February 14, 2013 Project No. 12129-01

Mr. Adam Smith
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Subject: ***Updated Geotechnical Evaluation, Proposed 84 Lot Residential Development (Tentative Tract 32535), Riverside County, California***

In accordance with your request, LGC Geotechnical, Inc. has performed an updated geotechnical evaluation of the site conditions for Tentative Tract Map No. 32535 in the County of Riverside, California. This report presents the results of our evaluation and geotechnical analysis and provides a summary of our conclusions and recommendations relative to the proposed development of the site. The geotechnical recommendations provided herein supersede all previous unless specified otherwise.

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

Respectfully,

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1.0 INTRODUCTION

1.1 Purpose

LGC Geotechnical has performed a limited geotechnical evaluation to assess the current site geotechnical conditions for the proposed development of Tentative Tract Map No. 32535 in the County of Riverside, California (see Site Location Map, Figure 1). The purpose of this report is to provide updated geotechnical recommendations for development of the site in accordance with the 2010 California Building Code (CBC) and based on the current geotechnical conditions. This report presents the results of our evaluation and geotechnical analysis and provides a summary of our conclusions and recommendations relative to the proposed development of the site. The recommendations provided herein supersede all previous unless specified otherwise.

Our scope of services included:

- Review of pertinent, readily available geotechnical reports and geologic maps (Appendix A);
- Excavation, sampling and logging of two hand-augered, exploratory borings in the area of the proposed detention basins;
- Conversion of the two borings for performance of infiltration testing;
- Infiltration testing;
- Reconnaissance level geologic mapping of the site;
- Preparation of an Updated Geotechnical Map depicting the interpreted geologic conditions on the site;
- Geotechnical analysis of the data reviewed/obtained; and
- Preparation of this report presenting our findings, conclusions, and preliminary recommendations with respect to the proposed site development.

1.2 Project Description and Background

The site is an irregularly-shaped property located generally north of the intersection of Clinton Keith Road and Palomar Street in the unincorporated territory of the County of Riverside, California. The site is currently occupied by several residential structures and associated auxiliary structures, dirt access roads and drives, buried utilities, horse corals, various fences and landscaping. Site grading is anticipated to include remedial grading followed by excavation of cut and placement of fill soils to reach design grades for construction of the proposed residential structures, associated streets and utilities.

Site development will include grading of the site for 84 single-family home sites with associated interior streets and improvements, detention basins and open space. Onsite graded slopes will be of 2:1 (horizontal to vertical) inclinations or flatter. Generally, the maximum proposed cut is approximately 18 feet and the maximum proposed fill is approximately 15 feet (not accounting for remedial grading). The largest slope on the site will be a proposed fill slope on the order of 22 feet high in the northern portion of the development. The largest cut slope will also be on the order of approximately 14 feet high along the northern edge of the property. Two detention basins are planned in the western side of the site and a third on the eastern side.

Topographically, the site generally consists of a central drainage, which is the convergence of two smaller drainages that flow to the west. The remainder of the site consists of gently sloping hillsides which all drain to the central drainage.

At least two previous geotechnical evaluations have been performed on the site; one by Lawson and Associates Geotechnical Consulting, Inc. (Lawson, 2005), and a supplemental evaluation by LGC Inland (2006). In total, these two evaluations included excavation, sampling and logging of seventeen exploratory test pits, six exploratory borings, and six fault trenches. The data gathered in these studies has been reviewed and considered in preparation of this report. The pertinent geotechnical data from these evaluations has been incorporated herein. The approximate location of borings, test pits and fault trenches excavated on the site are depicted on our Geotechnical Map (Sheet 1). Logs of the excavations are presented in Appendix B. Laboratory test results are presented in Appendix C.

2.0 LIMITED GEOTECHNICAL EVALUATION

2.1 Field Evaluation

In order to evaluate the current site conditions, we have performed a limited geotechnical evaluation. Our evaluation included review of available geologic data and maps pertinent to the site, site reconnaissance mapping, and a limited subsurface evaluation. As part of our evaluation, we have excavated, sampled and logged two hand-augered borings in the location of two of the proposed detention basins. The borings were excavated to depths of approximately 5 feet below existing grades within the proposed site detention basin areas. The borings were sampled and logged by a representative from our firm. The soils encountered within the borings were generally consistent with the findings of the previous site geotechnical evaluations. Each of the borings was converted for in-situ infiltration testing for measurement of the approximate infiltration rates of the site materials. Approximate boring locations are presented on our Updated Geotechnical Map (Sheet 1).

2.2 Laboratory Testing

Laboratory test results from the previous site evaluations have been considered as part of this study. The previous laboratory test results are included in Appendix C.

2.3 Infiltration Testing

Infiltration testing consisted of the excavation of two hand-augered borings (LGC-HA-1 & LGC-HA-2) to depths of approximately 5 feet below existing grade at the location of the planned detention basins. Prior to conducting the infiltration testing, the borings were filled with water and topped-off periodically in order to presoak the surrounding materials. Infiltration testing was performed the following day over several consecutive monitoring intervals.

The following morning, each infiltration boring was filled with approximately 3 feet of water and, using a hand-held Solinist electronic sounder, the water level was measured and monitored for two 25 minute periods per boring. The results of this pre-testing indicated infiltration rates of 0.5 foot or greater for the time interval measured. The main testing was then performed, which included the refilling of each boring with approximately 3 feet of water. After 10 minutes the level of the water surface was recorded and the infiltration boring was refilled with water again. This was repeated six times per boring for a total infiltration duration of one hour each. The results are provided in Table 1.

TABLE 1

Summary of Infiltration Testing

Boring Location	**Calculated Infiltration Rate* (Inches/Hr)**
LGC-HA-1	0.16
LGC-HA-2	0.33

*Based on Factor of Safety of 2

It should be emphasized that infiltration test results are only representative of the location and depth where they are performed. Varying subsurface conditions may exist outside of the test locations which could alter the calculated infiltration rates indicated above. Infiltration tests are performed using relatively clean water free of particulates, silt, etc. Refer to the discussion provided in Section 6.11

3.0 GEOTECHNICAL CONDITIONS

3.1 Regional Geology

Regionally, the site is located within the Perris structural block of the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are characterized by steep, elongated valleys that trend west to northwest. The northwest-trending topography is controlled by the Elsinore Fault Zone, which extends from the San Gabriel River Valley southeasterly to the United States/Mexico border. The Santa Ana Mountains lie along the western side of the Elsinore Fault Zone, while the Perris Block is located along the eastern side of the fault zone. The mountainous regions are underlain by Pre-Cretaceous, metasedimentary and metavolcanic rocks and Cretaceous plutonic rocks of the Southern California Batholith. Tertiary and Quaternary rocks are generally comprised of non-marine sediments consisting of sandstone, mudstones, conglomerates and occasional volcanic units.

3.2 Site-Specific Geology

Based on our subsurface evaluation and review of those by others (see Appendix A), the primary bedrock unit encountered within the subject area is Pauba Formational material. Surficial units consisting of undocumented landslide deposits, artificial fill, topsoil/colluvium, and alluvium overlie the bedrock material. A brief description of these geologic units is presented below (from youngest to oldest).

3.2.1 Artificial Fill - Undocumented (Map Symbol - Afu)

Areas of undocumented artificial fill material were observed at various locations on the site, usually associated with dirt roads, building pads, earthen dams, leveling of undulatory areas, etc. A large stockpile of soil was also observed in the northwestern portion of the site. It is apparent that little to no remedial grading was performed prior to placement of fill material on the site and that the fill was not placed with engineering observation and testing. In general, the fill materials encountered on the site were found to be loose to medium dense and damp to moist. The fill materials encountered on the site are considered potentially compressible and should be removed to competent material prior to additional fill placement. Existing undocumented fill is estimated to be on the order of approximately 5 feet thick in some portions of the onsite drainages, however deeper areas may be encountered during site grading. Only the larger areas of undocumented artificial fill were mapped on the site due to their relatively thin nature and variable lateral extent (Sheet 1). Therefore, additional pockets of undocumented fill material, other than those depicted on the map, should be anticipated.

3.2.2 Quaternary Landslide Deposits (Map Symbol - Qls)

During our recent site visit a small surficial landslide failure was observed and mapped in the northwestern portion of the site. The failure appears to be on the order of 4 feet thick and is comprised of loose unconsolidated soils and debris and should be completely removed during site grading.

3.2.3 Topsoil/Colluvium (Not Mapped)

The topsoil/colluvium observed during our field study mantles the mid- to lower-portions of the slopes across the majority of the site. The topsoil/colluvium, as observed, consists predominantly of brown to dark brown, damp to moist, loose to medium dense, clayey sand to sandy clay. These soils are typically massive, porous and contain scattered roots and organics. The potentially compressible topsoil is estimated to be approximately 1 to 2 feet in thickness; however, localized areas of thicker accumulations of topsoil may be encountered during grading. Topsoil/colluvial soils on the lower hillsides of the onsite drainages can be expected to be somewhat deeper in extent and locally variable in composition. Topsoil/colluvium was not mapped on the site due to its relatively thin nature and variable lateral extent, however, thicker deposits of colluvium have been incorporated into the material mapped as Quaternary Alluvium discussed below.

3.2.4 Quaternary Alluvium (Map Symbol - Qal)

Alluvial soils were encountered in the drainages on the site. Some of the suspected deeper accumulations were not investigated due to the presence of standing water on the surface within some of the alluvial channels. The alluvium, as observed, consists predominantly of brown, damp to moist, loose to medium dense, clayey sand to sandy clay. These soils are typically massive, porous and contain organics and scattered roots. The potentially compressible alluvium is estimated up to be approximately 5 to 10 feet in thickness; however, localized areas of thicker accumulations may be encountered during grading. Please note, in areas where undocumented fill soils have been placed above alluvial soils, deeper removals than those cited above should be anticipated. The approximate lateral extent of these materials has been depicted on our Updated Geotechnical Map (Sheet 1).

3.2.5 Quaternary Pauba Formation (Map Symbol - Qp)

The Pauba Formation underlies the majority of the site. As encountered, this material consists of moderately indurated silty sand and clayey sand with minor amounts of cobble-sized material. Typically this material has good bearing properties and a low potential for expansion.

3.3 Geologic Structure

The material observed on the site was generally massive with only rare, approximately horizontal bedding observed. Locally, cross bedding was encountered dipping approximately 25 degrees to the northwest.

No faults have been mapped on the site nor were any encountered during our field study.

3.4 Landslides

A shallow surficial landslide was observed on the site during our recent site visit. See discussion above. Larger landslides were not observed nor anticipated on the site.

3.5 Groundwater

While the static groundwater table in the area is thought to be on the order of 100 feet below the subject site, shallow groundwater and surface water seepage and flow has been observed in the vicinity of proposed Lots 7 through 10, 73 through 84 and the Lot 87 Open Space to the south of these lots. In this portion of the site, groundwater has been encountered at depths ranging from at the surface to approximately 20.5 feet below the surface in both bedrock and alluvial areas. We understand that an artesian flowing well is located on the residential property adjacent to this area. Evidence of artesian flowing springs has been observed up gradient from the site to the east.

3.6 Faulting

California is located on the boundary between the Pacific and North American Lithospheric Plates. The average motion along this boundary is on the order of 50-mm/yr in a right-lateral sense. The majority of the motion is expressed at the surface along the northwest trending San Andreas Fault Zone with lesser amounts of motion accommodated by sub-parallel faults located predominantly west of the San Andreas including the Elsinore, Newport-Inglewood, Rose Canyon, and Coronado Bank Faults. Within Southern California, a large bend in the San Andreas Fault north of the San Gabriel Mountains has resulted in a transfer of a portion of the right-lateral motion between the plates into left-lateral displacement and vertical uplift. Compression south and west of the bend has resulted in folding, left-lateral reverse thrust faulting, and regional uplift creating the east-west trending Transverse Ranges and several east-west trending faults. Further south within the Los Angeles Basin, “blind thrust” faults are believed to have developed below the surface also as a result of this compression, which have resulted in earthquakes such as the 1994 Northridge event along faults with little to no surface expression.

Prompted by damaging earthquakes in Northern and Southern California, State legislation and policies concerning the classification and land-use criteria associated with faults have been developed. Their purpose was to prevent the construction of urban developments across the trace of active faults. The result is the Alquist-Priolo Earthquake Fault Zoning Act, which was most recently revised in 2007 (CDMG, 2007). According to the State Geologist, an active fault is defined as one, which has had surface displacement within the Holocene Epoch (roughly the last 11,000 years). A potentially active fault is defined as any fault, which has had surface displacement during Quaternary time (last 1,600,000 years), but not within the Holocene. Fault-Rupture Hazard Zones have been delineated along the traces of active faults within California. Where developments for human occupation are proposed within these zones, the state requires detailed fault evaluations be performed so that engineering geologists can mitigate the hazards associated with active faulting by identifying the location of active faults and allowing for a setback from the zone of previous ground rupture.

While the subject site is not located within a mapped Fault-Rupture Hazard Zone for the Wildomar Quadrangle (CDMG, 1980), it is located approximately 780 feet east of the active trace of Elsinore-Temecula Fault and approximately 180 feet from the eastern margin of the Fault-Rupture Hazard Zone that surrounds it. The southwestern portion of the site is located within the County of Riverside

Fault Zone. A potentially active strand of the Elsinore-Temecula Fault has also been mapped approximately 80 feet east of the site (Sheet 1). The results of our geologic mapping and photolineament analysis did not indicate the presence of features suggestive of faulting on the site.

A total of six fault trenches were excavated at various locations across the site in an attempt to intercept potential onsite faulting. No evidence of active faulting was observed during the onsite fault study (LGC Inland, 2006).

The possibility of damage due to ground rupture is considered low since active faults are not known to cross the site and there are no known active or potentially active mapped on the site. Fault traces are depicted in close proximity to the western site boundary, but do not appear to cross the site. Short of leveling all structures on the site and excavating the entire site in search of faults, one can never be 100 percent sure of the absence of onsite faulting. Therefore, the potential presence of active or potentially active faults on the site cannot be absolutely precluded until the site subsurface conditions have been completely exposed and mapped by a geologist. With this said, the level of work performed for investigating the potential for active faulting on the site was within industry standards. Additional subsurface investigation can be performed (if desired) in the portions of the site closest to the known faults to provide further data with regard to the potential for onsite faulting. If active faulting is encountered on the site, building setbacks will be required from the trace of the active fault. If potentially active fault traces are identified on the site, recommendations are typically made on a case by case basis; often it is recommended that either buildings be set back from the trace of the fault or a deed be attached to the property, which identifies the presence of the fault.

Secondary effects of seismic shaking resulting from large earthquakes on the major faults in the Southern California region, which may affect the site include ground lurching and shallow ground rupture, soil liquefaction, dynamic settlement, seiches and tsunamis. These secondary effects of seismic shaking are a possibility throughout the Southern California region and are dependant on the distance between the site and causative fault and the onsite geology. The major active faults that could produce these secondary effects include the Glen Ivy and Temecula branches of the Elsinore Fault. A discussion of these secondary effects is provided in the following sections.

3.6.1 Lurching and Shallow Ground Rupture

Soil lurching refers to the rolling motion on the ground surface by the passage of seismic surface waves. Effects of this nature are not likely to be significant where the thickness of soft sediments does not vary appreciably under structures.

Ground rupture due to active faulting is not likely to occur on site due to the absence of known active fault traces. Minor cracking of near-surface soils due to shaking from distant seismic events is not considered a significant hazard, although it is a possibility at any site, and is often associated with ridgelines.

3.6.2 Liquefaction and Dynamic Settlement

Liquefaction is a seismic phenomenon in which loose, saturated, granular soils behave similarly to a fluid when subject to high-intensity ground shaking. Liquefaction occurs when three general conditions coexist: 1) shallow groundwater; 2) low density non-cohesive (granular) soils; and 3) high-intensity ground motion. Studies indicate that loose, saturated, near surface cohesionless soils exhibit the highest liquefaction potential, while dry, dense, cohesionless soils and cohesive soils exhibit low to negligible liquefaction potential. In general, cohesive soils are not considered susceptible to liquefaction. Effects of liquefaction on level ground include settlement, sand boils, and bearing capacity failures below structures. Dynamic settlement of dry sands can occur as the sand particles tend to settle and densify as a result of a seismic event.

Based upon the site consisting primarily of dense sandstone and siltstone and provided the recommended earthwork removals are performed (i.e., removal of site alluvium), the potential for soil liquefaction and associated seismic settlement is considered to be very low.

3.6.3 Lateral Spreading

Lateral spreading is a type of liquefaction induced ground failure associated with the lateral displacement of surficial blocks of sediment resulting from liquefaction in a subsurface layer. Once liquefaction transforms the subsurface layer into a fluid mass, gravity plus the earthquake inertial forces may cause the mass to move downslope towards a free face (such as a river channel or an embankment). Lateral spreading most commonly occurs on gentle slopes (up to about 5 percent) and may cause large horizontal displacements. Such movement typically damages pipelines, utilities, bridges, and structures. A procedure outlined by Youd, et al. requiring the design earthquake magnitude and corresponding fault distance is typically used to estimate lateral displacements.

Based on the low potential for liquefaction, the potential for lateral spreading is also considered very low.

3.6.4 Tsunamis and Seiches

Based on the distance of the site from the sea and other large bodies of water, the possibility of seiches and/or tsunamis affecting the site is considered to be very low.

3.7 Rippability

Based on the excavation characteristics encountered on the site, rippability is not anticipated to be an issue during site grading and construction. It is anticipated that the onsite soils may be excavated with conventional heavy-duty construction equipment.

3.8 Oversized Material

Generation of significant oversize material (greater than 8-inches in maximum dimension) is not anticipated. However, if encountered, recommendations are provided for appropriate handling of oversized materials in Appendix D.

3.9 Expansive Soil Characteristics

Generally, the onsite soils should be expected to have a Low to Very High expansion potential. Expansion potential testing of three samples on the site indicated expansion indices ranging from 35 "Low" to 140 "Very High."

3.10 Soil Corrosivity

Corrosion suites (pH, resistivity, soluble sulfate, and chloride content) were performed on two samples obtained during a previous subsurface evaluation of the site to estimate the corrosion potential of onsite soils (Lawson, 2005). The samples tested were obtained from Trenches T-1 and T-15. The resistivity tests resulted in a minimum resistivity of 605 and 800 ohm-centimeters, pH values of 7.5 and 8.2, chloride contents of 242 and 87 ppm. The soluble sulfate content for both samples was less than 0.02 percent. Caltrans defines a corrosive area where any of the following conditions exist: the soil contains more than 500 ppm of chlorides, more than 2,000 ppm (0.2 percent) of sulfates, or a pH of 5.5 or less.

4.0 ANALYSIS

4.1 General

Based on our review, site development will include graded slopes of 2:1 (horizontal to vertical) inclinations or flatter. The largest slope on the site will be on the order of 15 feet tall. Recommendations for the construction of design slopes are contained in Section 6.2.

4.1.1 Design Cut Slopes

In general, we anticipate that the proposed 2:1 (horizontal to vertical) cut slopes, excavated within Pauba Formational material and free of adverse geologic conditions, will be grossly stable.

4.1.2 Design Fill Slopes

Design fill slopes will be constructed utilizing fill material generated from the cut portions of the site. In general, we anticipate that the proposed 2:1 (horizontal to vertical) fill slopes, utilizing fill soils derived from the onsite materials, will be grossly stable.

4.1.3 Slope Erosion

Based on our experience with slopes made up of similar materials with low cohesion, the slopes are subject to erosion, raveling, and minor rock fall. As vegetation has a positive effect on slope erosion, the site slopes should be planted with deep-rooted and drought tolerant vegetation as soon as possible. Planted slopes above home sites should be properly irrigated and maintained, and loose materials should be removed from the slope face at the completion of landscaping installation.

4.2 Seismic Design Criteria

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2010 California Building Code (CBC). Representative site coordinates of latitude 33.5929 degrees north and longitude -117.2530 degrees west were utilized in our analyses. The maximum considered earthquake (MCE) spectral response accelerations (S_{MS} and S_{M1}) and adjusted design spectral response acceleration parameters (S_{DS} and S_{D1}) for Site Class D are provided in Table 2.

TABLE 2

Seismic Design Parameters

Selected Parameters from CBC Section 1613 - Earthquake Loads	**Seismic Design Values**
Site Class per Table 1613.5.2	D
Spectral Acceleration for Short Periods (S_S)*	1.841g
Spectral Accelerations for 1-Second Periods (S_1)*	0.672g
Site Coefficient F_a per Table 1613.5.3(1)	1.0
Site Coefficient F_v per Table 1613.5.3(2)	1.5
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_aS_S$]	1.841g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_vS_1$]	1.008g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3)S_{MS}$]	1.228g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3)S_{M1}$]	0.672g

* From USGS, 2011

Section 1802.2.7 of the 2010 CBC states that the PGA for a site may be defined as $S_{DS}/2.5$. Therefore, horizontal peak ground acceleration (PGA) is estimated at (1.228g/2.5) = **0.49g.**

5.0 CONCLUSIONS

Based on the results of our limited evaluation and our understanding of the proposed development, it is our opinion that the proposed development is feasible from a geotechnical standpoint, provided the recommendations contained in the following sections are incorporated during site design, grading, and construction.

A summary of our geotechnical conclusions is as follows:

- Based on our site visit and review of pertinent geologic maps and reports, the site is underlain by a thin veneer of surficial materials, which are in-turn underlain by Pauba Formation material.
- Groundwater and seepage has been encountered at relatively shallow depths within Open Space 87 and in portions of the development area to the north. This groundwater is likely a perched condition and may be encountered during required remedial grading and possibly during rough grading for the proposed site development. The earthwork contractor should anticipate encountering groundwater during grading within these areas, especially in construction of the roadway across the drainage.
- Active or potentially active faults are not known to exist on the site. However, the Elsinore-Temecula Fault is located only approximately 0.2 km southwest of the site. A potentially active strand of the Elsinore-Temecula Fault has been mapped approximately 80 feet west of the site.
- The main seismic hazard that may affect the site is from ground shaking from one of the active regional faults. The subject site will likely experience strong seismic ground shaking during its design life. The estimated peak horizontal ground acceleration is 0.49g.
- Based on our field tests and the presence of fine-grained soils, very low infiltration rates should be anticipated at this site at location for the planned detention basins. The calculated infiltration rates from our field tests were 0.16 and 0.33 inch per hour.
- Based on preliminary laboratory test results, the onsite soils are anticipated to have a Low to Very High potential for expansion. However, final design expansion potential must be determined at the completion of grading. Mitigation measures are required for foundations and site improvements such as concrete flatwork to minimize the impacts of expansive soils.

6.0 RECOMMENDATIONS

The following recommendations are to be considered preliminary, and should be confirmed upon completion of grading and earthwork operations. In addition, they should be considered minimal from a geotechnical viewpoint, as there may be more restrictive requirements from the architect, structural engineer, building codes, governing agencies, or the County.

It should be noted that the following geotechnical recommendations are intended to provide sufficient information to develop the site in general accordance with the 2010 CBC requirements. With regard to the potential occurrence of potentially catastrophic geotechnical hazards such as fault rupture, earthquake-induced landslides, liquefaction, etc. the following geotechnical recommendations should provide adequate protection for the proposed development to the extent required to reduce seismic risk to an "acceptable level." The "acceptable level" of risk is defined by the California Code of Regulations as "that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project" [Section 3721(a)]. Therefore, repair and remedial work of the proposed improvement may be required after a significant seismic event. With regards to the potential for less significant geologic hazards to the proposed development, the recommendations contained herein are intended as a reasonable protection against the potential damaging effects of geotechnical phenomena such as expansive soils, fill settlement, groundwater seepage, etc. It should be understood, however, that our recommendations are intended to maintain the structural integrity of the proposed development and structures given the site geotechnical conditions, but cannot preclude the potential for some cosmetic distress or nuisance issues to develop as a result of the site geotechnical conditions.

The geotechnical recommendations contained herein must be confirmed to be suitable or modified based on the actual as-graded conditions.

The following recommendations are based upon our evaluation of the near surface soils and our understanding of the proposed construction.

6.1 Site Earthwork

We anticipate that earthwork at the site will consist of rough and precise grading operations followed by retaining wall construction, utility construction, foundation construction, and asphalt paving of the streets and drives. We recommend that earthwork onsite be performed in accordance with the following recommendations, the County Grading Requirements, and the General Earthwork and Grading Specifications for Rough Grading included in Appendix D. In case of conflict, the following recommendations shall supersede all previous recommendations and those included as part of Appendix D. The following recommendations should be considered preliminary and may be revised based on the actual as-graded conditions of the site once grading is completed. If necessary, revisions will be provided in our as-graded report for the site following the completion of grading.

6.1.1 Site Preparation

Prior to grading of areas to receive structural fill or engineered structures, the areas should be cleared of surface obstructions and potentially compressible material (such as landslide debris,

undocumented fill, topsoil, colluvium, alluvium, and vegetation). Vegetation and debris should be removed and properly disposed of off-site. Holes resulting from the removal of buried obstructions, which extend below proposed design grades, should be replaced with suitable compacted fill material.

6.1.2 Control of Groundwater Seepage

Groundwater seepage and potentially artesian flowing springs may be encountered during site grading. Currently there is insufficient data to determine the source or the volume of groundwater that may be encountered during site development. Therefore, we recommend that the groundwater be mitigated based on the observed conditions encountered during site rough grading. Potential mitigation recommendations may include: placing "burrito-type" subdrains across areas of observed seepage in proposed fill areas; construction of "French Drains" across areas of observed seepage in proposed cut areas; overexcavation of areas of observed and/or potential seepage to allow for construction of a blanket of crushed rock with an integrated system of subdrains to collect and outlet accumulated water; construction of hydroaugers; and/or dewatering wells. Details of the appropriate mitigation method will be determined based on the actual conditions encountered during site grading and development.

It is hoped that the nature and structure through which the groundwater seepage is emanating becomes apparent during site rough grading and that appropriate and reasonable mitigation methods can be determined and implemented. However, it should be considered that the proposed grading may exacerbate the problem, potentially limiting mitigation options and/or potentially necessitating an extensive mitigation system. It also should be considered that groundwater seepage conditions can change in location and volume over time as rainfall amounts vary from year to year and due to increases in irrigation of onsite and up-gradient landscaping typically associated with new development. Although currently not anticipated, it should be considered that conditions may be found that would suggest that construction of a groundwater mitigation system should be implemented beyond the areas of observed seepage to mitigate the potential for migration of the seepage to other areas of the site.

6.1.3 Removal Depths

We anticipate removals on the site will generally range from approximately 1 to 3 feet, across the majority of the higher elevations of the site. Removals up to approximately 10 feet should be anticipated within the onsite drainages and their margins. Groundwater will likely be encountered for deeper removals, refer to above Section 6.1.2. Localized, deeper removals should be anticipated where deemed necessary by the geotechnical consultant based on observations during grading. The actual depth and lateral extents of grading should be determined by the geotechnical consultant, based on subsurface conditions encountered during grading.

6.1.4 Over-Excavation of Cut/Fill Transitions

To reduce the potential for differential settlement, the County of Riverside requires the cut portion of cut/fill transitions be over excavated by at least one half the maximum fill thickness not to exceed 15 vertical feet and extending at least 5 horizontal feet outside of the proposed building footprints. In addition, we recommend, the cut portion of cut/fill transitions be undercut a minimum of 3 vertical feet. The bottom of the over excavation should be graded to flow towards deeper fill areas. The over excavated material should then be replaced by compacted fill material to design grade. Additionally, to soften the affect of differential fill settlement, we recommend that all steep slopes remaining after remedial grading be laid back to 3:1 inclinations below buildings.

6.1.5 Temporary Excavations

Temporary excavations should be laid back or shored in accordance with OSHA requirements before personnel or equipment are allowed to enter. Materials meeting the criteria of soil Types A, B, and C were encountered during our subsurface investigation of the site. For planning purposes we recommend Type "C" soils be expected, however, we recommend the actual determination of the appropriate soil classification be determined on a case by case basis based on the actual conditions encountered. In general, all excavations should be performed in accordance with project plans, specifications, and all Occupational Safety and Health Administration (OSHA) requirements. Soil conditions should be mapped and frequently checked by a representative of LGC to verify conditions are as anticipated. The contractor shall be responsible for providing the "competent person" required by OSHA standards to evaluate soil conditions. Close coordination with the geotechnical consultant should be maintained to facilitate construction while providing safe excavations. Excavation safety is the responsibility of the contractor.

Vehicular traffic, stockpiles, and equipment storage should be set back from the perimeter of excavations a distance equivalent to a 1:1 projection from the bottom of the excavation. Once an excavation has been initiated, it should be backfilled as soon as practical. Prolonged exposure of temporary excavations may result in some localized instability. Excavations should be planned so that they are not initiated without sufficient time to shore/fill them prior to weekends, holidays, or forecasted rain.

It should be noted that any excavation that extends below a 1:1 (horizontal to vertical) projection of an existing foundation will remove existing support of the structure foundation. If requested, temporary shoring parameters will be provided.

6.1.6 Removal Bottoms and Subgrade Preparation

Removal bottoms and areas to receive fill should be observed and accepted by the geotechnical consultant prior to subsequent fill placement. In general, removal bottom areas and areas to receive compacted fill should be scarified to a minimum depth of 6 inches, brought to a near-optimum moisture condition, and re-compacted per project recommendations.

6.1.7 ***Material for Fill***

From a geotechnical perspective, the onsite soils are generally considered suitable for use as general compacted fill, provided they are screened of organic materials, construction debris and any oversize material (8 inches in greatest dimension).

Any required retaining wall backfill should consist of sandy soils with a maximum of 35 percent fines (passing the No. 200 sieve) per American Society for Testing and Materials (ASTM) Test Method D1140 and a Very Low expansion potential (EI of 20 or less per ASTM D4829). Soils should also be screened of organic materials, construction debris, and any material greater than 3 inches. The site contains soils that are not suitable for retaining wall backfill due to their clay content and expansion potential; therefore, import or potentially select grading and stockpiling will be required of the contractor for obtaining suitable retaining wall backfill soil.

From a geotechnical viewpoint, any required import soils should consist of clean, relatively granular soils of Very Low to Low expansion potential (expansion index 50 or less based on ASTM D4829) and no particles larger than 3 inches in greatest dimension. Import soils for retaining wall backfill must also meet the criteria (fines content and expansion potential) outlined in the above paragraph. Source samples of planned importation should be provided to the geotechnical consultant for laboratory testing a minimum of 3 working days prior to any planned importation for required laboratory testing.

Aggregate base (crushed aggregate base or crushed miscellaneous base) should conform to the requirements of Section 200-2 of the Standard Specifications for Public Works Construction ("Greenbook"), for untreated base materials (except processed miscellaneous base), or Caltrans Class 2 aggregate base.

6.1.8 ***Fill Placement and Compaction***

Material to be placed as fill should be brought to near-optimum moisture content (generally within optimum and 2 percent above optimum moisture content) and recompacted to at least 90 percent relative compaction (per ASTM D1557). Moisture conditioning of site soils will be required in order to achieve adequate compaction. The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in compacted thickness. Each lift should be thoroughly compacted and accepted prior to subsequent lifts. Generally, placement and compaction of fill should be performed in accordance with local grading ordinances and with observation and testing by the geotechnical consultant. Oversized material, as previously defined, should be removed from site fills.

Fill placed on any slopes greater than 5:1 (horizontal to vertical) should be properly keyed and benched into firm and competent soils as it is placed in lifts.

During backfill of excavations, the fill should be properly benched into firm and competent soils of temporary backcut slopes as it is placed in lifts.

Aggregate base material should be compacted to a minimum of 95 percent relative compaction at or slightly above optimum moisture content per ASTM D1557. Subgrade below aggregate base should be compacted to a minimum of 90 percent relative compaction per ASTM D1557 at or slightly above optimum moisture content.

6.1.9 Trench and Retaining Wall Backfill and Compaction

The onsite soils may generally be suitable as trench backfill, provided the soils are screened of rocks and other material greater than 6 inches in diameter and organic matter. If trenches are shallow or the use of conventional equipment may result in damage to the utilities, sand having a sand equivalent (SE) of 30 or greater may be used to bed and shade the pipes (per Caltrans Test Method [CTM] 217). Sand backfill within the pipe bedding zone may be densified by jetting or flooding and then tamping to ensure adequate compaction. Subsequent trench backfill should be compacted in uniform thin lifts by mechanical means to at least 90 percent relative compaction (per ASTM D1557).

Retaining wall backfill should consist of predominately granular, sandy soils as outlined in above Section 6.1.7. The limits of select sandy backfill should extend at minimum ½ the height of the retaining wall or the width of the heel, whichever is greater, refer to Figure 3. Retaining wall backfill soils should be compacted in relatively uniform thin lifts to a minimum of 90 percent relative compaction (per ASTM D1557). Jetting or flooding of retaining wall backfill materials should not be permitted.

A representative from LGC Geotechnical should observe, probe, and test the backfill to verify compliance with the project recommendations.

6.1.10 Shrinkage and Bulking

Allowance in the earthwork volumes budget should be made for an estimated 10 to 15 percent reduction in volume of the recompacted undocumented fill, topsoil/colluvium, and alluvium. Bulking on the order of 5 to 10 percent bulking should be anticipated for the Pauba Formational material. It should be stressed that these values are only estimates and that an actual shrinkage factor would be extremely difficult to predetermine. These estimates are based on our previous experience with similar site soils and conditions and are not based on laboratory test data. The effective shrinkage of onsite soils will depend primarily on the type of compaction equipment and method of compaction used onsite by the contractor. Shrinkage and bulking are also expected to vary with variations in survey accuracy during rough grading.

6.2 Slope Stability

6.2.1 Cut Slopes

Design cut slopes at the site are anticipated to be grossly and surficially stable as designed, provided the recommendations contained herein are implemented. During grading detailed geologic mapping should be performed to confirm the anticipated bedrock conditions. Cutting of the slope must be performed by the contractor to minimize potential fracturing of the near-surface material of the finished slope. Significant fracturing of the slope due to the method of excavation, may result in the necessity to perform additional surficial stabilization of loose material on the slope face, or the provision for debris catchment of the toe of slope. The exact determination of any additional surficial stabilization of the slope should be made at the completion of grading based on actual exposed conditions and the location of improvements close to the design cut slopes. Irrespective of the finish conditions, the cut slopes should be protected with properly designed vegetative covers. If trees are planned for slope construction, tree wells should be considered.

6.2.2 Fill Slopes

Design fill slopes at the site are anticipated to be both grossly surficially stable as designed, as long as they are constructed in accordance with the Standard Earthwork and Grading Specifications included in Appendix D. Fill slopes with a slope ratio of 2:1 (horizontal to vertical) and up to approximately 15 feet in height are proposed on the site.

6.2.3 Slope Maintenance Guidelines

It is recommended that any graded slopes be planted with ground cover vegetation as soon as practical to protect against erosion by reducing runoff velocity. Deep-rooted vegetation should also be established to protect against surficial slumping. Irrigation levels should be kept to the minimum level necessary to establish a healthy plant growth. Slopes must not be overwatered. If automatic sprinklers are used, they must be adjusted during periods of rainfall. Continuous erosion control, rodent control, and maintenance are essential to the long-term stability of all slopes. A program for the elimination of burrowing animals in slope areas must be established to protect slope stability by reducing the potential for surface water to penetrate into the slope face. Trenches excavated on a slope face for utility or irrigation lines and/or for any purpose must be properly backfilled and compacted to project recommendations (refer to Section 6.1.9) to the slope face. Observation/testing and acceptance by the geotechnical consultant during trench backfill are recommended. V-ditches should be inspected and cleared of loose soil and/or debris on a routine basis, especially prior to and during the rainy season.

6.3 Preliminary Foundation Recommendations

Limited laboratory test results for expansion potential ranged from “Low” to “Very High.” It is our opinion that the majority of site soils have a Low to Medium expansion potential. Therefore, we are

providing preliminary geotechnical foundation parameters for Low and Medium expansion potential. However, it should be emphasized that these parameters are preliminary based on limited testing, and must be verified on as-graded conditions. Required laboratory testing at the completion of grading may require the following geotechnical design parameters to be updated based on the as-graded conditions.

6.3.1 Post-Tensioned Foundation Design Recommendations

The geotechnical parameters provided herein may be used for post-tensioned slab foundations. These parameters have been determined in general accordance with the Post-Tensioning Institute (PTI) Standard Requirements for Design of Shallow Post-Tensioned Concrete Foundations on Expansive Soils, referenced in Chapter 18 of the 2010 CBC. In utilizing these parameters, the foundation engineer should design the foundation system in accordance with the allowable deflection criteria of applicable codes and the requirements of the structural designer/architect. Other types of stiff slabs may be used in place of the CBC post-tensioned slab design provided that, in the opinion of the foundation structural designer, the alternative type of slab is at least as stiff and strong as that designed by the CBC/PTI method.

Our design parameters are based on our experience with similar projects, test results performed by others, and the anticipated nature of the soil (with respect to expansion potential). Please note that implementation of our recommendations will not eliminate foundation movement (and related distress) should the moisture content of the subgrade soils fluctuate. It is the intent of these recommendations to help maintain the integrity of the proposed structures and reduce (not eliminate) movement, based upon the anticipated site soil conditions. Should future homeowners not properly maintain the areas surrounding the foundation, for example by overwatering, then we anticipate for highly expansive soils the maximum differential movement of the perimeter of the foundation to the center of the foundation to be on the order of a couple of inches. Soils of lower expansion potential are anticipated to show less movement.

6.3.2 Post-Tensioned Foundation Subgrade Preparation and Maintenance

Moisture conditioning of the subgrade soils is recommended prior to trenching the foundation. The recommendations, specific to anticipated site soil conditions, are presented in Table 3A and 3B. The subgrade moisture condition of the building pad soils should be maintained at the recommended moisture content up to the time of concrete placement. This moisture content should be maintained around the immediate perimeter of the slab during construction and up to occupancy of the building structures.

The geotechnical parameters provided herein assume that if the areas adjacent to the foundation are planted and irrigated, these areas will be designed with proper drainage and adequately maintained so that ponding, which causes significant moisture changes below the foundation, does not occur. Our recommendations do not account for excessive irrigation and/or incorrect landscape design. Plants should only be provided with sufficient irrigation for life and not overwatered to saturate subgrade soils. Sunken planters placed adjacent to the

foundation should either be designed with an efficient drainage system or liners to prevent moisture infiltration below the foundation. Some lifting of the perimeter foundation beam should be expected even with properly constructed planters.

In addition to the factors mentioned above, future owners/property management personnel should be made aware of the potential negative influences of trees and/or other large vegetation. Roots that extend near the vicinity of foundations can cause distress to foundations. Future owners (and the owner's landscape architect) should not plant trees/large shrubs closer to the foundations than a distance equal to half the mature height of the tree or 20 feet, whichever is more conservative, unless specifically provided with root barriers to prevent root growth below the building foundation.

It is the homeowner's responsibility to perform periodic maintenance during hot and dry periods to insure that adequate watering has been provided to keep soil from separating or pulling back from the foundation. Future owners and property management personnel should be informed and educated regarding the importance of maintaining a constant level of soil-moisture. The owners should be made aware of the potential negative consequences of both excessive watering as well as allowing potentially expansive soils to become too dry. Expansive soils can undergo shrinkage during drying and swelling during the rainy winter season, or when irrigation is resumed. This can result in distress to building structures and hardscape improvements. The builder should provide these recommendations to future homeowners and property management personnel.

TABLE 3A

Provisional Geotechnical Parameters for Post-Tensioned Foundation Slab Design – Low Expansion Potential

Parameter	**PT Slab with Perimeter Footing**
Expansion Index	Low[1]
Thornthwaite Moisture Index	-20
Constant Soil Suction	PF 3.9
Center Lift Edge moisture variation distance, e_m Center lift, y_m	 9.0 feet 0.25 inch
Edge Lift Edge moisture variation distance, e_m Edge lift, y_m	 5.5 feet 0.55 inch
Modulus of Subgrade Reaction, k (assuming presoaking as indicated below)	200 pci
Minimum Perimeter footing embedment below finish grade	18 inches

1. Assumed for preliminary design purposes. Further evaluation is required at the completion of earthwork grading.
2. Moisture condition to 100% of optimum moisture content to a depth of 12 inches prior to trenching.

TABLE 3B

Provisional Geotechnical Parameters for Post-Tensioned Foundation Slab Design-Medium Expansion Potential

Parameter	PT Slab with Perimeter Footing
Expansion Index	Medium[1]
Thornthwaite Moisture Index	-20
Constant Soil Suction	PF 3.9
Center Lift Edge moisture variation distance, e_m Center lift, y_m	 9.0 feet 0.50 inch
Edge Lift Edge moisture variation distance, e_m Edge lift, y_m	 4.7 feet 1.1 inch
Modulus of Subgrade Reaction, k (assuming presoaking as indicated below)	150 pci
Minimum Perimeter footing embedment below finish grade	18 inches

1. Assumed for preliminary design purposes. Further evaluation is required at the completion of earthwork grading.
2. Moisture condition to 120% of optimum moisture content to a depth of 24 inches prior to trenching.

6.3.3 Slab Underlayment Guidelines

The following is for informational purposes only since slab underlayment (e.g., moisture retarder, sand or gravel layers for concrete curing and/or capillary break) is unrelated to the geotechnical performance of the foundation. Post-construction moisture migration should be expected below the foundation. The foundation engineer/architect should determine whether the use of a capillary break (sand or gravel layer), in conjunction with the vapor retarder, is necessary or required by code. Sand layer thickness and location (above and/or below vapor retarder) should also be determined by the foundation engineer/architect. Sand layers should be installed, where applicable, in accordance with ACI Publication 302 – "Guide for Concrete Floor and Slab Construction."

6.3.4 Soil Bearing and Lateral Resistance

An allowable soil bearing pressure of 1,500 pounds per square foot (psf) may be used for the design of footings having a minimum width of 12 inches and minimum embedment of 18 inches below lowest adjacent ground surface. This value may be increased by 300 psf for each additional foot of embedment or 100 psf for each additional foot of foundation width to a

maximum value of 2,500 psf. These allowable bearing pressures are applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. Bearing values indicated are for total dead loads and frequently applied live loads and may be increased by ⅓ for short duration loading (i.e., wind or seismic loads).

In utilizing the above-mentioned allowable bearing capacity and provided our earthwork recommendations are implemented, foundation settlement due to structural loads is anticipated to be 1-inch or less. Differential settlement may be taken as half of the total settlement (i.e., ½-inch over a horizontal span of 40 feet).

Resistance to lateral loads can be provided by friction acting at the base of foundations and by passive earth pressure. For concrete/soil frictional resistance, an allowable coefficient of friction of 0.35 may be assumed with dead-load forces. An ultimate passive lateral earth pressure of 350 psf per foot of depth (or pcf) to a maximum of 3,500 psf may be used for the sides of footings poured against properly compacted fill. This passive pressure is applicable for level (ground slope equal to or flatter than 5H:1V) conditions only. We recommend that the upper foot of passive resistance be neglected if finished grade will not be covered with concrete or asphalt. The provided passive resistance value is an ultimate value, so appropriate safety factors (i.e., minimum of 1.5) should be applied by the structural designer.

6.3.5 Foundation Setback from Top of Slope and Bottom of Slope

The requirements of the County and the 2010 CBC are applicable in determining the appropriate top and bottom of slope setback for foundations. Foundation setback criteria should be reviewed by the geotechnical consultant based on the precise grading plan.

6.4 Lateral Earth Pressures and Retaining Wall Design Considerations

Lateral earth pressures are provided as equivalent fluid unit weights, in pound per square foot (psf) per foot of depth or pcf. These values do not contain an appreciable factor of safety, so the retaining wall designer should apply the applicable factors of safety and/or load factors during design. A soil unit weight of 120 pcf may be assumed for calculating the actual weight of soil over the wall footing.

The following lateral pressures are presented on Table 4 for approved select granular soils a maximum of 35 percent fines (passing the No. 200 sieve per ASTM D1140) and an Expansion Index of 20 or less per ASTM D4829. The retaining wall designer should clearly indicate on the retaining wall plans the required select sandy soil backfill.

TABLE 4

Lateral Earth Pressures – Select Sand Backfill

Condition	Equivalent Fluid Weight (pcf)	Equivalent Fluid Weight (pcf)
	Level Backfill	**2:1 Sloping Backfill**
	Approved Backfill Material	**Approved Backfill Material**
Active	35	55
At Rest	60	85

If the wall can yield enough to mobilize the full shear strength of the soil, it can be designed for "active" pressure. If the wall cannot yield under the applied load, the earth pressure will be higher. This would include 90-degree corners of retaining walls. Such walls should be designed for "at-rest." The equivalent fluid pressure values assume free-draining conditions and a drainage system will be installed and maintained to prevent the build-up of hydrostatic pressures. A relatively sandy backfill along with a subdrain pipe wrapped in drainage aggregate and filter fabric (e.g., "burrito" subdrain) properly outletted to a suitable discharge point is typically used for conventional retaining walls. Retaining wall structures should be provided with appropriate drainage and appropriately waterproofed. Typical conventional (i.e., backfilled) retaining wall drainage is shown on Figure 3. If conditions other than those assumed above are anticipated, the equivalent fluid pressure values should be provided on an individual-case basis by the geotechnical consultant.

Surcharge loading effects from any adjacent structures should be evaluated by the retaining wall designer. In general, structural loads within a 1:1 (horizontal to vertical) upward projection from the bottom of the proposed retaining wall footing will surcharge the proposed retaining structure. Uniform surcharges may be estimated using the applicable coefficient of lateral earth pressure using a rectangular distribution. A factor of 0.5 and 0.33 may be used for at-rest and active conditions, respectively. The retaining wall designer should contact the geotechnical engineer for any required geotechnical input in estimating any applicable surcharge loads.

If required, the retaining wall designer may use a seismic lateral earth pressure increment of 12 pcf for a level backfill condition. This increment should be applied in addition to the provided static lateral earth pressure using a "normal" triangular distribution with the resultant acting at H/3 in relation to the base of the retaining structure (where H is the retained height). When analyzing short duration seismic loading for the restrained, at-rest condition, the seismic increment may be added to the applicable active lateral earth pressure (in lieu of the at-rest lateral earth pressure). Per Section 1803.5.12 of the 2010 CBC, the seismic earth pressure is applicable to "structures assigned to Seismic Design Category D, E, or F in accordance with Section 1613." This seismic lateral earth pressure is estimated using the procedure outlined by the Structural Engineers Association of California (Lew, et al, 2010). The provided seismic lateral earth pressure is for a level backfill, if a sloping backfill condition is proposed LGC Geotechnical should be contacted for specific seismic lateral earth pressure increments based on the planned configuration of the retaining walls.

Soil bearing and lateral resistance (friction coefficient and passive resistance) are provided in Section 6.3.4. Earthwork considerations (temporary backcuts, backfill, compaction, etc.) for retaining walls are provided in Section 6.1 (Site Earthwork) and the subsequent earthwork related sub-sections.

6.5 ***Slope Creep***

As with most natural and manmade slopes and pad areas, some degree of slope creep should be expected for this site. The amount of slope creep is usually influenced by such factors as the slope geometry, slope exposure, aspect, height, composition, as well as plant type, precipitation, irrigation and landscaping programs. Since the depth of the creep zone is somewhat unknown and analytically is in its infancy, our estimates of the extent and magnitude of slope creep are, therefore, based on our observations at previous sites with similar soil conditions. In general, the effects of slope creep are most prevalent in the outer approximate 10 to 20 feet of the slope but can extend further into the lot. In general, more slope creep occurs as the slope height increases, expansion potential increases, and changes in the moisture content of the soil occur.

Slope creep is not expected to significantly influence the proposed buildings, which are to be constructed with a stiff slab and meet or exceed the required setback recommendations, but may impact improvements near the top of the slope. Although rear yard top-of-slope improvements are generally not considered structural, we recommend that decorative walkways, patios, and other landscaping features be constructed with flexibility to accommodate the effects of slope creep. Typical remediation methods include construction joints, separation joints, flexible pavers, flexible structures, or additional reinforcement to limit cracking (see Nonstructural Concrete Flatwork section). The exact amount of movement due to slope creep cannot be determined at this time; it is dependent to some extent upon irrigation practices of homeowners and homeowner associations. Lateral and vertical deflections on the order of 2 inches have been observed on projects with similar geotechnical conditions. Future homeowners should be made aware of these conditions so they can design their improvements appropriately.

6.6 ***Fences and Freestanding Walls***

As their name indicates, freestanding walls are those walls not designed to retain soil and/or water. These walls are generally located at the rear of the lot, or along the side yard or between lots. To reduce the potential for unsightly cracks, due to differential settlement, expansive soils or possible slope creep, we recommend the inclusion of construction joints at a maximum of 20 feet on center. This spacing may be altered by the structural engineer based upon the wall reinforcement. If the soil-moisture content below the wall foundation varies significantly, some wall movement should be expected. However, this movement is unlikely to cause more than cosmetic distress. Allowable soil bearing values for wall footing design are provided in Section 6.3.4.

Additionally, for fences near the tops of slopes, the fence designer should engineer the construction of the fence to be as flexible as possible while still maintaining integrity. Typical design features should include items such as slip couplings at the junction of top of slope fences and fences/walls perpendicular to the slope.

6.7 Preliminary Pavement Sections

Based on an assumed R-value of 25, we recommend the following provisional minimum street sections for Traffic Indices of 4.5, 5, and 6. These recommendations should be confirmed with R-value testing of representative near-surface soils at the completion of grading and after underground utilities have been installed and backfilled. Final street sections should be confirmed by the project civil engineer based upon the design Traffic Index. In addition, additional sections can be provided based on other desired traffic indices.

Assumed Traffic Index	4.5	5	6
R -Value Subgrade	25	25	25
AC Thickness	4.0 inches	4.0 inches	4.5 inches
Base Thickness	4.0 inches	5.5 inches	7.0 inches

The above recommendations are based on the assumption that proper maintenance and irrigation of the areas adjacent to the pavement will occur through the design life of the pavement. Failure to maintain a proper maintenance and/or irrigation program may jeopardize the integrity of the pavement.

Earthwork recommendations regarding aggregate base and subgrade are provided in the previous section "Site Earthwork" and the related sub-sections of this report.

6.8 Soil Corrosivity to Concrete and Metal

Although not corrosion engineers (LGC Geotechnical is not a corrosion consultant), several governing agencies in Southern California require the geotechnical consultant to determine the corrosion potential of soils to buried concrete and metal facilities. We therefore present the results of our testing with regard to corrosion for the use of the client and other consultants, as they determine necessary.

Based on Caltrans Corrosion Guidelines (2003), soils are considered corrosive if the pH is 5.5 or less, or the chloride concentration is 500 ppm or greater, or the sulfate concentration is 2,000 ppm or greater. Based on test results for chloride and sulfate content, onsite soils are not considered corrosive to bare metals and concrete using Caltrans criteria.

Based on laboratory sulfate test results, the near surface soils have a severity categorization of "Not Applicable" and are designated to a class "S0" per ACI 318, Table 4.2.1 with respect to sulfates. Concrete in direct contact with the onsite soils can be designed according to ACI 318, section 4.3 using the "S0" sulfate classification. This must be verified based on as-graded conditions.

6.9 Nonstructural Concrete Flatwork

Concrete flatwork (such as walkways, bicycle trails, etc.) has a high potential for cracking due to changes in soil volume related to soil-moisture fluctuations. To reduce the potential for excessive cracking and lifting, concrete should be designed in accordance with the minimum guidelines

outlined in Table 5. These guidelines will reduce the potential for irregular cracking and promote cracking along construction joints, but will not eliminate all cracking or lifting. Thickening the concrete and/or adding additional reinforcement will further reduce cosmetic distress.

TABLE 5

Nonstructural Concrete Flatwork for Low to Medium Expansion Potential

	Homeowner Sidewalks	**Private Drives**	**Patios/Entryways**	**City Sidewalk Curb and Gutters**
Minimum Thickness (in.)	4 (nominal)	5 (full)	5 (full)	City/Agency Standard
Presoaking	Wet down prior to placing	Wet down prior to placing	Wet down prior to placing	City/Agency Standard
Reinforcement	—	No. 3 at 24 inches on centers	No. 3 at 24 inches on centers	City/Agency Standard
Thickened Edge (in.)	—	8 x 8	—	City/Agency Standard
Crack Control Joints	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	Saw cut or deep open tool joint to a minimum of $^1/_3$ the concrete thickness	City/Agency Standard
Maximum Joint Spacing	5 feet	10 feet or quarter cut whichever is closer	6 feet	City/Agency Standard
Aggregate Base Thickness (in.)	—	—	2	City/Agency Standard

To reduce the potential for driveways to separate from the garage slab, the builder may elect to install dowels to tie these two elements together. Similarly, future homeowners should consider the use of dowels to connect flatwork to the foundation.

6.10 Control of Surface Water and Drainage Control

Positive drainage of surface water away from structures is very important. Water should not be allowed to pond adjacent to buildings or to flow freely down a graded slope. Per the 2010 CBC, positive drainage may be accomplished by providing drainage away from buildings at a gradient of at least 5 percent for earthen surfaces for a distance of at least 10 feet away from the face of wall. If a distance of 10 feet cannot be achieved, an alternative of a gradient of at least 5 percent to an area drain or swale having a gradient of 2 percent is acceptable. Where necessary, drainage paths may be shortened by use

of area drains and collector pipes. Eave gutters are recommended and should reduce water infiltration into the subgrade soils if the downspouts are properly connected to appropriate outlets.

Planters with open bottoms adjacent to buildings should be avoided. Planters should not be designed adjacent to buildings unless provisions for drainage, such as catch basins, liners, and/or area drains, are made. Overwatering must be avoided.

6.11 Subsurface Water Infiltration

In general, the vast majority of geotechnical distress issues are directly related to improper drainage. Distress in the form of movement of foundations and other improvements could occur as a result of soil saturation and loss of soil support of foundations and pavements, settlement, collapse, internal soil erosion, and/or expansion. Additionally, off-site properties and improvements may be subjected to seeps, springs, slope instability, movements of foundations or other impacts as a result of water infiltration and migration. Infiltrated water may enter underground utility pipe zones and migrate along the pipe backfill, potentially impacting other improvements located far away from the point of infiltration. Any proposed infiltration system should not be located near slopes or existing/proposed improvements in order to reduce the potential for slope failures and geotechnical distress issues related to infiltration. Where sufficient distance from slopes and improvements cannot be achieved, additional mitigation recommendations from the geotechnical consultant may be provided.

We recommend the design of the infiltration basins include at least one redundancy. It may be prudent to provide an overflow system directly connected to storm drain system in order to prevent failure of the infiltration system, either as a result of lower than anticipated infiltration and/or very high flow volumes. It should be noted that if pretreatment of runoff to remove debris, soil particles, etc., cannot be performed, design infiltration rates may need to be further reduced. Over time, siltation and plugging may reduce the infiltration rate and subsequent effectiveness of the infiltration system. These factors should be considered in selecting a design infiltration rate. The calculated infiltration rate from our field investigation for the planned basins was 0.16 inch/hour based on factor of safety of two. The designer of the infiltration system may contact the geotechnical consultant for any geotechnical input during the design process.

6.12 Preconstruction and Construction Monitoring

It is recommended that a program of photo documentation of the existing adjacent structures located off-site along the eastern perimeter of the site be implemented prior to the onset of any adjacent grading. This should include, but not necessarily be limited to, detailed documentation of existing improvements, buildings, and utilities adjacent to the proposed grading area, with particular attention to any distress that is already present prior to the start of work.

6.13 Grading and Foundation Plan Review

When available, grading and foundation plans should be reviewed by LGC Geotechnical in order to verify our geotechnical recommendations are implemented. Updated recommendations and/or additional field work may be necessary.

6.14 Geotechnical Observation and Testing During Construction

The recommendations provided in this report are based on limited subsurface observations and geotechnical analysis. The interpolated subsurface conditions should be checked in the field during construction by a representative of LGC Geotechnical. Geotechnical observation and testing is required per Section 1704.7-9 of the 2010 California Building Code (CBC).

Geotechnical observation and/or testing should be performed by LGC Geotechnical at the following stages:

- During rough and precise grading;
- During utility trench backfill and compaction;
- After presoaking building pads and other concrete-flatwork subgrades, and prior to placement of aggregate base or concrete;
- Preparation of pavement subgrade and placement of aggregate base;
- After building and wall footing excavation and prior to placing concrete and/or reinforcement; and
- When any unusual soil conditions are encountered during any construction operation subsequent to issuance of this report.

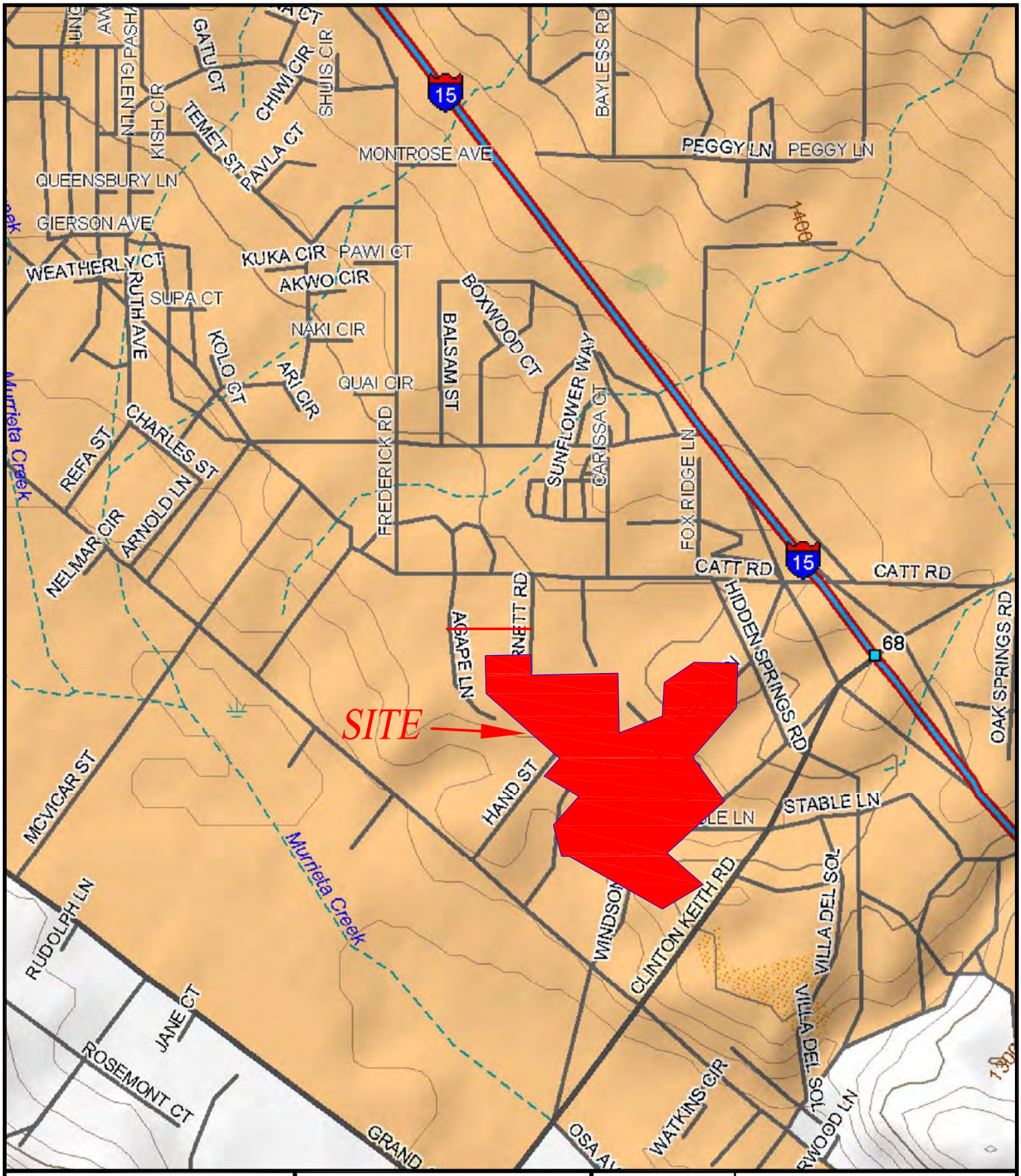
7.0 LIMITATIONS

Our services were performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable engineers and geologists practicing in this or similar localities. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report. The samples taken and submitted for laboratory testing, the observations made and the in-situ field testing performed are believed representative of the entire project; however, soil and geologic conditions revealed by excavation may be different than our preliminary findings. If this occurs, the changed conditions must be evaluated by the project soils engineer and geologist and design(s) adjusted as required or alternate design(s) recommended.

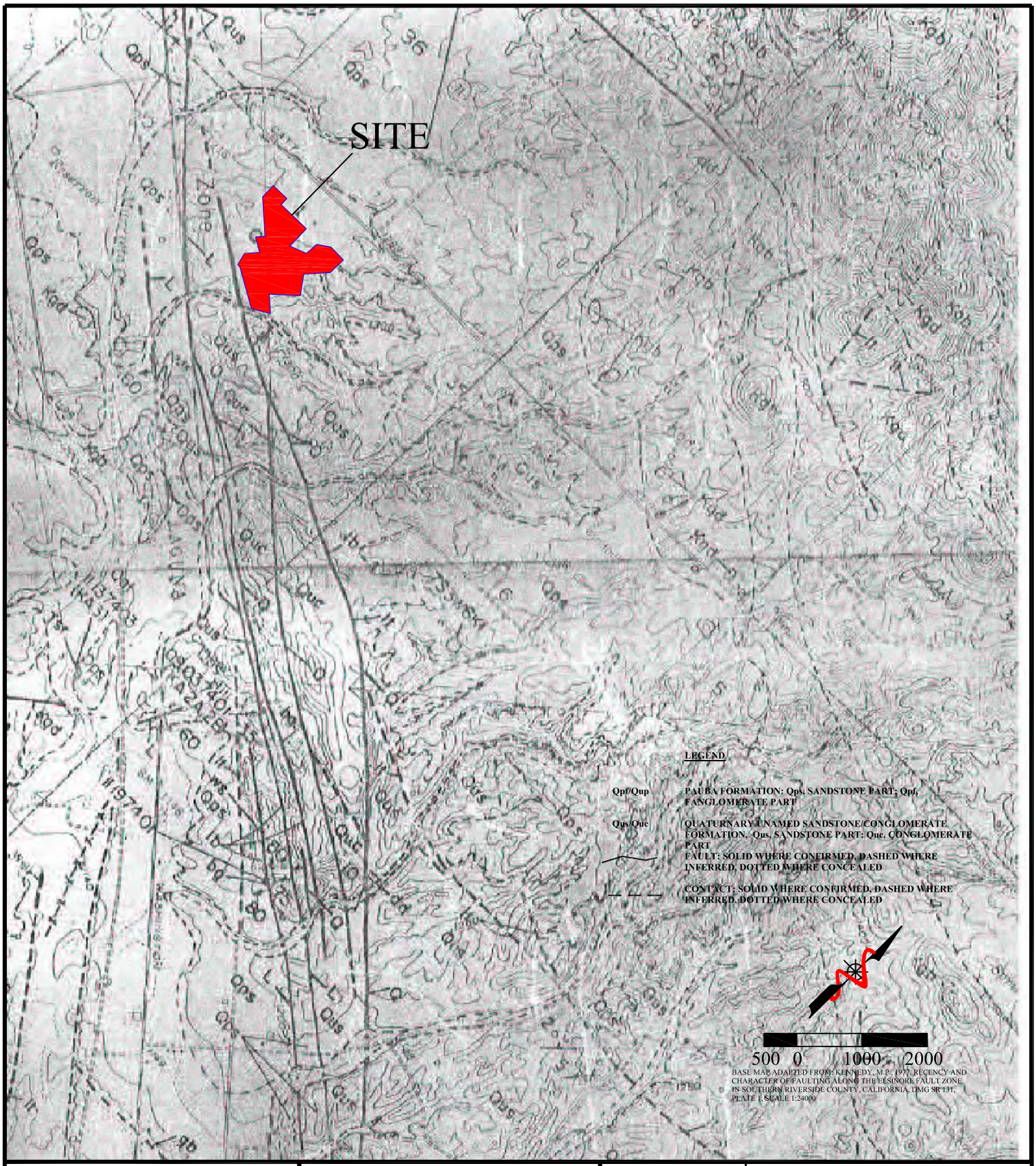
This report is issued with the understanding that it is the responsibility of the owner, or of his/her representative, to ensure that the information and recommendations contained herein are brought to the attention of the designer and/or project engineer and incorporated into the plans, and the necessary steps are taken to see that the contractor and/or subcontractor properly implements the recommendations in the field. The contractor and/or subcontractor should notify the owner if they consider any of the recommendations presented herein to be unsafe.

The findings of this report are valid as of the present date. However, changes in the conditions of a property can and do occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. Therefore, the findings, conclusions, and recommendations presented in this report can be relied upon only if LGC Geotechnical has the opportunity to observe the subsurface conditions during grading and construction of the project, in order to confirm that our preliminary findings are representative for the site.

In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and modification, and should not be relied upon after a period of 3 years.



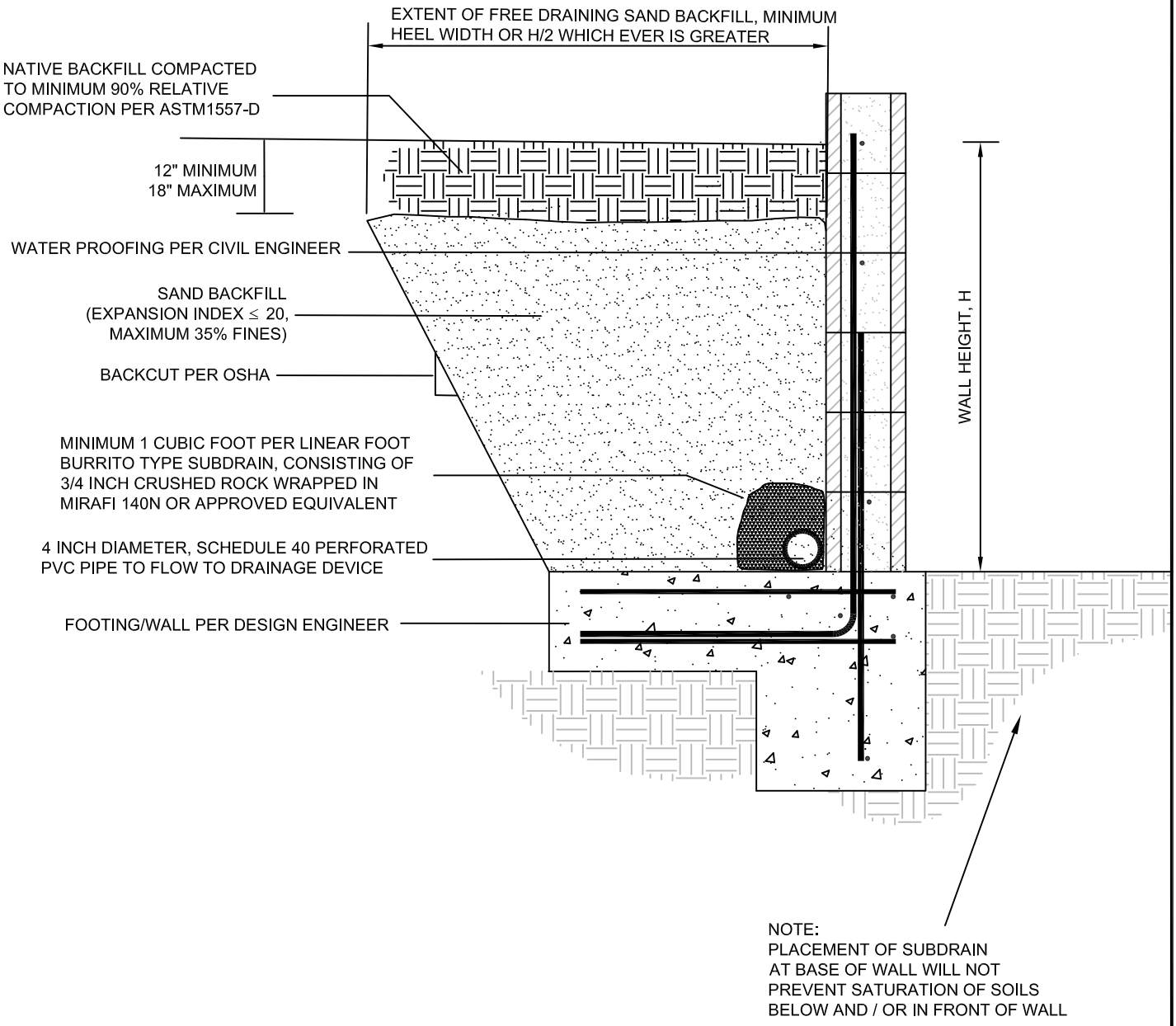
LGC Geotechnical, Inc.	**Figure 1** **Site Location Map**	Project Name: T.T. No. 32535 Project No.: 12129-01 Eng. / Geol.: BTZ / KBC Scale: N/A Date: February 2013



LGC Geotechnical, Inc.

Figure 2
Regional Geologic Map

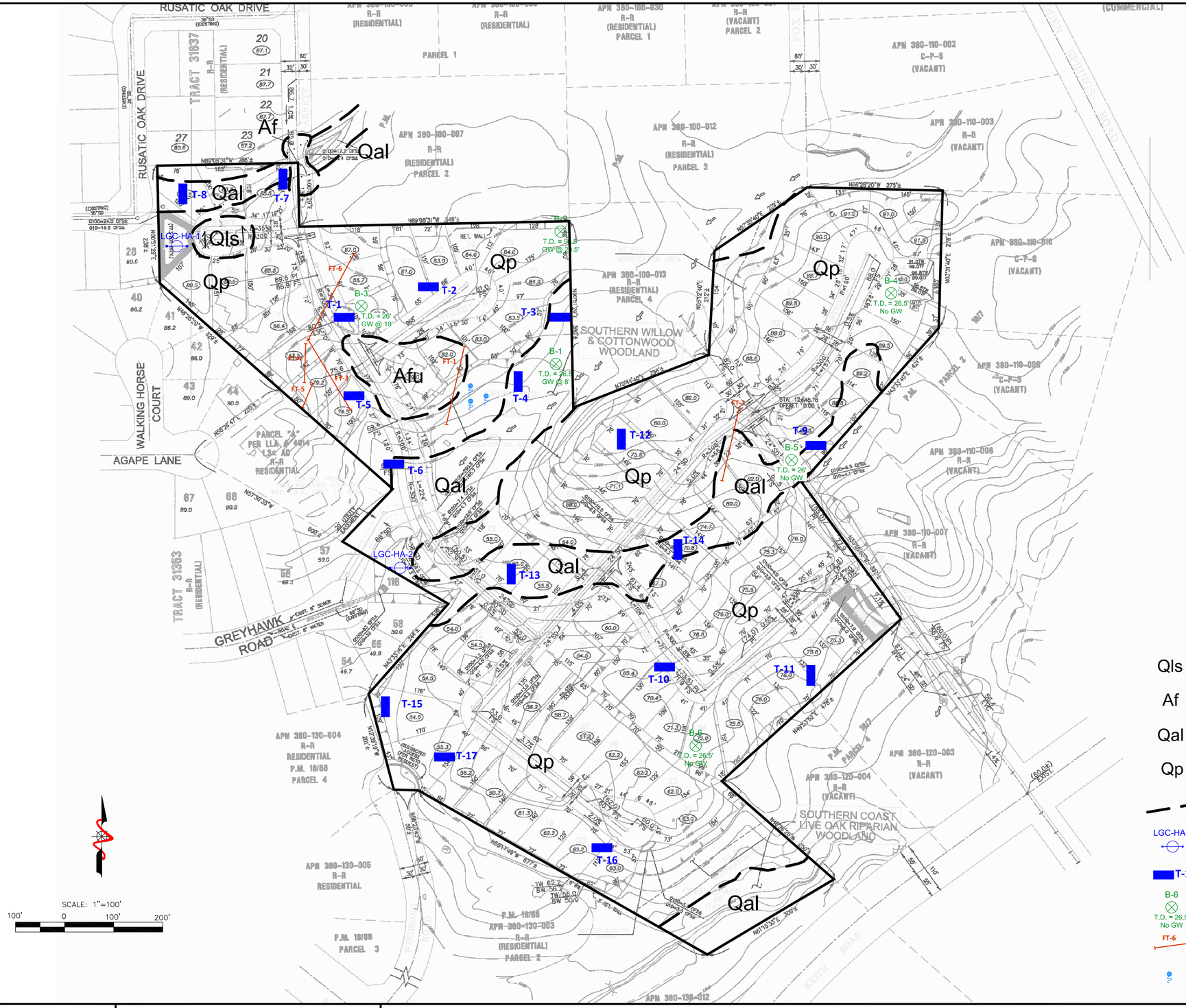
Project Name	T.T. No. 32535
Project No.	12129-01
Eng. / Geol.	BTZ/KBC
Scale	1" : 2000'
Date	February 2013



LGC Geotechnical, Inc.

FIGURE 3
Recommended Retaining Wall Backfill and Subdrain Detail

PROJECT NAME	Tentative Tract 32535
PROJECT NO.	12129-01
ENG. / GEOL.	BTZ / KBC
SCALE	Not to Scale
DATE	February 2013



LEGEND

Qls	Quaternary Landslide (Surficial)
Af	Artificial Fill - Undocumented
Qal	Quaternary Alluvium
Qp	Pauba Formation
	Approximate Location of Geologic Contact
LGC-HA-2	Approximate Location of Hand Auger Excavation
T-17	Approximate Location of Exploratory Trench (Lawson, 2005)
B-6 T.D. = 26.5' No GW	Approximate Location of Boring by Others (LGC Inland,)
FT-6	Approximate Location of Fault Trench by Others (LGC Inland)
	Approximate Location of Observed Seepage

LGC Geotechnical, Inc.

LGC GEOTECHNICAL, INC.
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San Clemente, CA 92672
TEL (949) 369-6141 FAX (949) 369-6142

Updated Geotechnical Map

PROJECT NAME	Tentative Tract 32535
PROJECT NO.	12129-01
ENG. / GEOL.	BTZ / KBC
SCALE	1" = 100'
DATE	February 2013

SHEET 1 of 1

Appendix A
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APPENDIX A

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Aerial Photographs

Flight No.	Photo No.	Date	Scale
AXM-5F	158	5/6/49	1"-800'
AXM-5F	159	5/6/49	1"-800'

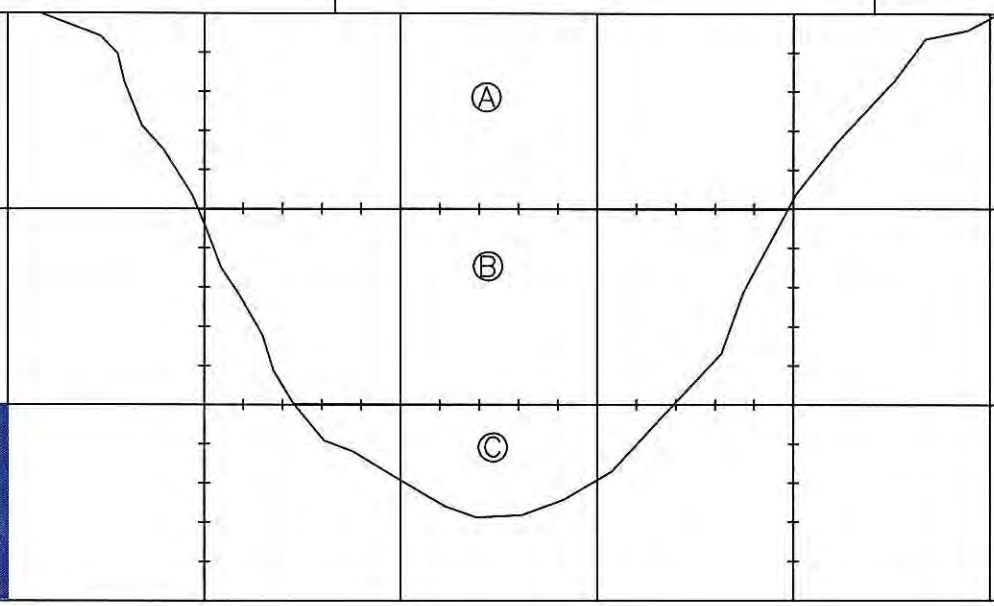
Appendix B
Logs of Borings, Test Pits and Fault Trenches

From Lawson, 2005a

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-1
Project Number: 041138-01	**Elevation:** 1285'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Pauba Formation:	Qp				
	A: @ 0-1' coarse Sand with Clay: red brown, dry, dense		SC			
	@ 1-4' coarse Sand with Clay: red brown, slightly moist to moist, dense			1 @ 2'-4'		
	@ 4'-5' Clayey to Clayey Sand: brown, moist, dense to medium dense					
	B: @ 5' Increasing Silt to Silty very fine Sand to fine Sandy Silt with Clay: yellow brown to yellow gray, moist, dense		SM			
	C: @ 10' Sand: yellow to light brown, moist, dense		SP			
	@ 13' Sand: yellow to light brown, moist to very moist, dense					

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** **TREND:** EW



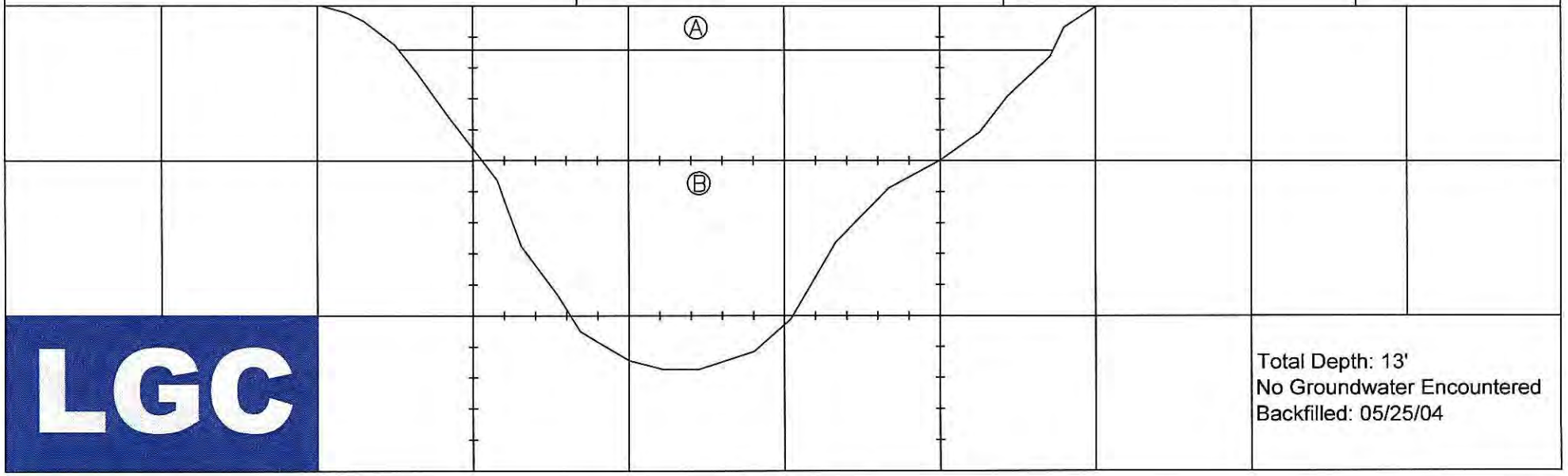
LGC

Total Depth: 13'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-2
Project Number: 041138-01	**Elevation:** 1273'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium: A: @ 0-1.5' Sand with Clay and Silt: red brown, dry to slightly moist, dense to slightly hard		SM/SC			
@ 3' B: 40E 25W	Quaternary Pauba Formation: B: @ 1.5' Sand with lenses of Gravel: red brown to yellow brown, moist, dense @ 7' less Gravel than above @ 12' Sand with lenses of Gravel: red brown, moist, dense	Qp	SP	1		

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** EW

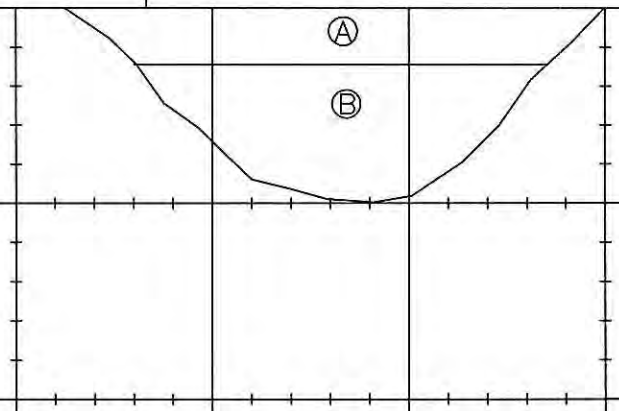


Total Depth: 13'
No Groundwater Encountered
Backfilled: 05/25/04

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-3
Project Number: 041138-01	**Elevation:** 1272'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium A: @ 0-1.5' Clay with Sand: Black, wet to very moist, soft; roots, organics		CL			
	Quaternary Pauba Formation: B: @ 1.5'- 5' Clayey Sand: brown, very moist, dense; Clay content decreases with depth, free water at contact with Clayey Sand	Qp	SC	1		

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** EW



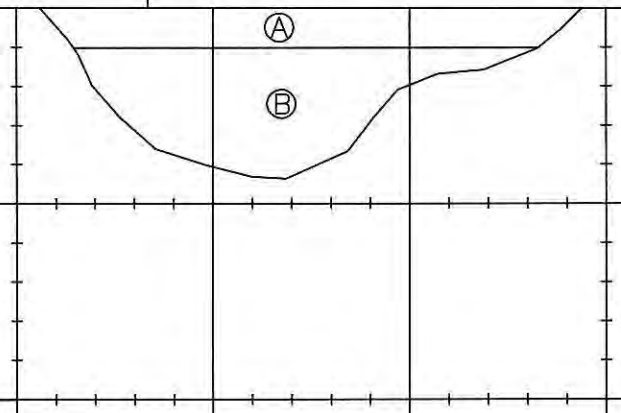
LGC

Total Depth: 5'
Groundwater @ 1.5'
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-4
Project Number: 041138-01	**Elevation:** 1263'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Alluvium:	Qal				
	A: @ 0-1' Sandy Clay: Black to dark brown, moist, soft; organics		CL			
	@ 1-3' Clayey Sand to Sandy Clay: Gray to dark Gray with yellow brown, very moist, soft; roots, seepage at 1.5'		CL/SC			
	Quaternary Pauba Formation:	Qp				
	B: @ 4' Increase Silt to Silty Sand to Sandy Clayey Silt		SM			
	@ 4.5' Sand with minor Clays: gray, wet, dense; flowing seepage		SC			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS



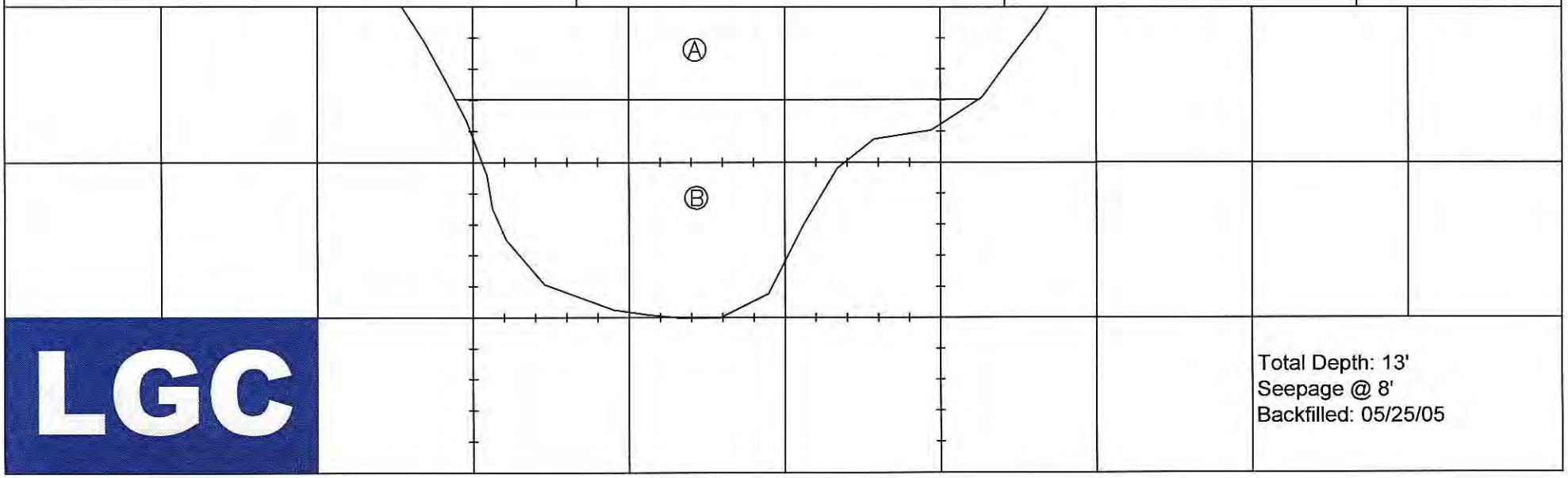
LGC

Total Depth: 5'
Groundwater @ 4.5'
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-5
Project Number: 041138-01	**Elevation:** 1267'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium: A: @ 0-1' Fine Sand with Silt: light brown, medium dense, roots		SM			
	Quaternary Pauba Formation: B: @ 1'-3' Sand with Silt and Clay: red brown, medium dense	Qp	SM/SC	1		
	@ 3'-5' Clayey Sand: Gray, very moist, medium dense to soft		SC			
	@ 5' Clayey Sand: brown, moist, medium dense					
	@ 8' seepage					
	@ 10' Clay to Clayey Sand: getting denser/stiffer with depth, seepage		CL/SC			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** EW

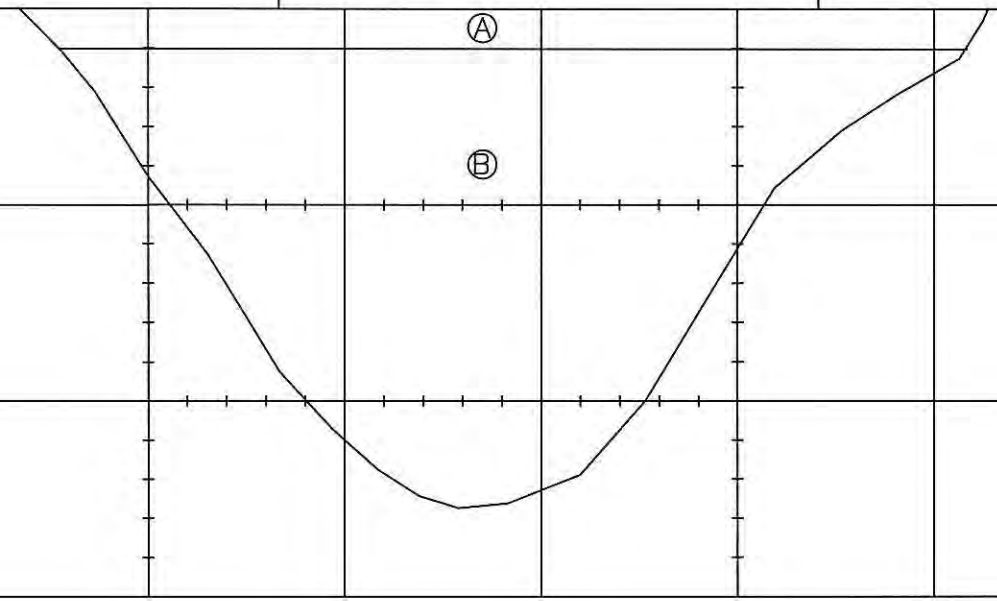


Total Depth: 13'
Seepage @ 8'
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-6
Project Number: 041138-01	**Elevation:** 1250'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
@ 0-1' Laminations: 40E 25W	Quaternary Alluvium: A: @ 0-1' Sand to Silt: brown with red tinge, slightly moist to dry, medium dense; thin laminations	Qal	SM/ML			
	Quaternary Pauba Formation: B: @ 1'-3' Silty Sand: brown to dark brown, moist, medium dense; roots	Qp	SM			
	@ 3' Silty Sand: brown to dark brown with light yellow brown sand pods/lenses 4-6" thick, 6"-1' long, minor scattered gravel					
	@ 9' Sand: yellow brown, moist, dense		SP			
	@ 13' Silt with Sand: Gray, slightly moist, stiff, rootlets in fractures		ML	1		

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** EW



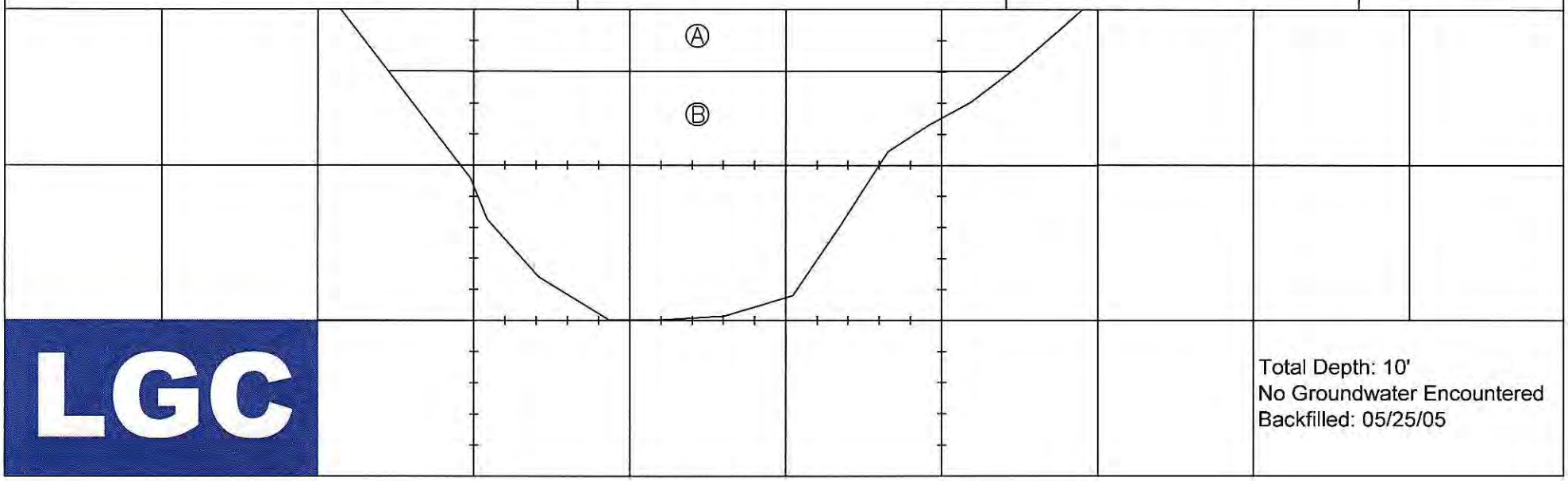
LGC

Total Depth: 13.5'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-7
Project Number: 041138-01	**Elevation:** 1277'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05	Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
		Quaternary Pauba Formation: A: @ 0-2' Coarse Sand and Silt with minor Gravel: red brown, dry, very dense to dense; weakly indurated	Qp	SW/SM			
		B: @ 2' Coarse Sand and Silt with an increase in clay: red brown, dry, very dense to dense; weakly indurated			1		
		@ 4' Sand with minor Clay and Silt: yellow brown, moist, dense		SC			
		@ 8' coarse Sand with minor Silt: light brown, slightly moist, dense		SM			
		@ 9'-10' coarse to medium Sand with minor Silt: brown, moist, very dense to slightly hard; indurated					

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS



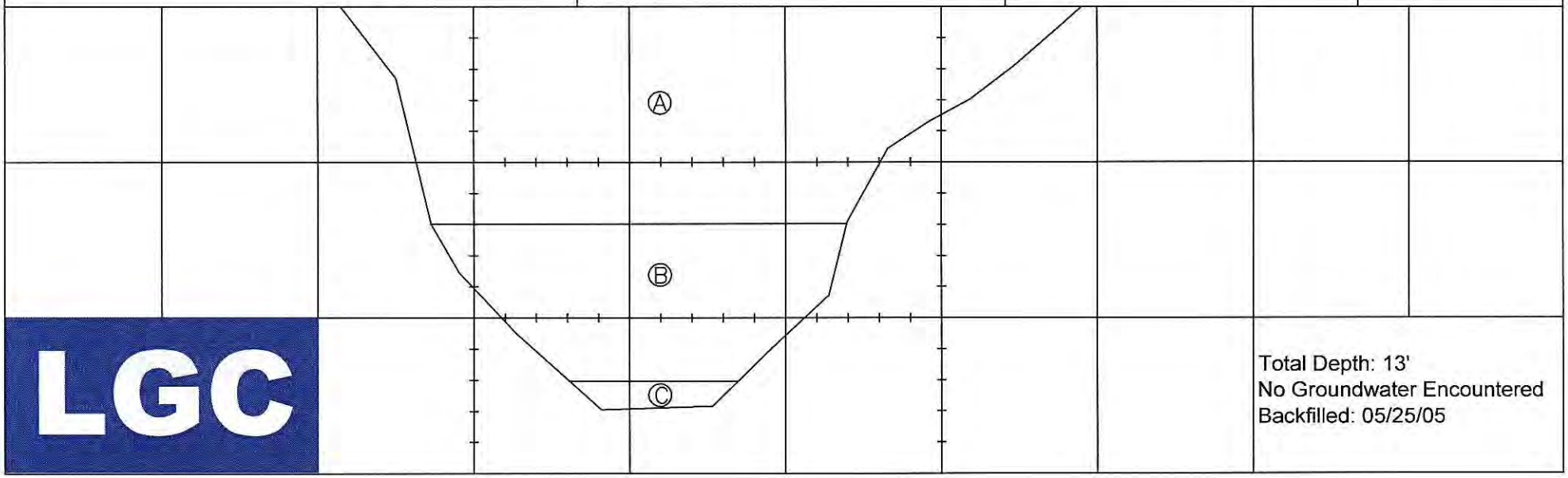
LGC

Total Depth: 10'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-8
Project Number: 041138-01	**Elevation:** 1273'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Alluvium:	Qal				
	A: @ 0-2' Sand with Silt and Clay: brown, slightly moist, very dense; minor gravel, roots		SM/SC			
	@ 2'-3' Sand with Silt and Clay: brown, slightly moist, very dense; roots decrease with depth					
	@ 3' Sand with Silt and Clay: Grayish brown, slightly moist, very dense; less gravel than above					
	Quaternary Pauba Formation:	Qp				
	B: @ 7' Coarse Sand with minor Silt: yellow light brown to reddish light brown, slightly moist, dense		SM			
	@ 8' Coarse Sand with rounded 9"-12" cobbles: red brown, moist, dense		SP			
	C: @ 12' Silt: Gray, slightly moist, stiff		ML			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS

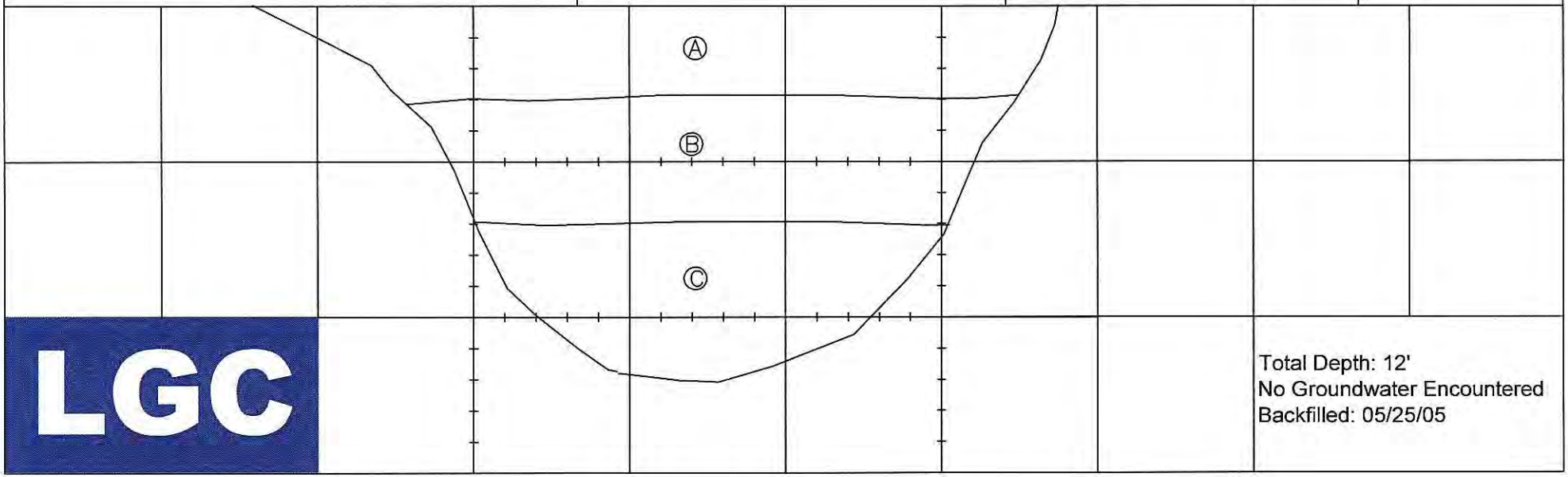


Total Depth: 13'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-9
Project Number: 041138-01	**Elevation:** 1278'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Pauba Formation:	Qp				
	A: @ 0-1' Silty Sand to Sandy Silt: reddish brown, dry to slightly moist, medium dense		SM			
	@ 1-3' Clayey Sand with lenses of Gravel: brown, slightly moist, dense		SC			
	B: @ 3' Clayey Sand with lenses of Sand and Gravel: brown, slightly moist, dense					
	@ 4' Clayey Sand: red brown, moist, dense					
	C: @ 7'-12' Sandy Clay: brown, moist, stiff		CL			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** EW

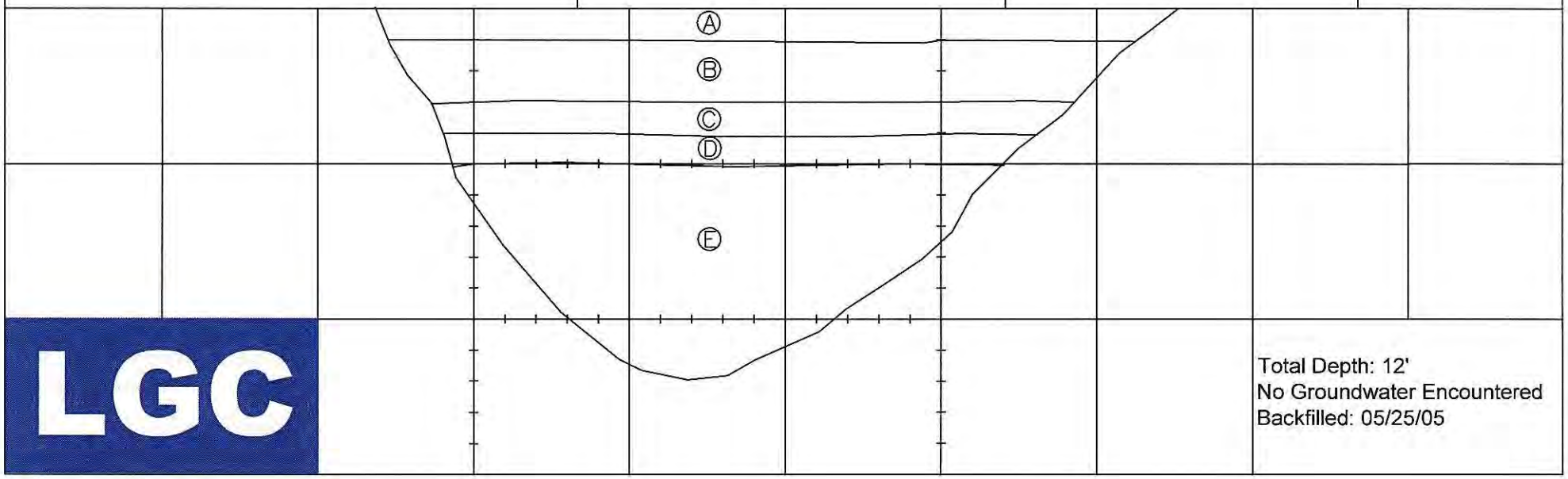


Total Depth: 12'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-10
Project Number: 041138-01	**Elevation:** 1280'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Pauba Formation:	Qp				
	A: @ 0-1' Silty Sand: brown, slightly moist to dry, medium dense		SM			
	B: @ 1'-3'Silty Sand: brown, slightly moist to dry, dense					
	C: @ 3'-4' Clayey Sand with Silt: red brown, slightly moist, dense		SC			
	D: @ 4' Fine Sand with Silt: brown, slightly moist, dense		SM			
	E: @ 5' Coarse Sand with Silt: brown, slightly moist, dense					
	@ 7' Sand with Silt: brown, slightly moist, dense					

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** **TREND:** EW

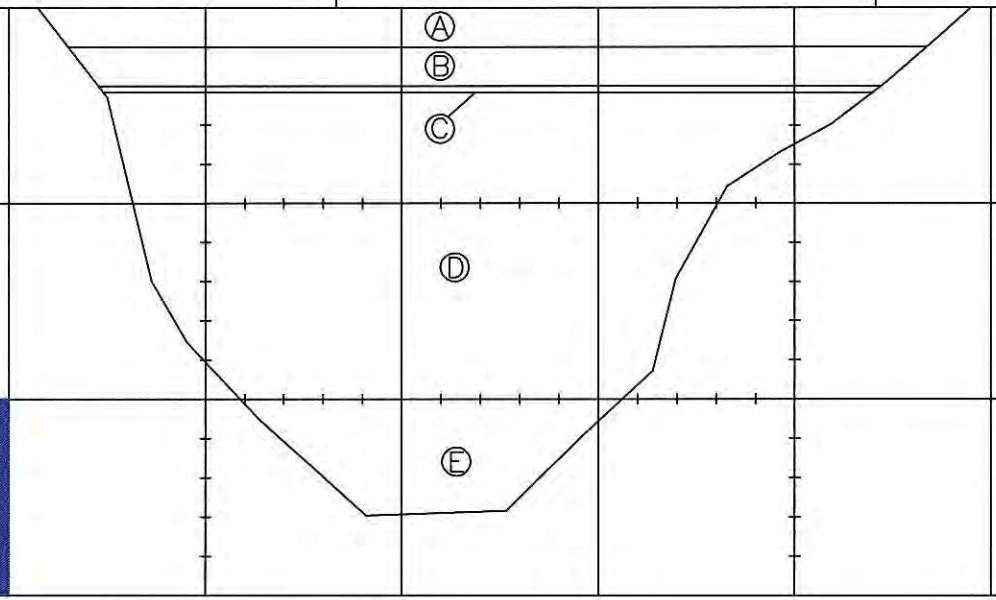


Total Depth: 12'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-11
Project Number: 041138-01	**Elevation:** 1275'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Alluvium:	Qal				
	A: @ 0-1' Clayey Fine Sand: brown, moist, slightly loose		SC			
	B: @ 1'-2' Clayey Fine Sand with cobbles: brown, moist, medium dense					
	C: @ 3' Loamy paleosoil: brown, slightly moist, loose					
	Quaternary Pauba Formation:	Qp				
	D: @ 3.5' Clayey Sand: brown, slightly moist, dense		SC			
	@ 6' Clayey Sand: brown, moist, dense			1		
	F: @ 10' coarse Sand: light brown, moist, dense		SP			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS



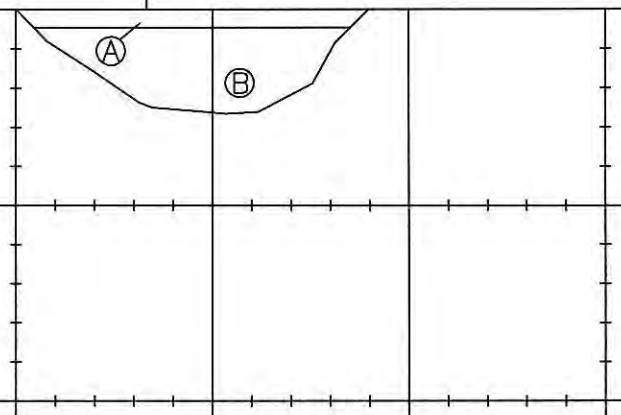
Total Depth: 13'
No Groundwater Encountered
Backfilled: 05/25/05

LGC

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-12
Project Number: 041138-01	**Elevation:** 1291'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium: A: @ 0-0.5' Very Fine Sandy Silt: light brown/White, dry, loose		ML			
@ 0.5'-2.5' joints: 70E 36S	Quaternary Pauba Formation: B: @ 0.5'-2.5' Sandstone: white, hard; roots in joints	Qp	SC			

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** **TREND:** NS



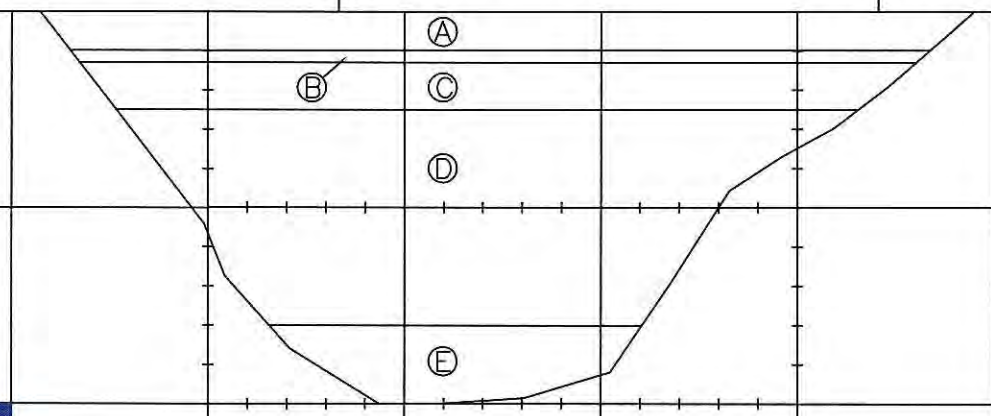
LGC

Total Depth: 2.5'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-13
Project Number: 041138-01	**Elevation:** 1250'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium:					
	A: @ 0-1' Sand with Silt: brown, moist, loose		SM			
	B: @ 1'-1.25' Sandy Clay: brown, moist, stiff		CL			
	Quaternary Pauba Formation:	Qp				
	C: @ 1.25'-2.5' Sand with minor Silt: light brown, moist, medium dense		SM			
	D: @ 2.5'-4' Clayey Sand: brown, moist, medium stiff		SC			
	@ 4' Clayey Sand: brown, moist, stiff					
	E: @ 8'-10' Coarse Sand: Gray, slightly moist, very dense; indurated		SP			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS



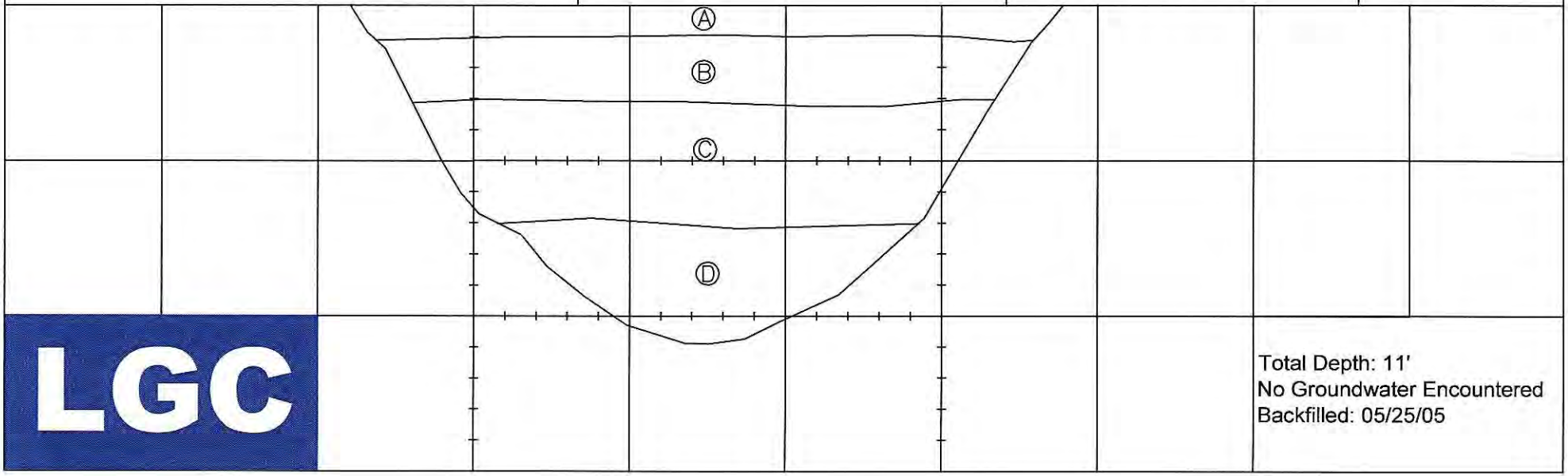
LGC

Total Depth: 10'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-14
Project Number: 041138-01	**Elevation:** 1262'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/5/04 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium: A: @ 0-1' Sand with Silt: brown to red brown, moist, loose		SM			
	Quaternary Pauba Formation: B: @ 1'-2' Sandy Clay: brown, moist, stiff	Qp	CL			
	@ 2'-3' Clayey Sand: brown, moist, medium stiff		SC			
	C: @ 3' Clayey Sand: brown, moist, stiff					
	D: @ 7'-10' coarse Sand: Gray, slightly moist, very dense; indurated		SP			

GRAPHICAL REPRESENTATION:	**SCALE:** 1" = 5'	**SURFACE SLOPE:**	**TREND:** NS



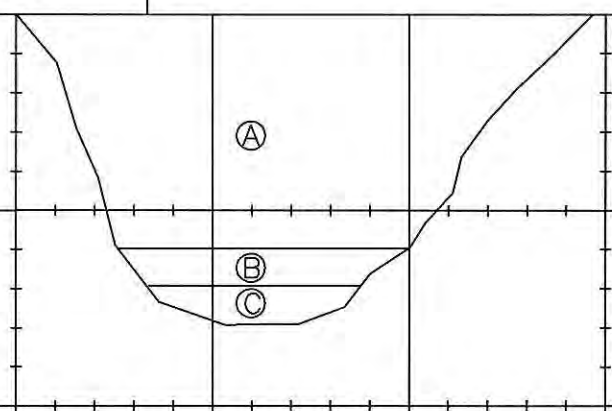
Total Depth: 11'
No Groundwater Encountered
Backfilled: 05/25/05

LGC

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-15
Project Number: 041138-01	**Elevation:** 1245'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/5/04 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Topsoil/Colluvium: A: @ 0-6' Clayey Sand: brown, slightly moist, very dense; slightly indurated, roots		SC	1		
	Quaternary Pauba Formation: B: @ 6' Clay with minor Sand: brown and White, slightly moist, very stiff; indurated, calcium carbonate nodules throughout		CL	2		
	C: @ 7' Sandstone: white, dry, hard		SP			

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** **TREND:** NS



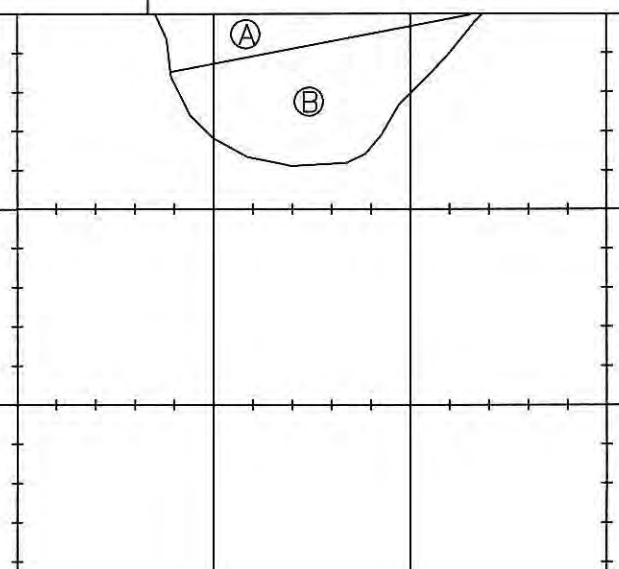
LGC

Total Depth: 8'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-16
Project Number: 041138-01	**Elevation:** 1263'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Artificial Fill - Undocumented A: @ 0-1.5' Clay, Silty Sand, and Sand: brown, Gray, red brown, dry to slighlty moist, med dense/medium stiff	Afu	CL/SM			
	Quaternary Pauba Formation: B: @ 1.5'-4' Sand: Gray, slightly moist, very dense; semi-well indurated	Qp	SP			

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** **TREND:** EW



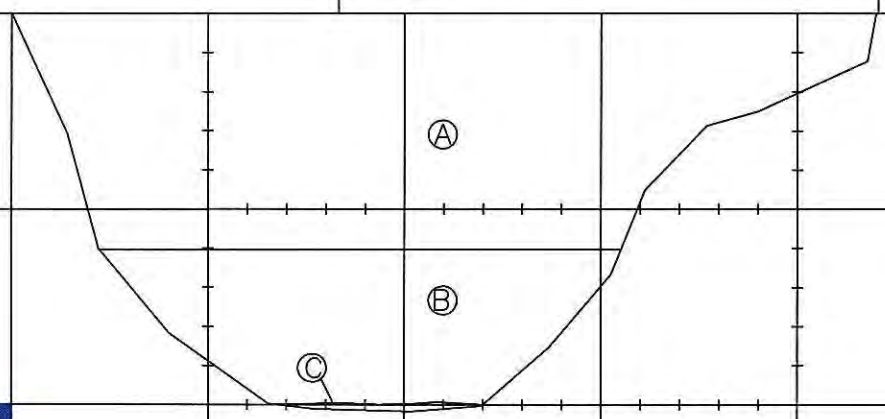
LGC

Total Depth: 4'
No Groundwater Encountered
Backfilled: 05/25/05

Project Name: T.T. 32535	**Logged by:** DAK	**LOG OF TRENCH** T-17
Project Number: 041138-01	**Elevation:** 1257'	**Engineering Properties**
Equipment: CASE 580L	**Location/Grid:** See Geotechnical Map	

Geologic Attitudes	Date: 05/25/05 / Description:	Geologic Unit	USCS	Sample No.	Moisture (%)	Dry Density (pcf)
	Quaternary Pauba Formation: A @ 0-1' Clayey Sand: brown, Dry, medium dense	Qp	SC			
	@ 1'-2' Clayey Sand: brown and White, slightly moist, dense					
	@ 2' Sand with Clay: yellow brown, slightly moist, dense					
	B: @ 6' Sand: Very light Gray, moist, dense		SP			
	C: @ 10' Sandstone: Gray, slightly moist, hard; white mineral infill in fractures					

GRAPHICAL REPRESENTATION: **SCALE:** 1" = 5' **SURFACE SLOPE:** 10°S **TREND:** EW



LGC

Total Depth: 10'
No Groundwater Encountered
Backfilled: 05/25/05

From LGC Inland, 2006

Geotechnical Boring Log B-1

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC — Page 1 of 1
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 — Hole Dia (in): 8
Top of Hole Elevation (ft): 1265	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0		Bag 1 0-5'				***Topsoil*:** Clayey SAND; dark yellowish brown, moist, medium dense	El, Max
	7 11 15	R-1	118.9	14.1			
5	12 12 10	R-2	–	–	Qal SM	***Quaternary Alluvium*:** Silty SAND; medium gray, wet, medium dense	
	10 7 10	R-3	112.3	▽ 17.7		groundwater at 8 feet; moderate brown	consol
10	12 16 18	R-4	114.9	16.9		medium gray, moist	consol
15	20 25 25	S-1	–	15.0	QTws	***Quaternary-Tertiary Sandstone*:** SANDSTONE; medium gray, wet, moderately hard, poorly graded	
20	40 50 for 5"	R-5	119.4	14.0		Silty SANDSTONE; medium gray, wet, hard	
25	13 20 45	S-2	–	16.7		moderate yellowish brown, moderately hard	
						Total Depth @ 26½ feet ***Groundwater @ 8 feet***	
30							

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Geotechnical Boring Log B-2

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0		Bag 1 0-5'			SC	***Topsoil:*** Clayey SAND; moderate brown, slightly moist, loose	
	40 50 for 5"	R-1	114.4	6.8	QTws	***Quaternary-Tertiary Sandstone:*** Silty SANDSTONE; moderate yellowish brown, wet, hard, fine to coarse sand	
5	32 50 for 4"	R-2	94.5	24.7		pale yellowish brown	
	50	R-3	102.4	5.9		coarse gravel at 7½ feet	
10	50 for 4"	R-4	–			moist	
	50 for 5"	R-5	100.7	4.9			
15	22 42 50	S-1	–	7.5		very pale orange, slightly moist, fine to medium sand	
20	50	R-6	113.3	13.4 ▽		pale yellow brown groundwater at 20½ feet	
25	30 40 50 for 5"	S-2	–	14.0		fine to coarse sand	
30							

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Geotechnical Boring Log B-2

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
30	23 43 50	R-7	114.5	18.4			
						SILTSTONE; moderate yellowish brown, moist, moderately hard	
35	9 14 20	S-3	–	21.8			
						Silty SANDSTONE; pale yellowish brown, wet, hard	
40	12 14 50 for 4"	R-8	120.3	14.6			
45	23 37 50	S-4	–	16.4		pale yellowish orange	
50	50	R-9	117.9	16.0		moderate yellowish brown, moist	
						Total Depth @ 50½ feet	
						Groundwater @ 20½ feet	
55							
60							

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Geotechnical Boring Log B-3

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC — Page 1 of 1
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 — Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0					SM	***Topsoil***:silty SAND; pale yellowish brown, moist, loose	
	15 32 50	Bag 1 0-5' R-1	116.4	11.2	QTws	***Quaternary-Tertiary Sandstone***: SILTSTONE; pale yellowsih brown, moist, hard	
5	26 50	R=2	120.6	1.1		CLAYSTONE; dark yellowish brown, moist, moderately hard	
	23 33 50	R-3	119.1	15.9		hard	
10	25 42 50	R-4	117.7	14.8			
	27 40 47	R-5	118.0	7.5		Silty SANDSTONE; pale yellowish brown, moist, hard	
15	15 18 20	S-1	–	8.7		moderately hard	
20	27 37 50 for 5"	R-6	116.6	▽ 12.1		Silty SANDSTONE; very pale orange, wet, hard, poorly-graded groundwater at 19.0 feet	
25	45 50	R-7	–	–			
						Total Depth @ 26 feet ***Groundwater @ 19 feet***	
30							

LGC INLAND

Geotechnical Boring Log B-4

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC — Page 1 of 1
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 — Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0						***Topsoil:*** Clayey SAND; dusky yellowish brown, moist, loose to medium dense, trace coarse gravel	
	12 32 40	R-1	125.7	10.3	Qps	***Quaternary Pauba Formation:*** Silty SANDSTONE; pale yellowish brown, slightly moist, hard	
5	13 25 37	R-2	103.1	19.9		SILTSTONE; pale yellowish brown, moist, moderately hard	
	33 50 for 4"	R-3 Bag 1 9-10'	119.7	13.5		Silty SANDSTONE; pale yellowish brown, moist, hard	
10	17 30 44	R-4	110.5	9.0		moderately hard	
	16 26 40	R-5	122.6	7.0		SILTSTONE; pale yellowish brown, moist, moderately hard	
15	9 13 24	S-1	–	17.3		dusky yellowish brown	
20	8 33 45	R-6	110.9	17.3			
25	29 39 50	R-7	114.9	13.0		Poorly-graded silty SANDSTONE; very pale orange, wet, hard	
						Total Depth @ 26½ feet ***No Groundwater***	
30		-	–	–			

LGC INLAND

Geotechnical Boring Log B-5

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC — Page 1 of 1
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 — Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0					Qal	***Alluvium:***	
					SM	Silty SAND; dark yellowish brown, moist, loose to medium dense, porous	
	7 10 11	R-1	101.6	4.5			
5					QTws	***Quaternary-Tertiary Sandstone:***	
	10 15 25	R-2	117.0	14.4		SILTSTONE; very pale orange, moist, moderately hard, caliche present	
	13 33 50	R-3	117.2	14.4		Silty SANDSTONE; very pale orange, moist, moderately hard, caliche present	
10	25 33 30	R-4	124.4	11.2		CLAYSTONE; very pale orange, moist, moderately hard, caliche present	
	8 18 35	R-5	110.6	19.9		hard	
15	8 16 23	S-1	–	11.5		Silty SANDSTONE; very pale orange, moist, moderately hard, caliche present	
20	33 50	R-6	126.1	10.4		no caliche	
25	25 50/4"	R-7	126.3	13.1		moderately hard, coarse gravel at 25'	
						Total Depth @ 26 feet	
						No Groundwater	
30		-	-	-			

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Geotechnical Boring Log B-6

Date: 5/8/06	Project Name: Temecula Creek Estates, LLC — Page 1 of 1
Project Number: I05873-10	Logged By: TJ
Drilling Company: 2R	Type of Rig: CME 55
Drive Weight (lbs): 140	Drop (in): 30 — Hole Dia (in): 8
Top of Hole Elevation (ft): 1287	Hole Location: See Geotechnical Map

Depth (ft)	Blow Count / 6"	Sample No.	Dry Density (pcf)	Moisture (%)	Geologic / USCS Symbol	DESCRIPTION	Type of Test
0					SM	***Topsoil:*** Silty SAND; dark yellowish brown, slightly moist, loose	
	40 50	R-1	108.5	11.4	QTws	***Quaternary-Tertiary Sandstone:*** Silty SANDSTONE; moderately yellowish brown, slightly hard, slightly porous, fine to medium sand	
5	35 40 50 for 3"	R-2	113.5	12.9		porous	
	30 50	R-3	116.4	5.7		moderately hard, fine to coarse sand, not porous	
10	30 50	R-4 Bag 1 10 15'	120.5	5.2		moist	
	24 26 32	R-5	102.9	3.7		CLAYSTONE; pale yellowish brown, moist, moderately hard	
15	14 16 18	S-1	–	7.2		Silty SANDSTONE; pale yellowish brown, moist, moderately hard	
20	30 32 50	R-6	109.0	3.4		hard, medium gray	
25	30 29 20	R-7	–	1.2		moderately hard	
						Silty SANDSTONE; very pale orange, slightly moist, moderately hard, trace coarse gravel, poorly-graded	
30						***Total Depth @ 26½ feet*** ***No Groundwater***	

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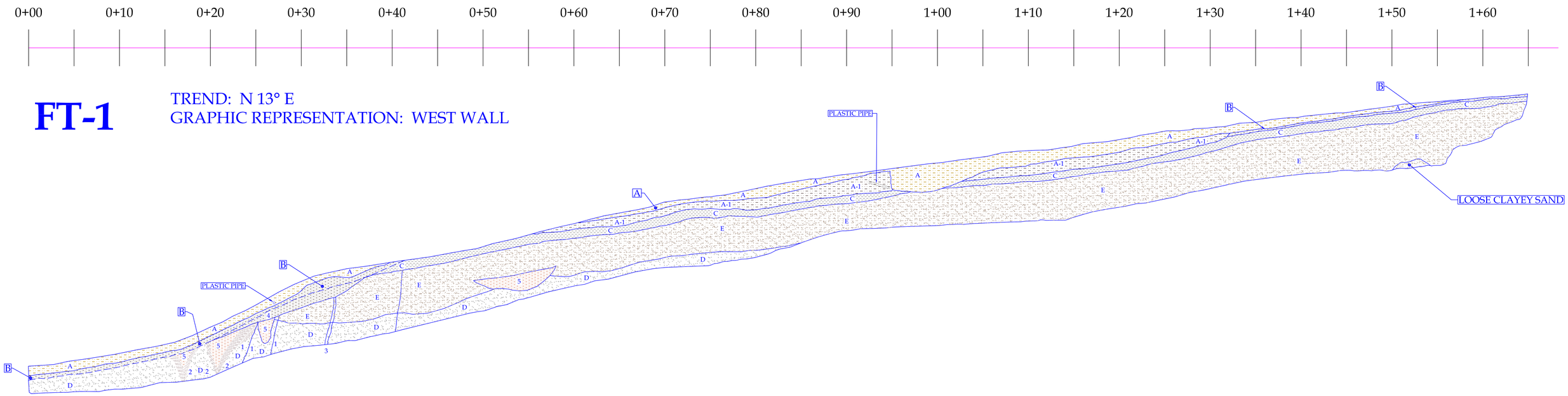

LEGEND
(FT-1)

Earth Units

Artificial Fill, Undocumented:

A - **Clayey SAND;** medium brown (7.5YR 4/4), slightly moist to moist, medium dense, fine to coarse sand, trace fine to coarse gravel.

A-1 - **Clayey SAND;** olive gray (5Y 4/2), moist, medium dense, fine to medium sand.

Topsoil:

B - **Clayey SAND;** very dark gray (10YR), dry to moist, medium dense, fine to coarse sand, abundant rootlets.

Quaternary- Tertiary Sandstone:

C - Sandy CLAYSTONE; very dark gray (10YR 3/1), moist, moderately soft, fine to coarse sand, zones of abundant caliche deposits.

D - SANDSTONE; light gray (7/N), dry, moderately hard, fine to medium sand, trace clay.

E - Clayey SANDSTONE; olive gray (10Y 4/1), moist, moderately hard, fine to coarse sand.

Graphic Representation

1 - Fractures; Clay lined, fine rootlets.

2 - Staining, reddish yellow oxidation stains.

3 - Clay seam, wet, capped by abundant roots.

4 - Zone of abundant caliche deposits.

5 - Scour and Fill Deposits: Clayey SAND; reddish brown (5YR 4/4), medium dense, fine to coarse sand, translocated clay films.

LGC INLAND

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MURRIETA, CALIFORNIA 92562
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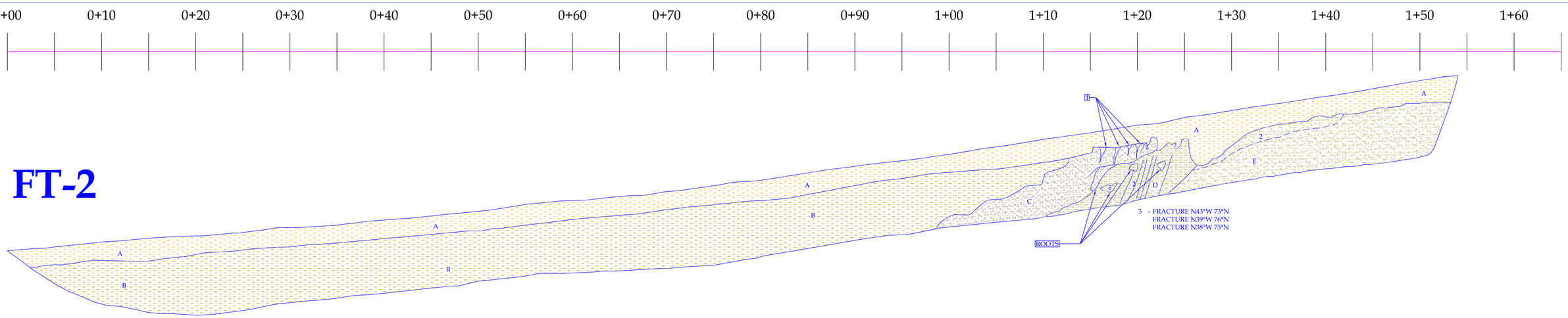
Mark Bergmann	Stephen Poole
Principal Geologist	Principal Engineer

FAULT TRENCH LOGS
TRACT 32535
FT-1

Name:	NORTH RANCH NO. 3
Project No.	I05873-10
Client:	TEMECULA CREEK ESTATES, LLC
Scale:	1"=5'
Date:	August 2006
Sheet No.	
Plate No.	2 OF 5

P:\Inland - 2005 Projects\I05873 Meeker Comb. North Ranch 85- Lots\CAD In Progress\FT_LOGS.dwg, FT-1, 1:1



TREND: N 13° E
GRAPHIC REPRESENTATION: WEST WALL

LEGEND
(FT-2)

Earth Units

Topsoil:

A - Clayey SAND; dark yellow brown, slightly moist, medium dense, fine to medium sand.

Quaternary Alluvium:

B - Clayey SAND; medium brown, dry, dense, fine to coarse sand, blocky peds, transmigrated clay films.

Quaternary- Tertiary Sandstone:

C - SANDSTONE; light yellowish white, dry, hard, fine to coarse sand, friable.

D - Sandy SILTSTONE; olive gray, dry, very hard, fine sand, extremely fractured, abundant $CaCO_3$ deposition on fracture surfaces.

E - Silty SANDSTONE; olive gray, dry, hard, fine to coarse sand, friable.

Graphic Representation

1 - Soil infilled Fractures, Zones, infilled with Clayey SAND; medium brown, slightly moist, loose.

2 - Heavily Fractured Zone with abundant $CaCO_3$ deposition

3 - Fracture Attitudes

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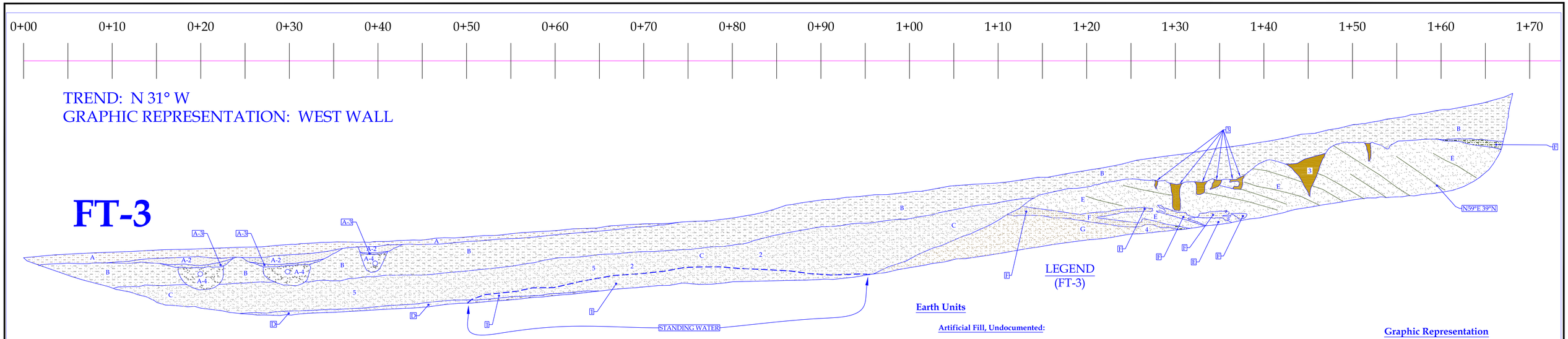
Mark Bergmann	Stephen Poole
Principal Geologist	Principal Engineer

FAULT TRENCH LOGS
TRACT 32535
FT-2

Name:	NORTH RANCH NO. 3
Project No.	I05873-10
Client:	TEMECULA CREEK ESTATES, LLC
Scale:	1"=5'
Date:	August 2006
Sheet No.	
Plate No.	3 OF 5

P:\Inland - 2005 Projects\I05873 Meadar Comp. North Ranch 85- Lots\CAD In Progress\FT_LOGS.dwg, FT-(2), 1:1



LEGEND (FT-3)

Earth Units

Artificial Fill, Undocumented:

A - Clayey SAND; strong brown (7.5YR 4/4),

A-2 - Sandy Silt; olive (5Y 5/3), dry, stiff.
A-3 - Silty SAND; very dark gray (10YR 3/1), dry, medium dense.
A-4 - Silty GRAVEL; gray, dry, loose, with sand.

Topsoil:

B - Silty SAND; very dark gray (2.5Y 3/3 - olive brown, 10YR 3/1 - dark gray), dry, medium dense, fine to coarse sand, rootlets, roots, moderate porosity.

Quaternary- Tertiary Sandstone:

C - Clayey SANDSTONE; dark grayish brown (2.5Y 4/2), moist, moderately hard, fine to coarse sand, slight porosity, zones of abundant $CaCo^3$ stringers, blocky peds, intensely weathered.

D - olive gray (5Y 4/2), wet, moderately hard, zones of bluish staining around rootlets.

E - SANDSTONE; white (white to pale yellow 5Y 8/1, 8/2), dry, hard, fine to coarse sand, bedding dipping northwest.

F - Sandy SILTSTONE; olive (5Y 5/3), moist, stiff, fine to medium sand.

G - Clayey SANDSTONE; olive (5Y 5/4), very moist, moderately hard, fine to medium sand, oxidation staining.

Graphic Representation

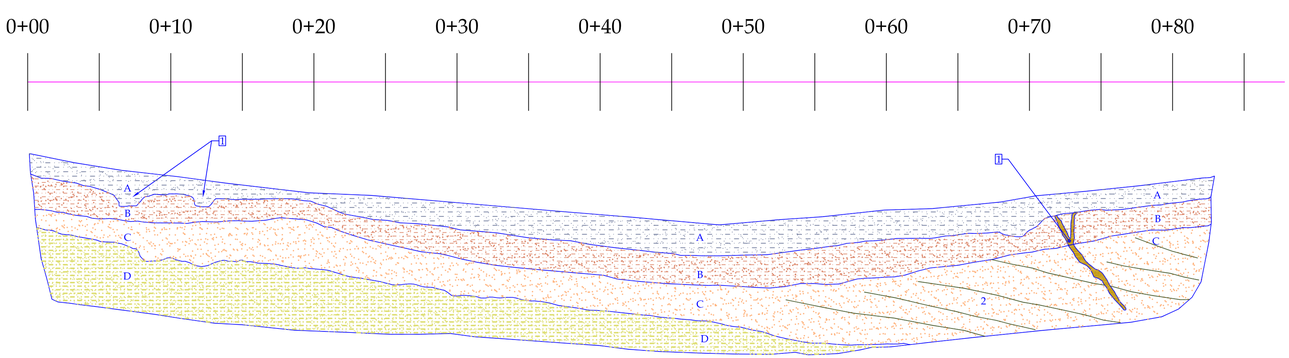
1 - Zone of increased moisture

2 - Zone of abundant $CaCO_3$ stringers

3 - Crotovina

4 - Approximate 6 inch offset

5 - Zone of abundant oxidation staining



FT-4

TREND: N 2° E
GRAPHIC REPRESENTATION: WEST WALL

LEGEND (FT-4)

Earth Units

Topsoil:

A - Silty SAND; very dark gray (10YR 3/1), loose, fine to coarse sand, porous.

Quaternary- Tertiary Sandstone:

B - Clayey SANDSTONE; strong brown (7.5YR 4/4), moist, hard, fine to coarse sand.

C - SANDSTONE; pale yellow (5Y 8/2), dry, hard, fine to coarse sand with clay.

D - Sandy SILTSTONE; olive gray (5Y 4/2), moist, hard, fine sand, Bedding N12°W 24°N.

Graphic Representation

1 - Crotovina infilled with Clayey SAND, rootlets

LGC INLAND

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41531 DATE STREET
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Mark Bergmann	Stephen Poole
Principal Geologist	Principal Engineer

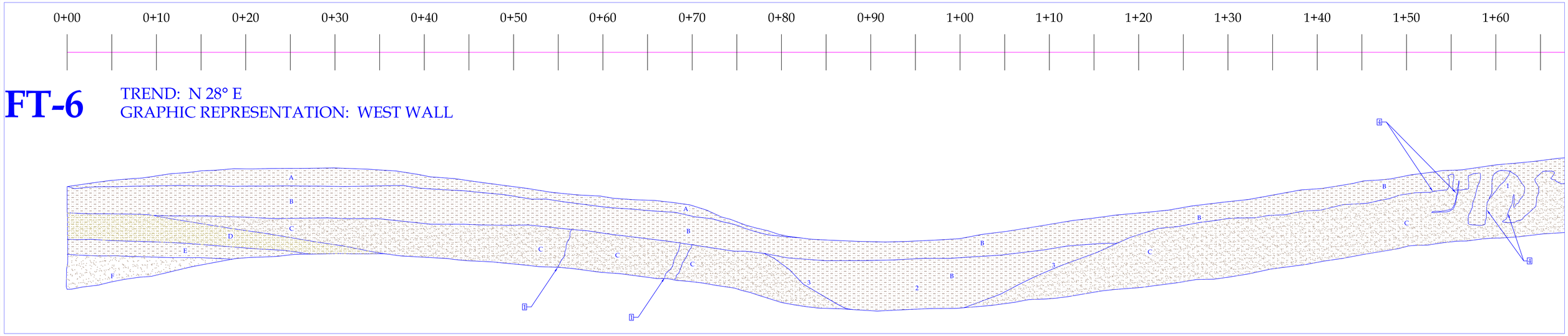
FAULT TRENCH LOGS
TRACT 32535
FT-3 AND FT-4

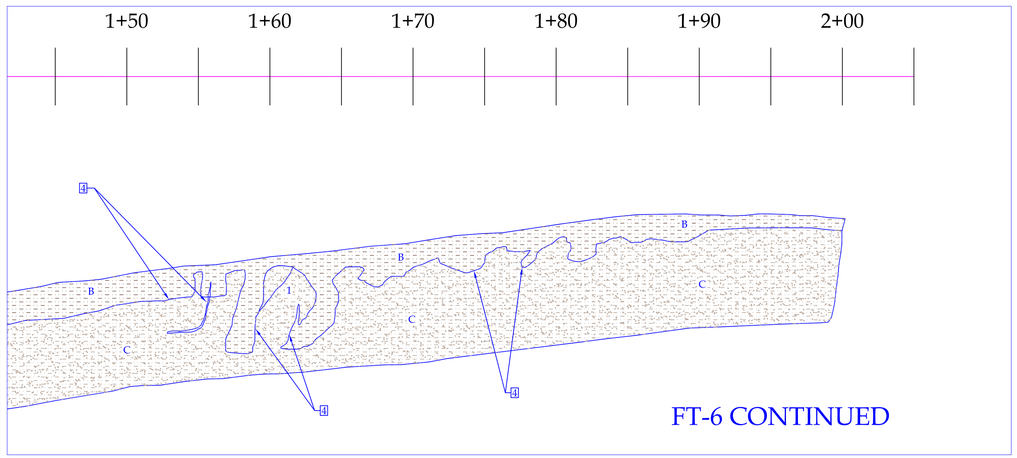
Name:	NORTH RANCH NO. 3
Project No.	I05873-10
Client:	TEMECULA CREEK ESTATES, LLC
Scale:	1"=5'
Date:	August 2006
Sheet No.	
Plate No.	4 OF 5

P:\Plotted - 2005 Projects\I05873 Hooker Comp. North Ranch 65- Lots\CAD In Progress\FT_LOGS.dwg, FT-(2-1), 1:1

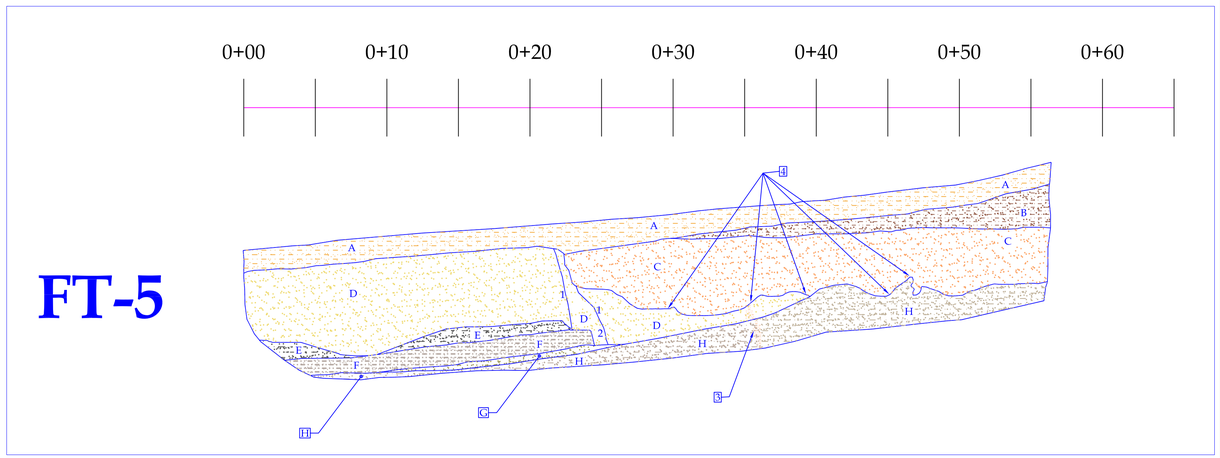
FT-6

TREND: N 28° E
GRAPHIC REPRESENTATION: WEST WALL





FT-5



LEGEND
(FT-6)

Earth Units

Artificial Fill, Undocumented:

A - Clayey SAND; medium brown (7.5YR ¾), dry, loose to medium dense, fine to coarse sand.

Topsoil:

B - Clayey SAND; brown, dry, loose to medium dense, fine to coarse sand, blocky peds, clay films.

Quaternary- Tertiary Sandstone:

C - Clayey SANDSTONE; light brown. slighty moist, hard, fine to coarse sand.

D - Sandy SILTSTONE; olive gray, slightly moist, moderately hard, fine sand with clay.

E - Clayey SAND; light olive gray, slightly moist, moderately hard, fine sand.

F - SANDSTONE; light yellow, dry, hard, fine to coarse sand.

Graphic Representation

1 - Fractures

2 - Zone of increased moisture

3 - Erosional contact

4 - Zone of extreme bioturbation

LEGEND
(FT-5)

TREND: N 23° E
GRAPHIC REPRESENTATION: EAST WALL

Earth Units

Topsoil:

A - Silty SAND; dark yellow brown, dry, loose, fine to coarse sand, porous.

Quaternary- Tertiary Sandstone:

B - Clayey SANDSTONE; strong brown (7.5YR ¾), dry, moderately hard, fine to coarse sand.

C - SANDSTONE; reddish brown (5YR ¾), dry, dense, fine to coarse sand with clay films coating grains, fine to coarse gravel interfingered with sand, Clayey sand, ripup clasts of Siltstone.

D - SANDSTONE; pale yellow (5Y ⅔), dry, moderately hard, clasts, fine to coarse sand.

E - Silty SANDSTONE; gray (5/N), moist, moderately hard, fine to medium sand with silt.

F - Sandy SILTSTONE; olive gray (5Y ⅔), moist, moderately hard, fine sand.

G - SANDSTONE; light gray (7/N), dry, moderately hard, fine to medium sand.

H - Silty SANDSTONE; olive gray (5Y ⅔), moist, moderately hard, fine sand.

Graphic Representation

1 - Fractures

2 - Sand layer with seemingly continuos silty layer beneath

3 - Oxidation staining

4 - Scour and fill bedding contact

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Mark Bergmann	Stephen Poole
Principal Geologist	Principal Engineer

FAULT TRENCH LOGS
TRACT 32535
FT-5 AND FT-6

Name:	NORTH RANCH NO. 3
Project No.	I05873-10
Client:	TEMECULA CREEK ESTATES, LLC
Scale:	1"=5'
Date:	August 2006
Sheet No.	
Plate No.	5 OF 5

P:\Inland - 2005 Projects\I05873 Meritor Corp. North Ranch\ IS\ Lots\CAD In Progress\FT_LOGS.dwg, FT-5(-6), 1:1

Appendix C
Laboratory Test Results

From Lawson, 2005a

APPENDIX C

Laboratory Testing Procedures and Test Results

The laboratory test program was formulated towards providing quantitative data relating to the relevant engineering properties of the anticipated site soil conditions. Samples considered representative of site conditions were tested in general accordance with American Society for Testing and Materials (ASTM) procedure aud/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.

Expansion Index: The expansion poteutial of selected samples were evaluated by the Expansion Index Test, CBC Standard No. 18-2 and/or ASTM D4829. Specimens are molded under a given compactive energy to approximately the optimum moisture content and approximately 50 percent saturation. 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 are presented in this appendix.

Maximum Dry Density and Optimum Moisture (Laboratory Compaction): 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:

Sample Location	Sample Description	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
T-1	Brown Slightly Silty Clayey Sand	121.0	12.0
T-5	Gray Slightly Clayey Silty Sand	120.0	12.0
T-15	Brown Clayey Silty Sand	125.0	10.0

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 this appendix.

Minimum Resistivity and pH Tests: Minimum resistivity and pH tests were performed in general accordance with CTM 643 and standard geochemical methods. The results are presented in this appendix.

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

Location	Sample No.	Depth (ft)	Molding Moisture Content (%)	Initial Dry Density (pcf)	Final Moisture Content (%)	Expansion Index	Expansion Classification[1]
T-1	B-1	2-4	10.5	106.0	22.6	58	Medium
T-3	B-1	1	12.7	101.8	21.3	41	Low
T-15	B-2	6.5	16.3	90.1	32.5	140	Very High

[1] 1997 U.B.C. / 2001 C.B.C. Table 18-I-B

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EXPANSION INDEX
(ASTM D 4829)

Project Number: 041138-01
Date: Jun-05

Tentative Tract 32535 / Riverside Co.

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

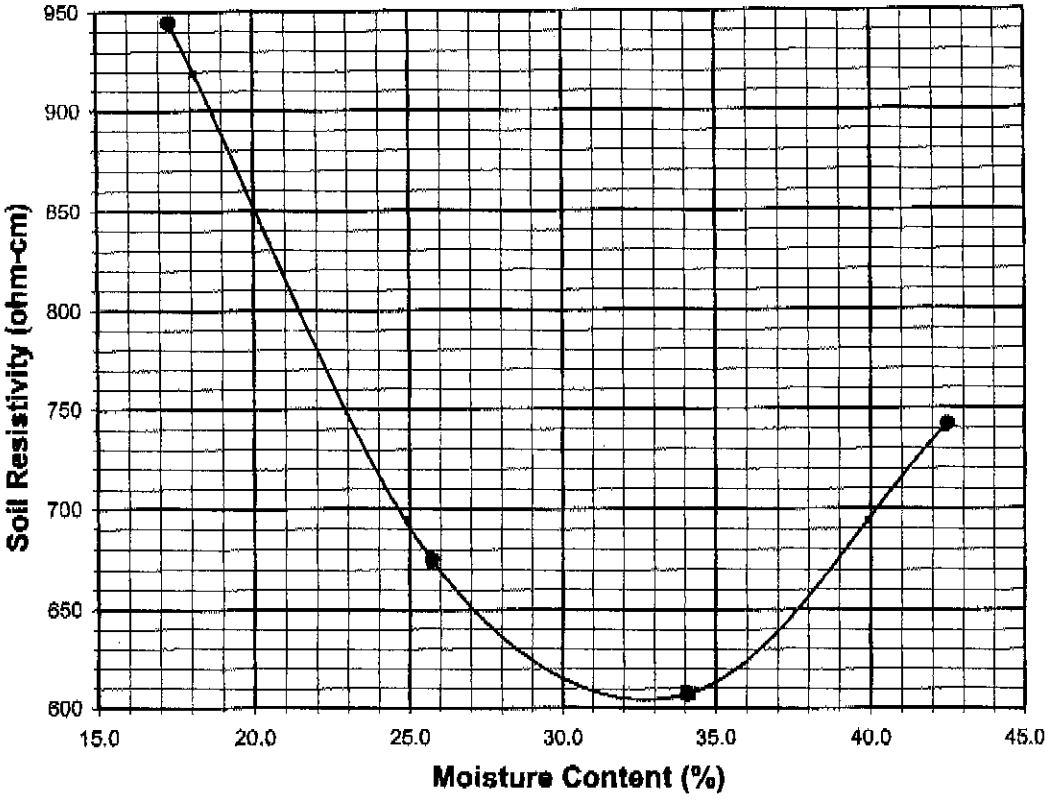
Project Name: Wildonar #9
Project No. : 041138-01
Boring No.: T-1
Sample No. : B-1
Soil Identification: SC

Tested By : GB Date: 06/01/05
Data Input By: LF Date: 06/07/05
Depth (ft.) : 2-4

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	17.34	140	944
2	200	25.72	100	675
3	300	34.10	90	607
4	400	42.48	110	742
5				

Moisture Content (%) (MCI)	8.96
Wet Wt. of Soil + Cont. (g)	237.13
Dry Wt. of Soil + Cont. (g)	223.14
Wt. of Container (g)	66.95
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mcl/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
605	**33.0**	**136**	**242**	**7.52**	**21.6**



Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

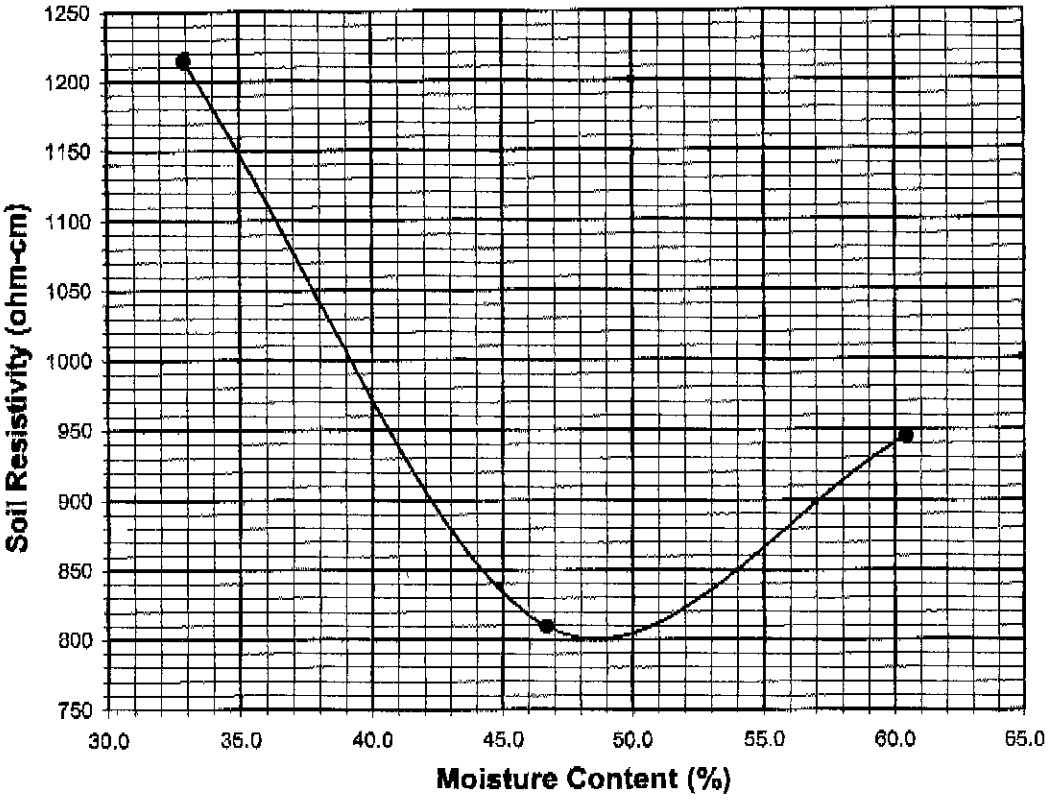
Project Name: Wildonar #9
Project No. : 041138-01
Boring No.: T-15
Sample No. : B-2
Soil Identification: SC

Tested By : GB Date: 06/01/05
Data Input By: LF Date: 06/07/05
Depth (ft.) : 6.5

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	150	32.92	180	1214
2	300	46.67	120	810
3	450	60.42	140	944
4				
5				

Moisture Content (%) (MCi)	19.17
Wet Wt. of Soil + Cont. (g)	221.12
Dry Wt. of Soil + Cont. (g)	196.87
Wt. of Container (g)	70.35
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
800	**48.5**	**102**	**87**	**8.22**	**21.7**



From LGC Inland, 2006

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 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 trench logs.

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 representative samples were evaluated with the Expansion Index Test, ASTM D 4829. The results of these tests are presented in the table below:

SAMPLE LOCATION	*SAMPLE DESCRIPTION*	*EXPANSION INDEX*	*EXPANSION POTENTIAL**
B-1 @ 0-5 feet	Clayey SAND, dark olive brown, fine to coarse sand, trace gravel	35	Low

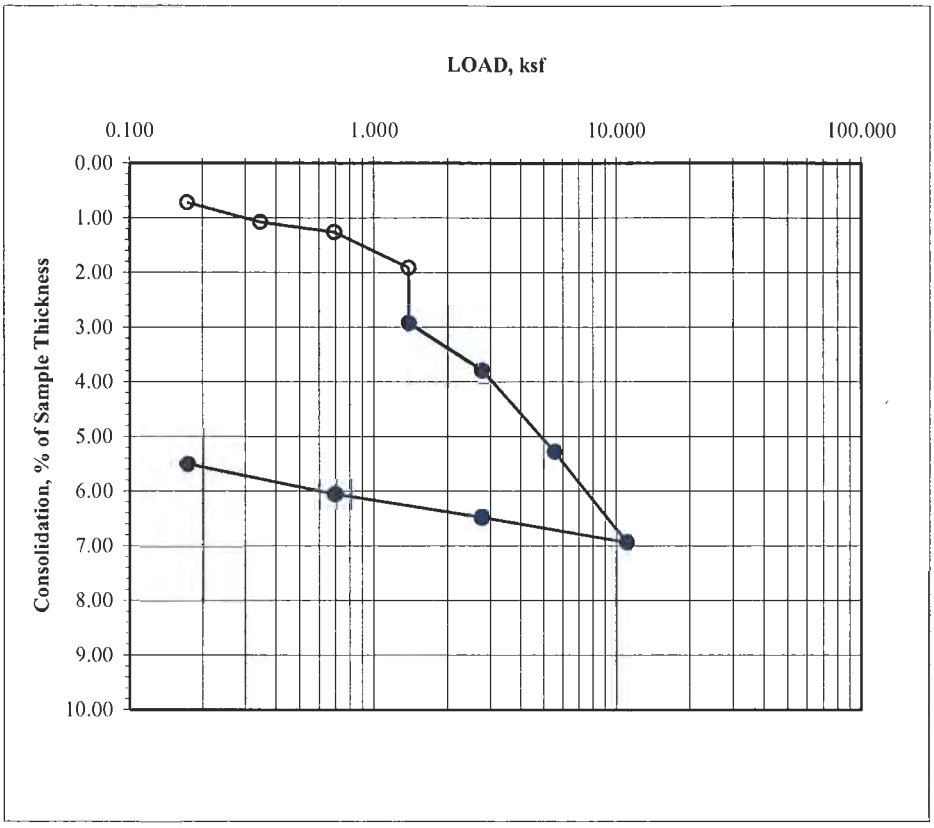
* Per Table 18-1-B of 1997 UBC.

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:

SAMPLE LOCATION	*SAMPLE DESCRIPTION*	*MAXIMUM DRY DENSITY (pcf)*	*OPTIMUM MOISTURE CONTENT (%)*
B-1 @ 0-5 feet	Clayey SAND, dark olive brown, fine to coarse sand, trace gravel	127.5	10.0

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.

CONSOLIDATION TEST RESULTS



Note: Filled circle denotes readings after sample was submerged in water

	In-place	Remolded:
Dry Density, (pcf):	112.3	
Moisture (%):	17.7	

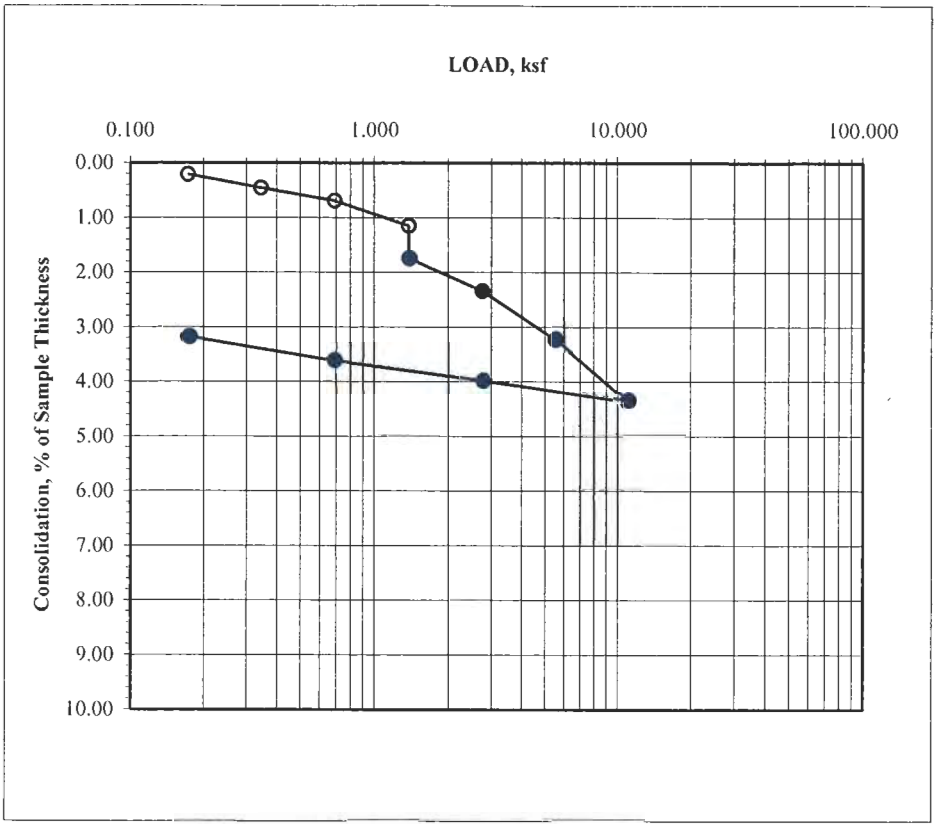
WATER ADDED @ ksf:	1.378
MAXIMUM LOAD, ksf:	11.020
SOIL DESCRIPTION:	Silty Sand
U.S.C.S.	SM
% Collapse/Swell (-):	1.01

P.N. I05823-10 **LOCATION:** B-1 @ 7.5 feet
CLIENT: Temecula Creek Estates

LGC

Plate: C-1

CONSOLIDATION TEST RESULTS



Note: Filled circle denotes readings after sample was submerged in water

	In-place	Remolded:
Dry Density, (pcf):	114.9	
Moisture (%):	16.9	

WATER ADDED @ ksf:	1.378
MAXIMUM LOAD, ksf:	11.020
SOIL DESCRIPTION:	Silty Sand
U.S.C.S.	SM
% Collapse/Swell (-):	0.60

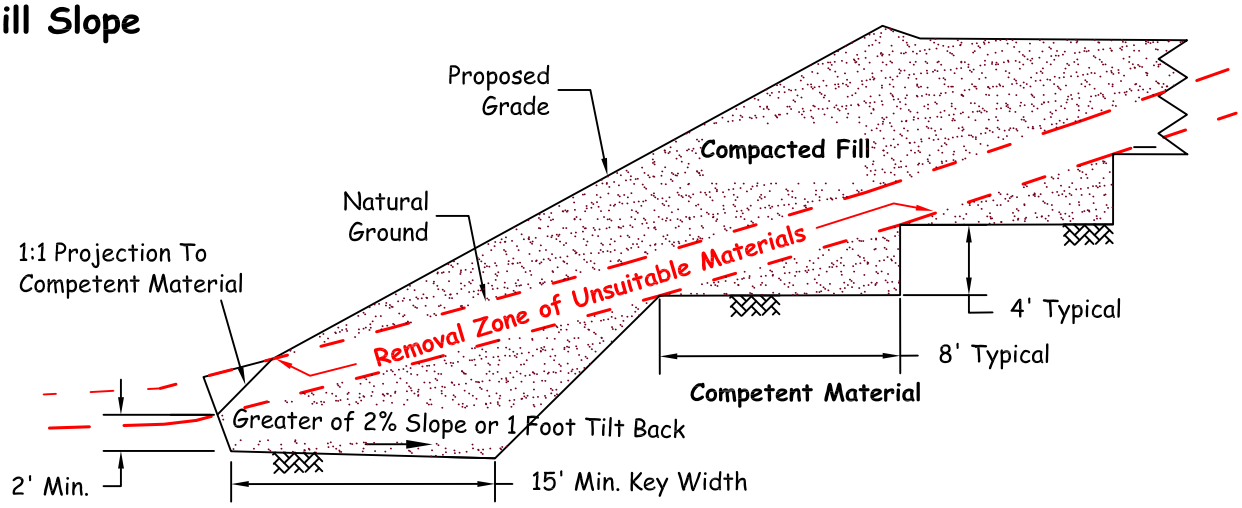
P.N. I05823-10 **LOCATION:** B-1 @ 10 feet
CLIENT: Temecula Creek Estates

LGC

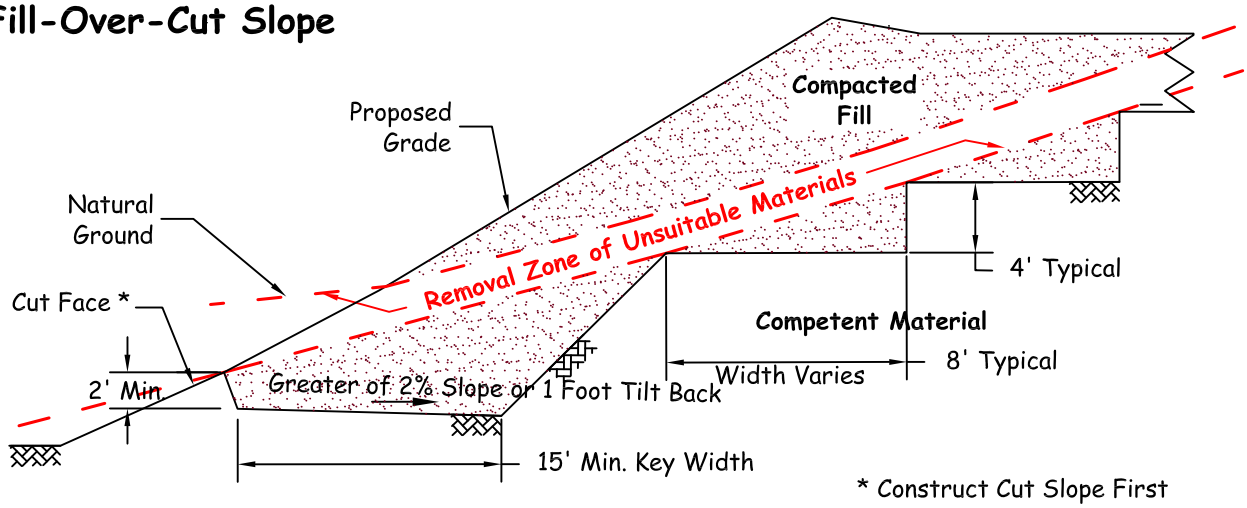
Plate: C-2

Appendix D
General Earthwork and Grading Specifications for Rough Grading

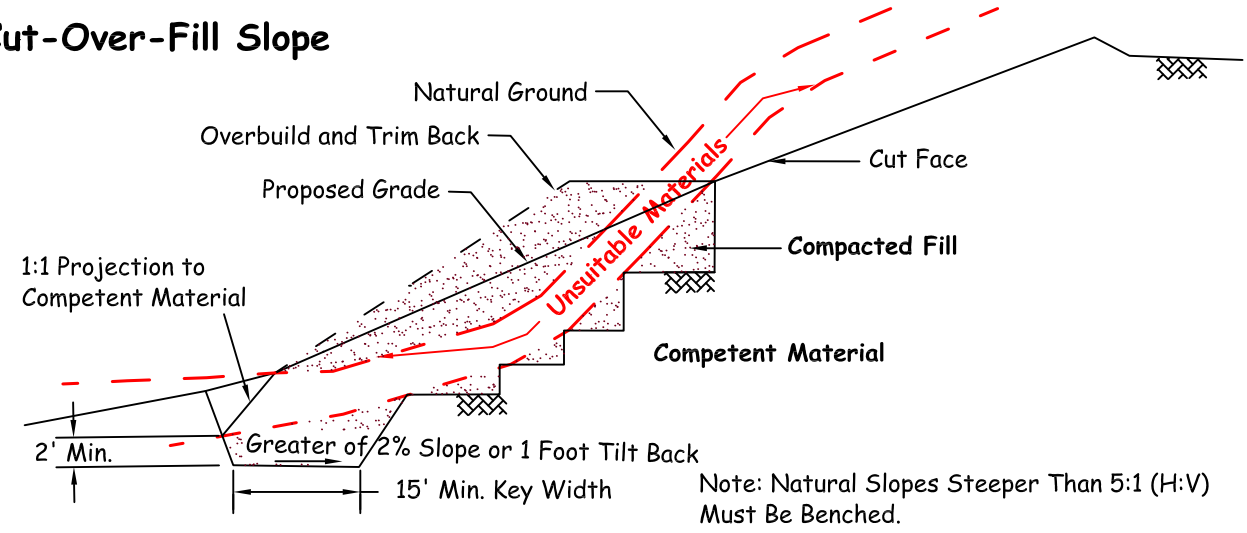
Fill Slope



Fill-Over-Cut Slope



Cut-Over-Fill Slope



Note: Natural Slopes Steeper Than 5:1 (H:V) Must Be Benched.

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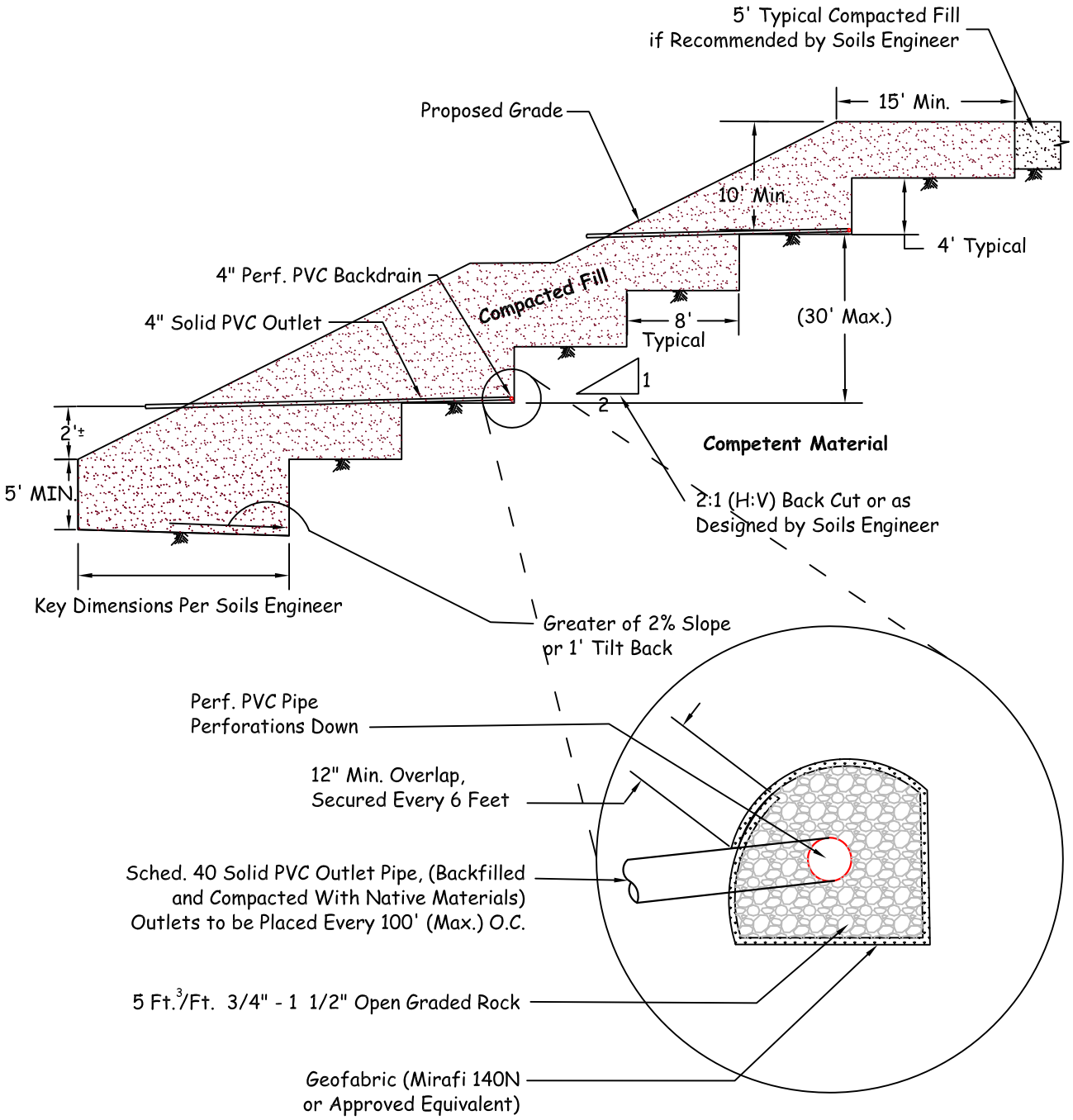
KEYING AND BENCHING



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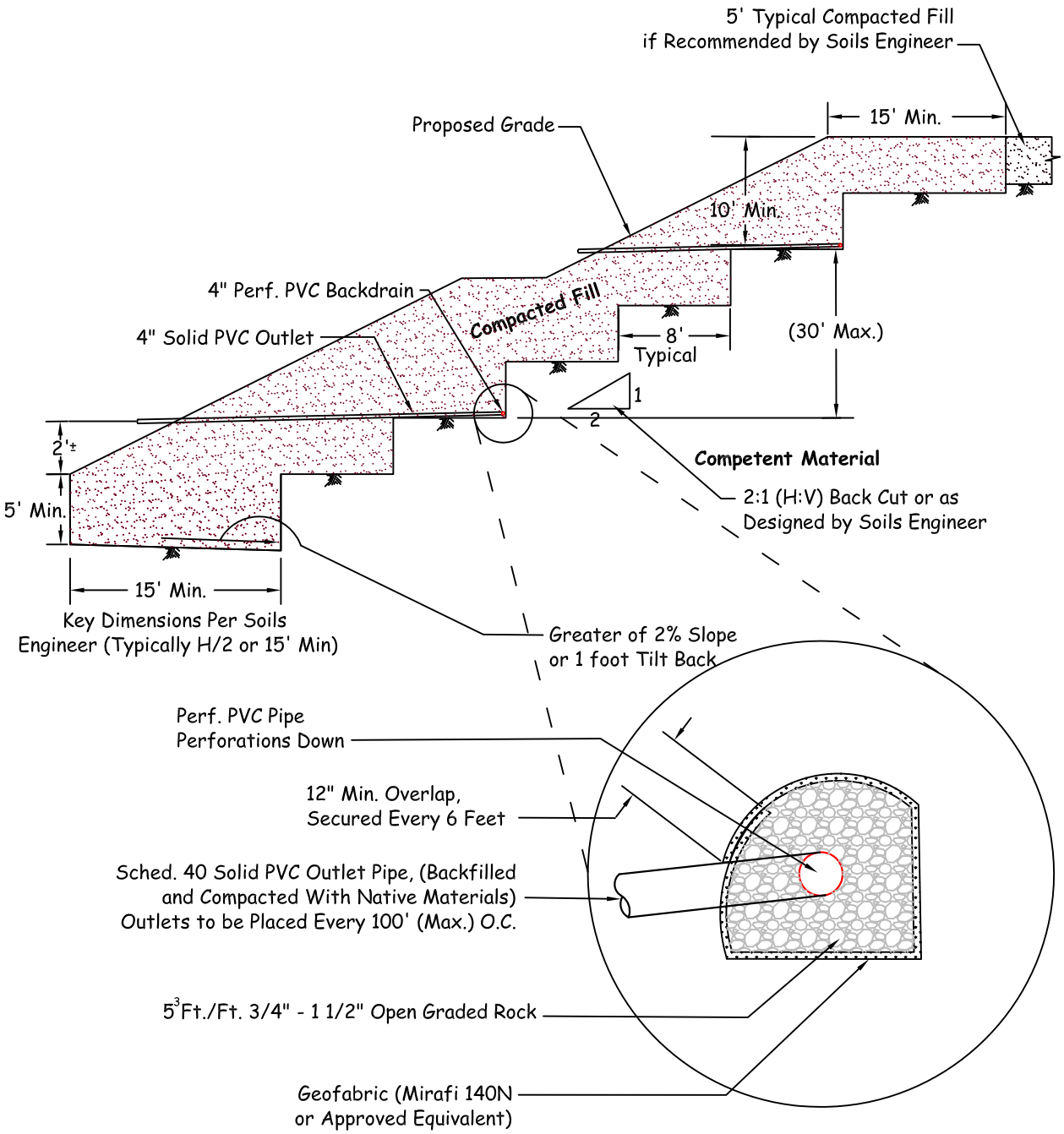
TYPICAL BUTTRESS DETAIL



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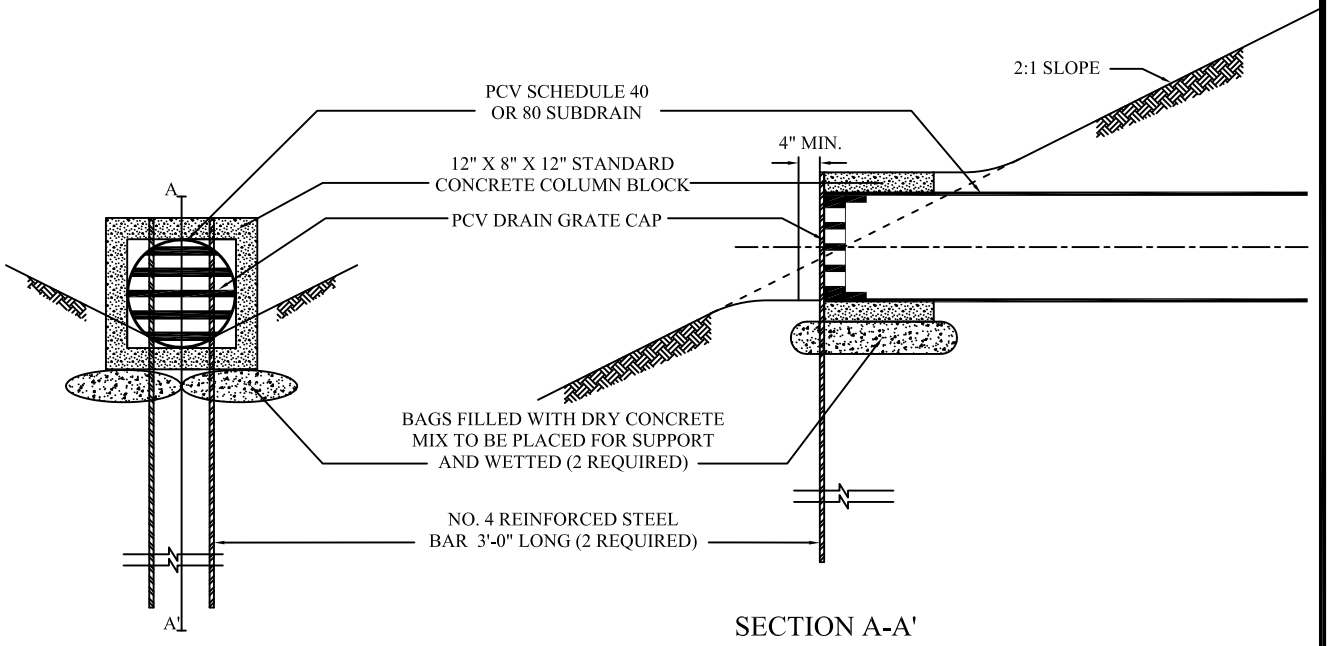
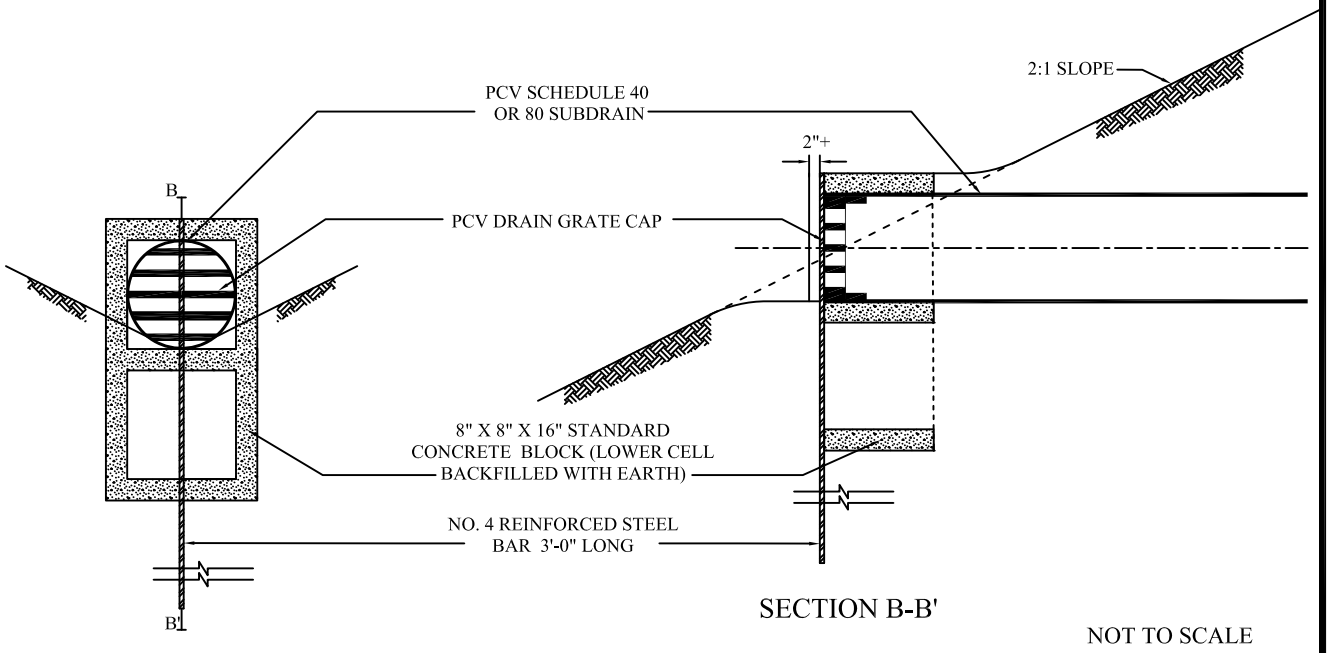
TYPICAL STABILIZATION FILL DETAIL

SUBDRAIN OUTLET MARKER -6" & 8" PIPE



SUBDRAIN OUTLET MARKER -4" PIPE



NOT TO SCALE

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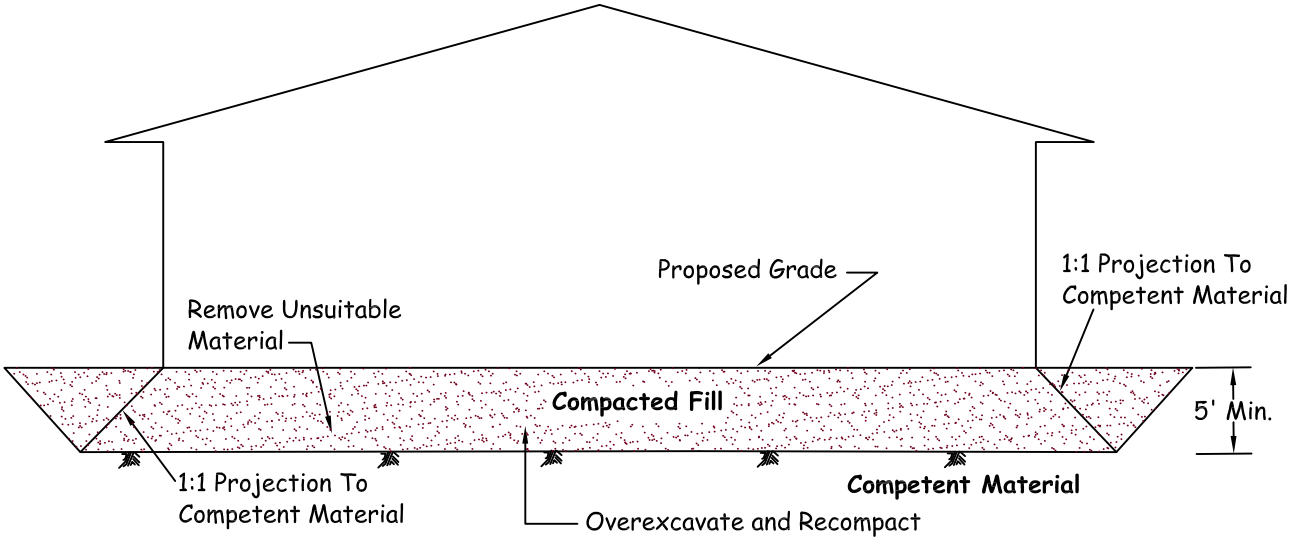
SUBDRAIN OUTLET MARKER DETAIL

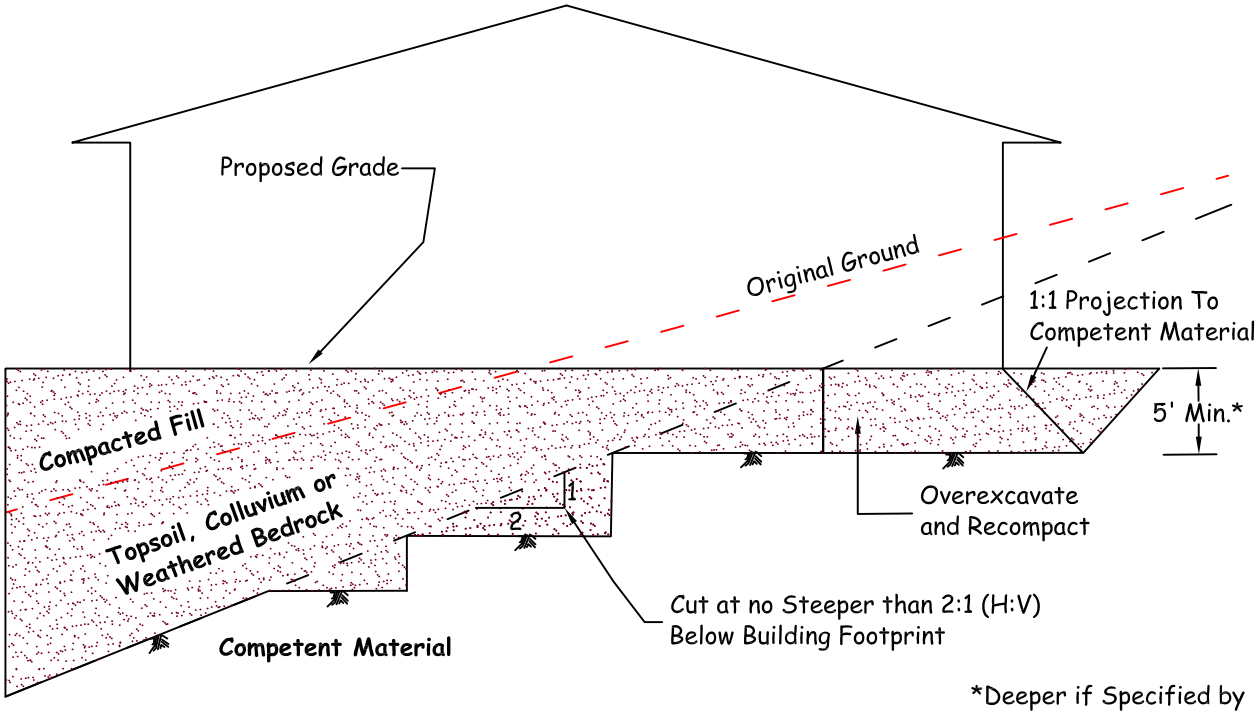
Cut Lot
(Exposing Unsuitable Soils at Design Grade)



Note 1: Removal Bottom Should be Graded With Minimum 2% Fall Towards Street or Other Suitable Area (as Determined by Soils Engineer) to Avoid Ponding Below Building

Note 2: Where Design Cut Lots are Excavated Entirely Into Competent Material, Overexcavation May Still be Required for Hard-Rock Conditions or for Materials With Variable Expansion Characteristics.

Cut/Fill Transition Lot



*Deeper if Specified by Soils Engineer

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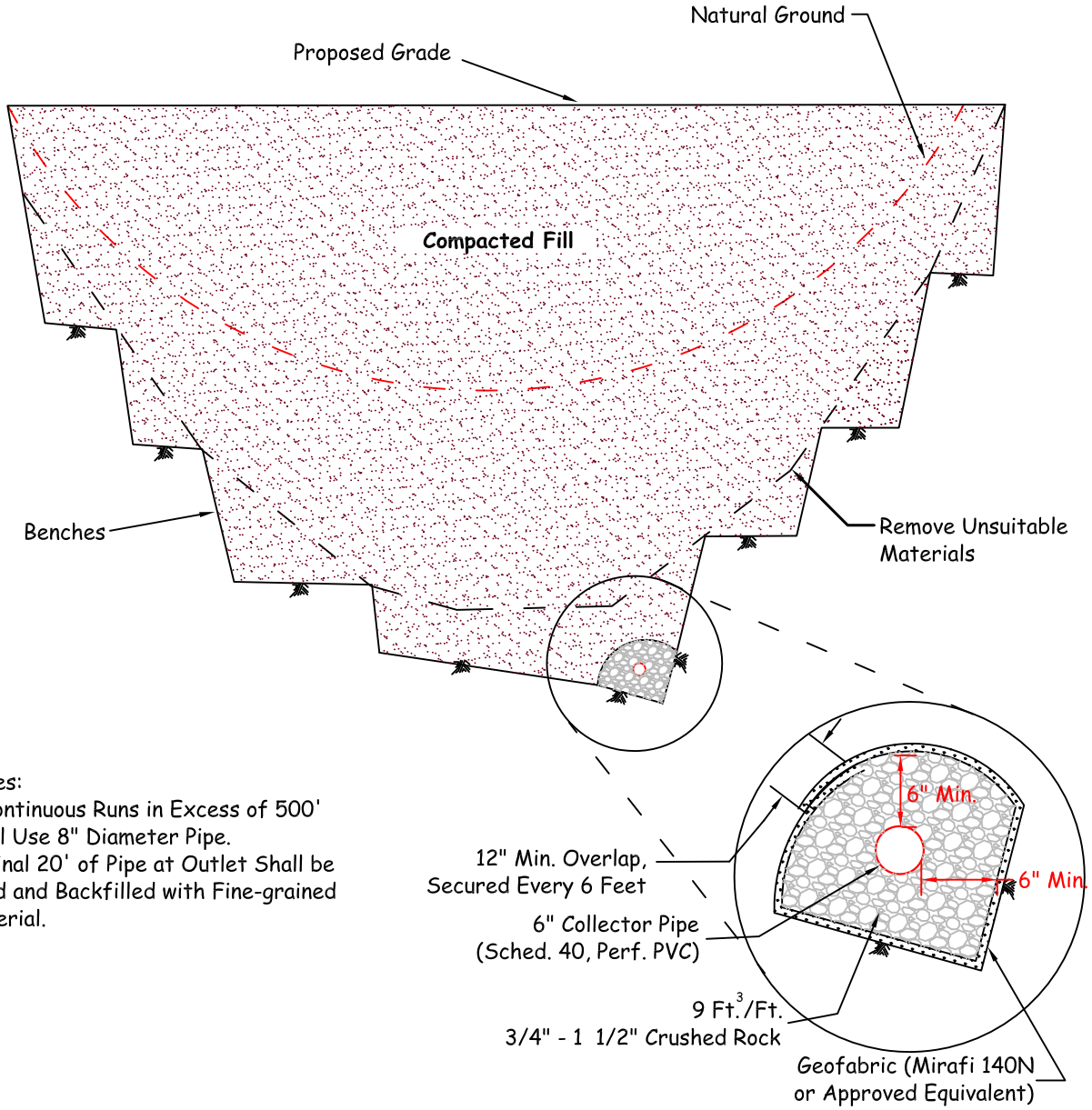
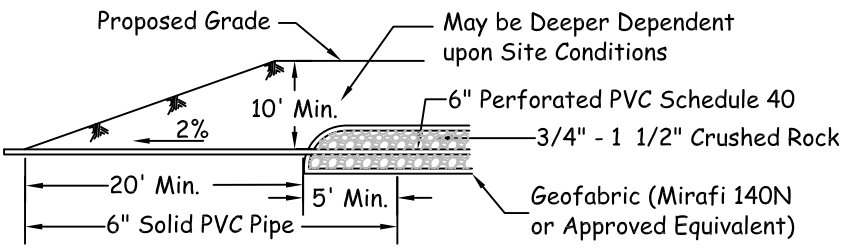
CUT AND TRANSITION LOT OVEREXCAVATION DETAIL



Notes:
1) Continuous Runs in Excess of 500' Shall Use 8" Diameter Pipe.
2) Final 20' of Pipe at Outlet Shall be Solid and Backfilled with Fine-grained Material.

Proposed Outlet Detail



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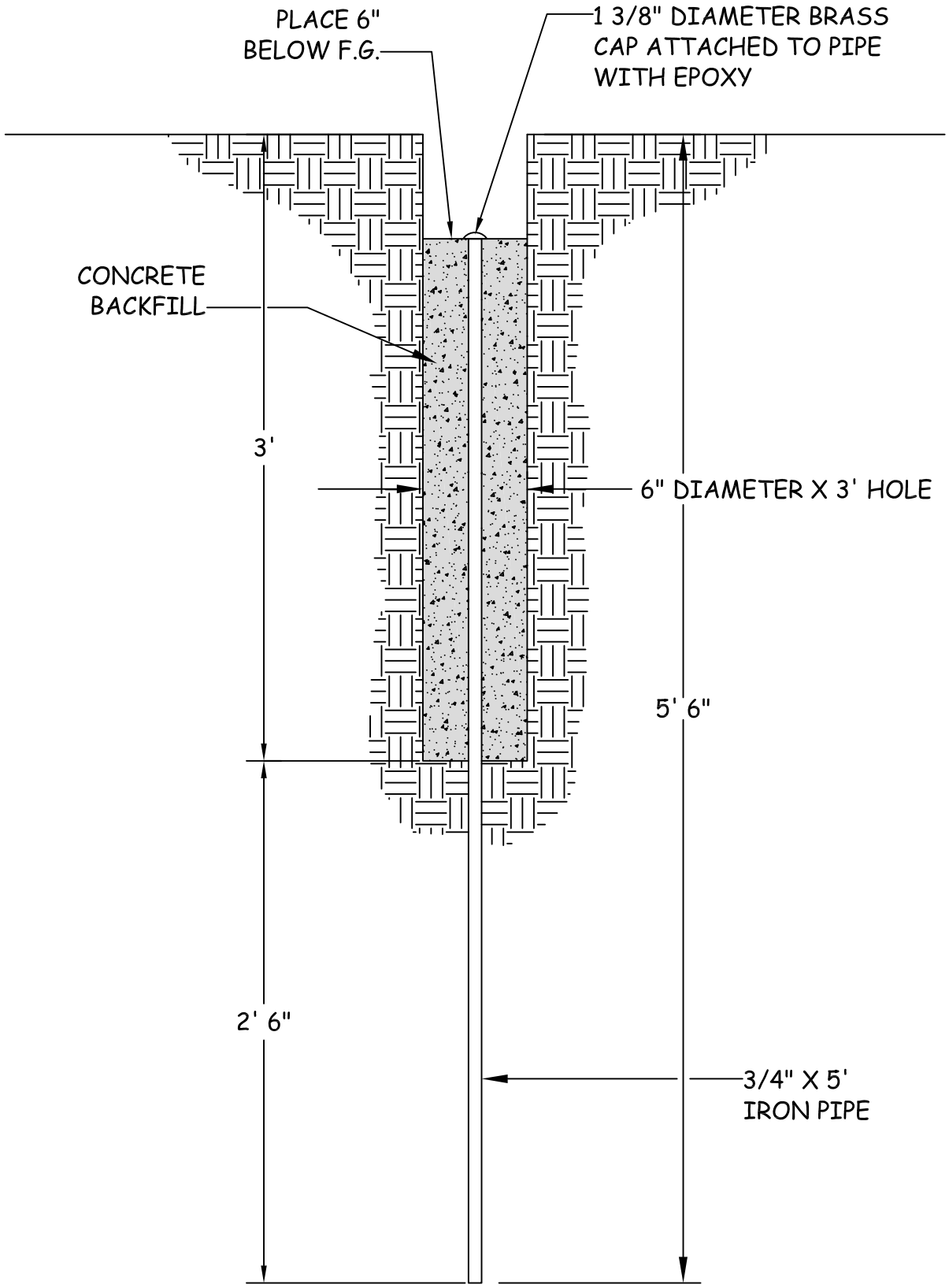
CANYON SUBDRAINS



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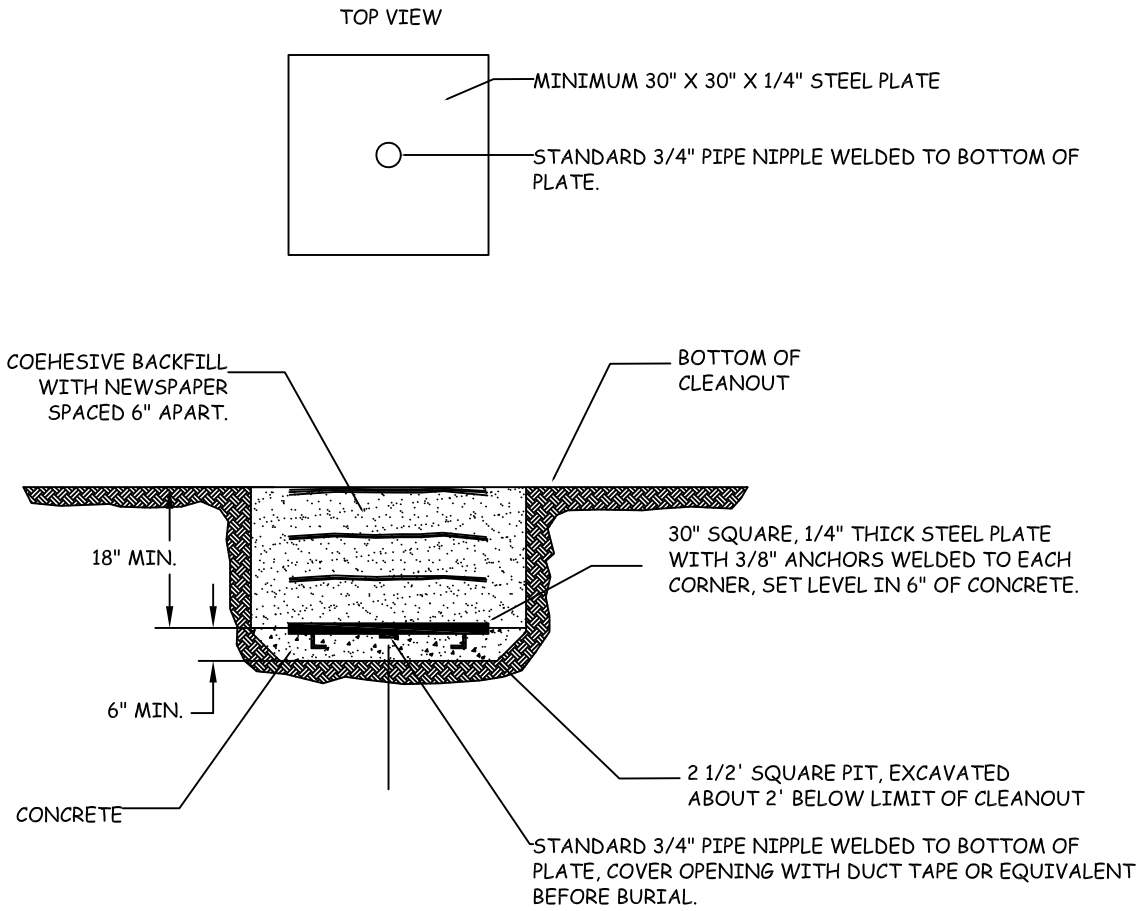
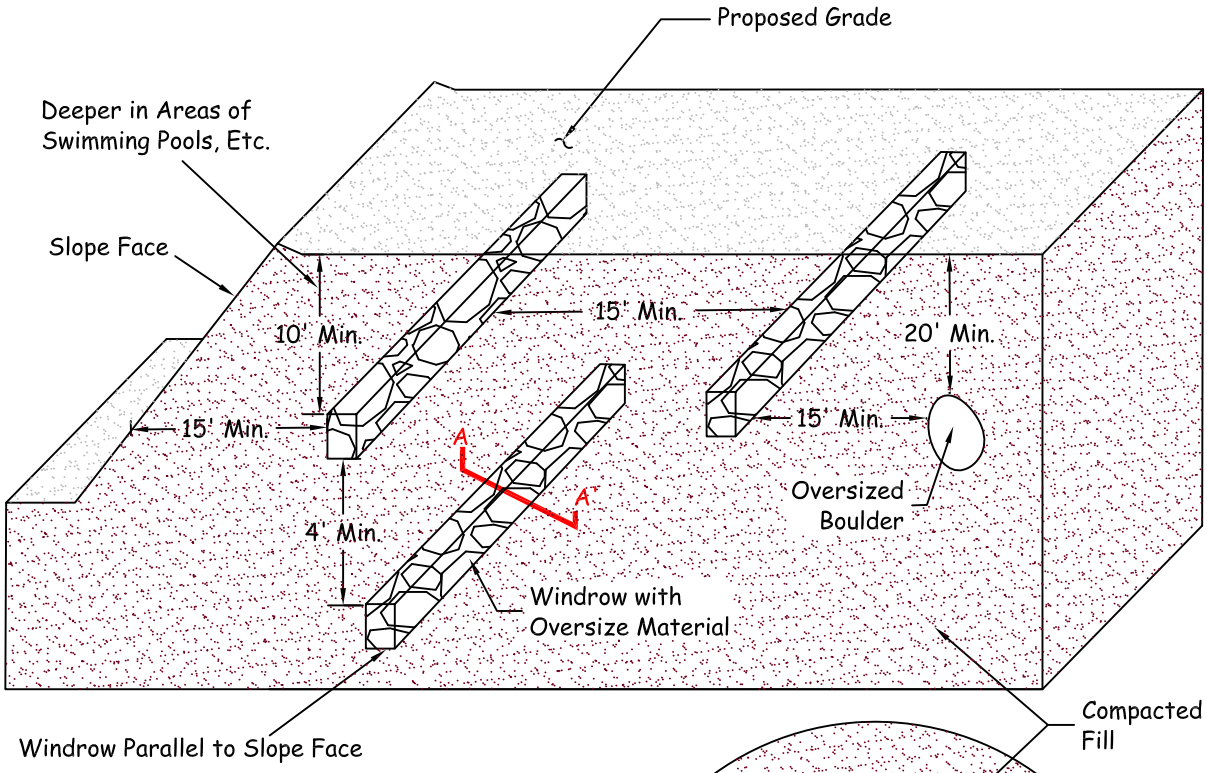
TYPICAL SURFACE SETTLEMENT MONUMENT

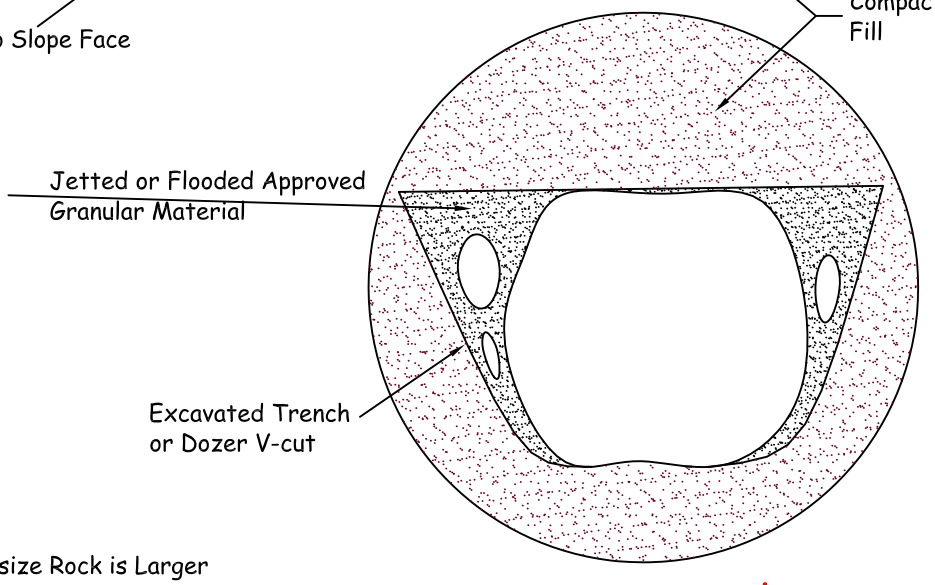


1. SURVEY FOR HORIZONTAL AND VERTICAL LOCATION TO NEAREST .01 INCH PRIOR TO BACKFILL USING KNOW LOCATIONS THAT WILL REMAIN INTACT DURING THE DURATION OF THE MONITORING PROGRAM. KNOW POINTS EXPLICITELY NOT ALLOWED ARE THOSE LOCATED ON FILL OR THAT WILL BE DESTROYED DURING GRADING.
2. IN THE EVENT OF DAMAGE TO SETTLEMENT PLATE DURING GRADING, CONTRACTOR SHALL IMMEDIATELY NOTIFY THE GEOTECHNICAL ENGINEER AND SHALL BE RESPONSIBLE FOR RESTORING THE SETTLEMENT PLATES TO WORKING ORDER.
3. DRILL TO RECOVER AND ATTACH RISER PIPE.

LGC Geotechnical, Inc.

TYPICAL SETTLEMENT PLATE AND RISER





Note: Oversize Rock is Larger than 8" in Maximum Dimension.

Section A-A'

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OVERSIZE ROCK DISPOSAL DETAIL