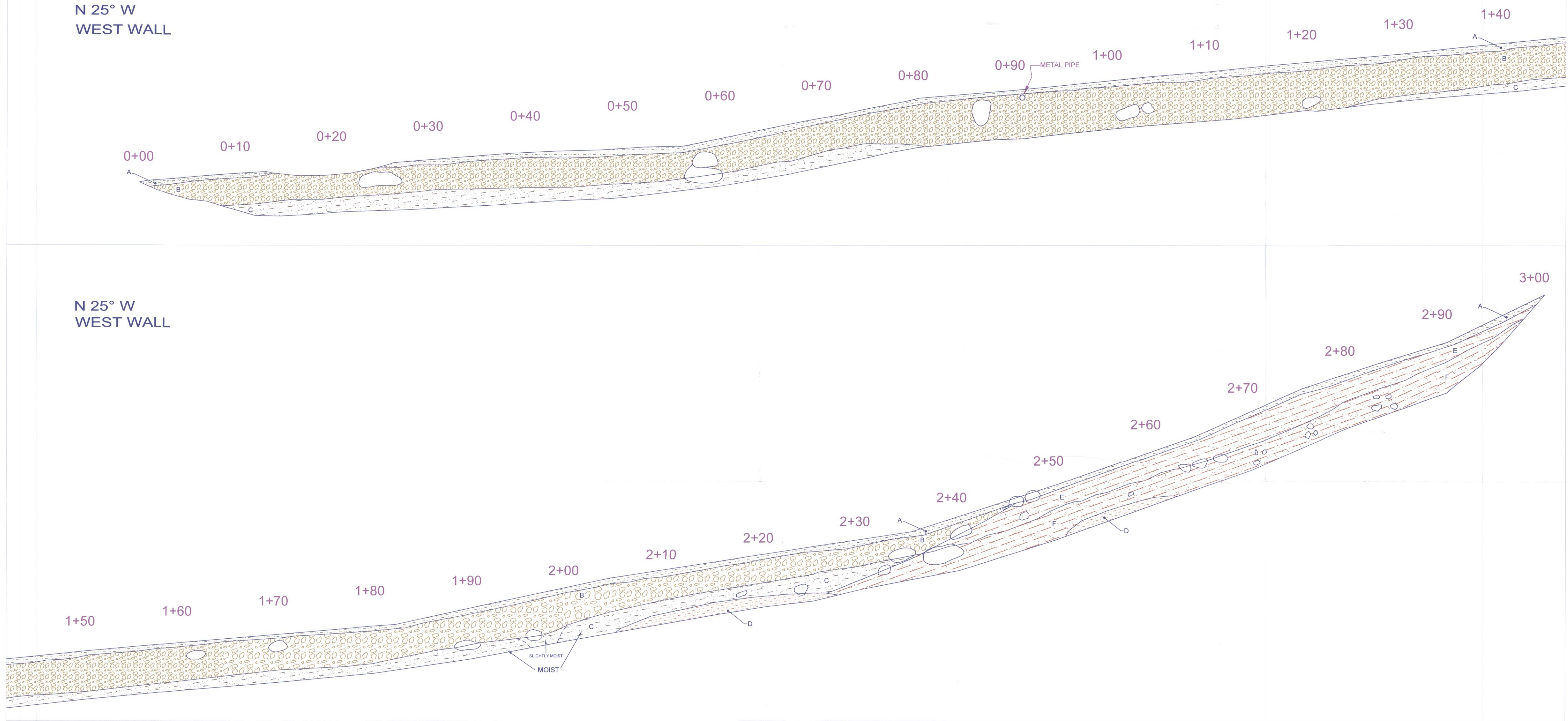
Project No. 4044-CR





LGC	LAWSON & ASSOCIATES GEOTECHNICAL CONSULTING, INC. 40935 County Center Drive, Suite A Temecula, California 92591 (909) 719-1076 Fax (909) 719-1077	Mark Bergmann Principal Geologist	Stephen Poole Principal Engineer	GEOTECHNICAL MAP TENTATIVE TRACT NO. 14473, 15188 AND 14949 SAN BERNARDINO COUNTY	Name: Project No. Client: Scale: Date: Sheet No. Plate No.	TIERNEY DEVELOPMENT
						032242-10
						TIERNEY DEVELOPMENT
						1"=100'
						JULY 2004
						PLATE NO. 1 OF 2

Z:\LAWSON & ASSOCIATES (PUBLIC)\PROJECTS\2003 Projects\032242 Tierney Development\CAD In Progress\TRENCH LOGS.dwg Layout1



LEGEND

(Locations are Approximate)

- A - Young Alluvial Fan Deposits (Qyf): Silty SAND (SM); light olive brown (2.5 YR 5/4), dry, loose, fine to coarse grained, trace coarse gravel, fine to medium rootlets.
- B - Young Alluvial Fan Deposits (Qyf): Silty GRAVEL (GM) with Sand; brownish yellow (10 YR 6/6), dry, loose, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- C - Young Alluvial Fan Deposits (Qyf): Silty SAND (SM) with Gravel; strong brown (7.5 YR 4/6), moist, loose, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- D - Very Old Fan Deposits (Qvof): Silty SAND (SM) with gravel; reddish yellow (2.5 YR 6/6), dry medium dense, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- E - Very Old Fan Deposits (Qvof): Clayey SAND (SC); light red 2.5 YR 6/8), slightly moist, dense, fine to coarse sand, fine to coarse gravel, trace cobbles/ boulders, translocation of clay films, pinhole porosity
- F - Very Old Fan Deposits (Qvof): Clayey SAND (SC); red (2.5 YR 4/8), moist, dense, fine to coarse sand, fine to coarse gravel, trace cobbles/ boulders, translocation of clay films, pinhole porosity.

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GEOTECHNICAL CONSULTING, INC.

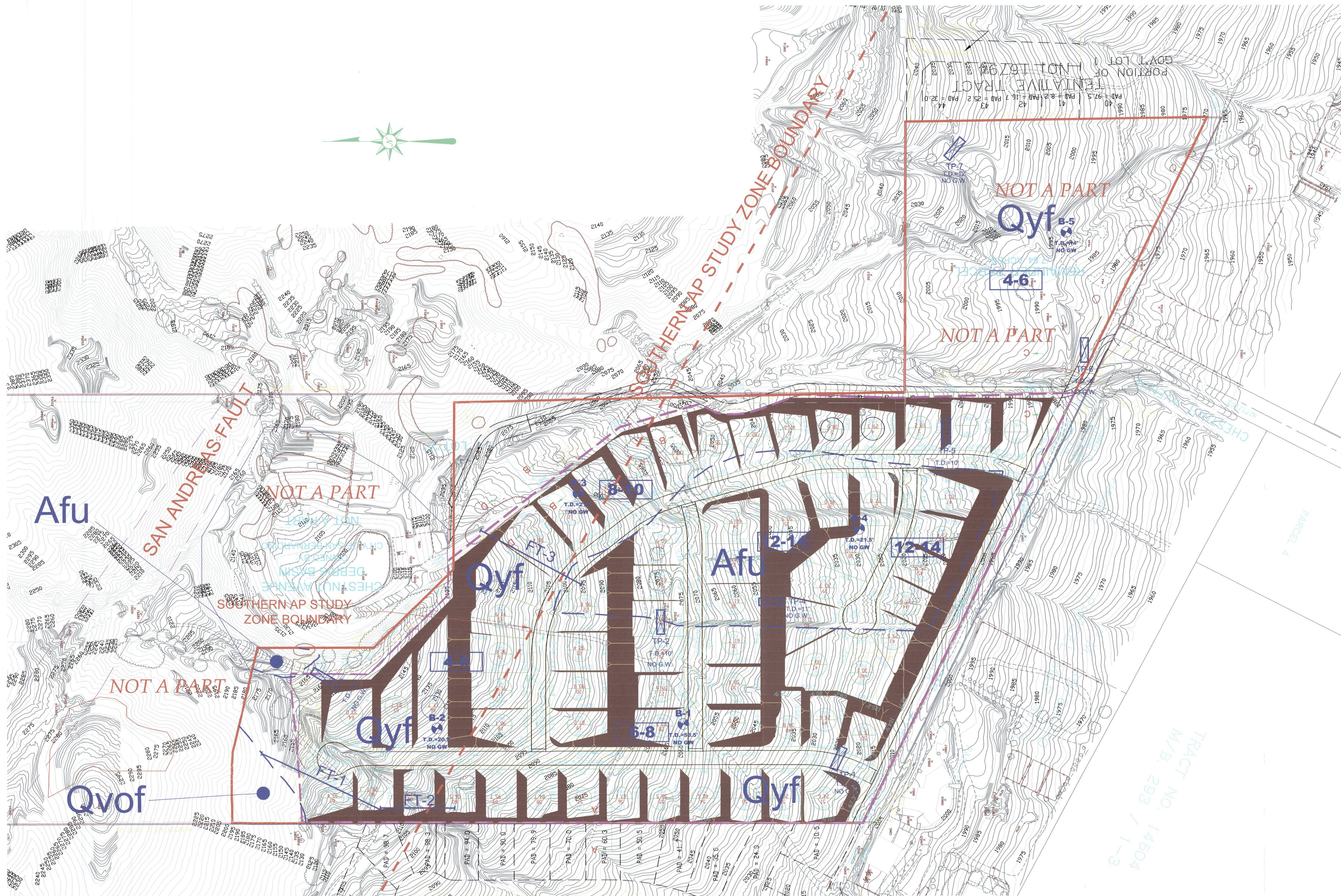
40935 County Center Drive, Suite A
Temecula, California 92591
(909) 719-1076 Fax (909) 719-1077

Mark Bergmann
Principal Geologist

Stephen Poole
Principal Engineer

TRENCH LOG
TRACT NO. 14473, 15188, & 14949

Name:	TIERNEY DEVELOPMENT - VERDEMONT
Project No.	032242-10
Client:	TIERNEY DEVELOPMENT
Scale:	1" = 5'
Date:	JULY 2004
Sheet No.	
Plate No.	PLATE NO. 2 OF 2



- LEGEND**
(Locations are Approximate)
- Earth Units**
- Afu - Undocumented Fill
 - Qyf - Young Alluvial Fan Deposits
 - Qvof - Very Old Fan Deposits
- Symbols**
- Limits of Report
 - Limits of Area to be Developed
 - Geologic Contact
 - Fault Trench Location
 - Test Pit Location
Including Total Depth and Depth to Groundwater
 - Boring Location
Including Total Depth and Depth to Groundwater
 - Approximate Location of AP Earthquake Study Zone Boundary
 - Recommended Removal Depth (feet)

REVISED 2005-12-05

**LGC
INLAND**

LGC INLAND
41531 DATE STREET
MURRIETA, CALIFORNIA 92562
Office: (951) 461-1919
Fax: (951) 461-7677

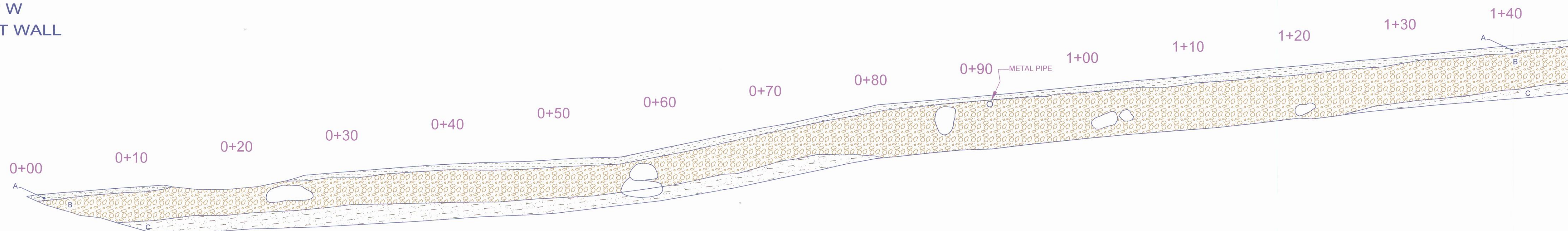
Mark Bergmann
Principal Geologist

Stephen Poole
Principal Engineer

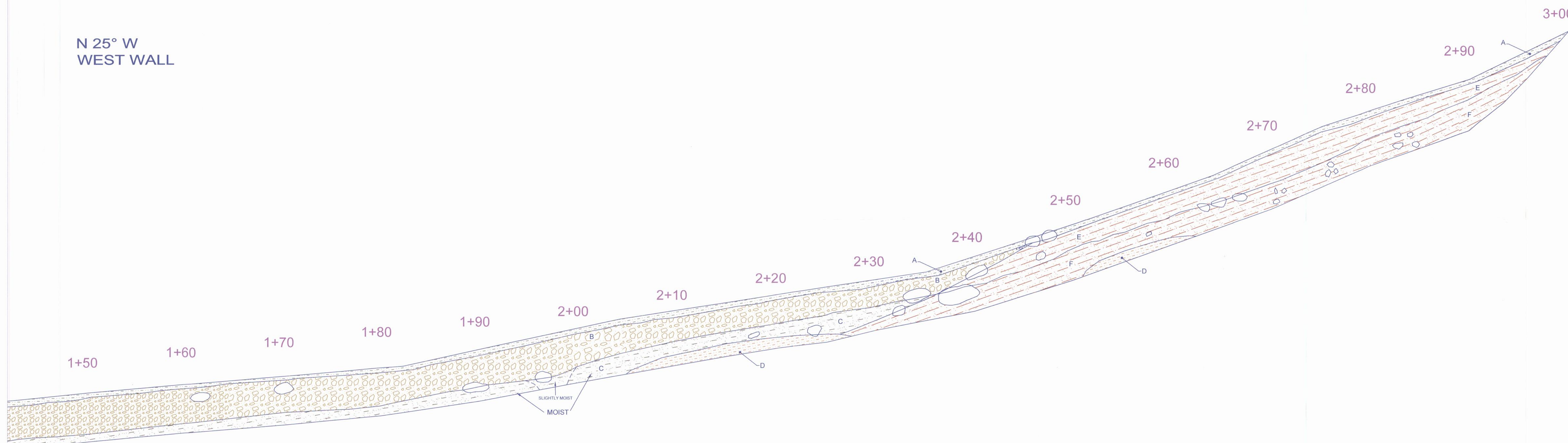
GEOTECHNICAL MAP
TENTATIVE TRACT NO. 17367
CITY OF SAN BERNARDINO, CALIFORNIA

Name:	TIERNEY DEVELOPMENT - VERDEMONT
Project No.	I03242-50
Client:	TIERNEY DEVELOPMENT
Scale:	1"=100'
Date:	JULY 2004 REVISED DECEMBER 2005
Sheet No.	
Plate No.	PLATE NO. 1 OF 4

N 25° W
WEST WALL



N 25° W
WEST WALL



LEGEND
(Locations are Approximate)

- A - Young Alluvial Fan Deposits (Qyf): Silty SAND (SM); light olive brown (2.5 YR 5/4), dry, loose, fine to coarse grained, trace coarse gravel, fine to medium rootlets.
- B - Young Alluvial Fan Deposits (Qyf): Silty GRAVEL (GM) with Sand; brownish yellow (10 YR 6/6), dry, loose, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- C - Young Alluvial Fan Deposits (Qyf): Silty SAND (SM) with Gravel; strong brown (7.5 YR 4/6), moist, loose, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- D - Very Old Fan Deposits (Qvof): Silty SAND (SM) with gravel; reddish yellow (2.5 YR 6/6), dry medium dense, fine to coarse sand, fine to coarse gravel, cobbles, trace boulders.
- E - Very Old Fan Deposits (Qvof): Clayey SAND (SC); light red 2.5 YR 6/8), slightly moist, dense, fine to coarse sand, fine to coarse gravel, trace cobbles/ boulders, translocation of clay films, pinhole porosity
- F - Very Old Fan Deposits (Qvof): Clayey SAND (SC); red (2.5 YR 4/8), moist, dense, fine to coarse sand, fine to coarse gravel, trace cobbles/ boulders, translocation of clay films, pinhole porosity.

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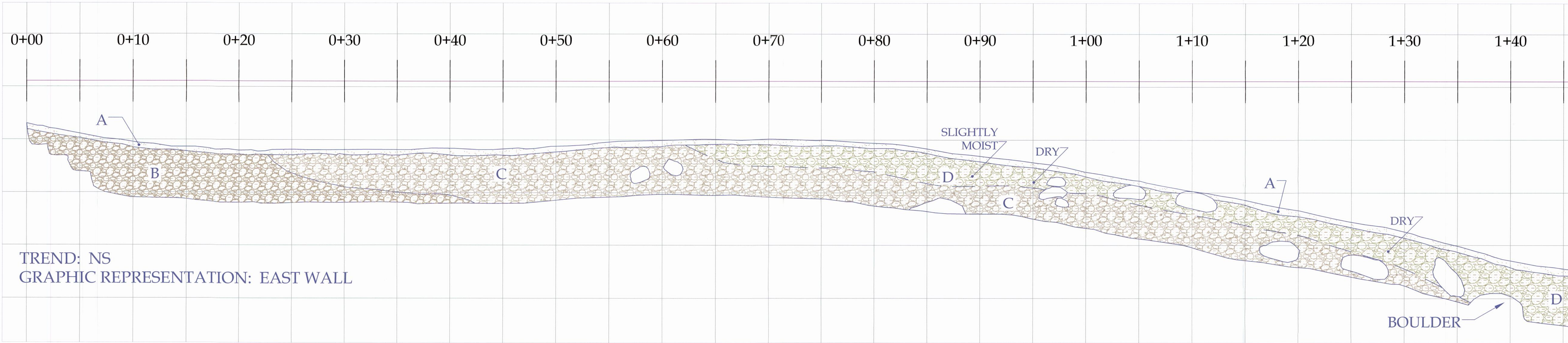
41531 DATE STREET
MURRIETA, CALIFORNIA 92562
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Mark Bergmann
Principal Geologist

Stephen Poole
Principal Engineer

TRENCH LOG
TRACT NO. 14473, 15188, & 14949

Name:	TIERNEY DEVELOPMENT - VERDEMONT
Project No.	032242-10
Client:	TIERNEY DEVELOPMENT
Scale:	1" = 5'
Date:	JULY 2004
Sheet No.	
Plate No.	PLATE NO. 2 OF 4

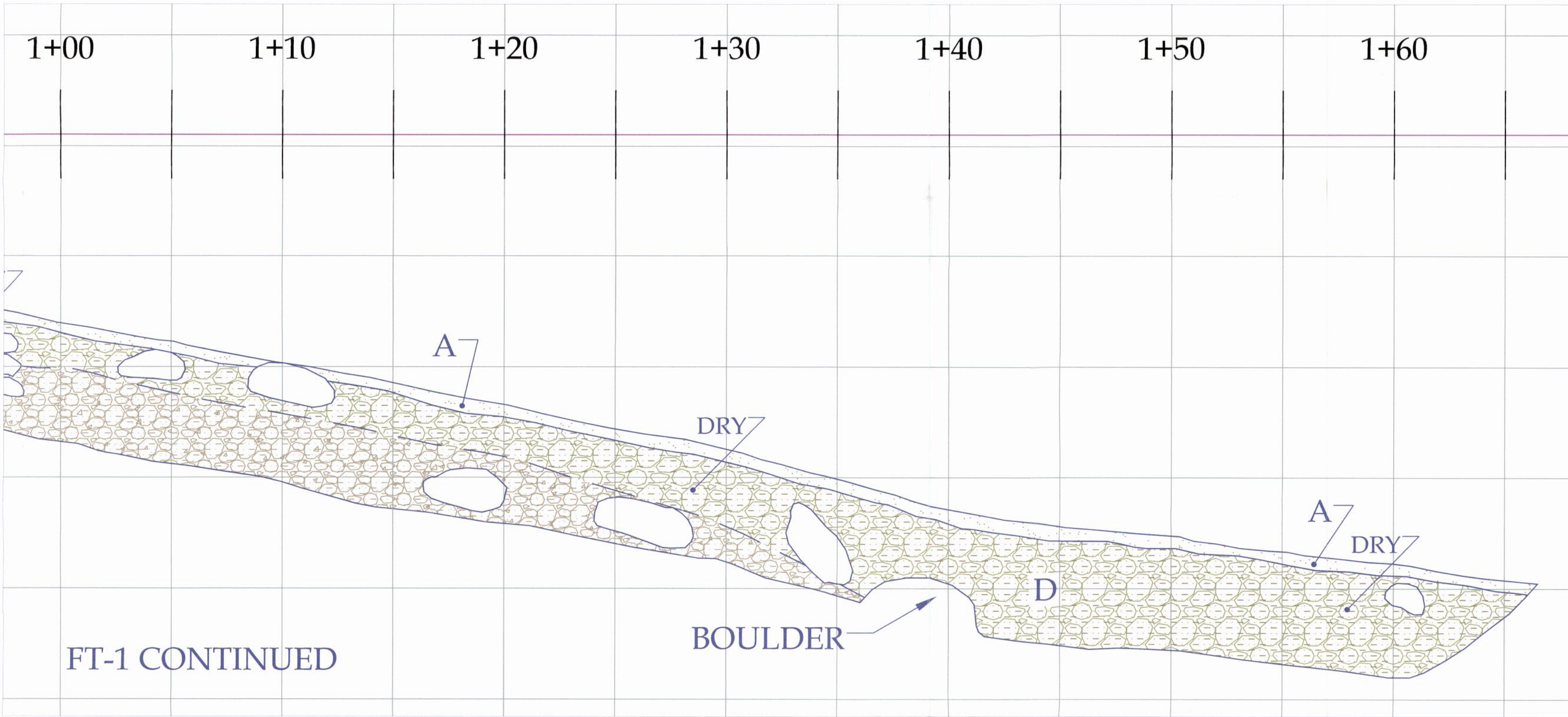


LEGEND
(Locations are Approximate)

- Earth Units**
- A - Young Alluvial Valley Deposits (Qyf): Silty SAND (SM); olive yellow brown, slightly moist, loose, fine to coarse sand, fine to coarse gravel, cobbles, fine to medium rootlets.
 - B - Young Alluvial Valley Deposits (Qyf): Silty SAND (SM); yellow brown, dry, medium dense, fine to coarse sand, fine to coarse gravel, cobbles, boulders.
 - C - Young Alluvial Valley Deposits (Qyf): Silty Gravel with Sand (GM); yellow brown, dry, medium dense, fine to coarse gravel, cobbles, boulders.
 - D - Young Alluvial Valley Deposits (Qyf): Silty SAND (SM); dark yellow brown, slightly moist, loose, fine to coarse sand, fine to coarse gravel, cobbles, boulders, moderate 1-2 mm pores.
 - E - Young Alluvial Valley Deposits (Qyf): Silty SAND (SM); dark yellow brown, dry, medium dense, fine to coarse sand, fine to coarse gravel, cobbles, boulders, rare to moderate 1-2 mm pores.

SYMBOLS

- Boulders



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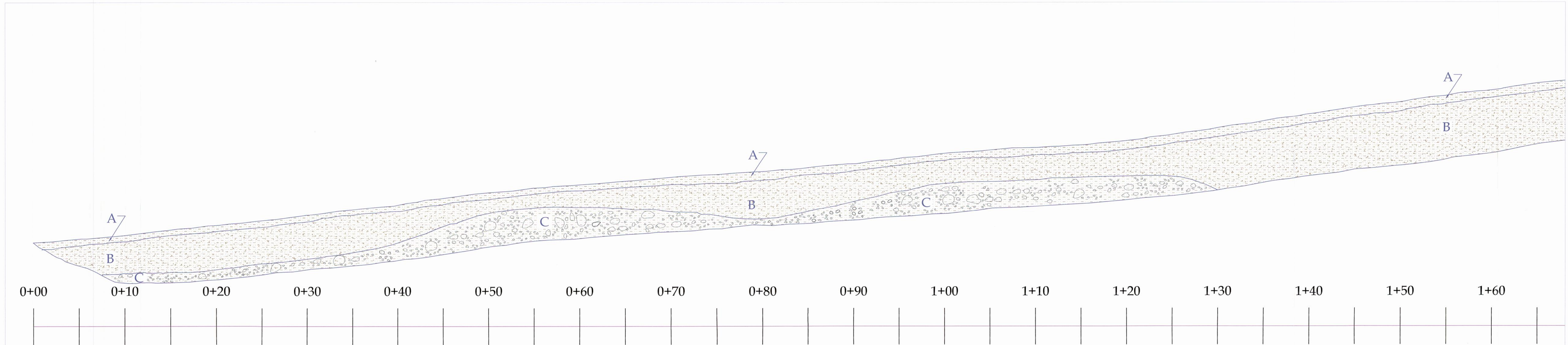
LGC INLAND
41531 DATE STREET
MURRIETA, CALIFORNIA 92562
Office: (951) 461-1919
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Mark Bergmann
Principal Geologist

Stephen Poole
Principal Engineer

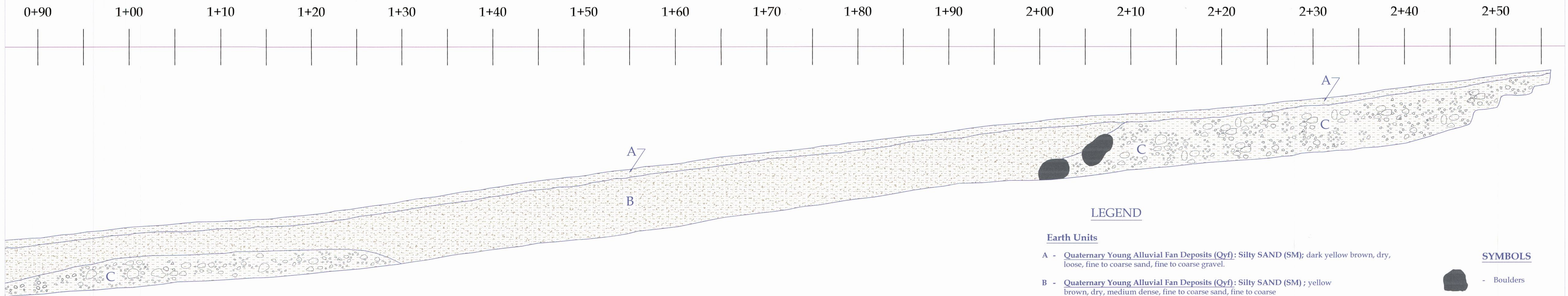
**TRENCH LOG
FT-2**

Name: TIERNEY DEVELOPMENT - VERDEMONT
Project No. I03242-50
Client: TIERNEY DEVELOPMENT
Scale: 1" = 5'
Date: November 2005
Sheet No.
Plate No. PLATE NO. 3 OF 4



TREND: N 35° E
GRAPHIC REPRESENTATION: WEST WALL

FT-3 CONTINUED



LEGEND

Earth Units

- A - Quaternary Young Alluvial Fan Deposits (Qyf): Silty SAND (SM); dark yellow brown, dry, loose, fine to coarse sand, fine to coarse gravel.
- B - Quaternary Young Alluvial Fan Deposits (Qyf): Silty SAND (SM); yellow brown, dry, medium dense, fine to coarse sand, fine to coarse gravel, trace cobbles, moderate porosity.
- C - Quaternary Young Alluvial Fan Deposits (Qyf): Silty SAND (SM); yellow brown, dry, medium dense, fine to coarse sand, fine to coarse gravel, cobbles, boulders.

SYMBOLS

 - Boulders

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Mark Bergmann
Principal Geologist

Stephen Poole
Principal Engineer

FAULT TRENCH LOG
FT-3

Name:	TIERNEY DEVELOPMENT - VERDEMONT
Project No.	I03242-10
Client:	TIERNEY DEVELOPMENT
Scale:	1" = 5'
Date:	December 2005
Sheet No.	
Plate No.	PLATE NO. 4 OF 4

Geotechnical Boring Log B-1

Date: January 8, 2004	Project Name: Tierney Development	Page 1 of 2
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 2060	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
0		B-1			Qyf	Young Alluvial Fan Deposits:	
	3	R-1	113.9	5.7	SM	Silty SAND; dark brown, loose, moist, porous.	Max EI
5	6 8 11	R-2	118.3	3.3		light brown, medium dense, slightly moist.	Consol
10	29 22 26	R-3		3.2		with gravel, cobbles, and boulders, 2½ inch gravel in sampler.	
15	35 50/ 5½"	R-4		2.8		gray, very dense.	
20	35 29 35	R-5	113.2	13.2		2 inch gravel in sampler, brown, dense, moist.	
25		R-6	117.5	3.9		very dense, slightly moist, 2 inch gravel in sampler.	
30							

Geotechnical Boring Log B-1

Date: January 8, 2004	Project Name: Tierney Development	Page 2 of 2
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 2060	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
30	31 50/ 5"	R-7	111.6	7.7		brown, very dense, moist.	
35	24 50/ 4½"	R-8	113.7	6.7		2½ inch gravel in sampler.	
40	50/ 5"	R-9	112.9	4.3		1½ inch gravel in sampler, slightly moist.	
45	50/ 6"	R-10	118.4	6.0		gravel lenses.	
50	50/ 5"		108.9	4.3			
55						Total Depth- 50½ Feet No Groundwater Backfilled with Cuttings.	
60							

Geotechnical Boring Log B-2

Date: January 8, 2004	Project Name: Tierney Development	Page 1 of 1
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 2121	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
0		B-2			Qyf	Young Alluvial Fan Deposits:	
	27	R-11	108.9	4.3	SM	Silty SAND; dark brown, loose, moist, porous.	Chem.
	24						
	27					with gravel, light brown, dense, slightly moist, lenses of SAND.	
5		R-12	94.0	2.6		medium dense.	
	14					no recovery.	
	20						
	25						
10		R-13	118.0	2.1		with cobbles and boulders, grayish brown, very dense, 2 inch gravel in sampler.	
	17						
	50/6"						
15		R-14	116.9	3.0		brown.	
	50/6"						
20		R-15	107.7	2.0		brown with gray gravel lenses, gravel in sampler.	
	50/5"						
						Total Depth - 20½ Feet	
						No Groundwater	
						Backfilled with Cuttings.	
25							
30							

Geotechnical Boring Log B-3

Date: January 8, 2004	Project Name: Tierney Development	Page 1 of 1
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 2082	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
0					Qyf SM	Young Alluvial Fan Deposits: Silty SAND; dark brown, loose, moist, porous. with gravel, light brown, medium dense, slightly moist. lenses of poorly graded SAND.	Consol
5	6 8 11	R-16	98.6	3.0			
	14 13 14	R-17	113.9	2.0			
10	15 15 16	R-18	113.9	2.9		light brown, medium dense, slightly moist.	
15	20 25 31	R-19	116.6	6.8		moist, dense, with sand and gravel lenses.	
20	15 22 44	R-20	115.7	9.6		2 inch gravel in sampler, with gravel lenses.	
						Total Depth - 21½ Feet No Groundwater Backfilled with Cuttings.	
25							
30							

Geotechnical Boring Log B-4

Date: January 8, 2004	Project Name: Tierney Development	Page 1 of 1
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 2020	Hole Location: See Geotechnical Map	

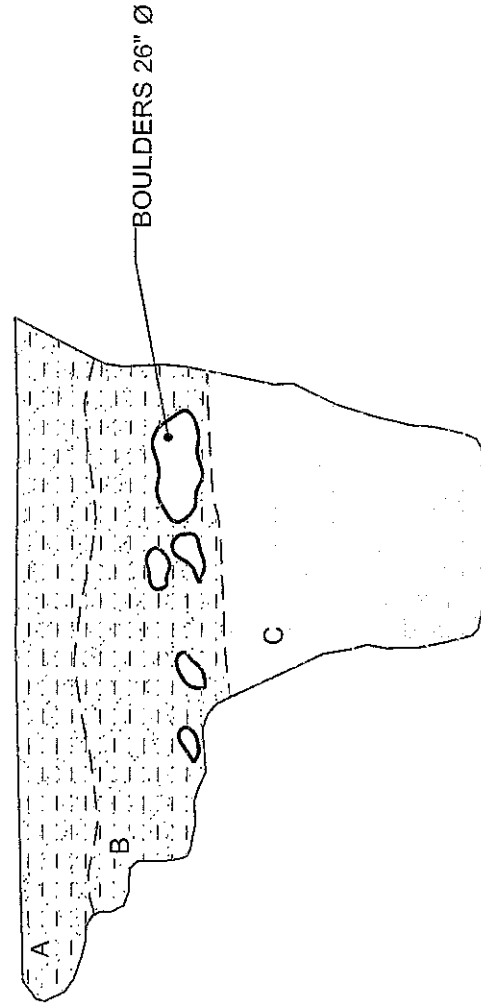
Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
0		B-3			Afu	Artificial Fill, Undocumented	
	14	R-21	125.9	9.0	SM	Silty SAND; brown to light brown, loose, moist, porous.	
	26						
	42				SC	Clayey SAND with gravel; brown, dense, slightly moist, some cobbles and boulders.	
5		R-22	114.7	7.6		lenses of poorly graded SAND.	
	9						
	16						
	20						
10		R-23	124.0	4.8	Qyf	Young Alluvial Fan Deposits: Silty SAND with gravel; brownish gray, medium dense, slightly moist, 2½ inch gravel in sampler.	
	10				SM		
	15						
	16						
15		R-24	113.2	10.8		moist.	
	11						
	11						
	12					1 inch gravel in sampler.	
20		R-25	114.2	3.5		slightly moist.	
	22						
	26						
	29						
25						Total Depth - 21½ Feet No Groundwater Backfilled with Cuttings.	
30							

Geotechnical Boring Log B-5

Date: January 8, 2004	Project Name: Tierney Development	Page 1 of 1
Project Number: 032242-10	Logged By: AS	
Drilling Company: 2R Drilling	Type of Rig: CME-55	
Drive Weight (lbs): 140	Drop (in): 30	Hole Dia (in): 8
Top of Hole Elevation (ft): 1988	Hole Location: See Geotechnical Map	

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / ASTM Symbol	DESCRIPTION	Type of Test
0		B-4	98.6	17.6	Qyf	Young Alluvial Fan Deposits:	
	3 3 3	R-26			SM	Silty SAND; light brown, very loose, moist, slightly porous.	
5	3 7 20	R-27	96.5	9.3		gravel, light brown, medium dense, lenses of SAND.	
						sample possibly disturbed.	
10	13 18 23					no recovery. broken equipment.	
15						Total Depth - 14 Feet	
						No Groundwater	
						Backfilled with Cuttings.	
20							
25							
30							

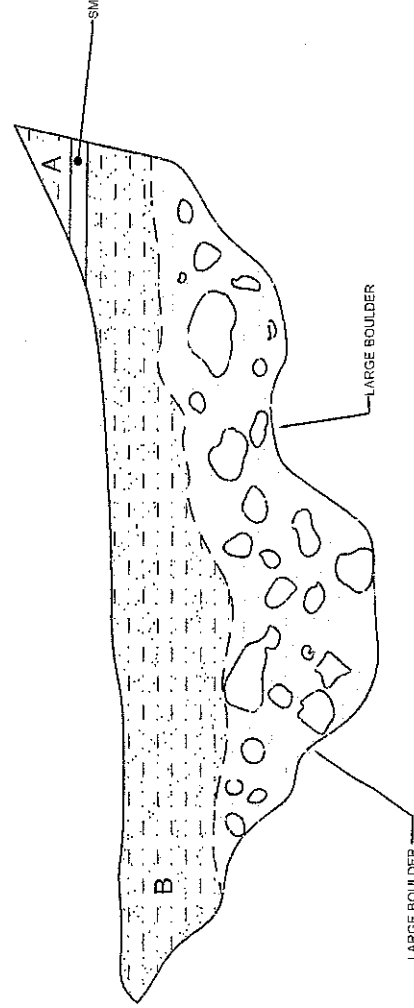
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Project Number: 032242-10			Elevation: 2022 ft			Engineering Properties			
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map						
Depth	Date: 1/12/04	Description:	Geologic Unit		USCS	Sample No.	Moisture (%)	Dry Density (pcf)	
0-2'	A	Young Alluvial Fan Deposits: Silty SAND, dark brown, loose, moist, very porous, fine to medium grained with coarse gravel.	Qyf		SM	DC 1 @ 2'	98.0	6.6	
2-7'	B	with cobbles and boulders; dark brown, medium dense, moist, boulders up to 26" in diameter from 3-6' deep.							
7-12'	C	Silty Gravel with cobbles; light brown, medium dense, dry, fine to coarse grained with coarse gravel.			GM				
GRAPHICAL REPRESENTATION: North Wall			SCALE: 1" = 5'			SURFACE SLOPE: <5°		TREND: N65W	



TOTAL DEPTH=12.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

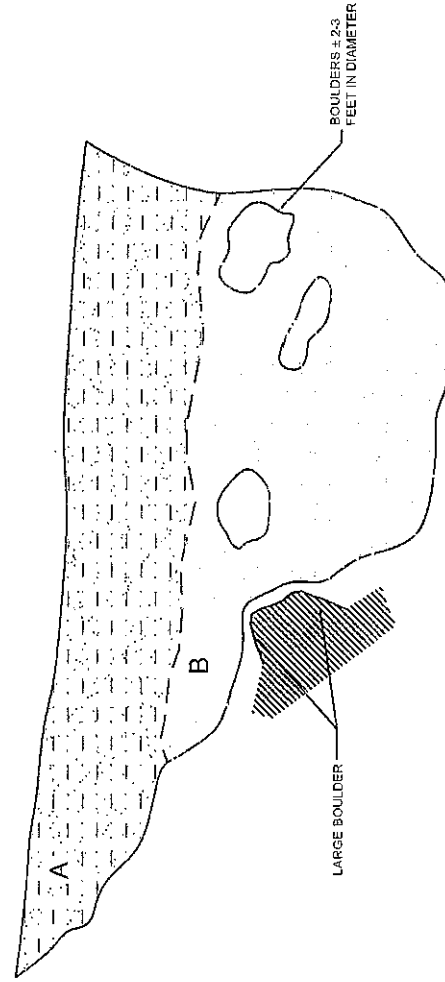
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Project Number: 032242-10			Elevation: 2072 ft		Engineering Properties			
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map					
Depth	Date: 1/12/04	Description:	Geologic Unit		USCS	Sample No.	Moisture (%)	Dry Density (pcf)
0-3'	A	Artificial Fill, Undocumented: interlayered Silty SAND and Sandy Clay; light brown to brownish red, medium dense, stiff, moist, trace gravel, cobbles and boulders.	Afu		CL/SM			
3-6'	B	Young Alluvial Fan Deposits: Silty SAND; dark brown, loose, moist, numerous rootlets at the surface.	Qyf		SM			
6-10'	C	Silty GRAVEL with boulders; light brown, medium dense, dry, fine to coarse grained with coarse gravel, cobbles and boulders.			GM			
GRAPHICAL REPRESENTATION: North Wall			SCALE: 1" = 5'		SURFACE SLOPE: Level		TREND: East	



TOTAL DEPTH= 10.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

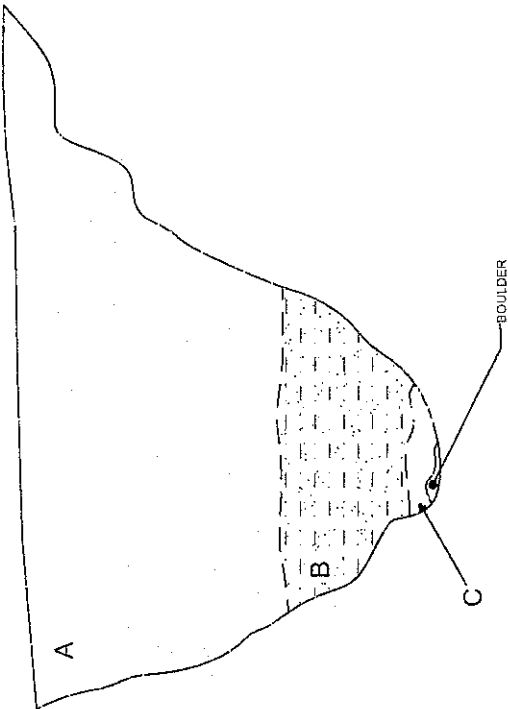
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Project Number: 032242-10			Elevation: 2160 ft		Engineering Properties			
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map		USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Depth	Date: 1/12/04	Description:	Geologic Unit					
0-3'	A	Young Alluvial Fan Deposits: Silty SAND; dark brown, loose, moist, numerous rootlets, fine to medium grained.	Qyf		SM	DC 3 @ 3'	87.1	8.0
3-10'	B	Silty GRAVEL with sand, cobbles and granitic boulders, light brown, medium dense, dry, fine to medium grained with coarse gravel and boulders, no boulders observed below 7', but increase in cobbles.			GM	DC 2 @ 4'	103.1	3.5
GRAPHICAL REPRESENTATION: East Wall			SCALE: 1" = 5'		SURFACE SLOPE: 10°		TREND: N30E	



TOTAL DEPTH= 10.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

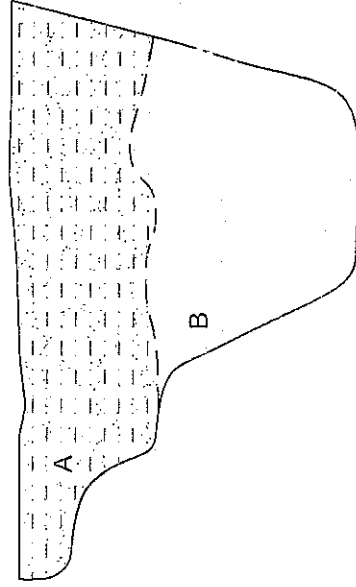
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Project Number: 032242-10			Elevation: 2045 ft		Engineering Properties			
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map					
Depth	Date: 1/12/04	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)	
0-7.5'	A	Artificial Fill, Undocumented: Silty SAND with gravel; light brown and reddish brown, moist drying upwards, medium dense, trace gravel, cobbles and boulders.	Afu	SM	Bag 1 @ 4'			
7.5-10'	B	Young Alluvial Fan Deposits: Silty SAND with gravel; dark brown, medium dense, moist, fine to medium grained with coarse gravel.	Qyf	SM				
10-11'	C	Alluvium: Silty Gravel with sand and boulders; light brown, medium dense, dry, fine to coarse grained with boulders.		GM				
GRAPHICAL REPRESENTATION: West Wall			SCALE: 1" = 5'		SURFACE SLOPE: 5°		TREND: North	



TOTAL DEPTH=11.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

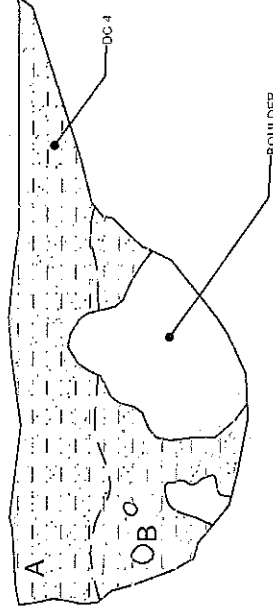
Project Name: TIERNEY DEVELOPMENT			Logged by: AS			LOG OF TEST PIT 5		
Project Number: 032242-10			Elevation: 2004 ft					
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map					
Depth	Date: 1/12/04	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)	
0-4'	A	Young Alluvial Fan Deposits: Silty SAND with gravel; dark brown, loose, moist, porous, numerous rootlets, fine to medium grained with coarse gravel.	Qyf	SM				
4-10'	B	Silty GRAVEL with cobbles; light brown, medium dense, dry, fine to coarse grained with cobbles.	Qyf	GM				
GRAPHICAL REPRESENTATION: North Wall			SCALE: 1" = 5'		SURFACE SLOPE: <5°		TREND: East	



TOTAL DEPTH= 10.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

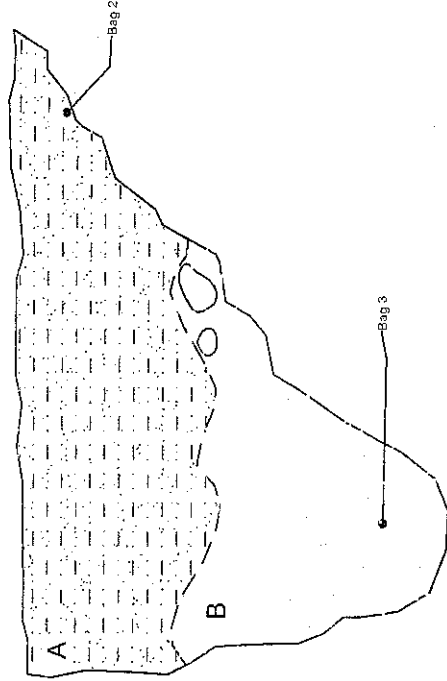
Project Name: TIERNEY DEVELOPMENT			Logged by: AS		LOG OF TEST PIT 6					
Project Number: 032242-10			Elevation: 1980 ft				Engineering Properties			
Equipment: Case 580 SL Extendahoe			Location/Grid: See Geotechnical Map				USCS	Sample No.	Moisture (%)	Dry Density (pcf)
Depth	Date: 1/12/04	Description:			Geologic Unit					
0-3'	A	Young Alluvial Fan Deposits: Silty SAND; dark brown, loose, moist, fine to medium grained, some gravel, porous, numerous rootlets.			Qyf	SM	DC 4 @ 2'	100.1	4.5	
3-6'	B	Silty GRAVEL with cobbles and boulders; brown, medium dense, moist, fine to coarse grained.				GM				
GRAPHICAL REPRESENTATION: North Wall			SCALE: 1" = 5'		SURFACE SLOPE: Level		TREND: East			



TOTAL DEPTH= 6.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

Project Name: TIERNEY DEVELOPMENT				Logged by: AS				LOG OF TEST PIT 7			
Project Number: 032242-10				Elevation: 2017 ft				Engineering Properties			
Equipment: Case 580 SL Extendahoe				Location/Grid: See Geotechnical Map							
Depth	Date: 1/12/04	Description:		Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)			
0-5'		A Young Alluvial Fan Deposits: Silty SAND with gravel; dark brown, loose, moist, fine to medium grained, porous, numerous rootlets 0-2'.		Qyf	SM	Bag 2 @ 2'					
5-12'		B Silty GRAVEL with sand and cobbles; light brown, medium dense, slightly moist, fine to coarse grained.			GM	Bag 3 @ 10'					
GRAPHICAL REPRESENTATION: North Wall				SCALE: 1" = 5'				SURFACE SLOPE: Level			
								TREND: N50W			



TOTAL DEPTH=12.0 FEET
NO GROUNDWATER
ENCOUNTERED

LGC

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory testing program was directed towards providing quantitative data relating to the relevant engineering properties of the soils. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure and/or California Test Methods (CTM), where applicable. The following summary is a brief outline of the test type and a table summarizing the test results.

Soil Classification: Soils were classified according the Unified Soil Classification System (USCS) in general accordance with ASTM Test Methods D2487 and D2488. This system utilizes the Atterberg limits and grain size distribution of a soil. The soil classifications (or group symbol) are shown on the laboratory test data, boring logs, and test pit logs.

Chloride Content: Chloride content was tested in accordance with Caltrans Test Method (CTM) 422. The results are presented below:

<i>SAMPLE LOCATION</i>	<i>CHLORIDE CONTENT, ppm</i>
B-2 @ 0-2 feet	Not Detected

Consolidation: Consolidation tests were performed on selected, relatively undisturbed ring samples (Modified ASTM Test Method D2435). Samples (2.42 inches in diameter and 1-inch in height) were placed in a consolidometer and increasing loads were applied. The samples were allowed to consolidate under "double drainage" and total deformation for each loading step was recorded. The percent consolidation for each load step was recorded as the ratio of the amount of vertical compression to the original sample height. The test samples were inundated at a surcharge loading approximately equal to the existing or proposed total overburden pressures in order to evaluate the effects of a sudden increase in moisture content (hydrocollapse potential). Results of these tests are graphically presented on Plates C-1 and C-2.

Expansion Index: The expansion potential of selected samples were evaluated by the Expansion Index Test ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch thick by 4-inch diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The results of these tests are presented in the table below:

<i>SAMPLE LOCATION</i>	<i>SAMPLE DESCRIPTION</i>	<i>COMPACTED DRY DENSITY (pcf)</i>	<i>EXPANSION INDEX</i>	<i>EXPANSION POTENTIAL *</i>
B-1 @ 0-2 feet	Silty Sand	116.4	4	Very Low

* Per Table 18-1-B of 1997 UBC.

Moisture and Density Determination Tests: Moisture content (ASTM D2216) and dry density determinations (ASTM D2937) were performed on relatively undisturbed samples obtained from the test borings and/or trenches. The results of these tests are presented in the boring and/or trench logs. Where applicable, only moisture content was determined from undisturbed or disturbed samples.

Maximum Density Tests: The maximum dry density and optimum moisture content of typical materials were determined in accordance with ASTM D1557. The results of these tests are presented in the table below:

<i>SAMPLE LOCATION</i>	<i>SAMPLE DESCRIPTION</i>	<i>MAXIMUM DRY DENSITY (pcf)</i>	<i>OPTIMUM MOISTURE CONTENT (%)</i>
TP-7, Bag3 @ 0-2 feet	Silty Sand	125.5	10.5
B-1 @ 0-2 feet	Silty Sand	131.5	9.0

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. As a result of a soil's resistivity decreasing, corrosivity increases. The results are presented in the table below:

<i>SAMPLE LOCATION</i>	<i>SAMPLE DESCRIPTION</i>	<i>pH</i>	<i>MINIMUM RESISTIVITY (ohm-cm)</i>
B-2 @ 0-2 feet	Silty Sand	6.6	15,000

R-Value: The resistance R-value was determined by the ASTM D2844 soils. The sample(s) were prepared and exudation pressure and R-value were determined. The result was used for asphaltic concrete pavement design purposes.

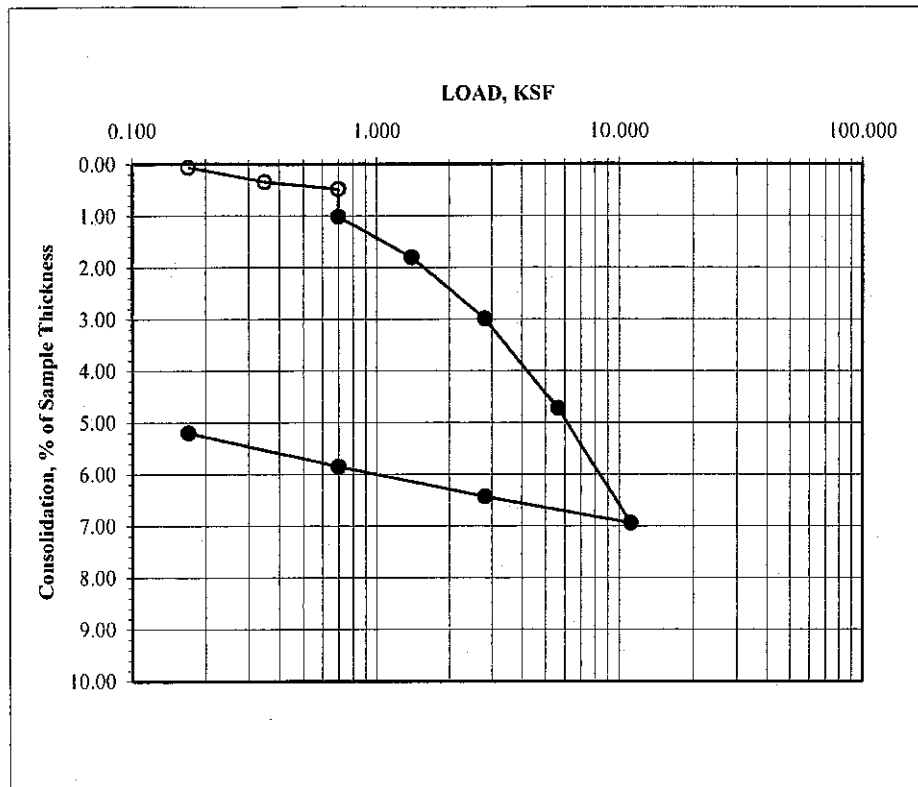
<i>SAMPLE LOCATION</i>	<i>SAMPLE DESCRIPTION</i>	<i>R-VALUE</i>
B-2 @ 0-2 feet	Silty Sand	58

Soluble Sulfates: The soluble sulfate contents of selected samples were determined by standard geochemical methods (CTM 417). The soluble sulfate content is used to determine the appropriate cement type and maximum water cement ratios. The test results are presented in the table below:

<i>SAMPLE LOCATION</i>	<i>SAMPLE DESCRIPTION</i>	<i>SULFATE CONTENT (ppm)*</i>	<i>SULFATE EXPOSURE*</i>
B-2 @ 0-2 feet	Silty Sand	Not Detected	Negligible

* Based on the 1997 edition of the Uniform Building Code (U.B. C.), Table No. 19-A-4, prepared by the International Conference of Building Officials (ICBO, 1997).

CONSOLIDATION TEST RESULTS



Note: Filled circle denotes readings after saturation with water

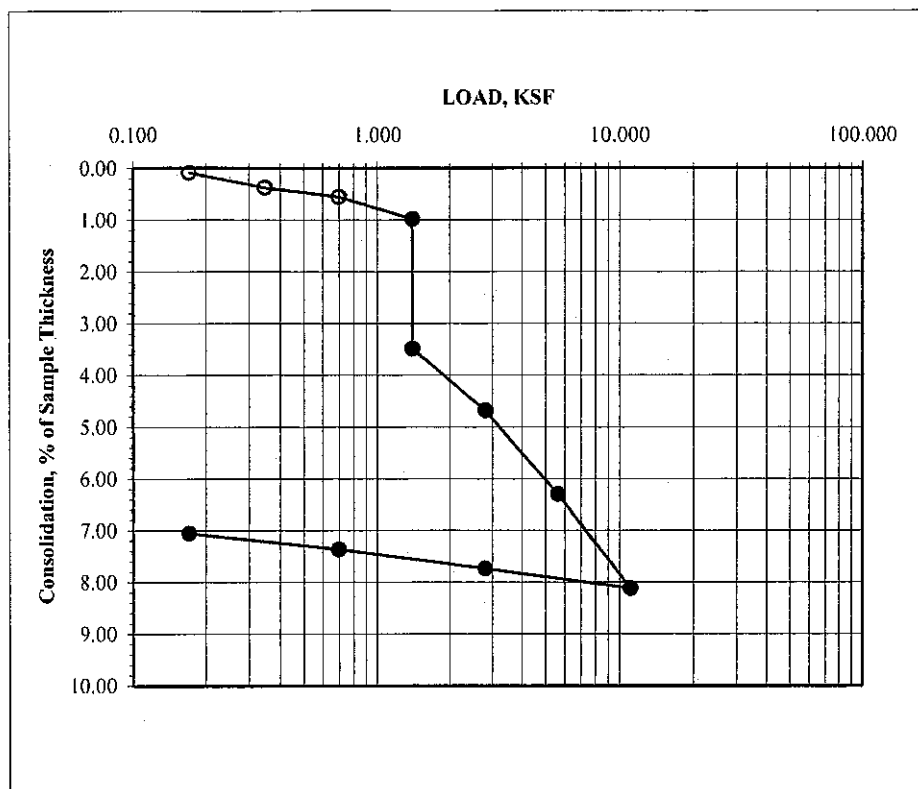
	<u>In-place</u>	<u>Remolded:</u>
Dry Density, (pcf):	118.3	
Moisture (%):	3.3	
 WATER ADDED @ KSF:	0.7	
MAXIMUM LOAD, KSF:	11.1	
SOIL DESCRIPTION:	Lt. brown silty sand	
U.S.C.S.	SM	
% Collapse:	0.53	

P.N. 032242-10 LOCATION: B-1 @ 5'
CLIENT: Tierney Development

LGC

Plate: C-1

CONSOLIDATION TEST RESULTS



Note: Filled circle denotes readings after saturation with water

	<u>In-place</u>	<u>Remolded:</u>
Dry Density, (pcf):	113.9	
Moisture (%):	2.0	
 WATER ADDED @ KSF:	1.4	
MAXIMUM LOAD, KSF:	11.1	
SOIL DESCRIPTION:	Lt. brown silty sand	
U.S.C.S.	SM	
% Collapse:	3.52	

P.N. 032242-10 LOCATION: B-3 @ 5'
CLIENT: Tierney Development

LGC

Plate: C-2

APPENDIX B

GENERAL EARTHWORK GRADING GUIDELINES

Proposed Single-Family Residential Development

Tract No. 20707

Verdemont Drive and North Antique Street

San Bernardino, San Bernardino County, California

Project No. 4044-CR



GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, Chapters 18 and 33 of the Uniform Building Code, CBC and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.

4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.
6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g., change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
 - a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
 - b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site, it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative. Typical procedures are similar to those indicated on Plate G-4.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed (see Plates E-1, E-2 and E-3) unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g., flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory backhoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Subdrainage

1. Subdrainage systems should be provided in canyon bottoms prior to placing fill, and behind buttress and stabilization fills and in other areas indicated in the report. Subdrains should conform to Plates E-1 and E-5, and be acceptable to our representative.
2. For canyon subdrains, runs less than 500 feet may use six-inch pipe. Typically, runs in excess of 500 feet should have the lower end as eight-inch minimum.
3. Filter material should be clean, 1/2 to 1-inch gravel wrapped in a suitable filter fabric. Class 2 permeable filter material per California Department of Transportation Standards tested by this office to verify its suitability, may be used without filter fabric. A sample of the material should be provided to the Soils Engineer by the contractor at least two working days before it is delivered to the site. The filter should be clean with a wide range of sizes.
4. Approximate delineation of anticipated subdrain locations may be offered at 40-scale plan review stage. During grading, this office would evaluate the necessity of placing additional drains.
5. All subdrainage systems should be observed by our representative during construction and prior to covering with compacted fill.
6. Subdrains should outlet into storm drains where possible. Outlets should be located and protected. The need for backflow preventers should be assessed during construction.
7. Consideration should be given to having subdrains located by the project surveyors.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).



2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
 - a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
 - b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
 - a) They are not placed in concentrated pockets;
 - b) There is a sufficient percentage of fine-grained material to surround the rocks;
 - c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal (see Plate E-4). On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If significant oversize materials are encountered during construction, these guidelines should be requested.
6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. 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.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.

3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every four (4) feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

Keyways, Buttress and Stabilization Fills

Keyways are needed to provide support for fill slope and various corrective procedures.

1. Side-hill fills should have an equipment-width key at their toe excavated through all surficial soil and into competent material and tilted back into the hill (Plates E-2, E-3). As the fill is elevated, it should be benched through surficial soil and slopewash, and into competent bedrock or other material deemed suitable by our representatives (See Plates E-1, E-2, and E-3).
2. Fill over cut slopes should be constructed in the following manner:
 - a) All surficial soils and weathered rock materials should be removed at the cut-fill interface.
 - b) A key at least one and one-half (1.5) equipment width wide (or as needed for compaction) and tipped at least one (1) foot into slope, should be excavated into competent materials and observed by our representative.
 - c) The cut portion of the slope should be excavated prior to fill placement to evaluate if stabilization is necessary. The contractor should be responsible for any additional earthwork created by placing fill prior to cut excavation. (see Plate E-3 for schematic details.)
3. Daylight cut lots above descending natural slopes may require removal and replacement of the outer portion of the lot. A schematic diagram for this condition is presented on Plate E-2.
4. A basal key is needed for fill slopes extending over natural slopes. A schematic diagram for this condition is presented on Plate E-2.
5. All fill slopes should be provided with a key unless within the body of a larger overall fill mass. Please refer to Plate E-3 for specific guidelines.

Anticipated buttress and stabilization fills are discussed in the text of the report. The need to stabilize other proposed cut slopes will be evaluated during construction. Plate E-5 shows a schematic of buttress construction.

1. All backcuts should be excavated at gradients of 1:1 or flatter. The backcut configuration should be determined based on the design, exposed conditions, and need to maintain a minimum fill width and provide working room for the equipment.
2. On longer slopes, backcuts and keyways should be excavated in maximum 250 feet long segments. The specific configurations will be determined during construction.
3. All keys should be a minimum of two (2) feet deep at the toe and slope toward the heel at least one foot or two (2%) percent, whichever is greater.
4. Subdrains are to be placed for all stabilization slopes exceeding 10 feet in height. Lower slopes are subject to review. Drains may be required. Guidelines for subdrains are presented on Plate E-5.
5. Benching of backcuts during fill placement is required.

Lot Capping

1. When practical, the upper three (3) feet of material placed below finish grade should be comprised of the least expansive material available. Preferably, highly and very highly expansive materials should not be used. We will attempt to offer advice based on visual evaluations of the materials during grading, but it must be realized that laboratory testing is needed to evaluate the expansive potential of soil. Minimally, this testing takes two (2) to four (4) days to complete.
2. Transition lots (cut and fill) both per plan and those created by remedial grading (e.g., lots above stabilization fills, along daylight lines, above natural slopes, etc.) should be capped with a minimum three foot thick compacted fill blanket.
3. Cut pads should be observed by our representative(s) to evaluate the need for overexcavation and replacement with fill. This may be necessary to reduce water infiltration into highly fractured bedrock or other permeable zones, and/or due to differing expansive potential of materials beneath a structure. The overexcavation should be at least three feet. Deeper overexcavation may be recommended in some cases.

ROCK PLACEMENT AND ROCK FILL GUIDELINES

It is anticipated that large quantities of oversize material would be generated during grading. It's likely that such materials may require special handling for burial. Although alternatives may be developed in the field, the following methods of rock disposal are recommended on a preliminary basis.

Limited Larger Rock

When materials encountered are principally soil with limited quantities of larger rock fragments or boulders, placement in windrows is recommended. The following procedures should be applied:

1. Oversize rock (greater than 8 inches) should be placed in windrows.
 - a) Windrows are rows of single file rocks placed to avoid nesting or clusters of rock.



- b) Each adjacent rock should be approximately the same size (within ~one foot in diameter).
 - c) The maximum rock size allowed in windrows is four feet
- 2. A minimum vertical distance of three feet between lifts should be maintained. Also, the windrows should be offset from lift to lift. Rock windrows should not be closer than 15 feet to the face of fill slopes and sufficient space must be maintained for proper slope construction (see Plate E-4).
- 3. Rocks greater than eight inches in diameter should not be placed within seven feet of the finished subgrade for a roadway or pads and should be held below the depth of the lowest utility. This will allow easier trenching for utility lines.
- 4. Rocks greater than four feet in diameter should be broken down, if possible, or they may be placed in a dozer trench. Each trench should be excavated into the compacted fill a minimum of one foot deeper than the largest diameter of rock.
 - a) The rock should be placed in the trench and granular fill materials (SE>30) should be flooded into the trench to fill voids around the rock.
 - b) The over size rock trenches should be no closer together than 15 feet from any slope face.
 - c) Trenches at higher elevation should be staggered and there should be a minimum of four feet of compacted fill between the top of the one trench and the bottom of the next higher trench.
 - d) It would be necessary to verify 90 percent relative compaction in these pits. A 24 to 72 hour delay to allow for water dissipation should be anticipated prior to additional fill placement.

Structural Rock Fills

If the materials generated for placement in structural fills contains a significant percentage of material more than six (6) inches in one dimension, then placement using conventional soil fill methods with isolated windrows would not be feasible. In such cases the following could be considered:

- 1. Mixes of large rock or boulders may be placed as rock fill. They should be below the depth of all utilities both on pads and in roadways and below any proposed swimming pools or other excavations. If these fills are placed within seven (7) feet of finished grade, they may affect foundation design.
- 2. Rock fills are required to be placed in horizontal layers that should **not exceed two feet in thickness, or the maximum rock size present, which ever is less**. All rocks exceeding two feet should be broken down to a smaller size, windrowed (see above), or disposed of in non-structural fill areas. Localized larger rock up to 3 feet in largest dimension may be placed in rock fill as follows:

- a) individual rocks are placed in a given lift so as to be roughly 50% exposed above the typical surface of the fill,
 - b) loaded rock trucks or alternate compactors are worked around the rock on all sides to the satisfaction of the soil engineer,
 - c) the portion of the rock above grade is covered with a second lift.
3. Material placed in each lift should be well graded. No unfilled spaces (voids) should be permitted in the rock fill.

Compaction Procedures

Compaction of rock fills is largely procedural. The following procedures have been found to generally produce satisfactory compaction.

1. Provisions for routing of construction traffic over the fill should be implemented.
 - a) Placement should be by rock trucks crossing the lift being placed and dumping at its edge.
 - b) The trucks should be routed so that each pass across the fill is via a different path and that all areas are uniformly traversed.
 - c) The dumped piles should be knocked down and spread by a large dozer (D-8 or larger suggested). (Water should be applied before and during spreading.)
2. Rock fill should be generously watered (sluiced)
 - a) Water should be applied by water trucks to the:
 - i) dump piles,
 - ii) front face of the lift being placed and,
 - iii) surface of the fill prior to compaction.
 - b) No material should be placed without adequate water.
 - c) The number of water trucks and water supply should be sufficient to provide constant water.
 - d) Rock fill placement should be suspended when water trucks are unavailable:
 - i) for more than 5 minutes straight, or,
 - ii) for more than 10 minutes/hour.
3. In addition to the truck pattern and at the discretion of the soil engineer, large, rubber-tired compactors may be required.
 - a) The need for this equipment will depend largely on the ability of the operators to provide complete and uniform coverage by wheel rolling with the trucks.
 - b) Other large compactors will also be considered by the soil engineer provided that required compaction is achieved.
4. Placement and compaction of the rock fill is largely procedural. Observation by trenching should be made to check:

- a) the general segregation of rock size,
 - b) for any unfilled spaces between the large blocks, and
 - c) the matrix compaction and moisture content.
5. Test fills may be required to evaluate relative compaction of finer grained zones or as deemed appropriate by the soil engineer.
- a) A lift should be constructed by the methods proposed, as proposed
6. Frequency of the test trenching is to be at the discretion of the soil engineer. Control areas may be used to evaluate the contractor's procedures.
7. A minimum horizontal distance of 15 feet should be maintained from the face of the rock fill and any finish slope face. At least the outer 15 feet should be built of conventional fill materials.

Piping Potential and Filter Blankets

Where conventional fill is placed over rock fill, the potential for piping (migration) of the fine-grained material from the conventional fill into rock fills will need to be addressed.

The potential for particle migration is related to the grain size comparisons of the materials present and in contact with each other. Provided that 15 percent of the finer soil is larger than the effective pore size of the coarse soil, then particle migration is substantially mitigated. This can be accomplished with a well-graded matrix material for the rock fill and a zone of fill similar to the matrix above it. The specific gradation of the fill materials placed during grading must be known to evaluate the need for any type of filter that may be necessary to cap the rock fills. This, unfortunately, can only be accurately determined during construction.

In the event that poorly graded matrix is used in the rock fills, properly graded filter blankets 2 to 3 feet thick separating rock fills and conventional fill may be needed. As an alternative, use of two layers of filter fabric (Mirafi 700 x or equivalent) could be employed on top of the rock fill. In order to mitigate excess puncturing, the surface of the rock fill should be well broken down and smoothed prior to placing the filter fabric. The first layer of the fabric may then be placed and covered with relatively permeable fill material (with respect to overlying material) 1 to 2 feet thick. The relative permeable material should be compacted to fill standards. The second layer of fabric should be placed and conventional fill placement continued.

Subdrainage

Rock fill areas should be tied to a subdrainage system. If conventional fill is placed that separates the rock from the main canyon subdrain, then a secondary system should be installed. A system consisting of an adequately graded base (3 to 4 percent to the lower side) with a collector system and outlets may suffice.

Additionally, at approximately every 25 foot vertical interval, a collector system with outlets should be placed at the interface of the rock fill and the conventional fill blanketing a fill slope

Monitoring

Depending upon the depth of the rock fill and other factors, monitoring for settlement of the fill areas may be needed following completion of grading. Typically, if rock fill depths exceed 40 feet, monitoring would be recommended prior to construction of any settlement sensitive improvements. Delays of 3 to 6 months or longer can be expected prior to the start of construction.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractor's responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.
2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
 - a) shallow (12 + inches) under slab interior trenches and,
 - b) as bedding in pipe zone.

The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.

3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.

4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractor's procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractor's attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

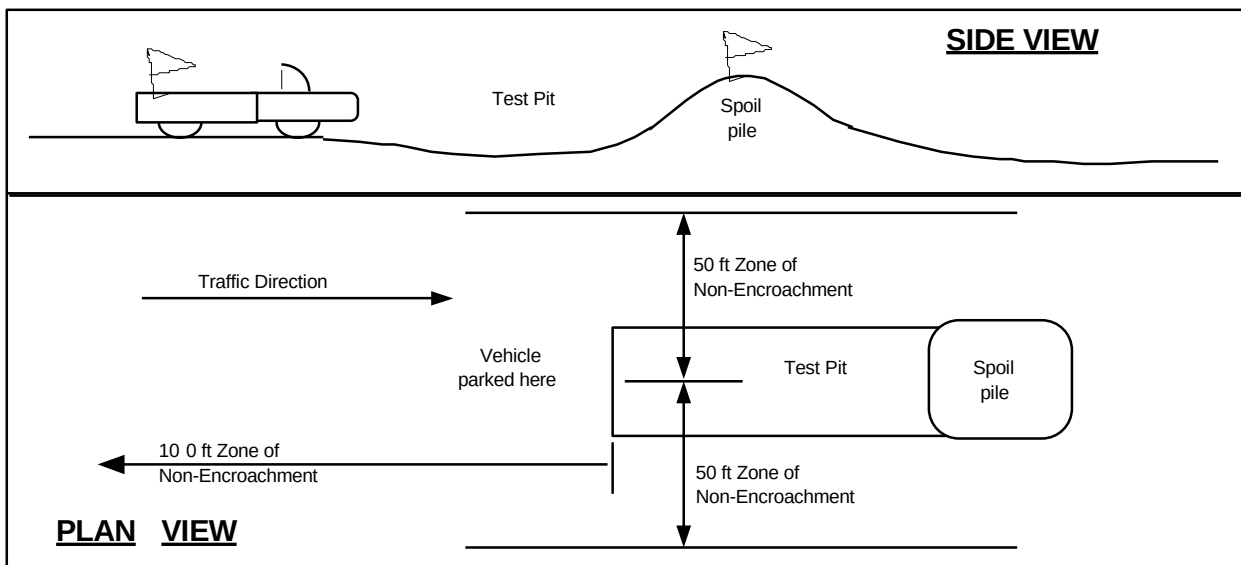
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g., dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g., 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractor's representative will then be contacted in an effort to affect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

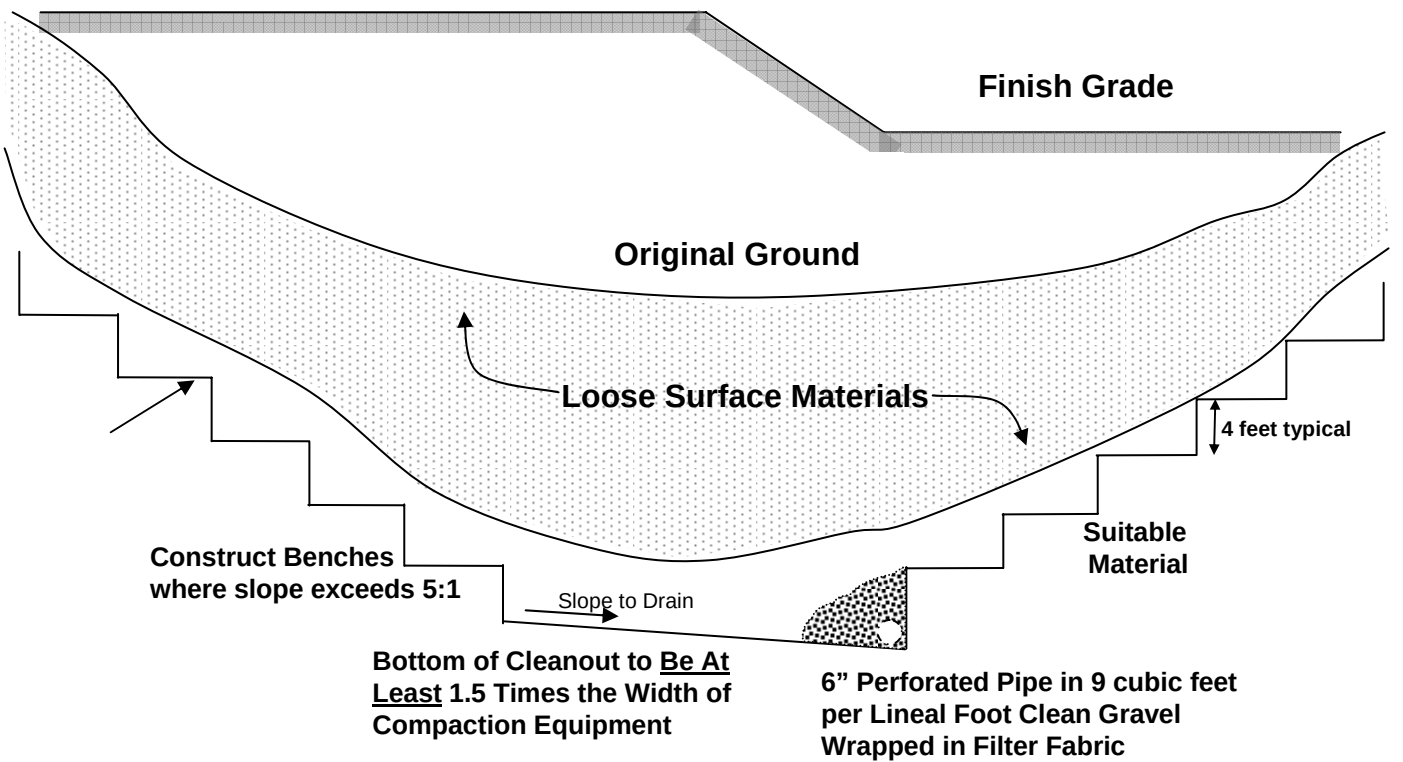
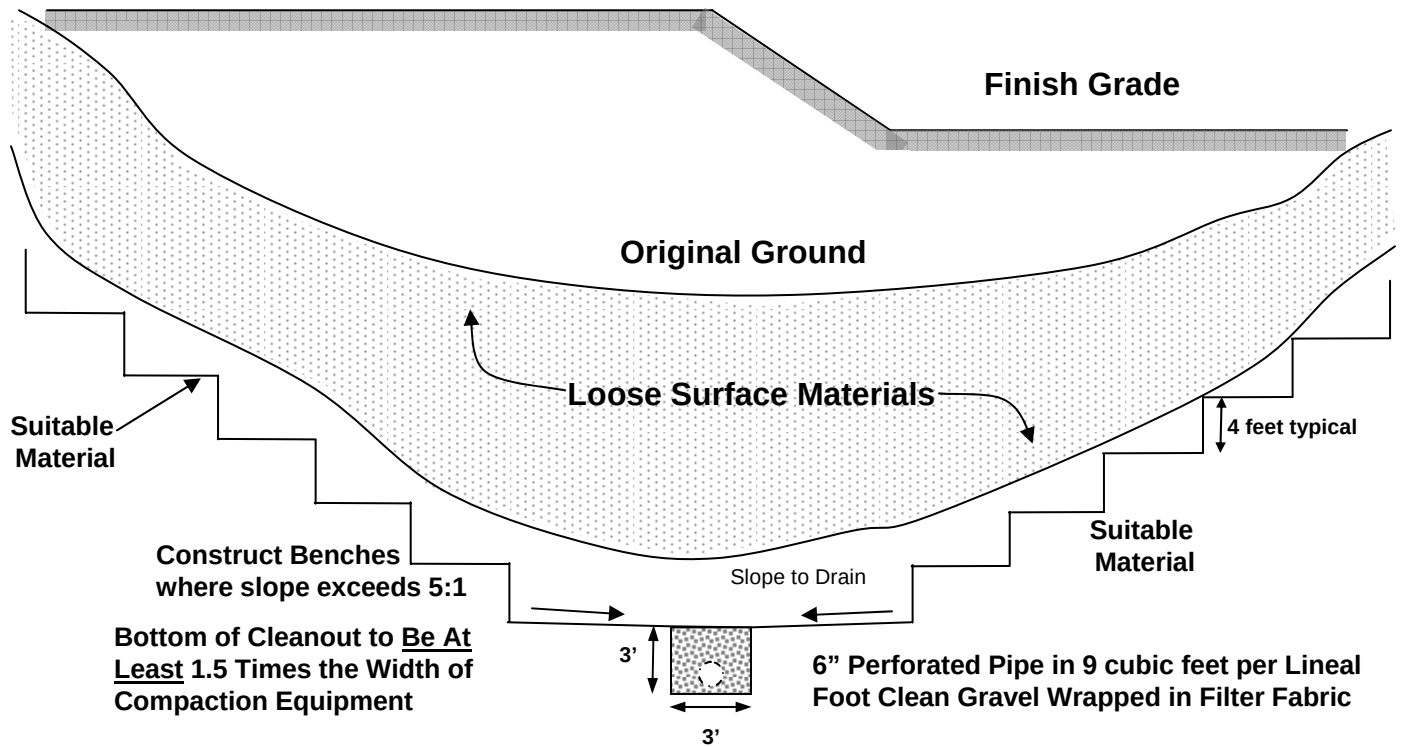
In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to affect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technician's attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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ALTERNATES



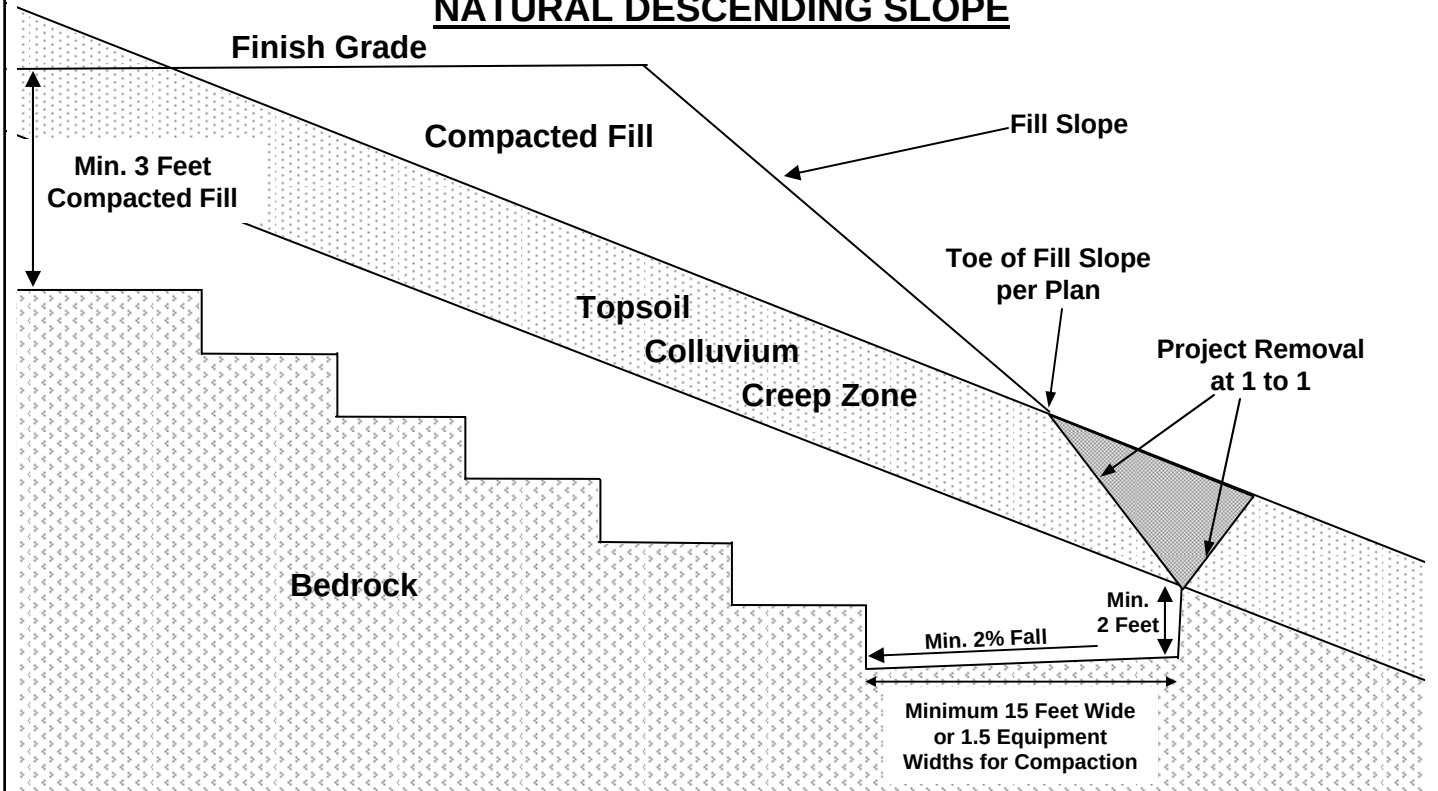
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TYPICAL CANYON
CLEANOUT

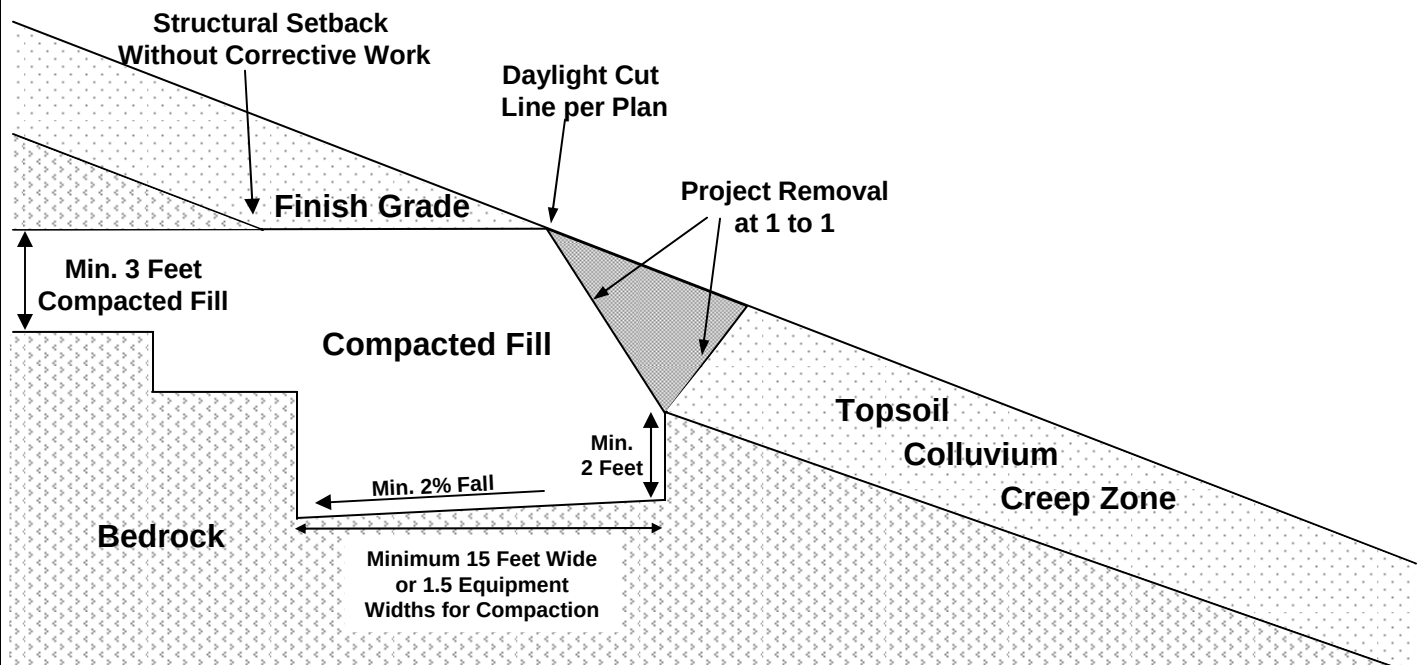
STANDARD GRADING
GUIDELINES

PLATE B-I

TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



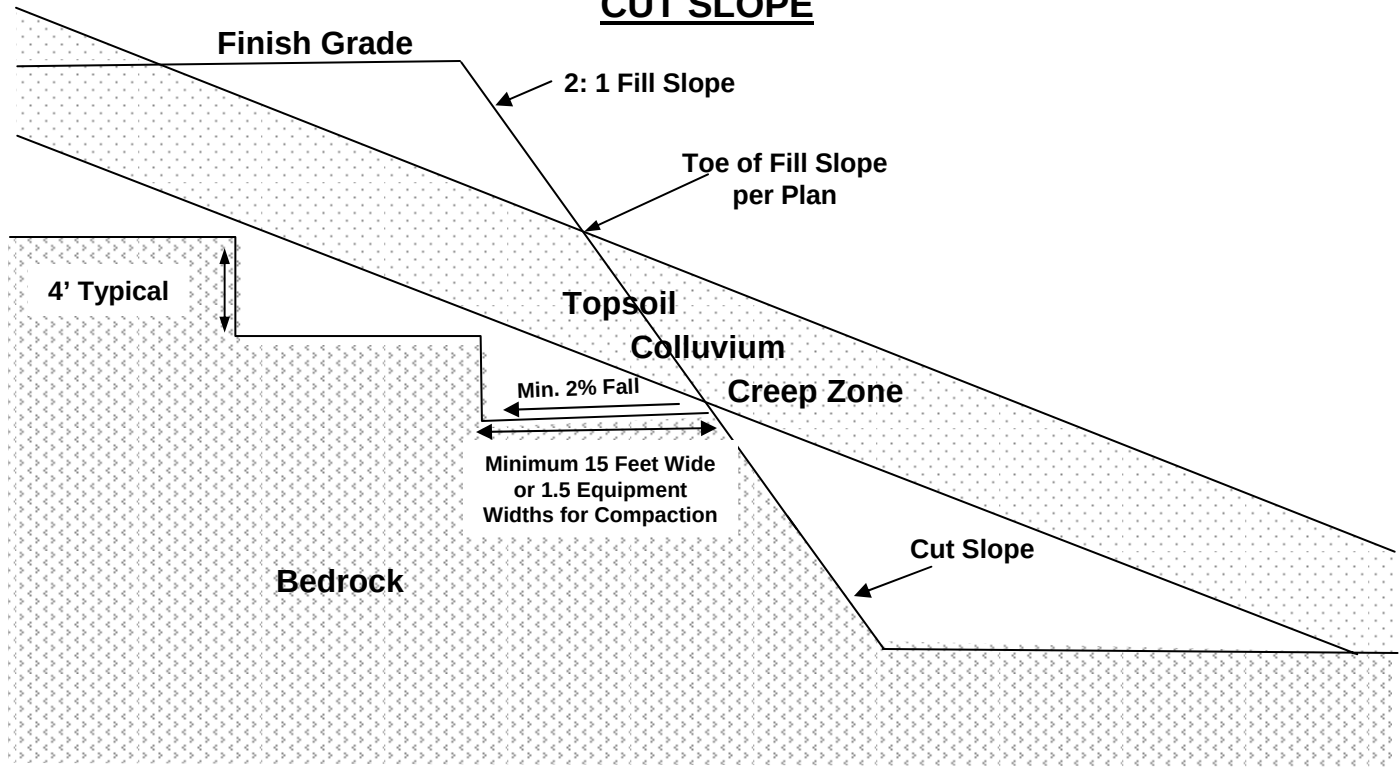
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TREATMENT ABOVE
NATURAL SLOPES

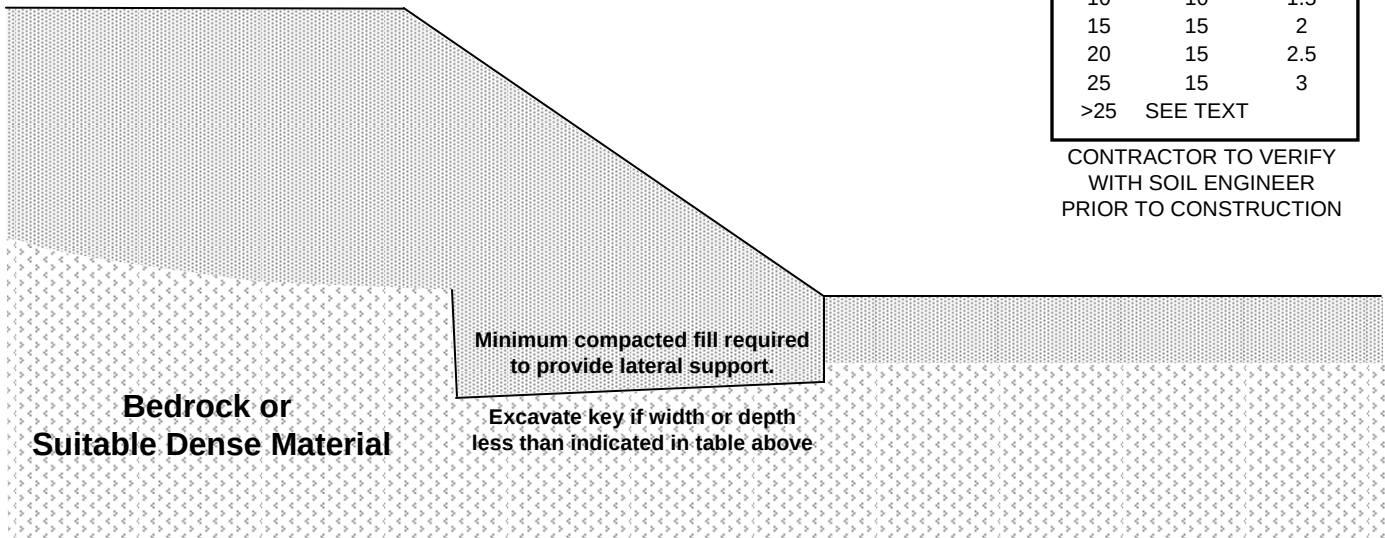
STANDARD GRADING
GUIDELINES

PLATE B-2

TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE



SLOPE HEIGHT	MIN. KEY WIDTH	MIN. KEY DEPTH
5	7	1
10	10	1.5
15	15	2
20	15	2.5
25	15	3
>25	SEE TEXT	

CONTRACTOR TO VERIFY
WITH SOIL ENGINEER
PRIOR TO CONSTRUCTION



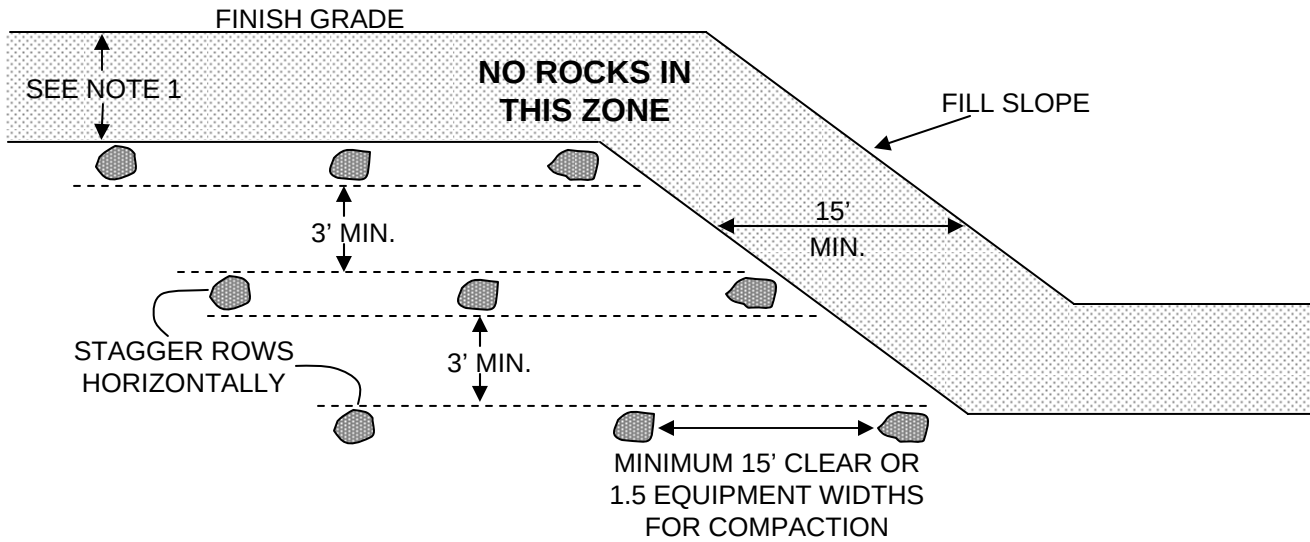
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COMMON FILL
SLOPE KEYS

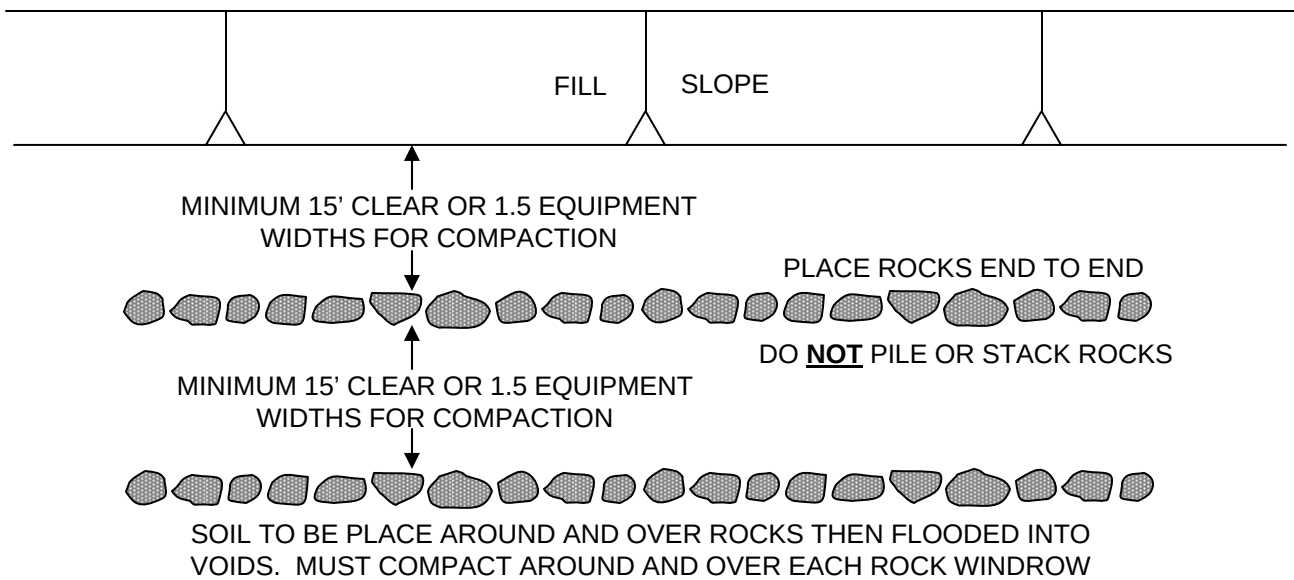
STANDARD GRADING
GUIDELINES

PLATE B-3

CROSS SECTIONAL VIEW



PLAN VIEW



NOTES:

- 1) SOIL FILL OVER WINDROW SHOULD BE 7 FEET OR PER JURISDICTIONAL STANDARDS AND SUFFICIENT FOR FUTURE EXCAVATIONS TO AVOID ROCKS
- 2) MAXIMUM ROCK SIZE IN WINDROWS IS 4 FEET IN DIAMETER
- 3) SOIL AROUND WINDROWS TO BE SANDY MATERIAL SUBJECT TO SOIL ENGINEER ACCEPTANCE
- 4) SPACING AND CLEARANCES MUST BE SUFFICIENT TO ALLOW FOR PROPER COMPACTION
- 5) INDIVIDUAL LARGE ROCKS MAY BE BURIED IN PITS.

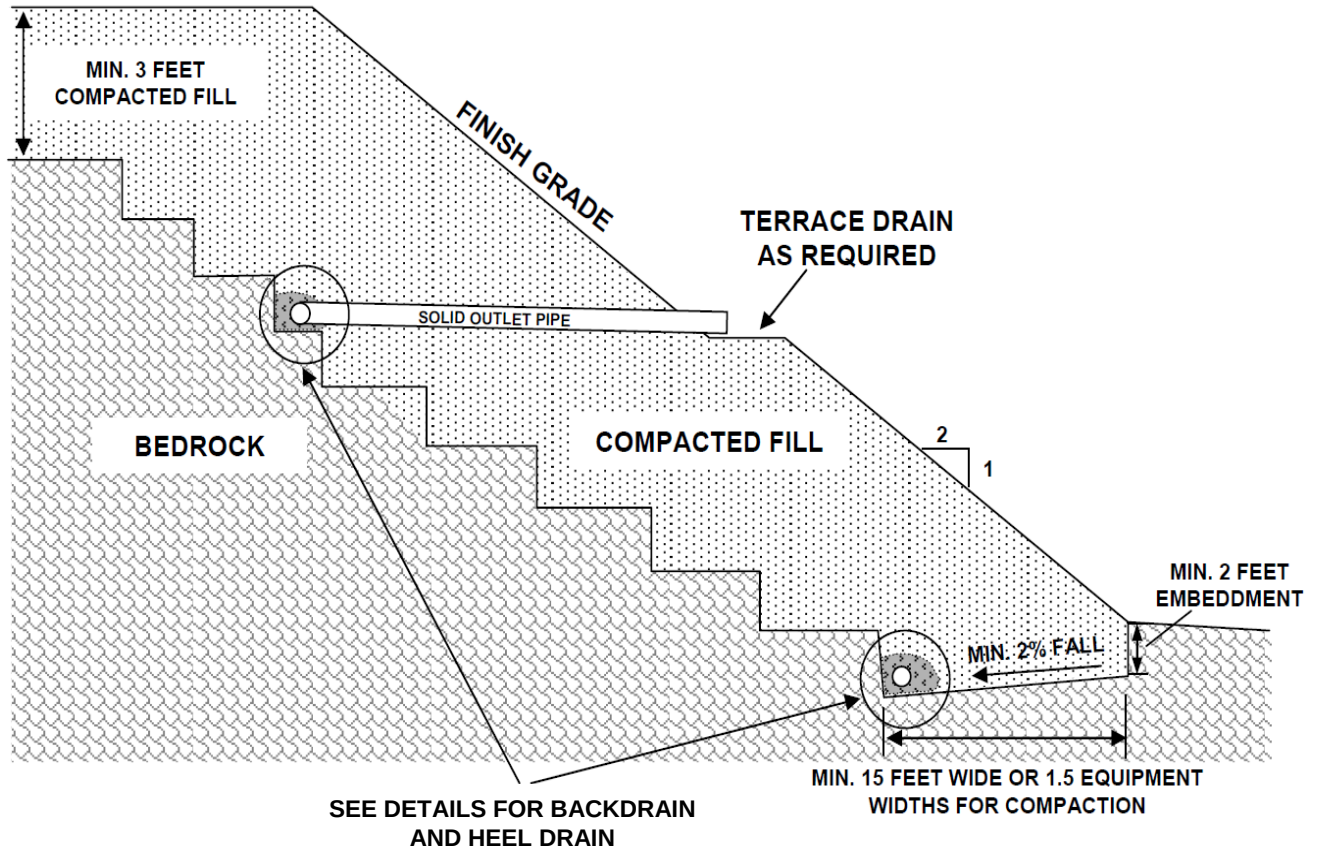


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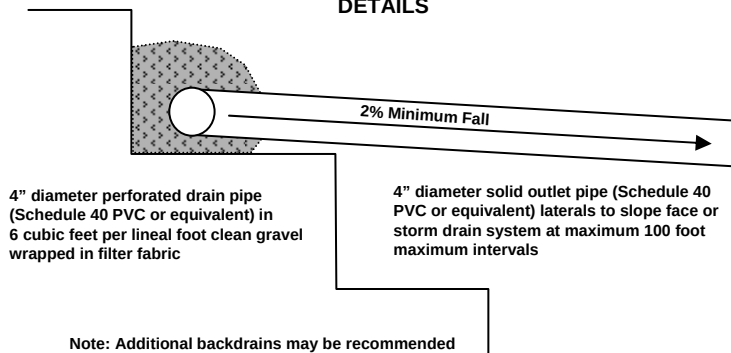
ROCK BURIAL DETAILS

STANDARD GRADING
GUIDELINES

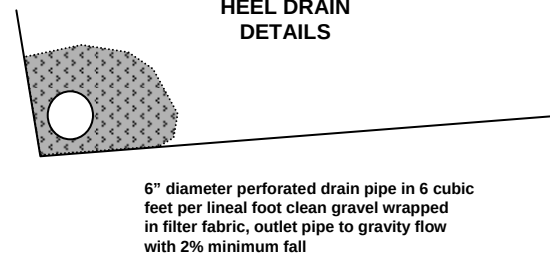
PLATE B-4



BACKDRAIN DETAILS



HEEL DRAIN DETAILS



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TYPICAL BUTTRESS AND
STABILIZATION FILL

STANDARD GRADING
GUIDELINES

PLATE B-5