APPENDIX 9.5

GEOLOGY AND SOILS TECHNICAL REPORTS

UPDATE GEOTECHNICAL REPORT
TENTATIVE TRACT MAP NO. 35853
MURRIETA HILLS SPECIFIC PLAN
SOUTHWEST OF KELLER ROAD AND I-215
MURRIETA, CALIFORNIA

Prepared for

PULTE/BP MURRIETA HILLS, LLC
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Project No. 10642.001

March 21, 2014

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

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Project No. 10642.001

Pulte/BP Murrieta Hills, LLC
550 Laguna Drive, Suite B
Carlsbad, California 92008

Attention: Mr. Rick Robotta

Subject: Update Geotechnical Report for Tentative Tract Map No. 35853 Murrieta Hills Specific Plan, Southwest of Keller Road and Interstate 215, City of Murrieta, California

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has completed this update report for the proposed Murrieta Hills Specific Plan - Tentative Tract Map (TTM) No. 35853. The approximately 974-acre site is located in southwest of the intersection of Keller Road and Interstate 215 in the City if Murrieta, California (Figure 1).

This update report includes the relevant geotechnical data from our previous studies and should be considered as a stand-alone report for the subject site. Based on our review of provided TTM and current site conditions, it is our opinion that the subject site is suitable for the intended use provided the recommendations included in this report are implemented during design and construction.

The opportunity to be of continued service on this project is greatly appreciated. Please call the undersigned if you have any questions.

Respectfully submitted,

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1.0 INTRODUCTION

1.1 Purpose and Scope

Our scope of work for this update geotechnical report included the following:

- Review of published geologic maps and in-house geotechnical reports relevant to this site,
- Review of geotechnical issues such as areas of nonrippable rock, rockfall hazards, seepage, large cut slopes, etc., in view of the provided site plans (Pangaea, 2013),
- Preparation of a geo-referenced map (Plate 1) presenting the existing geotechnical data on the new site plans,
- Site reconnaissance to confirm/review current surficial geologic conditions,
- Update seismic design parameters in accordance with the 2013 CBC for use in continued development,
- Preparation of this report summarizing our findings, conclusions and recommendations.

Additional geotechnical evaluations or review will be required as site development and/or grading plans become available.

1.2 Site Location and Description

The project site is an approximately 974-acre rectangular shaped parcel located southwest of the intersection of Keller Road and Interstate 215 in the City of Murrieta, California. The site is bounded by Keller Road on the north, Interstate 215 on the east, the existing Greer Ranch residential development on the south, and undeveloped rural land on the west. The location and approximate limits of the subject site are depicted on the Site Location Map (Figure 1).

The majority of the site was vacant at the time of our site reconnaissance. Two large water storage tanks are located within the site adjacent to Keller Road. Topographically, the site consists of steep hillsides and ridges to the north and south, with a low-lying, northeast-trending valley in the central portion of the site. An active drainage channel runs northeast through the central valley. The northeastern corner of the site is relatively flat with a shallow slope to the northeast. Elevations vary from a high of approximately 2,270 feet above sea level (msl) in a western ridge top to a low elevation of approximately 1,570 feet (msl) at the northeastern corner of the property (Pangaea, 2013).

1.3 Proposed Development

Based on TTM No. 35853 (Pangaea, 2013), the proposed development may include approximately 700 detached and attached family residences, two new water storage tanks, a 16 acre mixed use commercial lot, park space, water quality basins and other associated site improvements including roadways and underground utilities. The proposed development area is located generally in the central and northeastern portions of the overall property (see Plate 1). The remainder of the site will remain vacant and undeveloped land.

Conventional cut and fill grading will be utilized to construct the graded pads and roadways. The maximum proposed cuts and fills are on the order of 80 and 35 feet, respectively. These slopes are proposed at a 2:1 (horizontal:vertical) inclination except for 1.5:1 cut slope proposed along the easterly access roadway with a maximum height of 60 feet.

We anticipate that the proposed residential buildings to typically consist of one- to two-story wood-frame structures. The foundation loads are not anticipated to exceed 2,000 pounds per lineal foot (plf) for continuous footings and 50 kips for column loads. The foundation design requirements for the commercial buildings and water tanks are unknown at this time. As such, future geotechnical evaluations should be anticipated as site development and/or grading plans become available.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Previous Investigations

Leighton conducted several geotechnical investigations for the subject site (Leighton, 1987, 1992, 1993 and 2008). Twenty-two soil borings, Fifty six exploratory test pits, 34 rotary percussion test holes (penetration rate) and seven fault trenches were excavated during those investigations. The borings extended up to 30 feet in depth and all terminated in granitic bedrock. The borings and test pits were logged and sampled by Leighton engineers and geologists. Seismic refraction studies and rotary percussion test holes were utilized to evaluate the subsurface rippability characteristics of the underlying bedrock. The results of these studies were reviewed and incorporated into this report. The logs of borings/test pit and other relevant data are included in Appendix A and presented on the Geotechnical Map (Plate 1).

2.2 Previous Laboratory Testing

Representative soil samples collected during Leighton's previous investigations were tested and analyzed. Laboratory testing included in-situ moisture and density, maximum dry density, consolidation potential, grain size distribution, direct shear strength, and Atterberg limits. The relevant laboratory test results are reproduced in Appendix B.

3.0 SUMMARY OF GEOTECHNICAL FINDINGS

3.1 Regional Geologic Setting

The subject property is located within a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. This province is characterized by steep, elongated ranges and valleys that generally trend northwestward. Tectonic activity along the numerous faults in the region has created the geomorphology present today.

Specifically, the property is situated in the southern portion of the Perris Block, a stable, eroded mass of Cretaceous and older crystalline and metamorphic rock. Thin sedimentary, metamorphic and volcanic units locally mantle the bedrock with alluvial deposits filling in the lower valley and drainage areas. The Perris Block is bounded by the San Jacinto fault zone to the northeast, the Elsinore fault zone to the southwest, the Cucamonga fault zone to the northwest and the poorly-defined northern boundary of the Temecula basin to the southeast. The Temecula segment of the active Elsinore Fault Zone is approximately 5 miles to the southwest of the site.

The subject site is located within the Paloma Valley ring complex, (Figure 2) which consists of a granodiorite ring dike and numerous younger pegmatitic ring dikes and stringers emplaced into the older gabbro (Morton, 2006).

3.2 Site Geologic Units

Our field observations and review of pertinent literature (see References) indicate that subsurface materials within the site are composed of undocumented artificial fill, surficial topsoil/colluvium, younger and older alluvium and granitic bedrock (see Plate 1) as further described below.

3.2.1 Undocumented Artificial Fill (Afu)

Undocumented artificial fill is observed in isolated areas, primarily in the central portion of the site. The fill is associated with dirt roadways and former building pads. The undocumented artificial fill generally consists of silty sand with scattered debris. All undocumented artificial fill is considered to be unsuitable for the support of additional fills or structural improvements.

3.2.2 Surficial Soils (not a mapped unit)

Deposits of topsoil and colluvium are present throughout the site. These deposits typically extend to 2 to 3 feet, but they can be locally thicker. As encountered in our test pits, colluvial soils in excess of 14 feet thick were locally encountered. These soils consist of relatively loose sand silt and silty sand and are considered to be unsuitable for the support of additional fills or structural improvements.

3.2.3 Young Alluvium (Qal)

Deposits of unconsolidated Holocene-age alluvium are present in the central drainage channel and in the relatively low-lying northeastern corner of the site. The alluvial deposits are typically less than 5 feet, but they may locally be up to approximately 15 feet in thickness. The young alluvium is considered to be unsuitable for the support of additional fills or structural improvements.

3.2.4 Older Alluvium (Qalo)

Local deposits of older (Late to Middle Pleistocene) alluvial deposits overlie the bedrock along the central drainage channel and in north-trending valley areas in the western portion of the site. The older alluvial deposits are typically thin and discontinuous, but may be locally up to approximately 15 feet in thickness. The older alluvium generally consists of medium dense to dense silty sand and contains some roots and gravels/cobbles. It is anticipated that most of the older alluvium will be unsuitable for support of additional fills or structural improvements in its current condition.

3.2.5 Granitic Bedrock (Kgr)

The Cretaceous-age granitic bedrock within the site includes gabbro, granodiorite, and granophyre (Morton, 2006). The granitic rock contains numerous planar dikes and sills of quartz and granite. All of the granitic units, described in the following paragraphs, are considered suitable for the support of compacted fills and structural improvements. When excavated, these units will generate silty sand with varying percentages and sizes of gravel, and boulders.

The bedrock in the majority of the site consists of gabbro varying from greenish-gray to dark gray in color and is typically fine-grained. Fracture and joint spacing are close in the gabbro, and weathering is moderate to deep. In general, the gabbro may be somewhat more rippable than the other onsite granitic rocks.

Granodiorite is exposed in the hills of the south-central portion of the site. The granodiorite is light gray in color, generally massive, fine- to medium-grained, and slightly to deeply weathered.

Granophyre, a fine-grained and porphyritic rock, is exposed in the north-central ridges of the site. The granophyre generally is light gray in color, but weathers to form reddish-brown outcrops. Numerous pegmatitic dikes and sills cut through the granophyre.

3.3 Soil Compressibility

Compressibility characteristics of the onsite soils were interpreted from measured blow counts, in-situ dry density and moisture, consolidation tests, and field observations during trenching. The surficial soils, young alluvium, and weathered older alluvium are considered relatively compressible and unsuitable for the support of additional fills or settlement-sensitive improvements. The mitigation for such geologic hazard is presented in Section 5 of this report.

3.4 Expansive Soils

Based on our previous explorations and on our experience with similar materials in the vicinity of the subject site, we anticipate the onsite soils will generally have a very low to low expansion index (Expansion Index ≤ 50 per ASTM D4829). Localized deposits of medium or higher expansive soils may be encountered during grading surficial soils and alluvium. Additional testing should be performed before or during grading to confirm the expansion potential of the soils. The mitigation for such geologic hazard is presented in Section 5.

3.5 Surface Water and Groundwater

Surface water is intermittently present in the central drainage channel. This flow should be expected to fluctuate seasonally and as a result of future irrigation run-off within the site. No other significant surface water features were observed during our investigation.

Groundwater was encountered in an abandoned water well located in the east central portion of the site at a depth of 7 feet, and in boring B-5 at a depth of 18 feet (Leighton, 1987b). Groundwater was also encountered at a depth of 6.5 feet in an exploratory fault trench located in the northwest portion of the site (Leighton, 1992). This shallow groundwater is attributed to a bedrock fault that acts as a groundwater barrier. The fractured and jointed bedrock serves as the aquifer within the property.

Based on our experience with similar sites in the vicinity of the subject site, we anticipate that perched groundwater will be encountered locally during site grading and underground utility construction, and in cut slope exposures, particularly during and after rainy seasons. Seepage from slope faces may occur after the establishment of routine irrigation. In hardrock areas, surface seepage may develop during periods of prolonged rainfall or irrigation.

3.6 Landslides/Debris Flow and Rockfalls

No evidence of on-site landslides/debris flow was observed during our field investigation or in review of California Geologic Survey landslide inventory maps (CGS, 2012). However, the potential for rockfall due to either erosion or seismic ground shaking is considered possible in limited areas along the elevated portions of the site where rock outcrops and exposed boulders are present. Based on our review of the tentative tract map (Pangaea, 2013), we anticipate that exposed boulders will remain on the northern and southern ridges after the completion of grading and will require mitigation. Based on the moderate steepness of the southern hillside and the low density of exposed boulders in that area, we do not anticipate a rockfall hazard along the southern boundary of the development area. The northern ridge has very steep topography and contains a large number of exposed boulders that may be subject to rockfall. The areas of anticipated rockfall hazard are depicted on the Geotechnical Map (Figure 1).

Remedial measures may include removal of boulders, securing boulders, debris catchment devices, and rock fences. If additional loose rocks are exposed during grading, removal, repositioning, embedment or stabilization may be needed to prevent rockfall. Methods to further mitigate the rockfall hazard should be based on further rock stability evaluation and review of rough grading plans.

3.7 Rippability and Excavation Characteristics

Rippability of the bedrock underlying the subject site was evaluated in previous studies (Leighton, 1992, 1999 and 2008). Based on our findings, non-rippable rock should be anticipated generally below depths ranging from 20 to 50 feet. Localized non-rippable rock will be encountered within 5 feet of the ground surface. Seismic refraction and rotary percussion drill data should be reviewed by the grading and excavation contractors (See Appendix A). Blasting or other rock excavation and reduction methods will likely be required in the deeper cut and exposed boulder outcrop areas. The deeper cut areas in the vicinity of air track boring AT-11 through AT-15, AT-17, AT-19 and AT-27 through AT-34, appear to be the most resistant rock encountered onsite. It is likely that cuts in these sample areas or other areas underlain by similar rocks will require blasting.

For excavations in hard rock, it is our experience that the followings factors, and combination thereof, determine production rates and dictate the need for blasting. These include: 1) fracture pattern and spacing; 2) frequency of solid boulders in decomposed matrix; 3) regularity or irregularity of rippable overburden; 4) equipment type and condition; and finally 5) skill of equipment operators. Also, a certain amount of overburden is required to effectively reduce the size of blasted rock to a reasonable size specification. Thus, in areas where rippable overburden is shallow, there may not be opportunities to conventionally excavate the overburden and blasting may be required at the surface.

In areas where heavy ripping or blasting is required for excavation, consideration should be given to undercutting street and pad areas. Discussion of these recommended undercuts are contained in section 5.1 of this report. Oversize rock will be generated during blasting/excavation. Oversize rock may be placed in deeper fill areas as outlined in Section 5.1.5 of this report.

3.8 Faulting

3.8.1 Regional Faulting

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

The subject site is not included within an Earthquake Fault Zone as created by the Alquist-Priolo Earthquake Fault Zoning Act (Hart, 2007). Additionally, the site is not within a County of Riverside Fault Hazard Zone (Riverside, 2004). The nearest zoned active faults are the Temecula segment of the Elsinore Fault Zone, located approximately 5.2 miles (8.3 km) southwest of the site, the Glen Ivy segment of the Elsinore Fault Zone, located approximately 9.3 miles (15.0 km) northwest of the site the San Jacinto Valley segment of the San Jacinto Fault Zone, approximately 17.0 miles (27.4 km) northeast of the site, and the Anza segment of the San Jacinto Fault Zone located approximately 17.7 miles (28.5 km) east of the site (Blake, 2000).

3.8.2 Site Specific Faulting

Several aerial photolineaments were mapped within the site during a previous investigation (Leighton, 1987). Fault trenches were excavated across suspect photolineaments and the suspect faulting was determined to be older than Holocene and, therefore, not active (Leighton, 1992).

3.9 Ground Shaking

Strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. This is common to virtually all of Southern California. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. The site-specific seismic coefficients based on the 2013 California Building Code (CBC) are provided in following table:

Table 1. 2013 CBC Site-Specific Seismic Coefficients

CBC Categorization/Coefficient		Value (g)
Site Longitude (decimal degrees)	-117.17570	
Site Latitude (decimal degrees)	33.62465	
Site Class Definition	**D**	
Mapped Spectral Response Acceleration at 0.2s Period, S_s		**1.64**
Mapped Spectral Response Acceleration at 1s Period, S_1		**0.71**
Short Period Site Coefficient at 0.2s Period, F_a		**1.0**
Long Period Site Coefficient at 1s Period, F_v		**1.5**
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}		**1.64**
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}		**1.06**
Design Spectral Response Acceleration at 0.2s Period, S_{DS}		***1.1***
Design Spectral Response Acceleration at 1s Period, S_{D1}		***0.71***

* g- Gravity acceleration

3.10 Secondary Seismic Hazards

Secondary seismic hazards generally associated with severe ground shaking during an earthquake include ground rupture, lurching, ridgetop shatter, landsliding and rockfall, liquefaction and dynamic settlement, and flooding due to seiches and tsunamis. These hazards are discussed in the following sections.

3.10.1 Ground Rupture

Ground rupture is generally considered most likely to occur along pre-existing active faults. Based on our review of available maps and the conclusions of previous investigations, there are no known active faults within the site. The potential for ground rupture is considered very low for the subject site.

3.10.2 Lurching

Soil lurching refers to the rolling motion on the ground surface by the passage of seismic surface waves. Effects of this nature are likely to be most severe where the thickness of soft sediments varies appreciably under structures. The potential for lurching can be reduced if the potentially compressible soils present on the site are removed and properly compacted in accordance with the recommendations of this report.

3.10.3 Ridgetop Shatter

The focused effects of strong ground shaking during earthquakes can result in the shattering of certain geologic deposits where they form elevated ridges. Given the distance of the site from known active fault zones, and the granitic bedrock in the onsite ridgetop areas, the risk of ridgetop shatter at the site is considered to be low. Furthermore, and most significantly, the currently proposed area of development does not include the ridgetop areas.

3.10.4 Landsliding and Rockfall

Ground shaking during earthquakes can result in landsliding on natural slopes. No evidence of existing landslides was observed during our field mapping or during the previous field investigations of the subject site.

Numerous outcrops of granitic boulders are perched on the topographically elevated areas of the site to the north and south of the proposed development area. Strong seismic shaking or nonseismic factors, such as erosion, could cause some rocks to become dislodged and fall or roll, creating a rockfall hazard. As discussed in Section 3.6, the risk of rockfall is considered low on the southern slopes and significant on the northern slopes. The area of anticipated rockfall hazard is indicated on the Geotechnical Map (Plate 1).

3.10.5 Liquefaction and Dynamic Settlement

Liquefaction of cohesionless soils can be caused by strong vibratory motion due to earthquakes. Research and historical data indicate that loose granular soils below a near-surface groundwater table are most susceptible to liquefaction, while the stability of most clayey material is not adversely affected by vibratory motion. Liquefaction is characterized by a loss of shear strength in the affected soil layers, thereby causing the soil to behave as a viscous liquid. When insufficient confining overburden is present, liquefaction may be manifested at the ground surface by settlement or sand boils. In order for the potential effects of liquefaction to be manifested at the ground surface, the soils generally have to be granular, loose to medium dense, saturated relatively near the ground surface and must be subjected to a sufficient magnitude and duration of ground shaking.

The subject site contains undocumented fills of granular soils and alluvial soil deposits. Assuming that the loose soils will be removed and recompacted in accordance with the recommendations of Section 5.0 of this report, it is our opinion the potential for liquefaction due to the design earthquake event to affect structures at this site is low.

Ground accelerations generated from a seismic event can produce settlements in sands or granular earth materials both above and below the water table. Assuming unsuitable shallow soil will be removed and recompacted in accordance with the recommendations provided in this report, total post construction dynamic settlement (dry sand settlement) due to the design earthquake is anticipated to be on the order of 1 inch or less with a differential settlement of ½ inch in a 40-foot horizontal distance.

3.10.6 Flooding

The site is not within a flood plain and potential for flooding is considered low for this site. However, in the event of strong persistent inclement weather, some local flooding could occur along the slopes of the adjacent hillsides.

3.10.7 Seiches and Tsunamis

Due to the inland location and distance from major bodies of water, the site is not at significant risk from seiches or tsunamis.

4.0 CONCLUSIONS

It is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations presented herein are incorporated into the design and construction phases of development. The following is a summary of the major geotechnical constraints or opportunities associated with this site:

- The site contains undocumented artificial fills, surficial soils, young alluvium, and weathered older alluvium that are potentially compressible, Thus, these materials should be removed and compacted beneath structural improvements or prior to placing any additional fills.
- The onsite soils are geotechnically suitable for re-use as compacted fill during proposed grading, provided they are relatively free of organic matter, other deleterious material or oversize rock fragments.
- Onsite near surface soils are anticipated to generally be very low to low expansive. Medium or higher expansive soils may be encountered in localized deposits.
- The shallow soils and upper 5 to 20 feet of bedrock in most areas of the site can be excavated with heavy-duty conventional grading equipment in good working condition.
- Nonrippable rock may be encountered in cuts deeper than 5 to 20 feet. A significant amount of oversized rock will be generated from the bedrock cuts.
- Groundwater was encountered in localized areas. Perched groundwater may be encountered locally during grading and utility construction. Seepage may occur after grading.
- Evidence of active faulting was not identified within the subject site.
- The liquefaction potential is considered very low for this site.
- 2:1 cut and fill slopes are proposed to maximum heights of approximately 80 and 35 feet, respectively. Steeper cut slopes (up to 1.5:1) may be acceptable in the less weathered onsite rock provided further field verification and evaluation are performed.
- Cut slopes excavated in younger or older alluvium is considered unstable and should be constructed as a replacement fill as depicted in Appendix D.
- Localized rock fill hazards, exist onsite and mitigation methods should be further evaluated.
- The sites of the two domestic water tanks are generally suitable form a geotechnical point of view. Additional site specific studies of each tank site should be performed when design details are known.

5.0 PRELIMINARY RECOMMENDATIONS

5.1 General

The proposed development is considered feasible from a geotechnical viewpoint provided our recommendations included in this report are implemented during design and construction phases of development. However, these recommendations should be further evaluated based on site-specific development plans and prevailing geologic conditions during construction.

5.2 Earthwork Considerations

Earthwork should be performed in accordance with the General Earthwork and Grading Specifications included in Appendix D and as per the following recommendations. The recommendations contained in Appendix D, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix D. The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly in accordance with the recommendations of this report and the specifications in Appendix D, notwithstanding the Leighton's testing and observation. Additional site specific evaluation of the proposed water tank sites should be performed when the specific design is determined.

5.2.1 Site Preparation and Removal

Prior to grading, the proposed structural improvement areas (i.e. all-structural fill areas, pavement areas, buildings, tank pads, etc.) of the site should be cleared of surface and subsurface obstructions and organic material. Heavy vegetation, roots, and debris should be disposed of offsite. Septic tanks and cesspools, if encountered, should be removed or abandoned in accordance with the local regulations. Voids created by removal of buried material should be backfilled with properly compacted soil in general accordance with the recommendations of this report.

The near surface soils comprised of undocumented artificial fill, surficial soils, young alluvium, low density older alluvium, and highly weathered bedrock are considered unsuitable for structural fill or foundation support and should be removed to expose competent material as determined by the geotechnical consultant during grading. After removal of unsuitable materials, the excavated soils may be cleared of organic matter and other deleterious material, and re-used as compacted fill.

Competent material is considered to be generally non-porous, dense, undisturbed older alluvium with minimum of 85 percent relative compaction (based on ASTM D1557) or dense granitic bedrock. All removal bottoms should be reviewed and approved by the geotechnical consultant. The removal bottom elevations, methodology of testing older alluvium and test results of left-in-place older alluvium should be documented in the as-graded geotechnical report.

The remedial removal depths will vary with location and with the proposed site configuration. The removal depths are generally expected to range from approximately 3 to 5 feet below existing grade over most of the site. Deeper removals, up to approximately 15 feet, or locally deeper, will be required in areas of deep younger/older alluvium.

The removal limit should be established by a 1:1 projection from the edge of fill soils downward and outward to competent material identified by Leighton. Removals will also include benching into competent material as the fills rise. Areas adjacent to existing structures, including roadways, may require special monitoring. Temporary slopes in these areas should be no steeper than 1:1 (horizontal:vertical). Friable materials, if encountered, may require additional layback.

After completion of the recommended removal and prior to placing additional fill, the approved surface should be scarified a minimum of 8 inches, moisture conditioned and compacted.

5.2.2 Cut/Fill Transition Lots

In order to mitigate the impact of underlying cut/fill transition conditions, we recommend overexcavation of the cut portion of transition lots. Overexcavation should extend to a minimum depth of 3 feet below the bottom of the proposed footings or one-half of the maximum fill thickness beneath the building pad, whichever is deeper. This overexcavation does not include scarification or preprocessing prior to placement of fill. Overexcavation bottoms should be sloped minimum two (2) percent away from the lot to allow for subsurface drainage as needed to prevent the accumulation of subsurface water.

5.2.3 Cut Lots and Streets

We recommend that cut lots be overexcavated to a depth of 3 feet below the bottom of the proposed footings and then capped with compacted fill. The bottom of the overexcavation should be sloped at minimum 2 percent or as needed toward the streets to allow for subsurface drainage.

Furthermore, to facilitate utility construction in cut or shallow fill areas, we recommend that streets be overexcavated to a depth of 1 foot below the deepest utility during rough grading and then brought back up to design grades with compacted fill containing rocks fragments no greater than 8 inches in diameter. The street pavement area should be overexcavated to a minimum of 12 inches below the street design subgrade elevation and replaced with compacted fill.

5.2.4 Structural Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris and organic matter. Rocks over 12 inches in maximum dimension may be placed within the compacted fill in accordance with the recommendations in Section 5.2.5. Utility area fill zones (pads and street overexcavation areas) should be relatively free of rocks greater than 8 inches.

Areas to receive structural fill and/or other surface improvements should be scarified to a minimum depth of 8 inches, moisture conditioned to at least optimum moisture content, and compacted. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and at near or above optimum moisture content. Fill soils placed at depths over 50 feet below finish grade should be compacted to a minimum of 95 percent relative compaction and at or above optimum moisture content.

Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of Leighton. 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 thickness.

Fill slope keyways will be necessary at the toe of all fill slopes and at fill-over-cut contacts. Keyway schematics, including dimensions and subdrain recommendations, are provided in Appendix D of this report. All keyways should be excavated into dense bedrock or dense alluvium as determined by Leighton. The cut portions of all slope and keyway excavations should be geologically mapped and approved by a geologist prior to fill placement.

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix F for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times.

Fill slopes should be overbuilt a minimum of 2 feet and trimmed back to the compacted core. In areas where overbuilding is not practical, slope faces may be compacted by rolling with weighted sheepsfoot compaction rollers as the fill slope height increases in maximum 5 foot increments.

5.2.5 Oversize Rock

Based on our observations, we anticipate that grading of the subject site will produce a significant amount of oversized rock (greater than 12 inches in maximum dimension). No rock in excess of 12 inches in maximum dimension should be placed in any fill within 10 feet of finish grade without review by Leighton and approval by the local regulatory agency. Oversized rock may be placed in fills deeper than 10 feet below finish grade, if placed in accordance with the following guidelines and the specifications contained in Appendix D.

Within the upper 5 feet of finish pad grade or utility overexcavation zones, fill soils should not contain rock greater than 6 inches in maximum dimension in order to facilitate foundation construction, utility trench excavation and compaction procedures. For fill soils between 5 and 10 feet below finish pad grade or below utilities, the fill may contain rock up to 12 inches in maximum dimension if mixed with sufficient soil to eliminate voids. Below a depth of 10 feet (or deeper utility), rocks up to a maximum dimension of 36 inches may be incorporated into the fill provided adequate fines to fill all voids are present. Rocks greater than 36 inches in diameter may be placed on a case-by-case basis, if encountered.

We anticipate that a minimum of approximately 35 to 40 percent by volume of coarse grained material will be necessary to adequately fill all voids in rock fills. Soil used to fill voids in rock fills should be flooded during placement with a sufficient amount of water to wash soil into all voids. Material filling voids should be compacted to a minimum of 90 percent of the soil's maximum dry density. The outer 20 feet (10 feet vertically) of all fill slopes should not contain rocks greater than 12 inches. Subdrains should be provided at the base of all rock fills to minimize the potential for a build-up of hydrostatic pressure.

Oversized rock may also be placed on the surface in ungraded areas. Rocks placed on the surface should be embedded or nested, as needed, to prevent a rockfall hazard.

Rock fills are inherently more difficult to place and test than non-rock containing fills. Adequate equipment and time must be provided to allow the geotechnical consultant the ability to observe, test and document the rock fill placement and compaction. The grading contractor should consider the amount of available rock disposal volume afforded by the design when establishing blast pattern, excavation techniques and grading logistics. Rock placement techniques should be provided to and approved by the geotechnical consultant prior to implementation.

5.2.6 Import Soils

Import soils if needed, and/or the borrow site should be evaluated by Leighton prior to importation. Import soils should be granular in nature, free of organic material, have very low to low expansion potential, have a minimum R-value of 30, and have a low corrosion impact to the proposed improvements.

5.2.7 Trench Excavations and Backfill

The onsite soils are generally suitable as trench backfill provided they are screened of rocks over 6 inches in diameter (or per governing agency requirements) and organic matter. Trench backfill should be compacted in uniform lifts (not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (ASTM Test Method D1557).

Excavation of utility trenches should be performed in accordance with the project plans, specifications, and all applicable OSHA requirements. The contractor should be responsible for providing the "competent person" required by OSHA standards. Contractors should be advised that sandy soils (such as native site alluvium and future fills generated from the onsite alluvium and bedrock) could make excavations particularly unsafe, even if all safety precautions are taken. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavations and construction equipment should be kept away from the sides of the trenches.

5.3 Shrinkage and Bulking

The volume change of excavated onsite materials upon recompaction is expected to vary with materials, density, insitu moisture content, location, and compaction effort. The in-place and compacted densities of soil materials vary and accurate overall determination of shrinkage and bulking cannot be made. Therefore, we recommend site grading include, if possible, a balance area or ability to adjust import quantities to accommodate some variation. Based on in situ density characteristics of soil samples and our experience with similar materials, the following values are provided as guidelines.

Table 2. Shrinkage/Bulking Factor (%)

Earthwork Shrinkage and Bulking Estimates	
Geologic Unit	**Estimated Shrinkage**
Undocumented Fill	5 to 15 percent shrinkage
Topsoil/colluvium/Young Alluvium	10 to 15 percent shrinkage
Older Alluvium	0 to 10 percent shrinkage
Granitic Bedrock (rippable)	0 to 10 percent bulking
Granitic Bedrock (nonrippable)	10 to 20 percent bulking

In addition, we recommend that a surface subsidence value of 0.1 foot be applied to topographic elevations in most areas underlain by topsoil/granite bedrock. In alluvial areas subjected to agricultural disking, a subsidence value of 0.25 feet should be applied.

5.4 Preliminary Foundation Design

5.4.1 Bearing and Lateral Pressures

Based on our analysis, the proposed single-family residential structures may be founded on conventional foundation systems based on a Plasticity Index of 15 and the design parameters provided below. The proposed foundations and slabs should be designed in accordance with the structural consultants' design, the minimum geotechnical recommendations presented herein, and the applicable CBC. In utilizing the minimum geotechnical foundation recommendations, the structural consultant should design the foundation system to acceptable deflection criteria as determined by the architect. Foundation footings may be designed with the following geotechnical design parameters:

- Allowable Bearing Capacity:	2,000 psf at a minimum depth of embedment of 12 inches (minimum width of 12 inches). This bearing capacity may be increased by ⅓ for short-term loading conditions (e.g., wind, seismic).
- Sliding Coefficient:	0.35
- Total Settlement:	1 inches (including static and seismic)
- Differential Settlement:	0.5 inch in 40 feet horizontal distance

The footing width, depth, reinforcement, slab reinforcement, and the slab-on-grade thickness should be designed by the structural consultant based on recommendations and soil characteristics indicated herein.

5.4.2 Vapor Retarder

It has been a standard of care to install a moisture retarder underneath all slabs where moisture condensation is undesirable. Moisture vapor retarders may retard but not totally eliminate moisture vapor movement from the underlying soils up through the slabs. Moisture vapor transmission may be additionally reduced by use of concrete additives. Leighton does not practice in the field of moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/

firm be engaged/consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person/firm should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate. The slab subgrade soils should be well wetted prior to placing concrete.

5.5 Settlement Considerations

Fill thickness on the project site is expected to range from 5 feet to approximately 35 feet. Remedial earthwork will increase this to approximately 45 to 50 feet. Compressibility of properly placed compacted fills and underlying granitic bedrock is anticipated to be relatively low. We recommend that the planned residential buildings be designed in anticipation of up to 2 inches of total static settlement with one inch of static differential settlement across a lateral distance of 40 feet (1/480 angular distortion). The majority of the static settlement associated with the building loads (elastic compression) is anticipated to occur during construction as building/fill load is applied. Earthquake-induced settlements are estimated to be less than one inch (total) and ½ inch in 40 lateral feet (differential). When available, the rough grading plans should be reviewed by Leighton with regard to anticipated settlement.

5.6 Footing Setback

We recommend a minimum horizontal setback distance from the face of slopes for all structural footings (retaining and decorative walls, building footings, etc.). This distance is measured from the outside bottom edge of the footing horizontally to the slope face (or to the face of a retaining wall) and should be a minimum of H/2, where H is the slope height (in feet). The setback should not be less than 7 feet and need not be greater than 15 feet.

Soils within the structural setback area may possess poor lateral stability. Improvements such as retaining walls, pools, decks, sidewalks, fences, or pavements constructed within this setback area may be subject to lateral movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a pier and grade-beam foundation system to support the improvement. The deepened footing should meet the setback as described above.

5.7 Slope Stability

A generalized stability analysis was performed for the proposed 2:1 (horizontal:vertical) cut and fill slopes based on the previous tentative tract map (Appendix C). The cut and fill slopes were generally higher than what is currently proposed (be up to 111 feet in height). Based on our analysis, the proposed slopes are anticipated to be grossly stable for both static and pseudostatic loading conditions. Slopes up to 1.5:1 may be considered stable when excavated into the onsite granitic bedrock pending further review and evaluation during construction or when rough-grading plans become available.

Slope faces are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability.

5.7.1 Cut Slopes

As indicated previously in this report, the excavation of cut slopes in gabbro or granodiorite may require localized heavy ripping and /or blasting for efficient excavation. Slopes cut into gabbro or granodiorite may likely daylight natural joints, fractures or partings whose orientations with respect to the slope face could possibly adversely affect the stability of the slope in the form of seismically induced rock falls, wedge failures, slides or slumps.

Susceptibility to the above geometric failure modes will be greatly affected by the degree of weathering along joint or fracture surfaces. Our observations of onsite exposures indicate that weathering and clay development along joint surfaces is minor to locally moderate. However, each cut slope should be evaluated during grading. Adverse conditions could possibly require the construction of a stabilization fill, buttress or possibly rock bolting.

Recognizing the mass grading and possible blasting aspects of site development, it is possible that surface boulders may be dislodged or that shot portions of cut areas may become displaced along joint sets or foliations. During seismic loading (i.e. earthquakes) these conditions could be problematic and result in boulder or rock falls. During grading, geologic observation will be required to identify potential boulder and rock fall areas that may be created by site grading. This condition may include dislodgment of surface boulders or removal of locally intensely fractured zones prone to seismically induced failure. Rock bolting or other suitable measures such as debris catchment are also possible mitigations.

The most common slope stabilization method is a stabilization fill. Stabilization fills require a minimum key dimension of fifteen (15) feet wide by two (2) feet deep in to competent bedrock at the toe. Larger key dimensions will be required where slope heights and field conditions dictate. The excavation of keyways may require blasting. Final determination as to slope remediation measures should be evaluated on a case by case basis during grading. Drains should be provided as per Appendix D.

Cut slopes up to a 1.5:1 (horizontal to vertical) inclinations are feasible in the less weathered gabbro or granodiorite provided each slope is evaluated on a case-by-case basis and slopes are not exceeding 30 feet in height. Less weathered gabbro or granodiorite are generally those rocks which are massive and expose no adverse geologic conditions.

5.7.2 Fill Slopes

Based on our review of the site plans, fills slopes are designed for inclinations of 2:1 or flatter to vertical heights of up to 78 feet. Fill slopes constructed of properly compacted onsite materials are considered grossly stable to the heights proposed.

5.7.3 Fill-Over-Cut Slopes

Prior to filling, the cut portion of the slope should be observed by the soil engineer or engineering geologist to confirm that the underlying material is sound and capable of supporting the fill. If unsuitable materials are encountered, it will be necessary to overexcavate the cut portion and replace it with compacted fill. Overexcavations may require blasting for efficient excavation and to achieve the required keyway widths.

Where the underlying material is capable of supporting the fill, a fill key of at least one equipment width and tilted into the slope with at least one (1) foot differential shall be constructed prior to fill placement (see Appendix D). This may entail blasting in areas of hard rock exposures. All surficial soils and other loose, soft materials must be removed prior to fill placement. Whenever possible, back drains should be provided at the fill key heel for the fill-over-cut slope (see Appendix D).

5.7.4 Fill Slopes over Natural Ground

Fill slopes should be keyed and benched into natural ground as depicted in Appendix D. Removals and ground preparation should follow the recommendations presented in Section 5.2 of this report. Keyways should be at least 15 feet, or one half of the slope height in width. It is possible that rock excavation may require blasting or other methods to achieve the necessary keyway width and inclination (tilt) back into the slope. Backdrains may be recommended at the keyway heel and the need will be based on field conditions.

5.8 Natural Slopes

It is our opinion that the natural slopes located on the subdivision boundaries are grossly stable. Our preliminary review indicates that surficial stability will be minimally impacted by the proposed grading.

However, it is possible that natural slopes containing thick colluvial soils could present a potential for erosion, localized surficial slumping and possible debris flows. Mitigation measures may include the construction of catchment ditches or debris fences

5.9 Lateral Earth Pressures

Retaining wall earth pressures are a function of the amount of wall yielding horizontally under load. If the wall can yield enough to mobilize full shear strength of backfill soils, then the wall can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance. Retaining walls backfilled with non-expansive soils should be designed using the following equivalent fluid pressures:

Table 3. Retaining Wall Design Earth Pressures (Static, Drained)

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	35	50
At-Rest	50	80
Passive*	300	150 (2:1, sloping down)

* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,000 psf at depth. If sloping down (2:1) grades exist in front of walls, then they should be designed using passive values reduced to ½ of level backfill passive resistance values.

Unrestrained (yielding) cantilever walls should be designed for the active equivalent-fluid weight value provided above for very low to low expansive soils that are free draining. In the design of walls restrained from movement at the top (non-yielding) such as basement or elevator pit/utility vaults, the at-rest equivalent fluid weight value should be used. Total depth of retained earth for design of cantilever walls should be measured as the vertical distance below the ground surface measured at the wall face for stem design, or measured at the heel of the footing for overturning and sliding calculations. Should a sloping backfill other than a 2:1 (horizontal:vertical) be constructed above the wall (or a backfill is loaded by an adjacent surcharge load), the equivalent fluid weight values provided above should be re-evaluated on an individual case basis by us. Non-standard wall designs should also be reviewed by us prior to construction to check that the proper soil parameters have been incorporated into the wall design.

All retaining walls should be provided with appropriate drainage. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated in Appendix E, *Retaining Wall Backfill and Subdrain Detail*. Wall backfill should be non-expansive (EI $\leq$ 21) sands compacted by mechanical methods to a minimum of 90 percent relative compaction (ASTM D 1557). Clayey site soils should not be used as wall backfill. Walls should not be backfilled until wall concrete attains the 28-day compressive strength and/or as determined by the Structural Engineer that the wall is structurally capable of supporting backfill. Lightweight compaction equipment should be used, unless otherwise approved by the Structural Engineer.

5.10 Site Drainage and Erosion Control

All drainage should be directed away from structures by means of approved permanent or temporary drainage devices. Adequate storm drainage should be provided to avoid siltation of any temporary catch basins. Linear sandbagging of the pads tangential to flow directions in periodic intervals, should reduce erosion potential of runoff over these pads.

In general, ponding of water should be avoided adjacent to the structures or pavements. For preliminary planning purposes, positive drainage may be accomplished by providing a minimum 2 percent gradient away from the structures for a distance of at least 5 feet. Protective measures to mitigate excessive site erosion and runoff during construction should also be implemented in accordance with the local grading ordinances.

5.11 Soil Corrosivity

Factors contributing to soil corrosivity commonly include soluble sulfate and chloride concentrations, soil pH, and minimum soil resistivity. Soluble sulfates may cause corrosion of concrete in contact with the soil. High chloride levels tend to reduce soil resistivity and break down otherwise protective surface deposits, which can result in corrosion of buried steel or reinforced concrete structures. Low minimum resistivity and or high soil pH indicate a potential for corrosion to buried metal conduits or other metal improvements.

Soil corrosivity testing was not conducted during the previous or current investigations. Based on Leighton's experience with similar geologic units, we anticipate that the onsite soils likely possess a negligible concentration of soluble sulfates and a relatively neutral soil pH. Elevated chloride concentrations may be encountered. Minimum soil resistivity is likely to be low enough to create a severe potential for corrosion to exposed metal.

Site-specific soil corrosivity testing should be performed prior to construction of the proposed site improvements. A corrosion engineer should be consulted to review the soil corrosion potential and provide specific recommendations if corrosion sensitive materials are to be used.

5.12 Preliminary Pavement Design Parameters

In order to provide the following preliminary recommendations, we have assumed an R-value of 35 for preliminary design purposes. These recommendations are intended for planning purposes only and should not supersede minimum City or County requirements. For the final pavement design, appropriate traffic indices should be selected by the project civil engineer or traffic engineering consultant and representative samples of actual subgrade materials should be tested for R-value.

Table 4. Preliminary Pavement Design

Traffic Index	*AC Pavement Section Thickness*	
	Asphaltic-Concrete (AC) Thickness (inches)	Aggregate Base (AB) Thickness (inches)
4.5 to 5	3.0	4
5.5 to 6	3.5	6
6.5 to 7	4.0	7

The subgrade soils in the upper 6 inches should be properly compacted to at least 95 percent relative compaction (ASTM D1557) and should be moisture-conditioned to near optimum and kept in this condition until the pavement section is constructed. Proof-rolling subgrade to identify localized areas of yielding subgrade (if any) should be performed prior to placement of aggregate base and under the observation of the geotechnical consultant.

Minimum relative compaction requirements for aggregate base should be 95 percent of the maximum laboratory density as determined by ASTM D1557. Base rock should conform to the "Standard Specifications for Public Works Construction" (green book) current edition or Caltrans Class 2 aggregate base having a minimum R-value of 78. Asphaltic concrete should be placed on compacted aggregate base and compacted to a minimum 95 percent relative compaction based on the laboratory standards ASTM D1561 and D2726.

The preliminary pavement sections provided in this section are meant as minimum, if thinner or highly variable pavement sections are constructed, increased maintenance and repair may be needed.

6.0 GEOTECHNICAL REVIEW

Geotechnical review is of paramount importance in engineering practice. Poor performances of many foundation and earthwork projects have been attributed to inadequate construction review. We recommend that Leighton be provided the opportunity to review the grading plan and foundation plan(s) prior to bid.

Reasonably-continuous construction observation and review during site grading and foundation installation allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction. Geotechnical conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction, and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site demolition and clearing,
- During preparation and overexcavation of surface soils as described herein,
- During compaction of all fill materials,
- After excavation of all footings, and prior to placement of concrete,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

Additional geotechnical exploration and analysis may be required based on final development plans, for reasons such as significant changes in proposed structure locations/footprints. We should review grading (civil) and foundation (structural) plans, and comment further on geotechnical aspects of this project.

7.0 LIMITATIONS

This report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is necessarily incomplete. The nature of many sites is such that differing characteristics can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time. This investigation was performed with the understanding that the subject site is proposed for residential development only.

This report was prepared for Pulte/BP Murrieta Hills, LLC based on Pulte/BP Murrieta Hills, LLC's needs, directions, and requirements. This report is not authorized for use by, and is not to be relied upon by any party except Pulte/BP Murrieta Hills, LLC and its successors and assigns as owner of the property, with whom Leighton and Associates, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton and Associates, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton and Associates, Inc.

The client is referred to Appendix E regarding important information provided by the Associated Soil and Foundation Engineers (ASFE) on geotechnical engineering studies and reports and their applicability.

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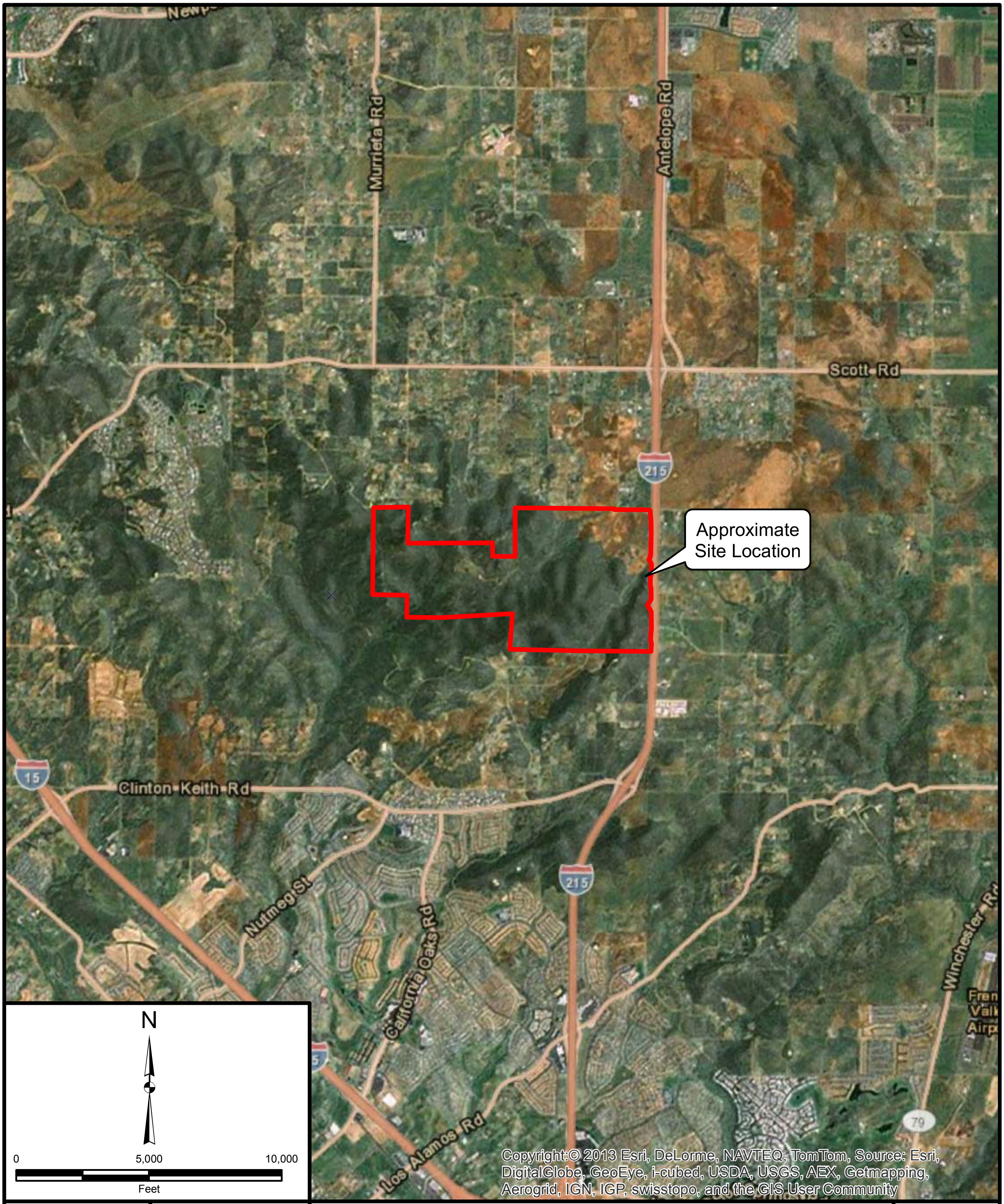

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Project: 10642.001

Eng/Geol: SIS/RFR

Scale:1 " = 5,000 '

Date: March 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

SITE LOCATION MAP

Murieta Hills
Murrieta, California

Figure 1

Leighton

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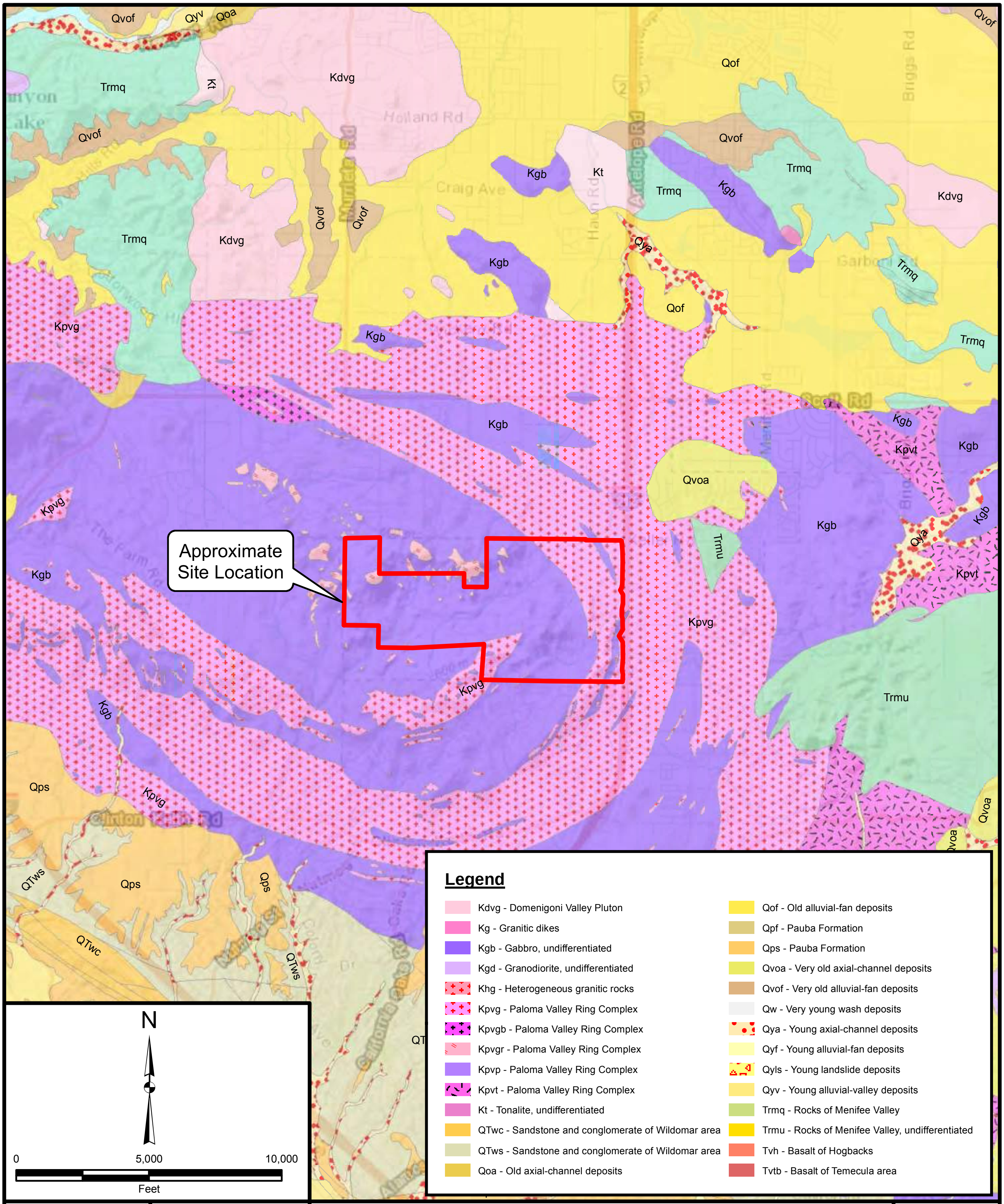

Project: 10642.001
Eng/Geol: SIS/RFR
Scale:1 " = 5,000 '
Date: March 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton
Author: Leighton Geomatics (mmurphy)

REGIONAL GEOLOGY MAP

Murieta Hills
Murrieta, California

Figure 2

Leighton

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LEGEND

NOTE:
GEOLOGIC FEATURES ON THIS MAP ARE ADAPTED FROM A PREVIOUS GEOTECHNICAL REPORT (LEIGHTON, 1992) AND CURRENT LIMITED EXPLORATION.

Afu	ARTIFICIAL FILL
Qal	QUATERNARY ALLUVIUM
Qoal	OLDER ALLUVIUM
Kg	CRETACIOUS GRANITICS
54	STRIKE AND DIP OF FOLIATION
17	STRIKE AND DIP OF JOINT
— — —	APPROXIMATE LOCATION OF GEOLOGIC CONTACT
S-4	APPROXIMATE LOCATION SEISMIC REFRACTION LINE (LEIGHTON 1987,b)
SL-5	APPROXIMATE LOCATION SEISMIC REFRACTION LINE (LEIGHTON 1992)
L-1	APPROXIMATE LOCATION SEISMIC REFRACTION LINE (LEIGHTON 1999)
LINE 8	APPROXIMATE LOCATION SEISMIC REFRACTION LINE (LEIGHTON, 2008)
TP-40	APPROXIMATE LOCATION OF TEST PIT (LEIGHTON, 2008)
T-16	APPROXIMATE LOCATION OF TEST PIT (LOGS DATED 7/20/87) (LEIGHTON 1987a)
T-8	APPROXIMATE LOCATION OF TEST PIT (LOGS DATED 10/29/87) (LEIGHTON 1987b)
T-7	APPROXIMATE LOCATION OF TEST PIT (LEIGHTON 1993)
B-8 ◐	APPROXIMATE LOCATION OF BORING (LEIGHTON 1987a)
B-6	APPROXIMATE LOCATION OF BORING (LEIGHTON 1987b)
B-8 ⊕	APPROXIMATE LOCATION OF BORING (LEIGHTON 1992)
AT-34 ⊙	APPROXIMATE LOCATION OF ROTARY PERCUSSION TEST HOLES (LEIGHTON, 2008)

PLATE 1

GEOTECHNICAL MAP
MURRIETA HILLS
MURRIETA, CALIFORNIA

Leighton

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APPENDIX A

Geotechnical Boring, Rotary Percussion Test Drilling Logs, Test Pit and Seismic Refraction Survey Data

Boring Logs B1-B8 Leighton, 1987a

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 1 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1764'± Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by CK Sampled by CK
0	OLDER ALLUVIUM (Qoal)			21 49	130	5	SM	SILTY SAND: Dark yellowish brown *(10 yr. 4/4), fine to medium grained, moderately damp, porous, rootlets, blocky soil structure, moderately dense to dense.
5	GRANITICS (Kgr)			50 for 3" no recovery				DECOMPOSED GRANITE: Varigated white, orange, gray, black, fine to medium grained, slightly moist, micaceous, dense, highly weathered (WH), well decomposed, massive,
10				50 for 4"				
15				40 50 for 5'				At 15 feet vertical joint, caliche present along fracture.
				50 for 4"				
20								TOTAL DEPTH 20.5' NO GROUND WATER MODERATE DRILLING NO CAVING HOLE BACKFILLED
25								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 2 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1668'± Ref. or Datum

Logged by CK

Sampled by CK

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	OLDER ALLUVIUM (Qoal)			14 24	116	12	SM	SILTY SAND: Dark reddish brown, *(5 yr 3/4), fine to coarse grained, moderately moist, poorly sorted, moderately cohesive, minor clay, moderately dense.
5	GRANITICS(Kgr)		Bag	23 50	121	8		DECOMPOSED GRANITE: Varigated yellow, gray, black, fine to medium grained, slightly moist, completely weathered (WC), massive. At 4 feet becoming completely decomposed, moderately dense. At 8 feet becoming moderately weathered (WM). Refusal at 10 feet.
				50 for 3" no recovery				
10								TOTAL DEPTH 10' NO GROUND WATER MODERATE TO HARD DRILLING NO CAVING HOLE BACKFILLED
15								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 3 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1591'± Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by CK Sampled by CK
0	ALLUVIUM (Qal)		Bag	10 16	124	6	SM	SILTY SAND: Dark brown *(7.5 yr 3/2), fine to medium grained, moist, cohesive, trace of clay, slightly sorted, loose.
5	GRANITICS (Kgr)			21 50 for 1"	134	4	SW-SM	DECOMPOSED GRANITE: Varigated yellow, gray, black, fine to medium grained, slightly moist, micaceous, massive, highly weathered (WH), well decomposed, darks to 50%, amorphous fabric form, dense.
				50 for 5½"				At 8 feet becoming fine to coarse grained,
10								
15				50 for 2½"				At 15 feet darks to 70%.
20				50 for 2½"				
								TOTAL DEPTH 20.5' NO GROUND WATER MODERATE DRILLING NO CAVING HOLE BACKFILLED

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 4 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1573'± Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by CK Sampled by CK
0	ALLUVIUM (Qal)						SM	SILTY SAND: Dark brown *(7.5 yr 3.5/4), fine to medium grained, moist, poorly sorted, loose, slightly cohesive, trace of rootlets.
			Bag	4 9	107	9		
								At 4 feet becoming fine to coarse grained, slightly dense.
5				6 11	102	6		
	GRANITICS (Kgr)			50 for 6"	127	7		DECOMPOSED GRANITE: Varigated yellow to black, fine to medium grained, moderately moist, abundant mica, highly weathered (WH), well decomposed, fractures present, platy fabric form.
10								
				50 for 3"				
15				50 for 5"				
								At 18 feet becoming moderately weathered, moderately decomposed, hard,
20								
								Refusal at 22 feet. TOTAL DEPTH 22' NO GROUND WATER HARD DRILLING BELOW 15 feet HOLE BACKFILLED
25								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 5 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1605'± Ref. or Datum

Logged by CK

Sampled by CK

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	TOPSOIL						SM	SILTY SAND: Dark reddish brown, *(5 yr 3/4), fine to medium grained, moist, poorly sorted, trace of rootlets, slightly dense.
			■	50 for 5½"	107	6		
	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated yellow to black, fine to medium grained, moist, abundant mica, dense, highly weathered, well decomposed, closely placed joints.
5			⊠	20 23 21				At 5 feet highly fractured with abundant CaCO³,
10		GS	⊠	50 for 6"				
15			⊠	50 for 5"				At 15 feet becoming 75%
		▼						Ground water at 18 feet. Drill rig is bogging down,
20			⊠	50 for 6"				Refusal at 21½ feet.
								TOTAL DEPTH 21.5' GROUND WATER AT 18' MODERATE TO HARD DRILLING HOLE BACKFILLED
25								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 6 Sheet 1 of 1 -
Project Rose Hills Job No. 6870318-02
Drilling Co. Datum Exploration Type of Rig CME-75
Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.
Elevation Top of Hole 1634'± Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by CK Sampled by CK
0	TOPSOIL						SM	SILTY SAND: Dark brown *(7.5 yr 3/2), fine to coarse grained, moist, poorly sorted, trace of clay, slightly cohesive.
	GRANITICS (Kgr)			36 50	123	9		
5				24 18 15				DECOMPOSED GRANITE: Varigated yellow, orange, gray, black, fine to medium grained, moist, micaceous, CaCo^{3} present, highly weathered (WH), well decomposed, massive.
10				26 50				
								Slightly easier drilling 12 to 14 feet.
15				26 50 for 4"				
20				33 33 37				
25				11 17 29				At 25 feet mottled buff to olive gray, wet. At 26 feet becoming moderately weathered(WM) moderately decomposed. Refusal @ 27 feet.
								TOTAL DEPTH 27' MODERATE TO HARD DRILLING NO GROUND WATER HOLE BACKFILLED
30								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 7 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1656'± Ref. or Datum

Logged by CK

Sampled by CK

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Dark brown, *(10 yr. 3/3), fine to medium grained, moist, poorly sorted, micaceous, slightly dense, blocky soil structure.
				5 9	116	9		
5				9 12	126	8		
	GRANITICS (Kgr)		Bag	50 for 6"	114	6		DECOMPOSED GRANITE: Varigated orange, gray, black, fine to medium grained, moderately damp, micaceous, fractured, highly weathered(WH), well decomposed, amorphous fabric form, refusal at 9 feet.
10								TOTAL DEPTH 9' NO GROUND WATER MODERATE TO HARD DRILLING HOLE BACKFILLED
15								

GEOTECHNICAL BORING LOG

Date 7-21-87 Drill Hole No. B - 8 Sheet 1 of 1 -

Project Rose Hills Job No. 6870318-02

Drilling Co. Datum Exploration Type of Rig CME-75

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole Ref. or Datum

Depth Feet	Graphic Log	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by CK Sampled by CK
0	OLDER ALLUVIUM (Qoal)							SILTY SAND: Dark yellowish brown, *(10 yr 4/4), fine to coarse grained, moist, slightly cohesive, slightly dense, at 2 feet becoming dark reddish brown *(5 yr 3/4), blocky soil structure, occasional pores. Passing #200 sieve=37% At 4 feet becoming very poorly sorted, trace of fine gravels, silt is minor. At 5 feet becoming moderately dense. At 7 feet slightly mottled gray to brown, dense.
			Bag	8 15	108 (84)	7	SM	
				9 17	113	4		
5		CP GS SE=21		19 29	116	3		
				25 42	115	9		
10	GRANITICS (Kgr)			26 40	115	9		DECOMPOSED GRANITE: Varigated yellow, olive gray, black, fine to medium grained, moderately damp, micaceous, highly weathered (WH), well decomposed, moderately fractured, dense. Hard drilling below 10 feet. Refusal at 12 feet. TOTAL DEPTH 12' NO GROUND WATER MODERATE TO HARD DRILLING HOLE BACKFILLED
15								

Boring Logs B1-B6 Leighton, 1987b

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-1 Sheet 1 of 1

Project Rosehills Job No. 6870318-03

Drilling Co. 2-R Drilling Type of Rig CME-55

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1865'± Ref. or Datum Map

Depth Feet	EARTH MATERIAL	TYPE OF TEST	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Medium reddish brown, micaceous, dense, massive, nonporous, dry, with trace of clay.
				9/22				
5	GRANITICS (Kgr)			13/23				GRANITICS: Buff to tan, micaceous, moderately decomposed, dry, moderately hard, massive.
10								TOTAL DEPTH 10' NO GROUND WATER HARD DRILLING NO CAVING HOLE BACKFILLED
15								
20								
25								
30								

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-2 Sheet 1 of 1-

Project Rosehills Job No. 6870318-03

Drilling Co. 2-R Drilling Type of Rig CME-55

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1900'± Ref. or Datum Map

Depth Feet	EARTH MATERIAL	TYPE OF TEST	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0								
	OLDER ALLUVIUM (Qoal)	CP		14/18	115 (86)	8	SM	SILTY SAND: Medium reddish brown, slightly damp, massive, moderately dense, micaceous.
5				16/21				
	GRANITICS (Kgr)							GRANITICS: Tan to light buff, dry, highly decomposed, drill easily, slightly jointed.
10				18/32				
15				27/35				Drilling harder. @ 15', Buff to off-white, micaceous, slightly jointed, moderately weathered, dry, produces fine to coarse grained sands when drilled, >10% dark minerals and slightly oxidized.
20								
25								TOTAL DEPTH 25' NO GROUND WATER HARD DRILLING NO CAVING HOLE BACKFILLED
30								

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-3 Sheet 1 of 1-

Project Rosehills Job No. 6870318-03

Drilling Co. 2-R Drilling Type of Rig CME-55

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1838'± Ref. or Datum Map

Depth Feet	EARTH MATERIALS	TYPE OF TEST	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0	ALLUVIUM (Qal)						SM	SILTY SAND: Medium reddish brown, fine to coarse grained, massive, slightly damp.
	GRANITICS (Kgr)		▨	17/38				GRANITICS: Buff to light tan, micaceous, hard to very hard, produces angular cobbles diameter when drilled, highly weathered, decomposed.
5			■	15/24				
10			■	37/50	per	4"		@ 10', Off-white, peppered, slightly mottled, very hard, micaceous, dry, slightly weathered, slightly jointed, makes fine to coarse grained sand when drilled.
			▨					
15								
20			■	31/50	per	5"		@ 20', Off-white, peppered with dark mica, very hard, slightly jointed, dry, slightly weathered.
25								TOTAL DEPTH 30' NO GROUND WATER ENCOUNTERED HARD DRILLING NO CAVING HOLE BACKFILLED
30								

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-4 Sheet 1 of 1-
Project Rosehills Job No. 6870318-03
Drilling Co. 2-R Drilling Type of Rig CME-55
Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.
Elevation Top of Hole 1824'± Ref. or Datum Map

Depth Feet	EARTH MATERIAL	TYPE OF TEST	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0	ALLUVIUM (Qal)						SM	SILTY SAND: Light reddish brown, very moist, micaceous, massive, moderately dense to loose.
	GRANITICS (Kgr)			11/19				GRANITICS: Flesh to buff, peppered with mica, moderately weathered, massive, easy to drill, dry, decomposed.
5				23/44				
								@ 6', Off-white and black, massive, hard, moderately decomposed, damp, very hard to drill.
10								
15								@ 15', producing cobbles to 1" in diameter and coarse sands.
20								Refusal @ 21'
25								TOTAL DEPTH 21' NO GROUND WATER VERY HARD DRILLING NO CAVING HOLE BACKFILLED
30								

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-5 Sheet 1 of 1-

Project Rosehills Job No. 6870318-03

Drilling Co. 2-R Drilling Type of Rig CME-55

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1877'± Ref. or Datum Map

Depth Feet	EARTH MATERIAL	TYPE OF TEST	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0	COLLUVIUM (Qcol)			21/37			SM	SILTY SAND: Reddish brown to dark brown, sticky, massive, nonporous to slightly porous, dense, moist, trace of clay.
	GRANITICS (Kgr)	CP						GRANITICS: Buff to off-white, micaceous, hard massive, dry, decomposed, hard to drill.
5								
10								
15								
20								TOTAL DEPTH 20' NO GROUND WATER HARD DRILLING NO CAVING HOLE BACKFILLED
25								
30								

GEOTECHNICAL BORING LOG

Date 11/3/87 Drill Hole No. B-6 Sheet 1 of 1-

Project Rosehills Job No. 6870318-03

Drilling Co. 2-R Drilling Type of Rig CME-55

Hole Diameter 8" Drive Weight 140 lbs. Drop 30 in.

Elevation Top of Hole 1858'± Ref. or Datum Map

Depth Feet			Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged by RLA Sampled by RLA
0	COLLUVIUM (Qcol)	CP					SM	SILTY SAND: Medium reddish brown, nonporous, loose, moist and massive, rootlets to 2", trace of clay.
				21/27				GRANITICS: Buff and black, micaceous, soft to firm, moderately decomposed, massive, dry, easily drilled.
5	GRANITICS (Kgr)			16/29	115	13		
10								
15								
20								TOTAL DEPTH 20' NO GROUND WATER EASY DRILLING NO CAVING HOLE BACKFILLED
25								
30								

500A (2/77)

Leighton & Associates

Boring Logs B1-B8 Leighton, 1992

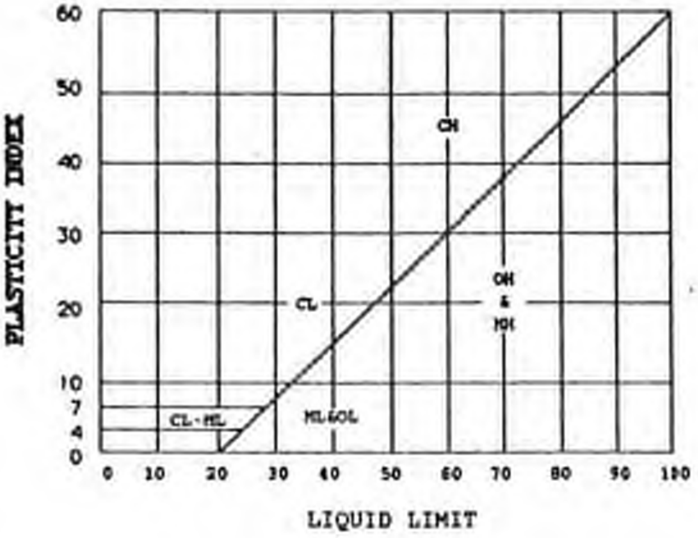
MAJOR DIVISIONS		SYMBOLS	TYPICAL NAMES
COARSE-GRAINED SOILS (More than 1/2 of soil > no. 200 sieve)	GRAVELS (More than 1/2 of coarse fraction > no. 4 sieve size)	GW	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than 1/2 of coarse fraction < no. 4 sieve size)	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than 1/2 of soil < no. 200 sieve)	SILTS & CLAYS LL < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	Organic silts and organic silty clays of low plasticity
	SILTS & CLAYS LL > 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic clays of medium to high plasticity, organic silty clays, organic silts
	HIGHLY ORGANIC SOILS	Pt	Peat and other highly organic soils

CLASSIFICATION CHART

(UNIFIED SOIL CLASSIFICATION SYSTEM)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDERS	ABOVE 12"	ABOVE 305
COBBLES	12" to 3"	305 to 76.2
GRAVEL	3" to No. 4	76.2 to 4.76
COARSE	3" to 3/4"	76.2 to 19.1
FINE	3/4" to No. 4	19.1 to 4.76
SAND	No. 4 to 200	4.76 to 0.074
COARSE	No. 4 to 10	4.76 to 2.00
MEDIUM	No. 10 to 40	2.00 to 0.420
FINE	No. 40 to 200	0.420 to 0.074
SILT & CLAY	BELOW No. 200	BELOW 0.074

GRAIN SIZE CHART



PLASTICITY CHART

METHOD OF SOIL CLASSIFICATION	Project No. 6870318-06 Project Name Murrieta Hills

2080 389

KEY FOR GEOTECHNICAL LOGS

LABORATORY TESTS

GS - GRAIN SIZE ANALYSIS

AL - ATTERBERG LIMITS

SE - SAND EQUIVALENT

EI - EXPANSION INDEX

CP - MAXIMUM DENSITY/OPTIMUM MOISTURE

CN - CONSOLIDATION

DS - DIRECT SHEAR

RS - REMOLDED SHEAR

SF - SULFATE CONTENT

RV - R-VALUE

C - CHEMICAL TESTS

NR - NO RECOVERY

STANDARD PENETRATION TEST (SPT)			
Cohesive Soils		Cohesionless Soils	
Consistency	Blow Counts (N)	Density	Blow Counts (N)
Very Soft	<2	Very Loose	<4
Soft	2-4	Loose	4-10
Medium Stiff	4-8	Medium Dense	10-30
Stiff	8-15	Dense	30-50
Very Stiff	15-30	Very Dense	>50
Hard	>30		

The above table is based on "Soil Mechanics in Engineering Practice", by Karl Terzaghi and Ralph B. Peck, dated 1967

NOTE: Blow counts recorded on the boring logs and Log of Test Boring Sheets with Sample Type "S" designation (Split Spoon Sampler) are SPT numbers. Blow counts with Sample Type "D" (Drive Sampler) are actual field values and have not been converted to SPT values.

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/8/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-1
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1760.000 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1760						**TOPSOIL** @0', Light brown SILT, dry, stiff.				
		R	1	50/3"		No Recovery					
							DECOMPOSED GRANITICS (Dg) @3', Light olive-brown, 1/4" to 1/2" gravelly very fine to fine SANDY SILT, dry, very dense.				
5	1755	S	1	50/3"							
							NOTES: Total Depth at 6.5' No Ground Water Caved to 3' Backfilled on 10/8/92				

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

GW WHILE DRILLING
GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/7/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-2
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1650.000 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1650	R	1	29			**TOPSOIL** @0', Dark brown SILT with some (40%) fine SAND, dry, stiff, abundant rootlets, some (25%) pinhole porosity.	7	110		
		S	1	70		Bulk Sample B-1 from 2'-7'	**DECOMPOSED GRANITICS (Dg)** @2', Gray, very fine SANDY SILT, dry, very dense.				
5	1645	R	2	62/6"		No Recovery					
		S	2	50/1"		No Recovery	Slow drilling.				
10	1640	S	3	50/1"		No Recovery					

NOTES:
Total Depth at 11.5'
No Ground Water
Caved to 5'
Backfilled on 10/7/92

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-3
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1520.000 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1520	R	1	36		Bulk Sample B-1 from 0'-1'	**TOPSOIL** @0', Reddish-brown, very fine SANDY SILT, dry, stiff, rare rootlets.	4	127		
		S	1	86							
							DECOMPOSED GRANITICS (Dg) @3', Light olive-brown SILTY very fine SAND, dry, very dense.				
5	1515	R	2	57/6"				1	123		
							Moderate drilling.				
		S	2	64/6"			@7', Same as at 3', except SILTY very fine to fine SAND with trace (2%) of medium sand.				
10	1510	R	3	50/2"							
							NOTES: Total Depth at 11' No Ground Water Caving to 5' Backfilled on 10/8/92				

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV *
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-4
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1800.000 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1800	R	1	34			**OLDER ALLUVIUM (Qoal)** @0', Reddish-brown, very fine CLAYEY SAND, dry, stiff, tract (10%) pinhole porosity, coarsening with depth to fine to medium SANDY SILT with tract (15%) coarse sand, rare rootlets.	5	123		
		R	2	54			@2', Reddish-brown SILTY fine to coarse SAND, occasional (1%) 1/2" cobbles, dry, very dense.	6	121		
5	1795	S	1	23			**DECOMPOSED GRANITICS (Dg)** @5', Olive-brown SILTY with some (30-35%) very fine SAND, damp, medium dense. Very slow drilling.	16	110		
		R	3	72			@7', Olive-brown SILT with some (20%) very fine SAND, moist, hard, abundant orangish-brown oxidation, abundant calcium carbonate stringers.				
						Bulk Sample B-1 from 9'-15'					
10	1790	S	2	19			Gradational contact. @10.5', Orangish- to reddish-brown, very fine SANDY SILT, moist, very stiff. @12', Brown to olive-brown SILT with tract (2%) of very fine SAND, tract (10%) clay.				
15	1785	S	3	21		Bulk Sample B-2 from 15'-21'					
20	1780	R	4	50/3"			@20', Same as at 12', except SILTY fine to medium SAND.	7	125		
25	1775	S	4	50			@25', Yellowish-reddish-brown, very fine to very coarse SANDY SILT, moist, very dense.				
							NOTES: Total Depth at 26.5' No Ground Water Caved to 10' Backfilled on 10/8/92				

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

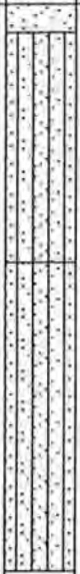
GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-5
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1840.000 ±
DROP (IN) 30



DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1840	S	1	18			**CHANNEL DEPOSITS** @0', Brown, medium to very coarse SAND, dry, loose. **ALLUVIUM (Qal)** @0.5', Reddish-brown SILTY very fine SAND, dry, hard, occasional rootlets.				
		R	1	50/3"			Percent Passing No. 200 Sieve = 39.				
5	1835	S	2	53/6"		Bulk Sample B-1 from 5'-10'	**DECOMPOSED GRANITICS (Dg)** @5', Light tan SILT with trace (5%) of medium SAND, dry, very dense.				
		R	2	50/1"		No Recovery	Very slow.				
10	1830	S	3	30/0"		No Recovery					

NOTES:
Total Depth at 11'
No Ground Water
Caved to 5'
Backfilled on 10/8/92

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

GW WHILE DRILLING
GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-6
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1890.00 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1890						**TOPSOIL** @0', Reddish-brown SILTY fine SAND with some (25%) clay, dry, loose, occasional rootlets.				
		S	1	72			**DECOMPOSED GRANITICS (Dg)** @2', Light tan, fine to medium SAND with SILT (15%), dry, dense. Slow drilling.				
5	1885	R	1	54/6"				4	105		
		S	2	20/0"		No Recovery					
							NOTES: Total Depth at 8.5' No Ground Water Caved to 3' Backfilled on 10/8/92				

SAMPLE TYPES:

C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 1 OF 2

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/8/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-7
STATION
OFFSET (FT)
GROUND ELEV. (FT) ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
		R	1	50			**OLDER ALLUVIUM (Qoal)** @0', Brown SILT with trace (5%) of medium SAND and CLAY, dry, hard.	4	115		
		S	1	17			Percent Passing No. 200 Sieve = 50.				
						Bulk Sample B-1 from 3'-7'					
5		R	2	77							
		S	2	22			**DECOMPOSED GRANITICS (Dg)** @7', Olive-brown SILT, moist, stiff, trace (5%) of oxidation staining.				
10		R	3	50			@10', Same as at 7', except CLAYEY very fine SAND. Slow drilling.	14	117		
15		S	3	22							
20		R	4	50/5"			@20', Whitish-brown, fine to medium SAND, damp, dense.	5	128		
25		S	4	26			@25', Olive-brown CLAYEY SILT with some (25%) SAND very moist, stiff.				
		S	5	50/4"			@28', Blackish-olive-brown, SILTY very fine SAND, dry, very dense. Practical refusal @ 28'.				

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 2 OF 2

PROJECT NAME	Murrieta Hills				
PROJECT NO	6870381-06			BORING DESIG.	B-7
DATE STARTED	10/7/92	DATE FINISHED	10/8/92	STATION	
TYPE OF DRILLING	Barge's Drilling	LOGGED BY	VAM	OFFSET (FT)	
GROUND WATER ELEV	±	GW DEPTH (FT)		GROUND ELEV. (FT)	±
TYPE OF DRILL RIG	Hollow-Stem Auger	DRIVE WT (LBS)	140	DROP (IN)	30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
							NOTES: Total Depth at 30' No Ground Water Caved to 11' Backfilled on 10/8/92				

SAMPLE TYPES:

C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

▼ GW WHILE DRILLING
▽ GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

GEOTECHNICAL BORING LOG

SHEET 1 OF 1

PROJECT NAME Murrieta Hills
PROJECT NO 6870381-06
DATE STARTED 10/7/92
TYPE OF DRILLING Barge's Drilling
GROUND WATER ELEV ±
TYPE OF DRILL RIG Hollow-Stem Auger

DATE FINISHED 10/7/92
LOGGED BY VAM
GW DEPTH (FT)
DRIVE WT (LBS) 140

BORING DESIG. B-8
STATION
OFFSET (FT)
GROUND ELEV. (FT) 1620.000 ±
DROP (IN) 30

DEPTH (FEET)	ELEV	SAMPLE TYPE	SAMPLE	BLOWS/FT	GRAPHIC LOG	COMMENTS	GEOTECHNICAL DESCRIPTION	MOISTURE CONTENT%	DRY (PCF) DENSITY	SHEAR STRENGTH (KSF)	OTHER TESTS
	1620					Bulk Sample B-1 from 0'-2'	**TOPSOIL** @0', Brown SILTY fine to medium SAND, dry, very loose.				
		R	1	75			**DECOMPOSED GRANITICS (Dg)** @2.5', Olive-brown SILTY fine to medium SAND, trace (10%) of CLAY, damp, very dense. @3', Moderate brown SILTY fine to medium SAND, damp.	9	117		
5	1615	S	1	71		Bulk Sample B-2 from 5'-8'	@5', Olive-brown, SILTY fine to medium SAND, moist, very dense.				
		R	2	50/5"				9	128		
10	1610	S	2	42			@10', Moderate brown SILTY fine SAND with some (25%) medium SAND.				
							NOTES: Total Depth at 11.5' No Ground Water Caved to 2.5' Backfilled on 10/7/92				

SAMPLE TYPES:
C ROCK CORE
S STANDARD PEN
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
b SMALL BAG

GW WHILE DRILLING
GW HRS.
B BEDDING PLANE
J JOINTING
C CONTACT
F FAULT
S SHEAR

LEIGHTON AND ASSOCIATES INC.

Rotary Percussion Drilling Report ECM, Leighton, 2008

Drilling Report

E.C.M.

EarthConstructionMining

Rotary Percussion Test Drilling Penetration Rates

Job Name MURRIETA HILLS DEVELOPMENT

Location RIVERSIDE

Job Number 4177

For LEIGHTON & ASSOCIATES

Drill Date(s) 4/8, 4/9, 4/11 & 4/14/08

3½": ——● 4": ··················◆

Field Tech(s)

Drill Model 370

Disclaimer:

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets faulting or hydrologi

EarthConstructionMining

4177 MURRIETA HILLS DEVELOPMENT
RIVERSIDE

Test Drilling Graphs

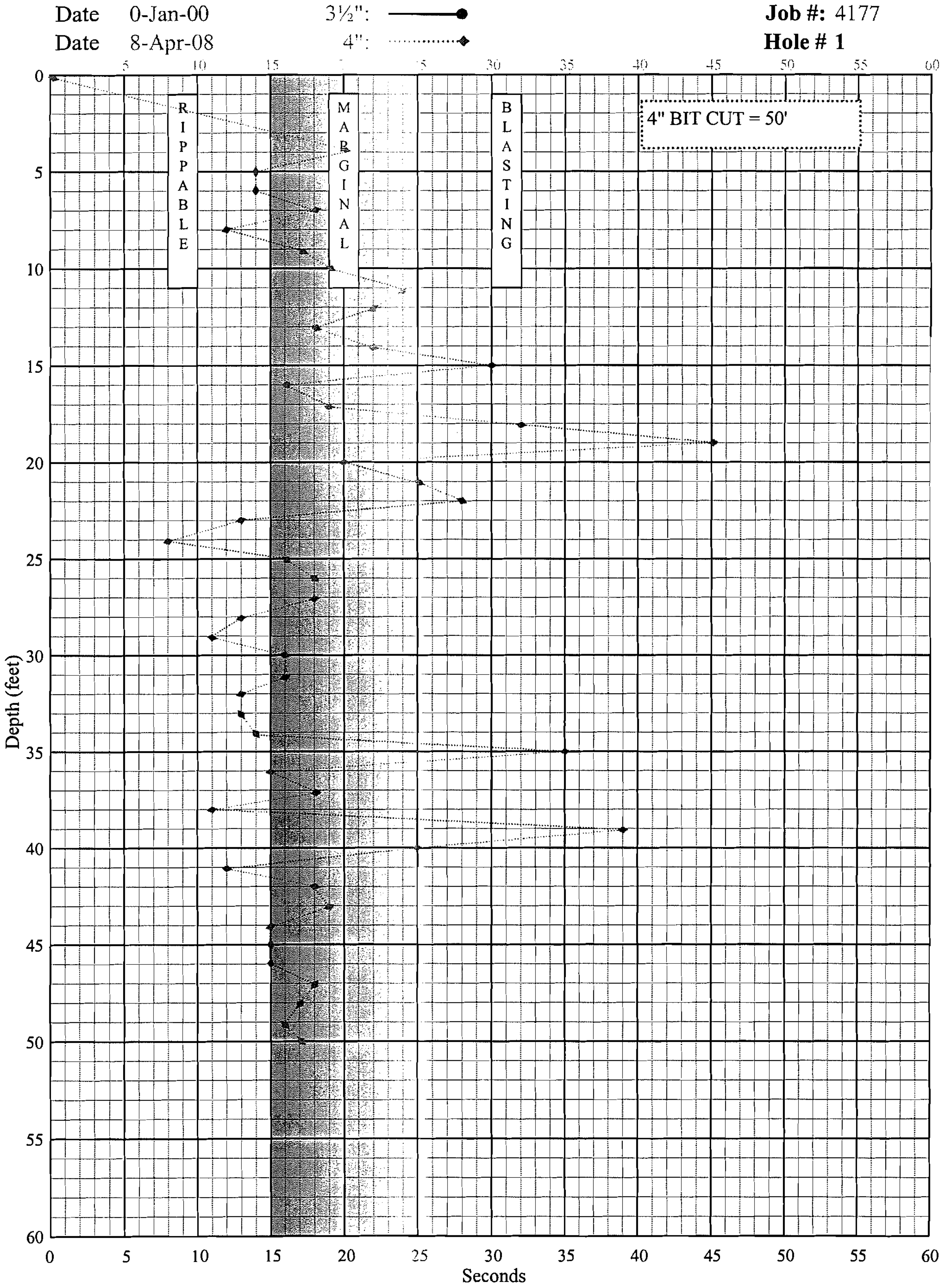
Graphs	Hole Number	Number of Feet with 3½" Bit	Number of Feet with 4" Bit	**Total Feet**
1			50	**50**
2			40	**40**
3			50	**50**
4			40	**40**
5			50	**50**
6			48	**48**
7			36	**36**
8			33	**33**
9			31	**31**
10			25	**25**
11			21	**21**
12			33	**33**
13			48	**48**
14			69	**69**
15			21	**21**
16			40	**40**
17			60	**60**
18			48	**48**
19			48	**48**
20			40	**40**
21			60	**60**
22			60	**60**
23			45	**45**
24			43	**43**
25			52	**52**
26			30	**30**
27			30	**30**
28			50	**50**
29			33	**33**
30			51	**51**
31			51	**51**
32			33	**33**
33			21	**21**
34			33	**33**
35				**0**
36				**0**
37				**0**
38				**0**
39				**0**
40				**0**
41				**0**
42				**0**
43				**0**
44				**0**
45				**0**

TOTAL FEET **1,423**

TOTAL HOURS

E.C.M.
Date 0-Jan-00
Date 8-Apr-08

RIVERSIDE
Job #: 4177
Hole # 1



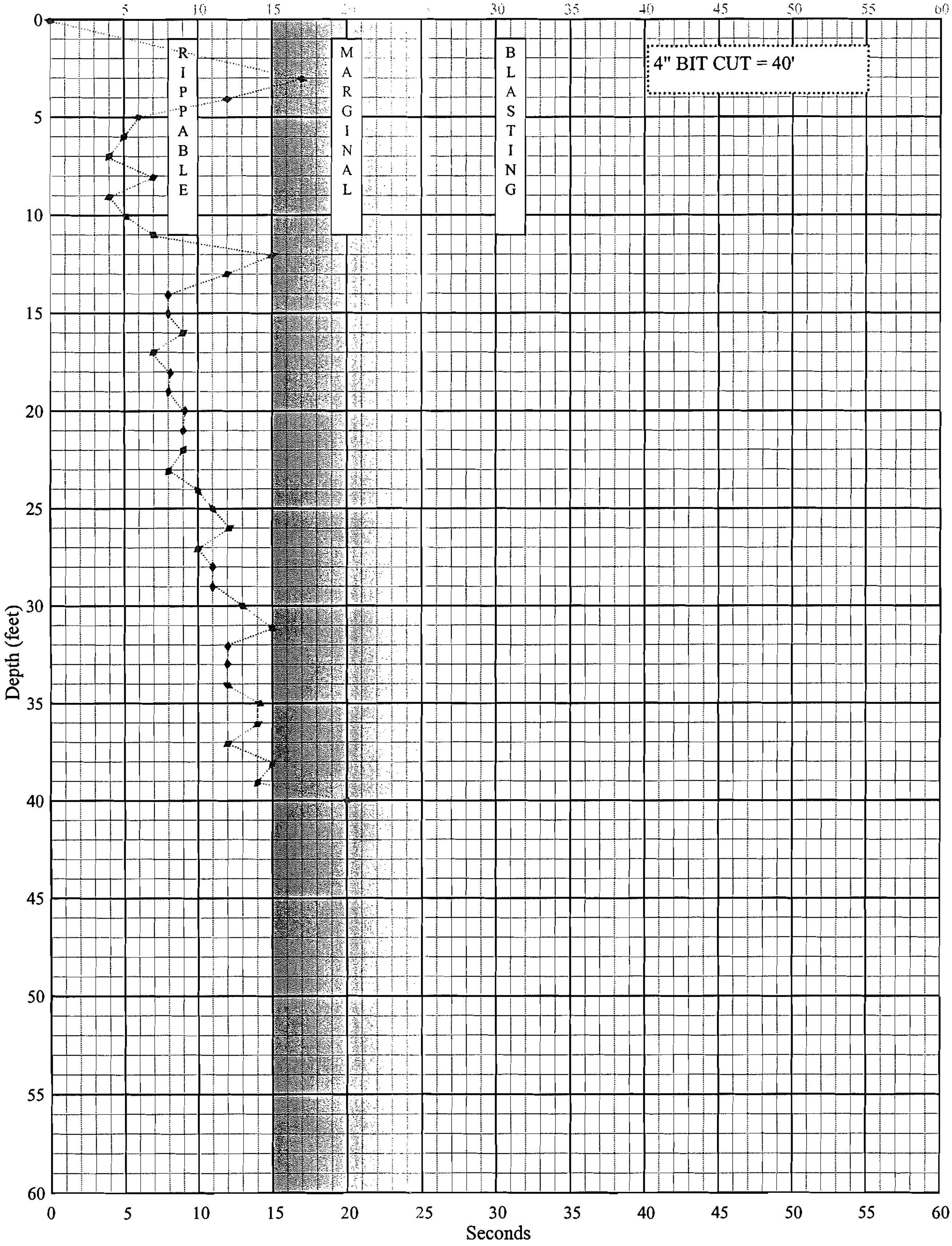
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——●

Job #: 4177

Date 8-Apr-08 4": ·········◆

Hole # 2



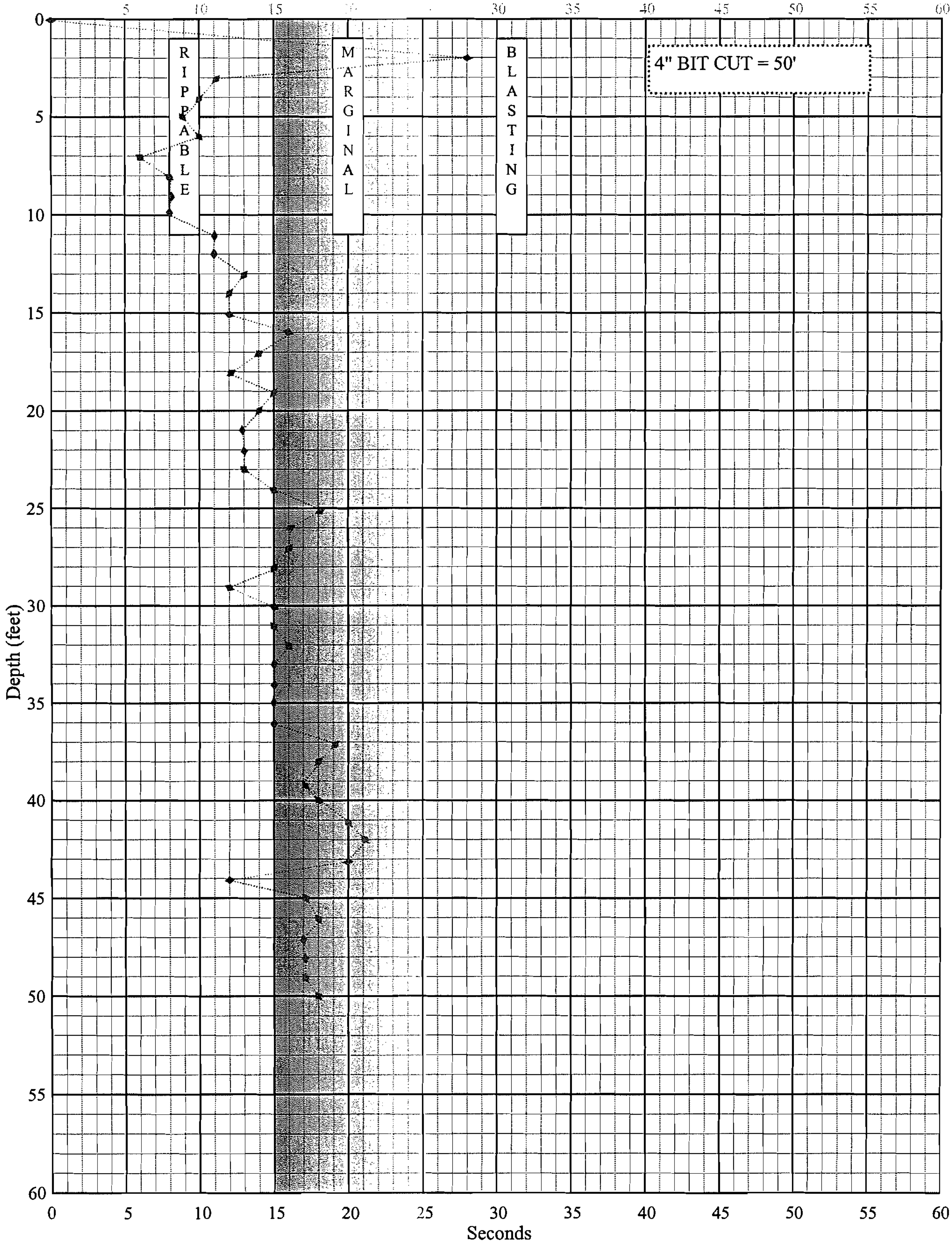
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——●

Date 8-Apr-08 4": ·····◆

Job #: 4177

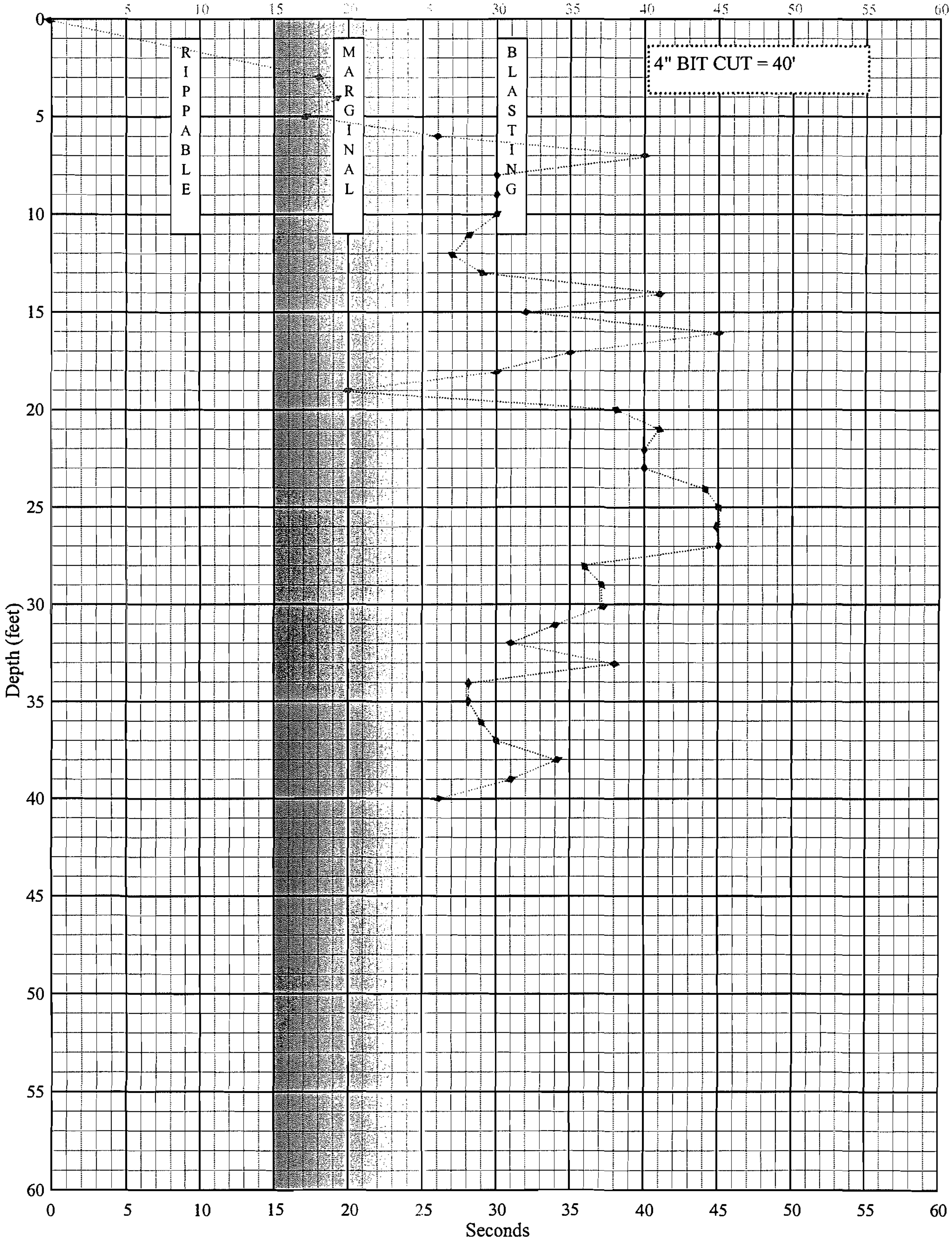
Hole # 3



E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——● **Job #:** 4177

Date 8-Apr-08 4": ·········◆ **Hole # 4**



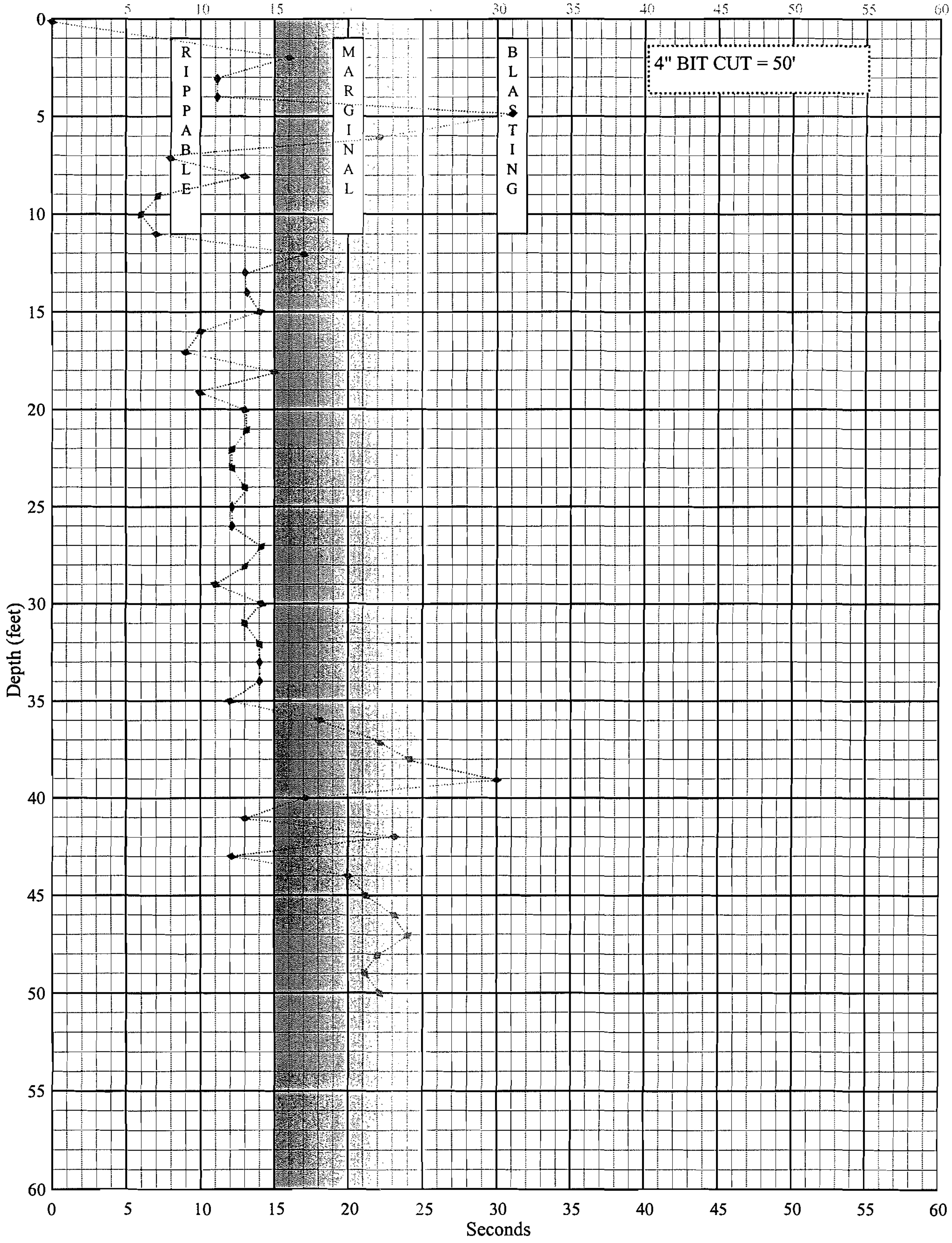
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——●

Job #: 4177

Date 8-Apr-08 4": ·········◆

Hole # 5



E.C.M.

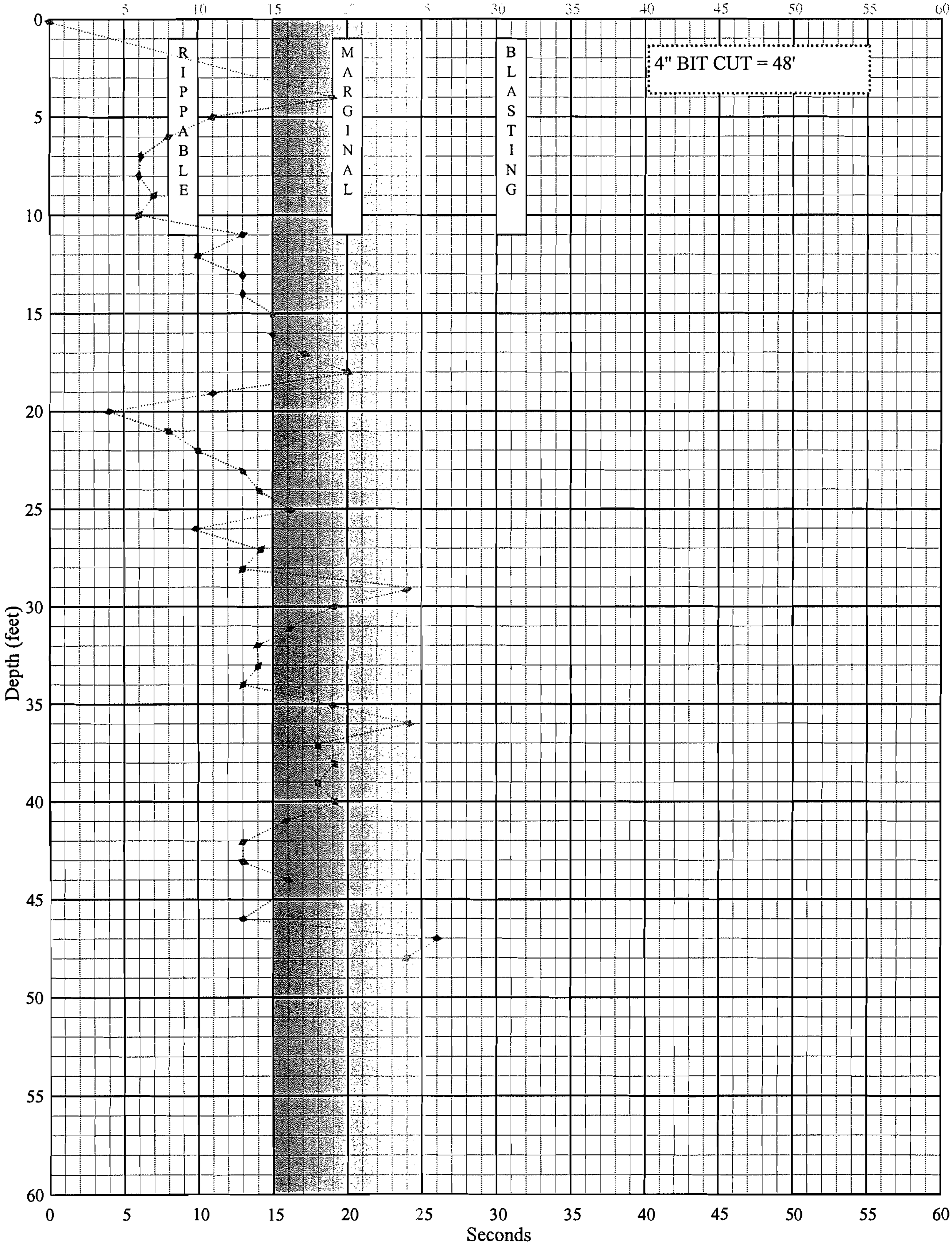
Date 0-Jan-00 3½": ———●

Date 8-Apr-08 4": ········◆

RIVERSIDE

Job #: 4177

Hole # 6



E.C.M.

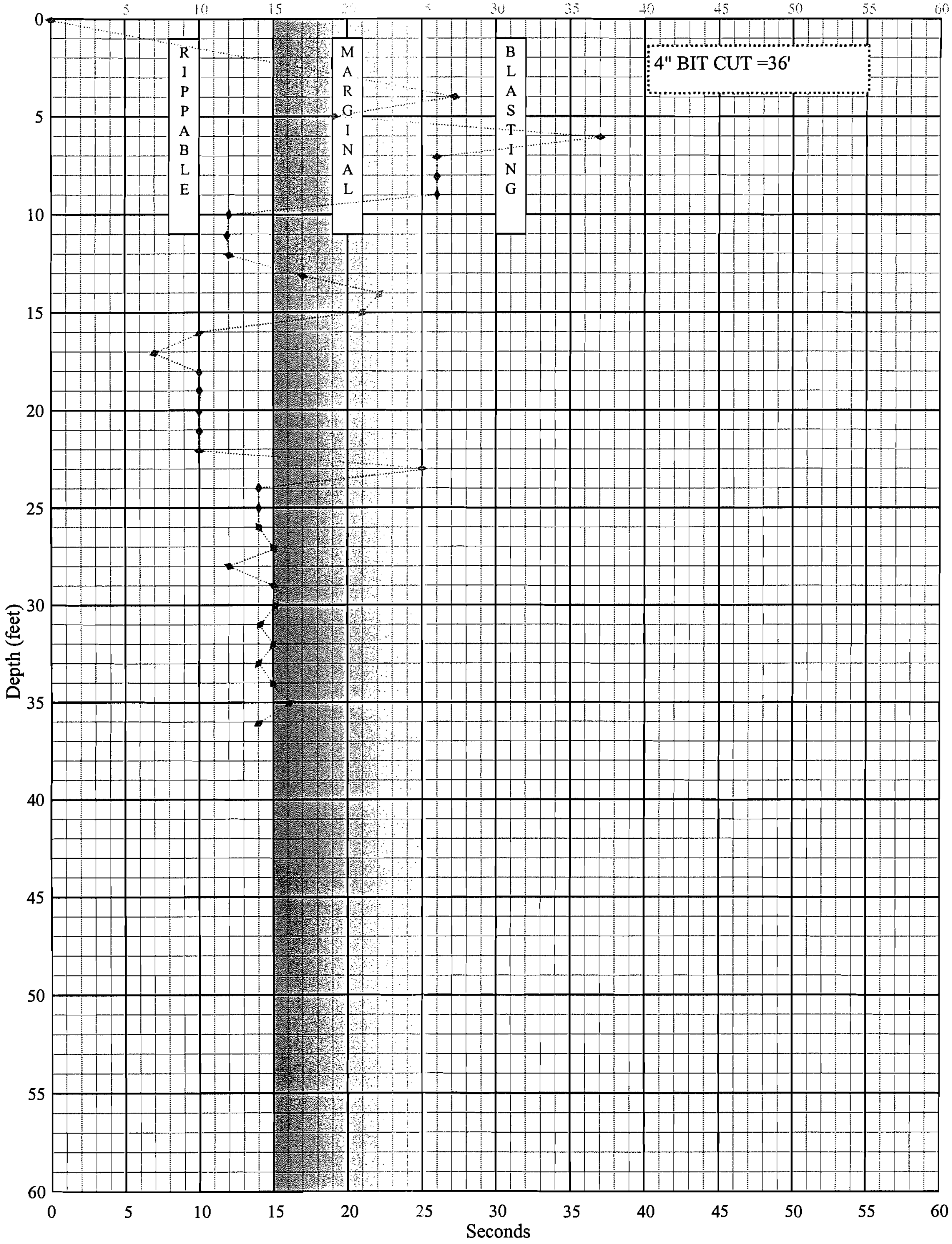
Date 0-Jan-00 3½":

Date 8-Apr-08 4":

RIVERSIDE

Job #: 4177

Hole # 7



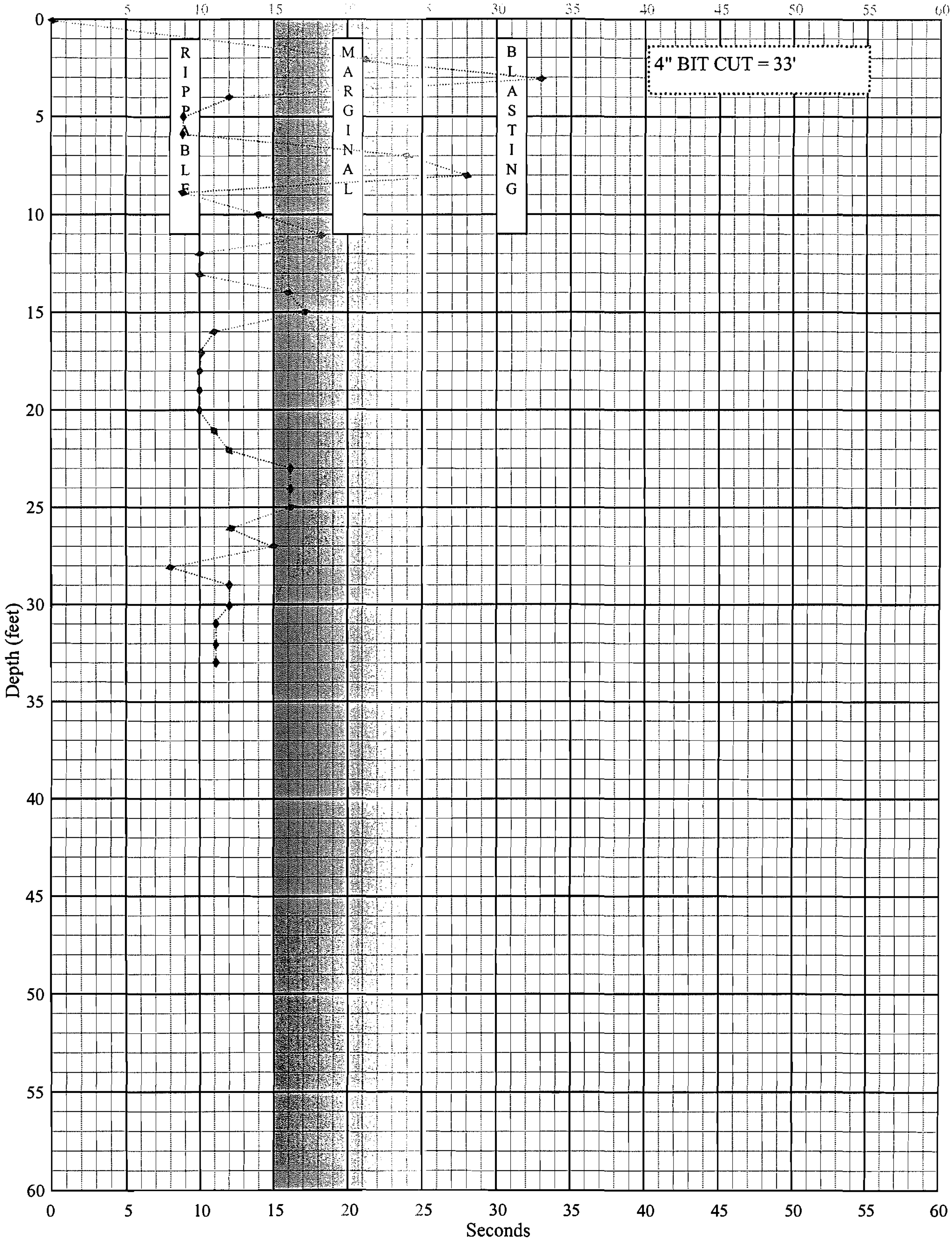
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——●

Job #: 4177

Date 8-Apr-08 4": ·········◆

Hole # 8



E.C.M.

Date 0-Jan-00

Date 9-Apr-08

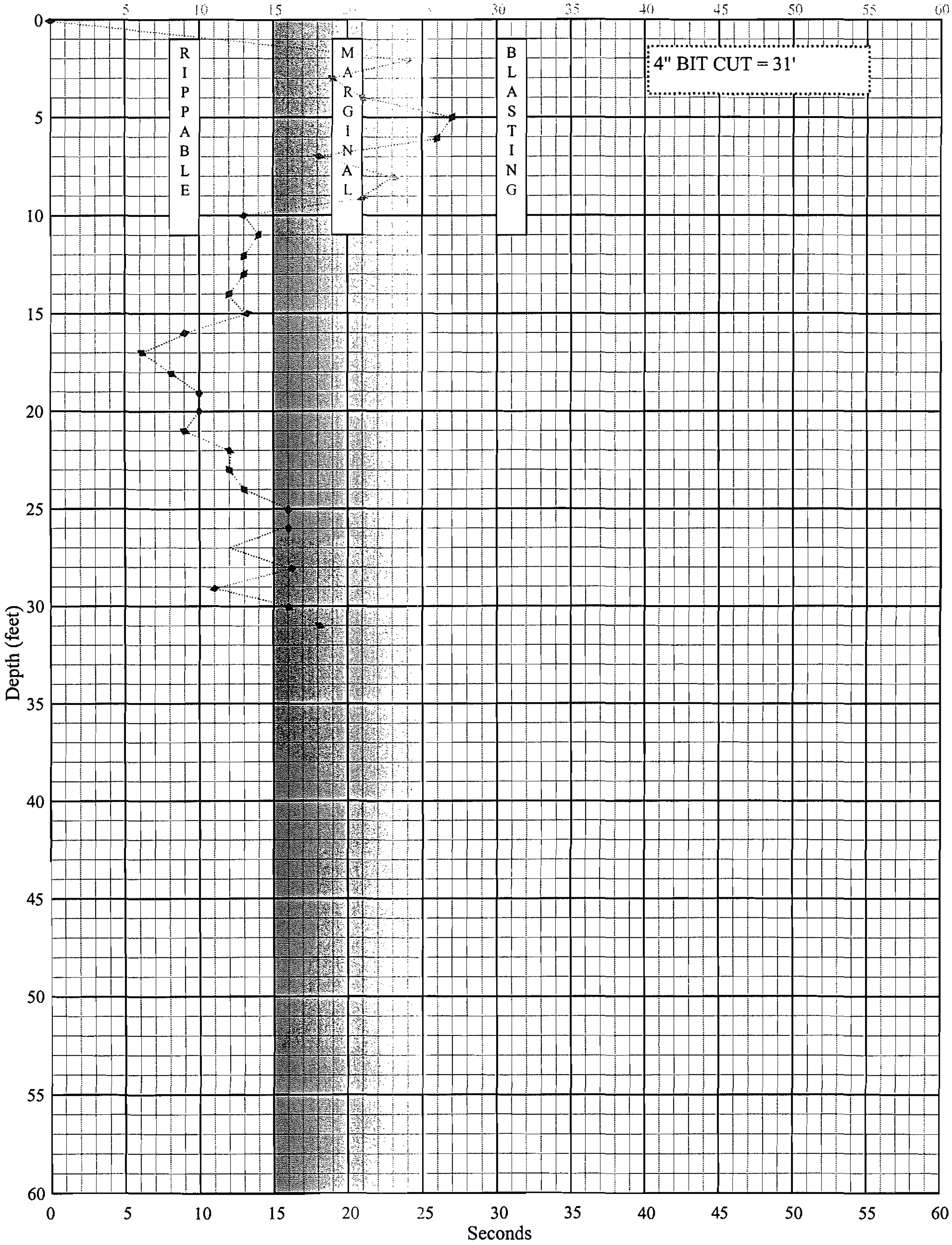
RIVERSIDE

Job #: 4177

Hole # 9

3½": ——●

4": ·········◆



E.C.M.

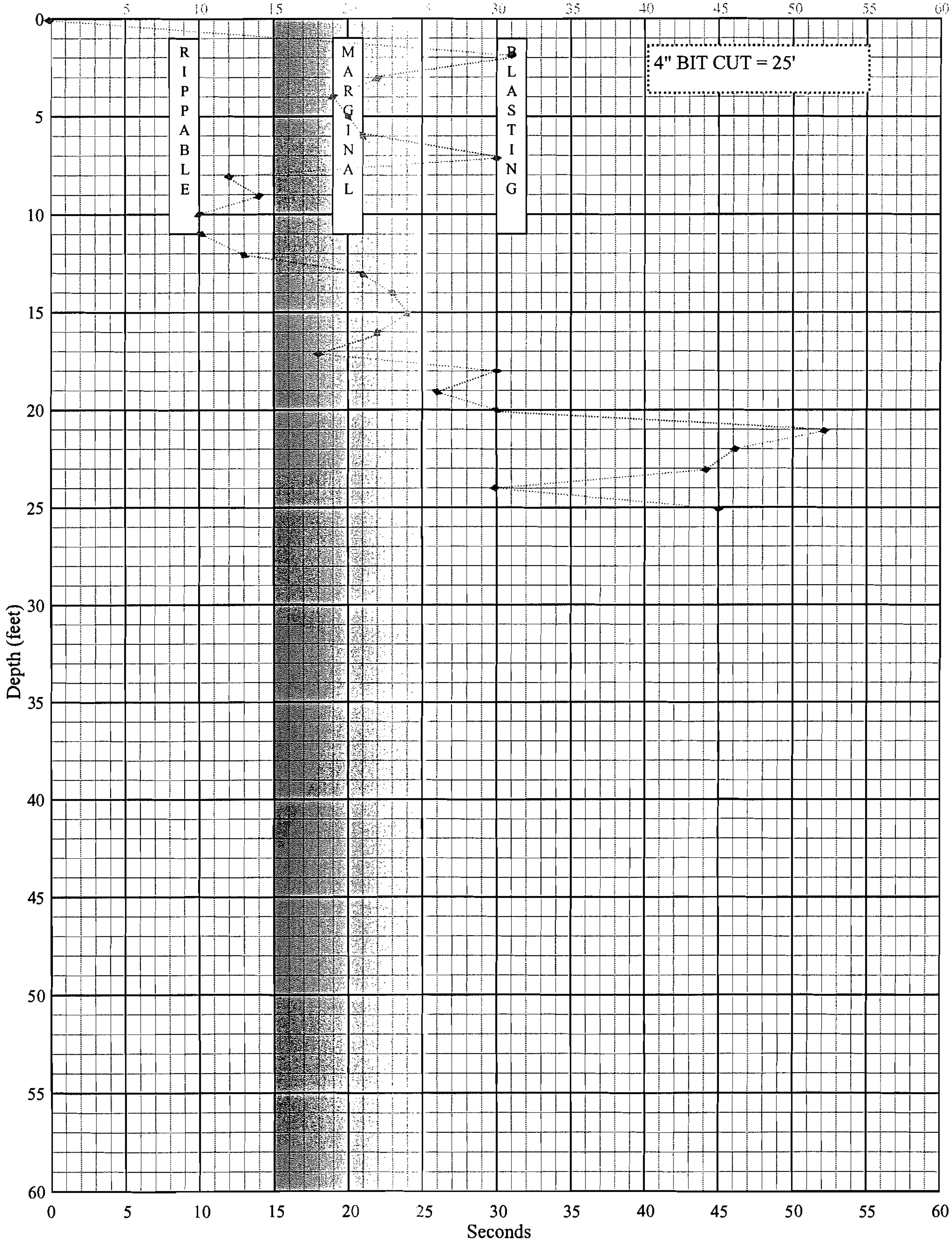
RIVERSIDE

Date 0-Jan-00 3½": ——●

Job #: 4177

Date 9-Apr-08 4": ·········◆

Hole # 10



E.C.M.

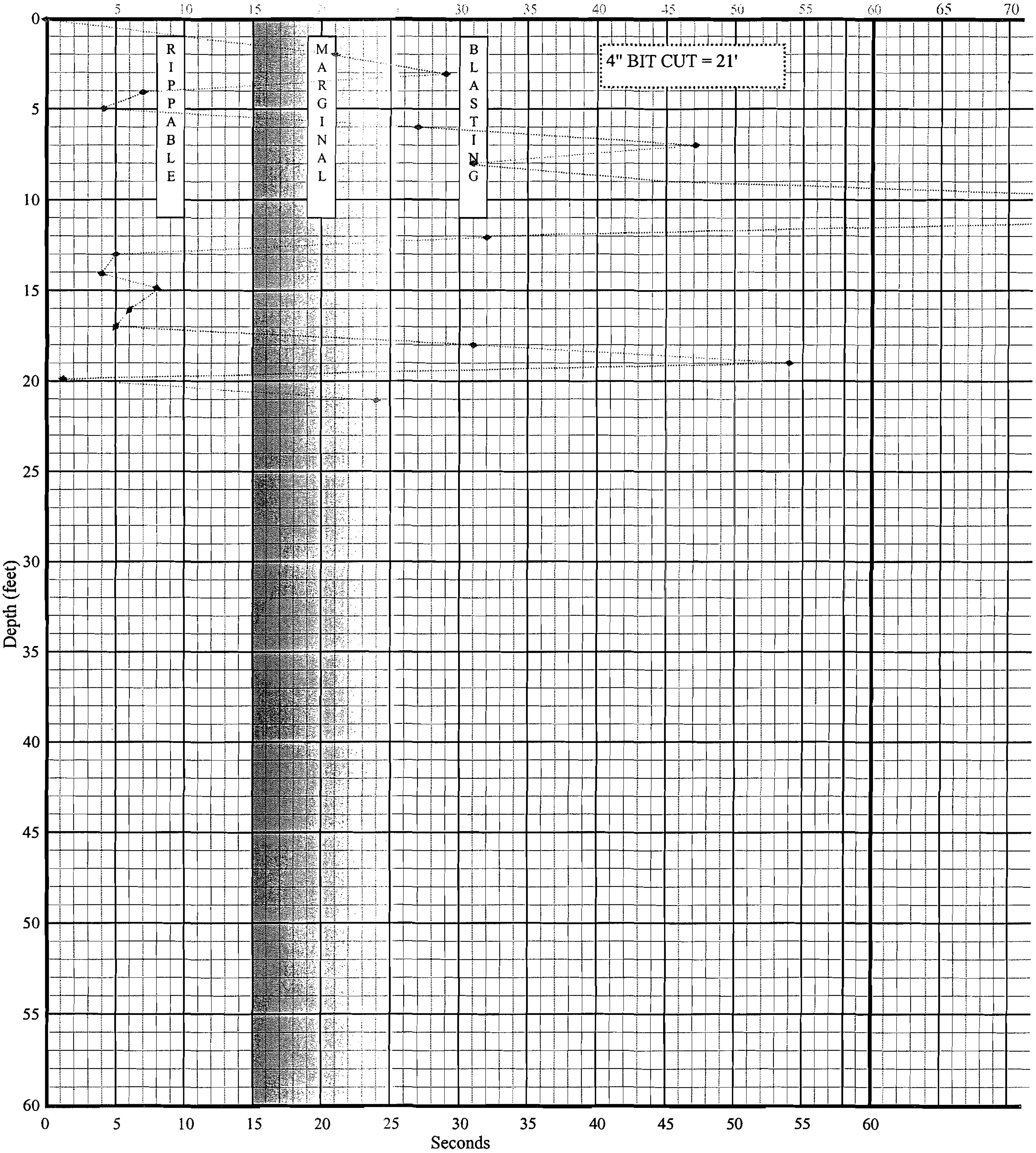
RIVERSIDE

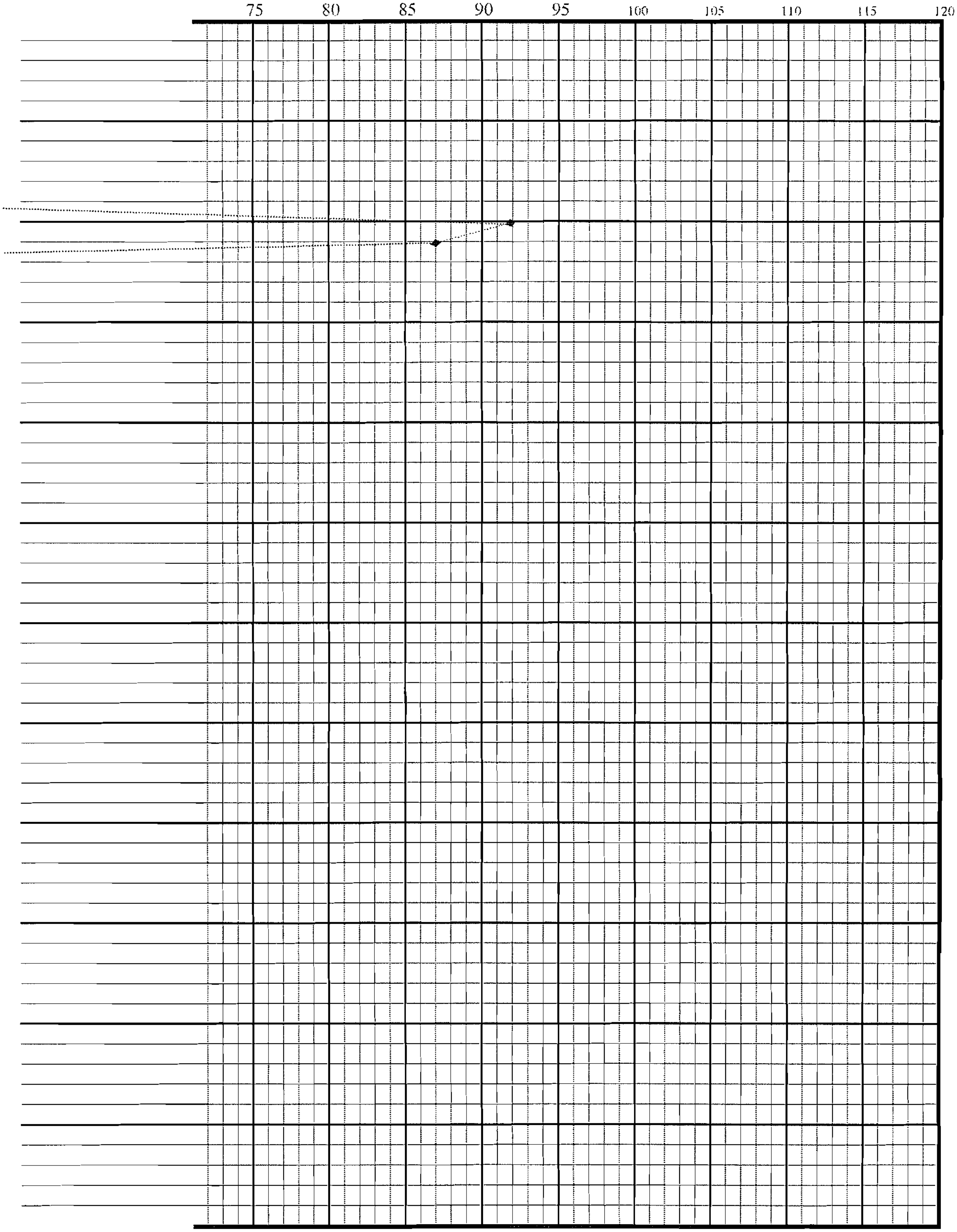
Date 0-Jan-00 3½": ———●

Job #: 4177

Date 9-Apr-08 4": ·········◆

Hole # 11




75
80
85
90
95
100
105
110
115
120

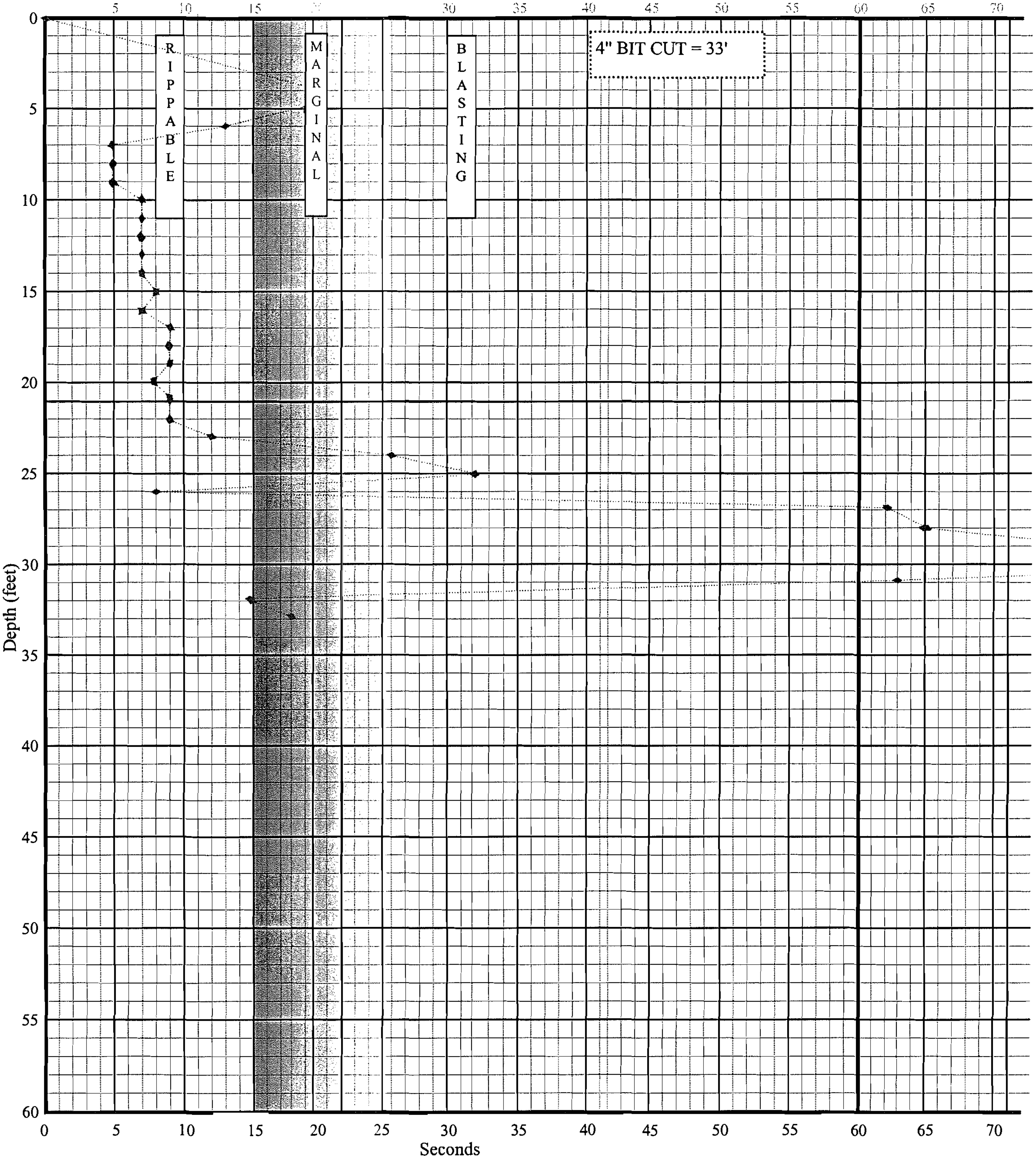
E.C.M. RIVERSIDE

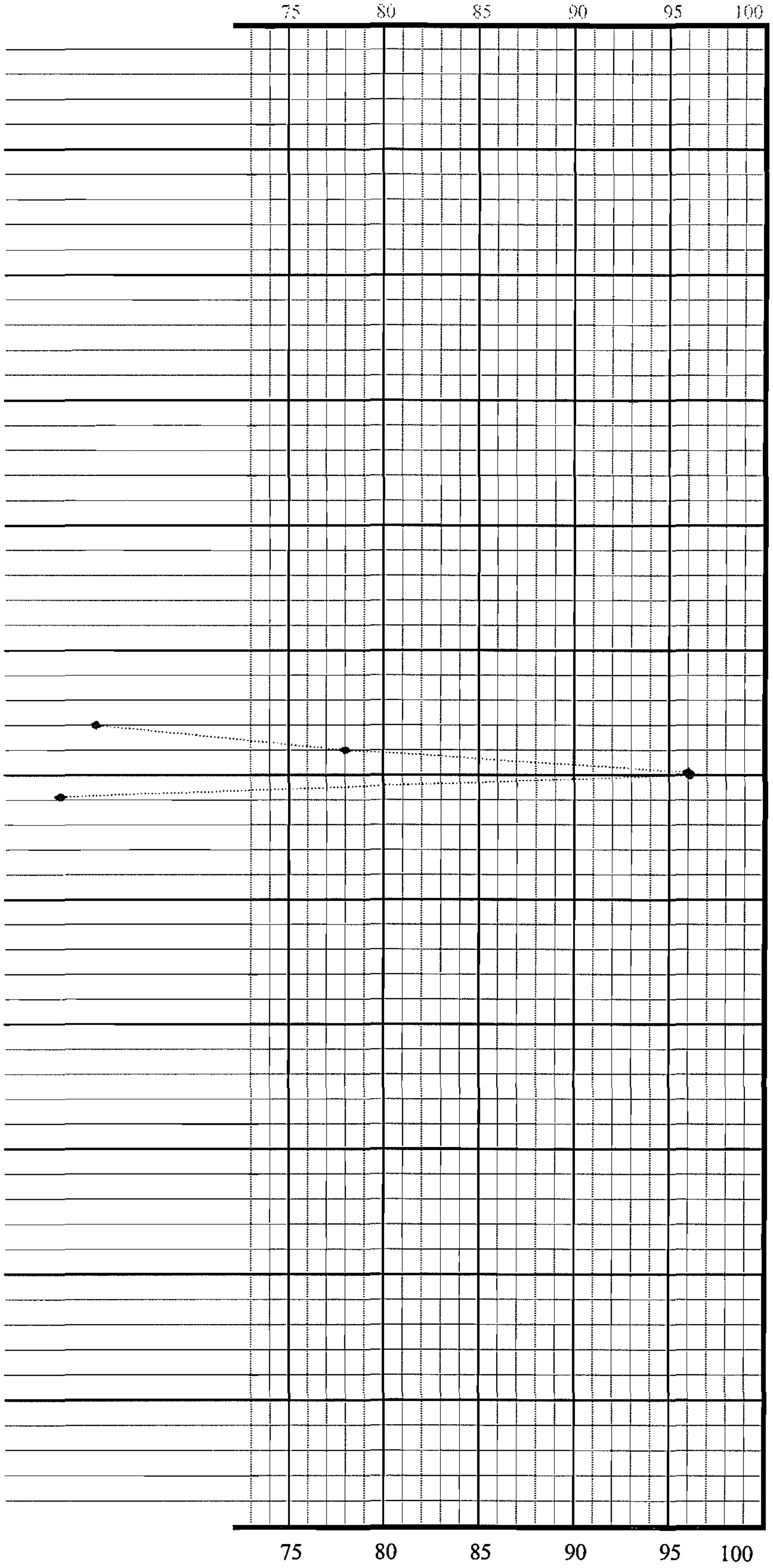
Date 0-Jan-00 3½": ——●

Job #: 4177

Date 9-Apr-08 4": ·······◆

Hole # 12




75
80
85
90
95
100
75
80
85
90
95
100

E.C.M.

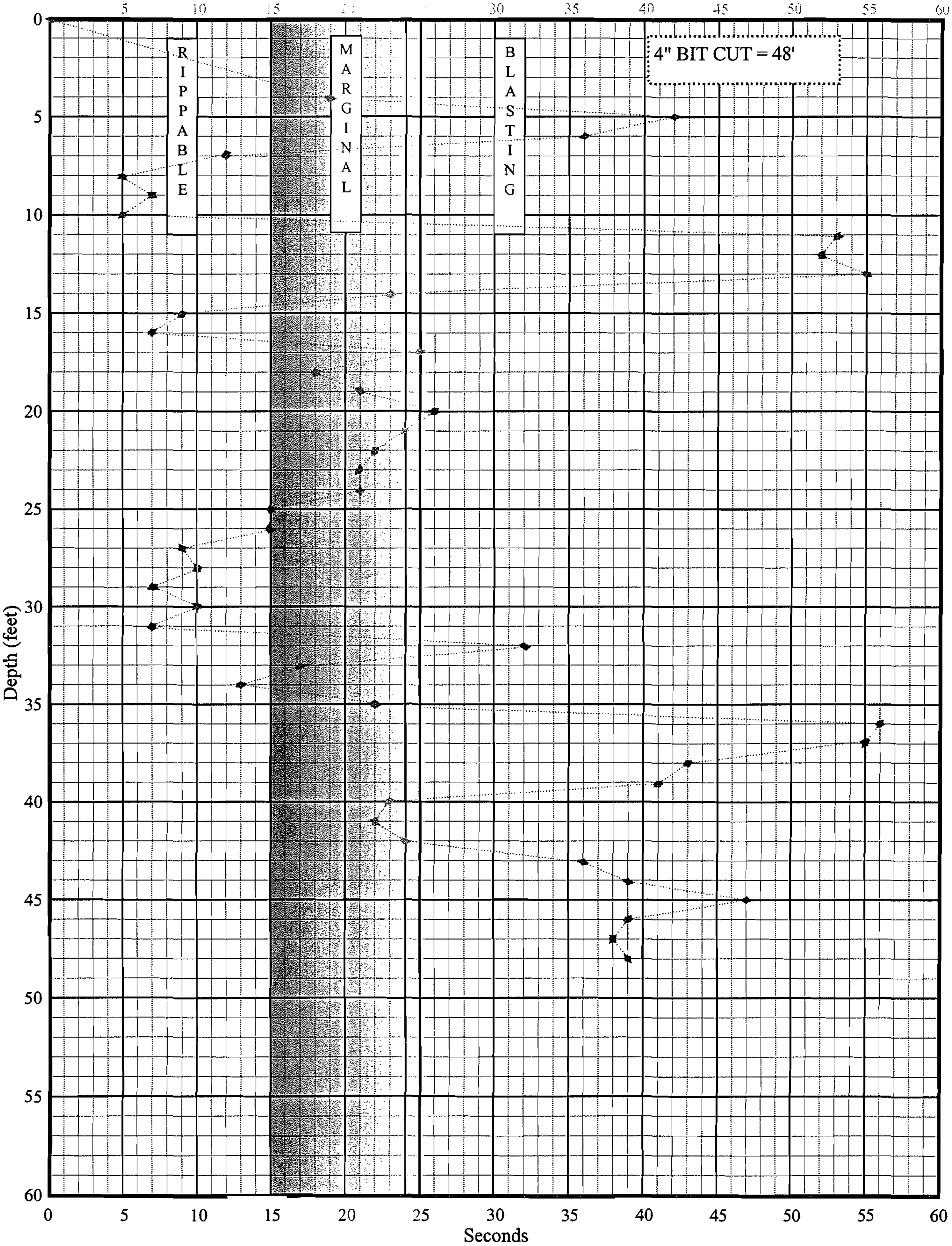
Date 0-Jan-00 3½": ——●

Date 9-Apr-08 4": ·········◆

RIVERSIDE

Job #: 4177

Hole # 13



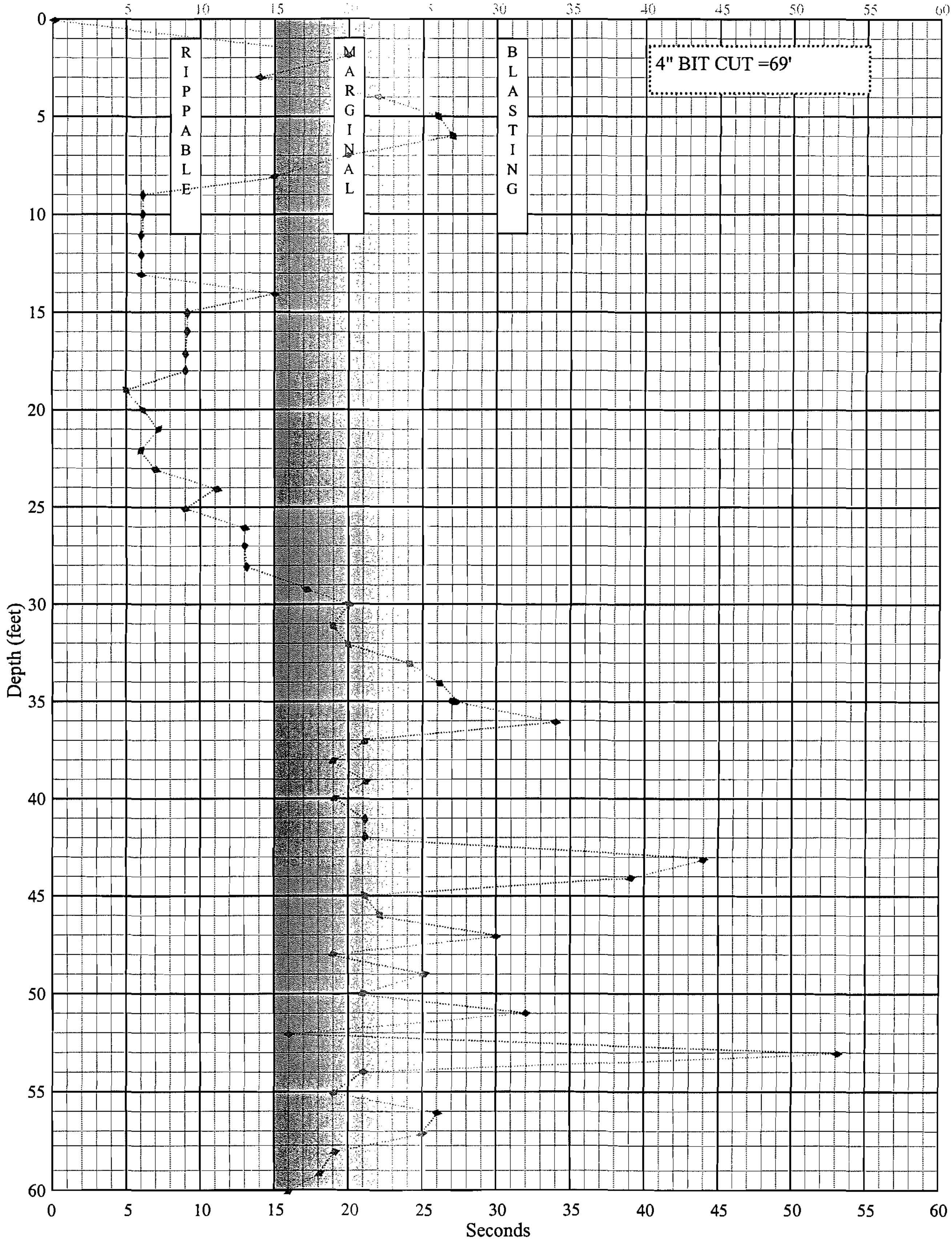
E.C.M. RIVERSIDE

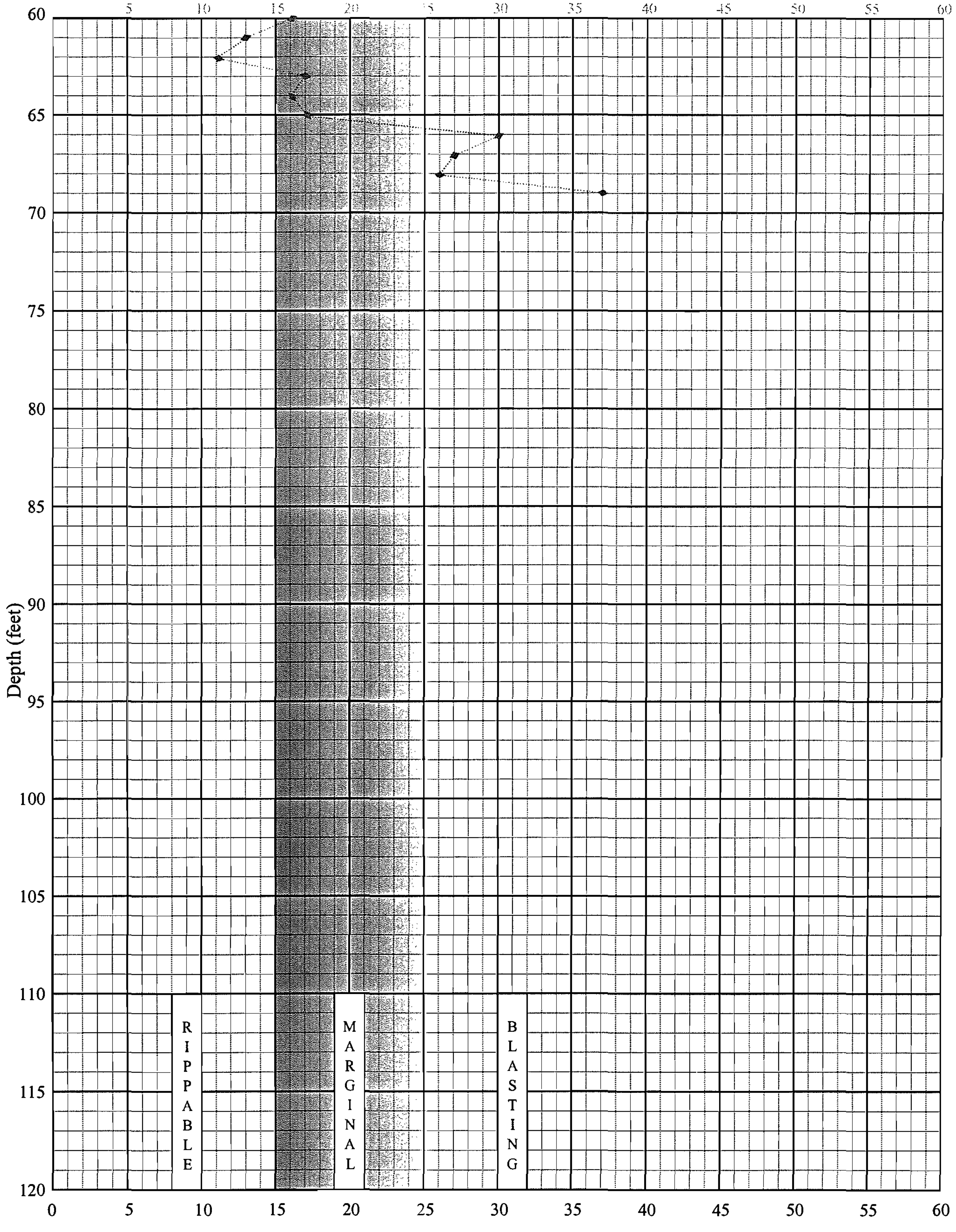
Date 0-Jan-00 3½": ——●

Date 9-Apr-08 4": ·········◆

Job #: 4177

Hole # 14



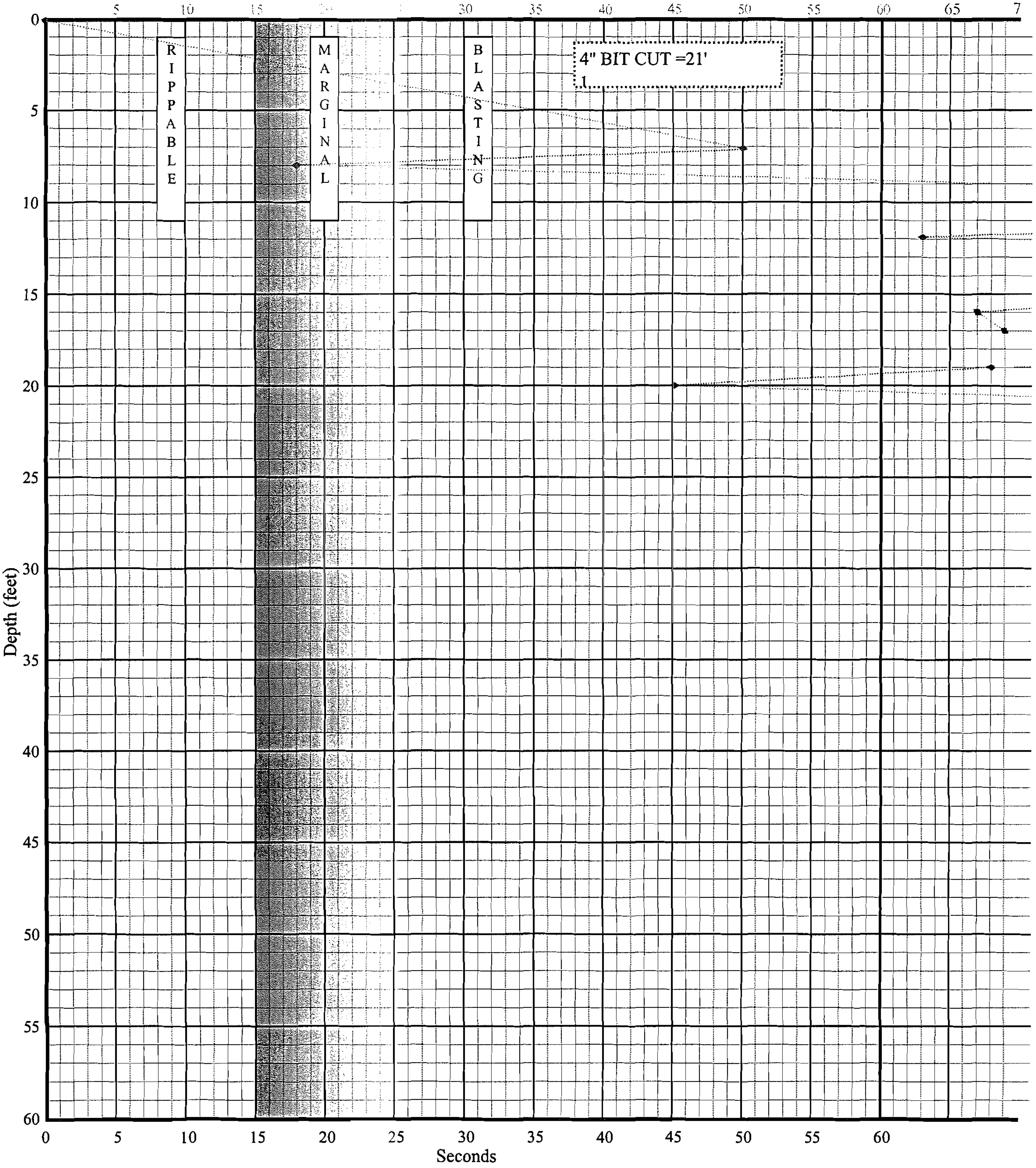


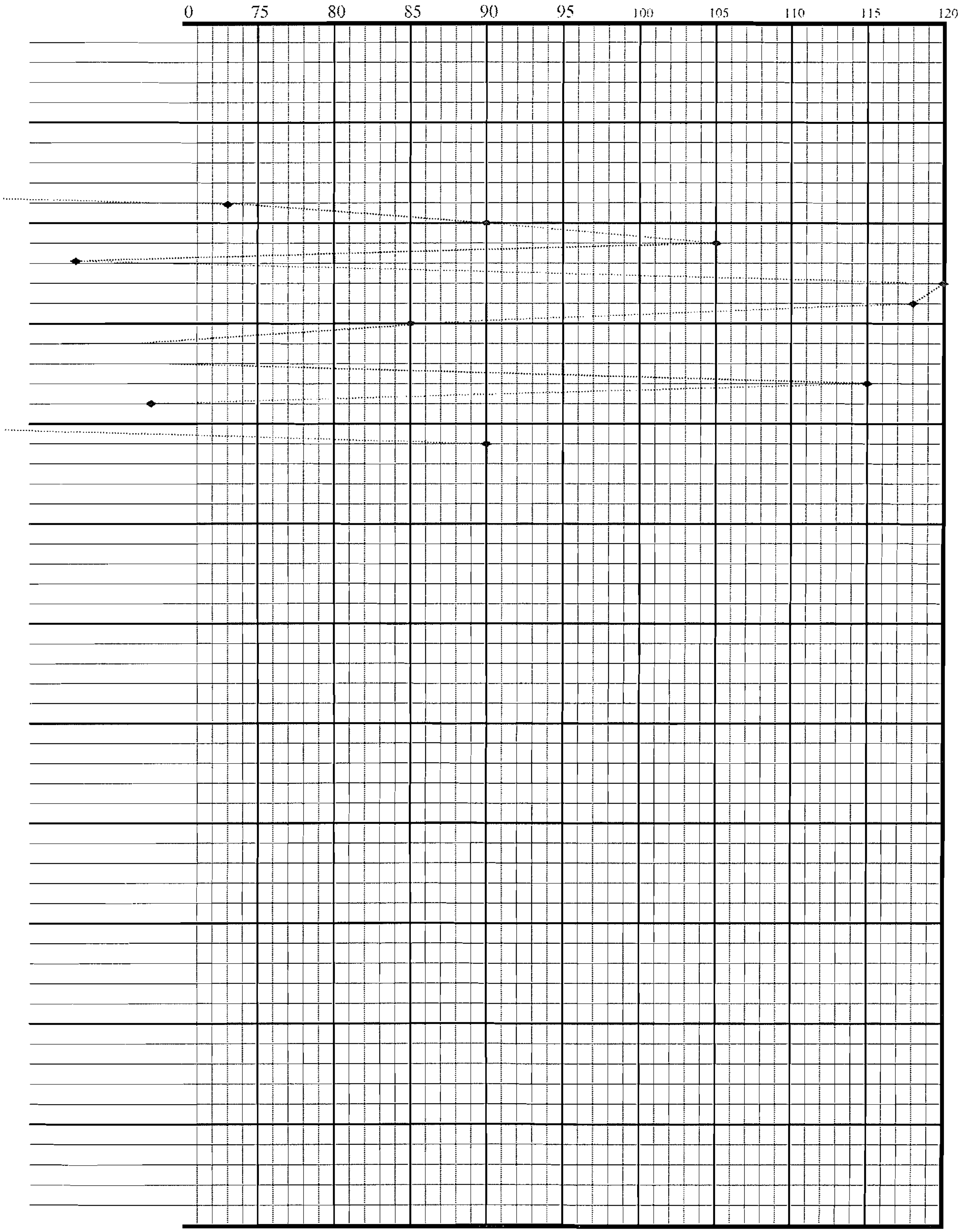
Depth (feet)
60
65
70
75
80
85
90
95
100
105
110
115
120
0
5
10
15
20
25
30
35
40
45
50
55
60
RIPPABLE
MARGINAL
BLASTING

E.C.M. RIVERSIDE

Date 0-Jan-00 3½": **Job #:** 4177

Date 9-Apr-08 4": **Hole # 15**




0
75
80
85
90
95
100
105
110
115
120

E.C.M.

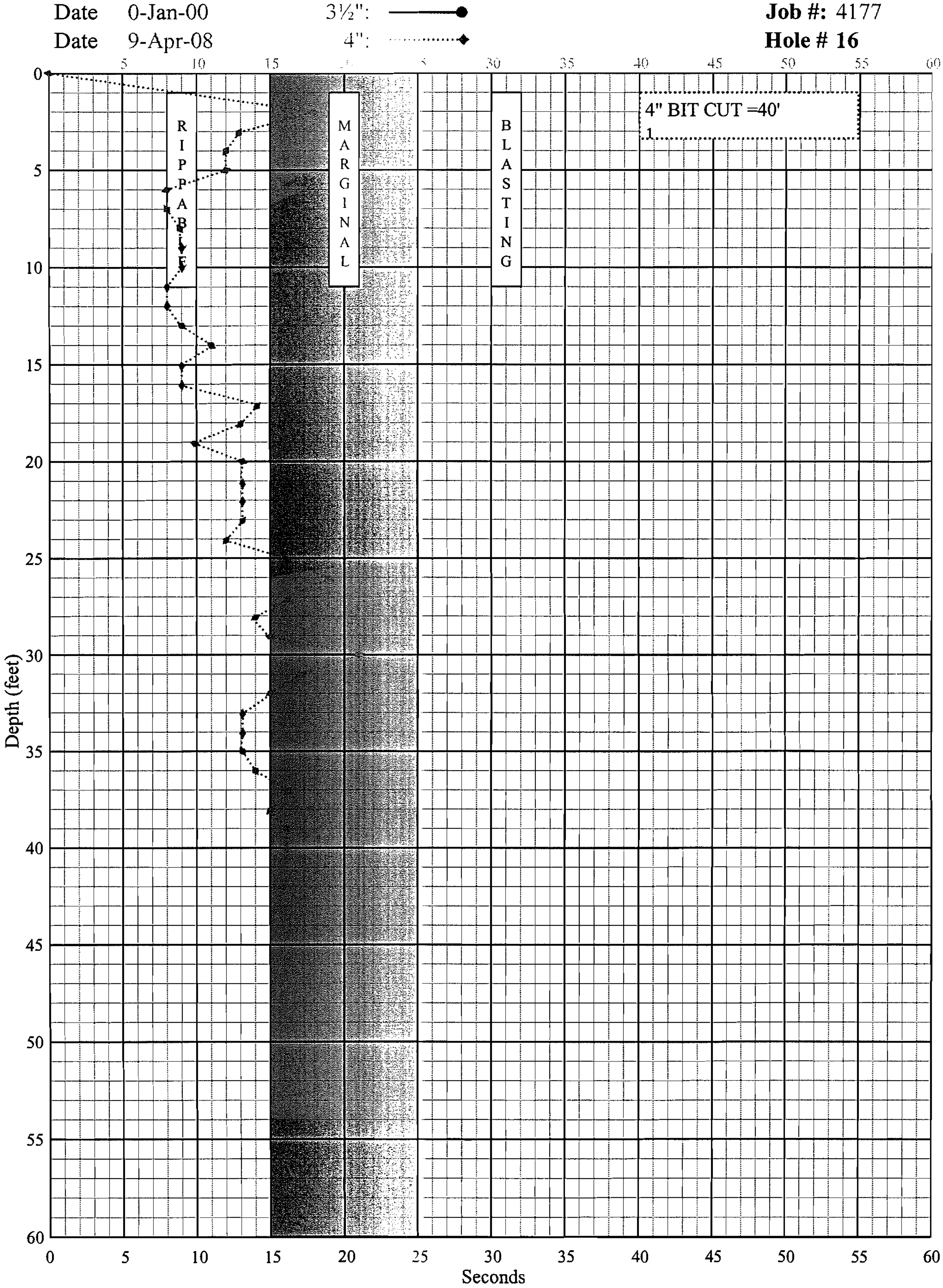
Date 0-Jan-00

Date 9-Apr-08

RIVERSIDE

Job #: 4177

Hole # 16



E.C.M.

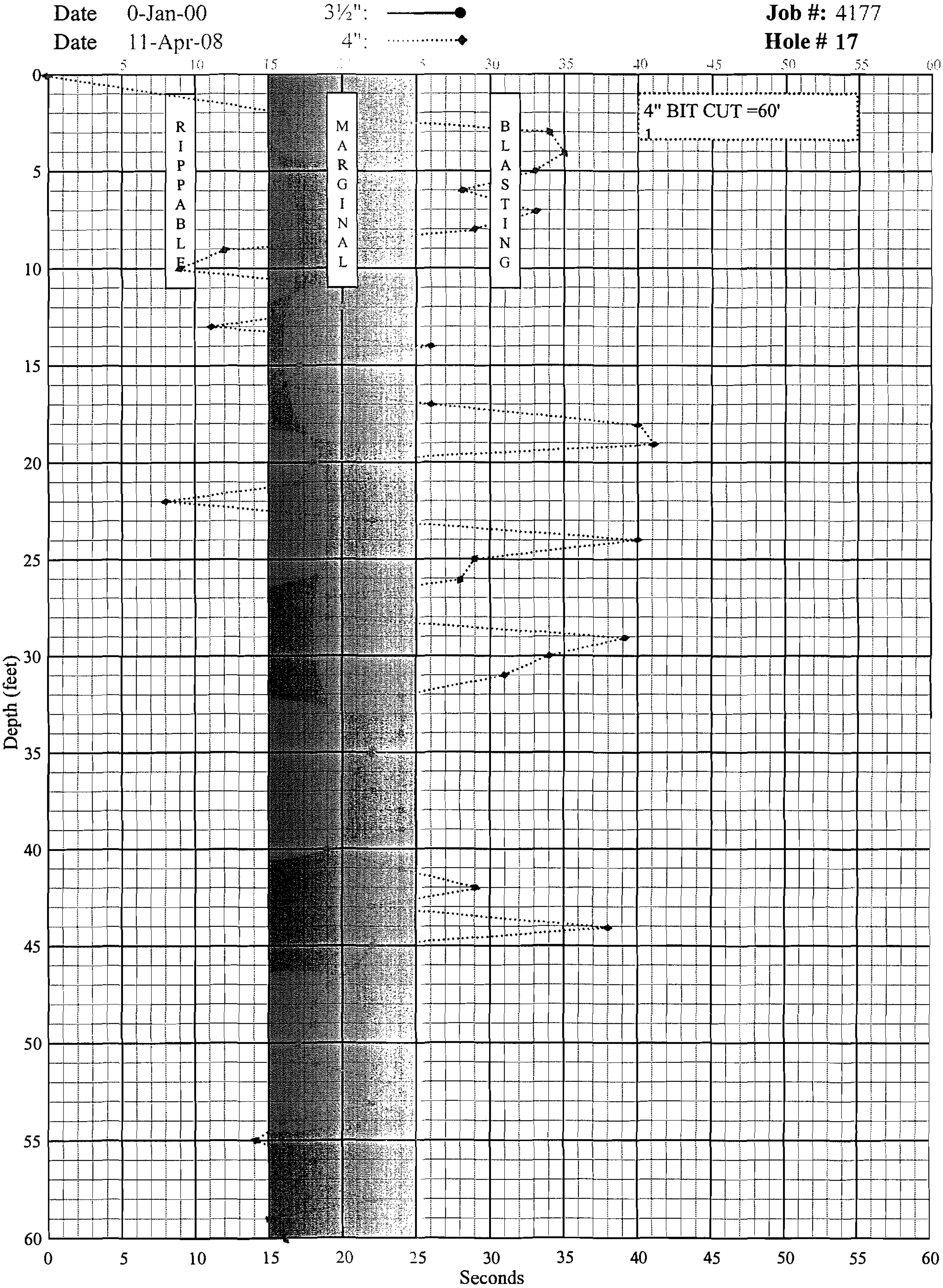
Date 0-Jan-00

Date 11-Apr-08

RIVERSIDE

Job #: 4177

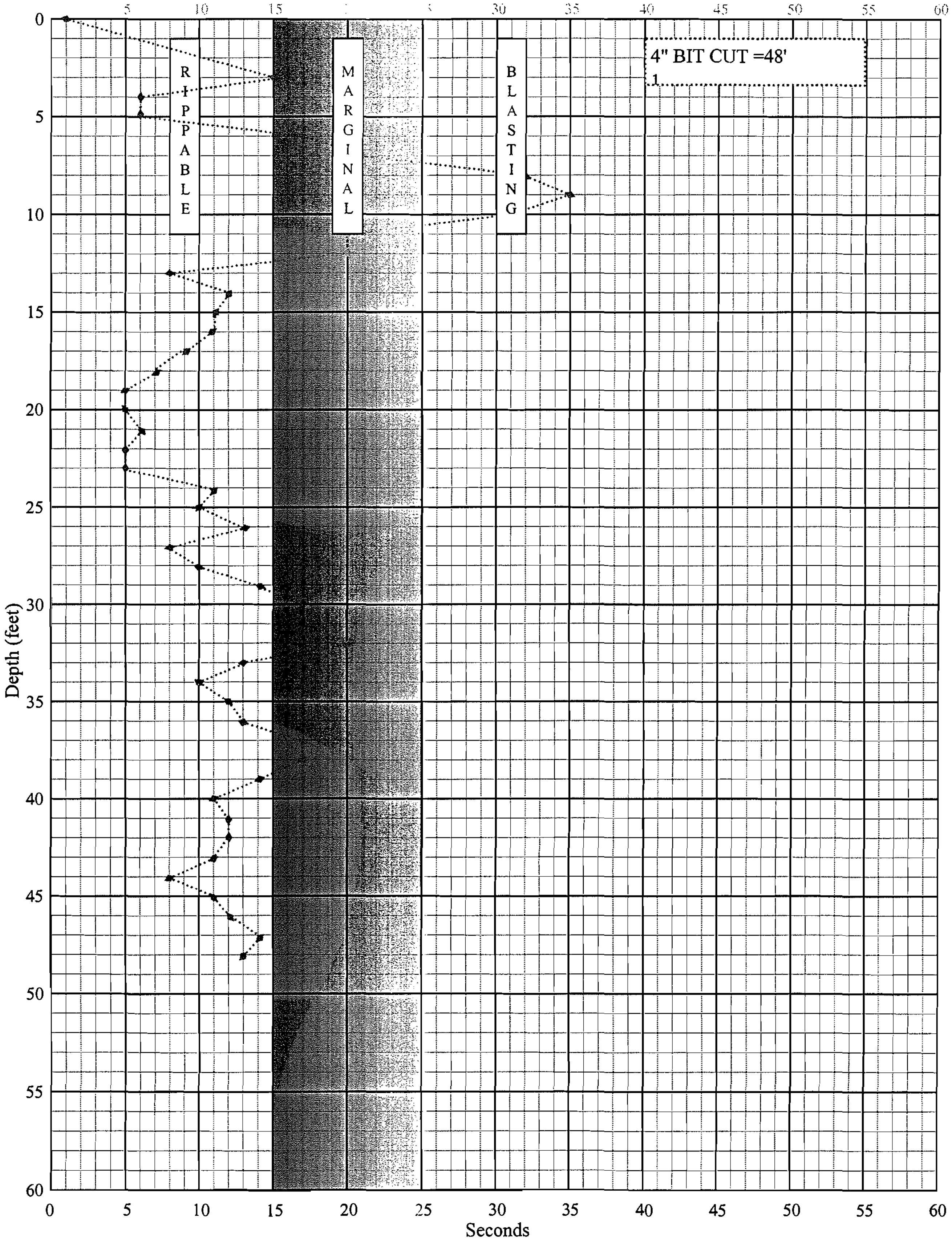
Hole # 17



E.C.M. RIVERSIDE

Date 0-Jan-00 3½": **Job #:** 4177

Date 11-Apr-08 4": **Hole # 18**



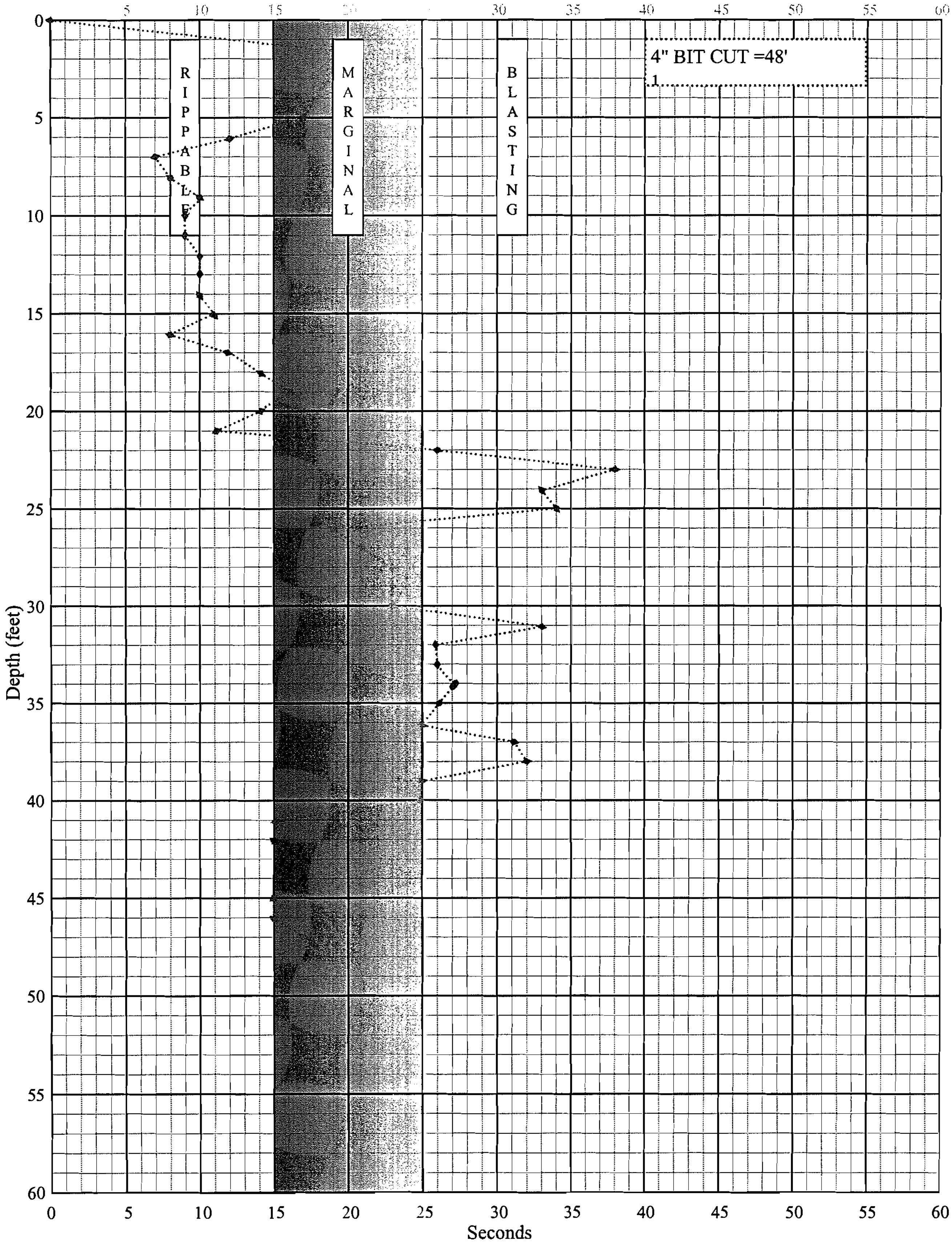
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——●

Date 11-Apr-08 4": ········◆

Job #: 4177

Hole # 19



E.C.M.

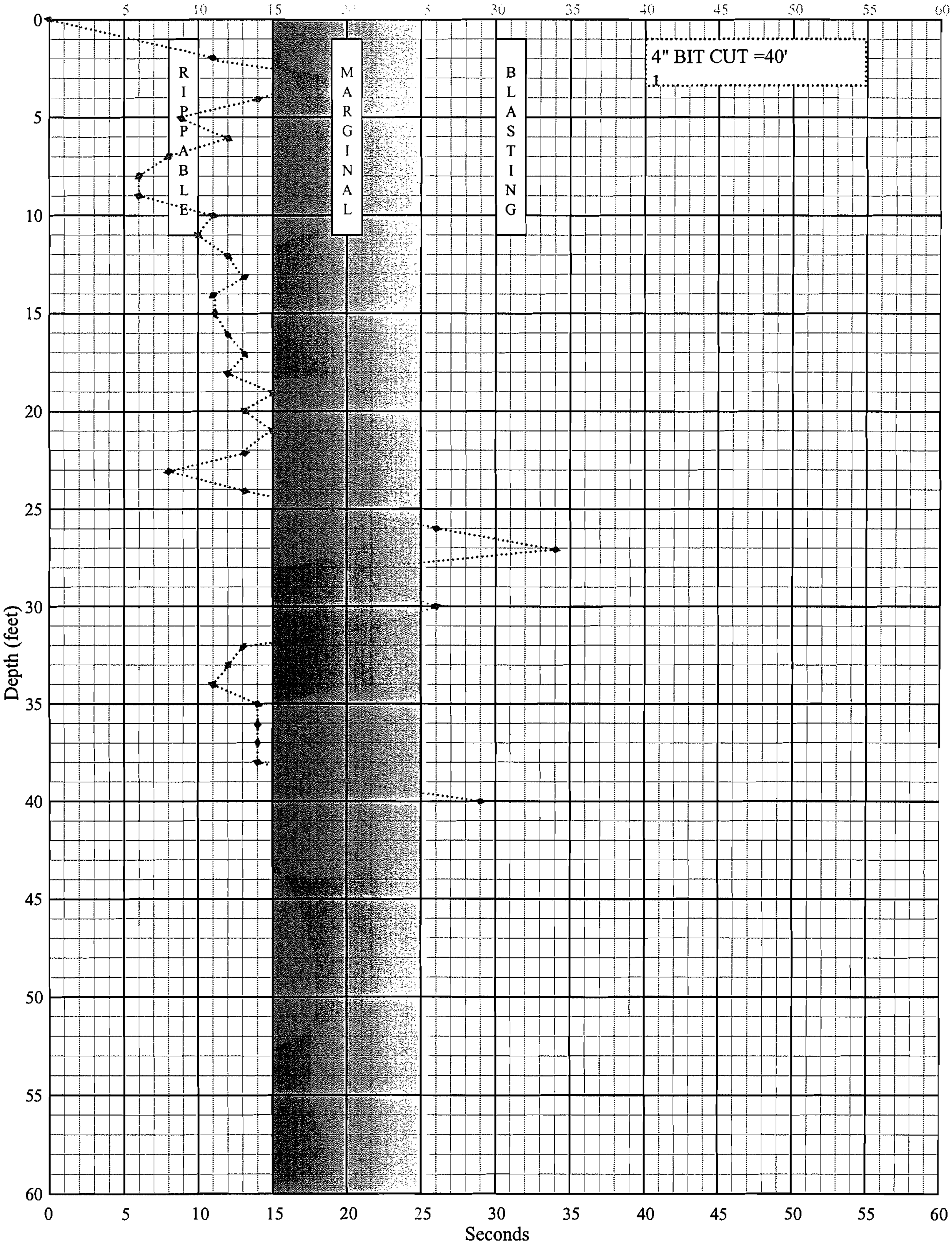
RIVERSIDE

Date 0-Jan-00 3½": ——●

Job #: 4177

Date 11-Apr-08 4": ·······◆

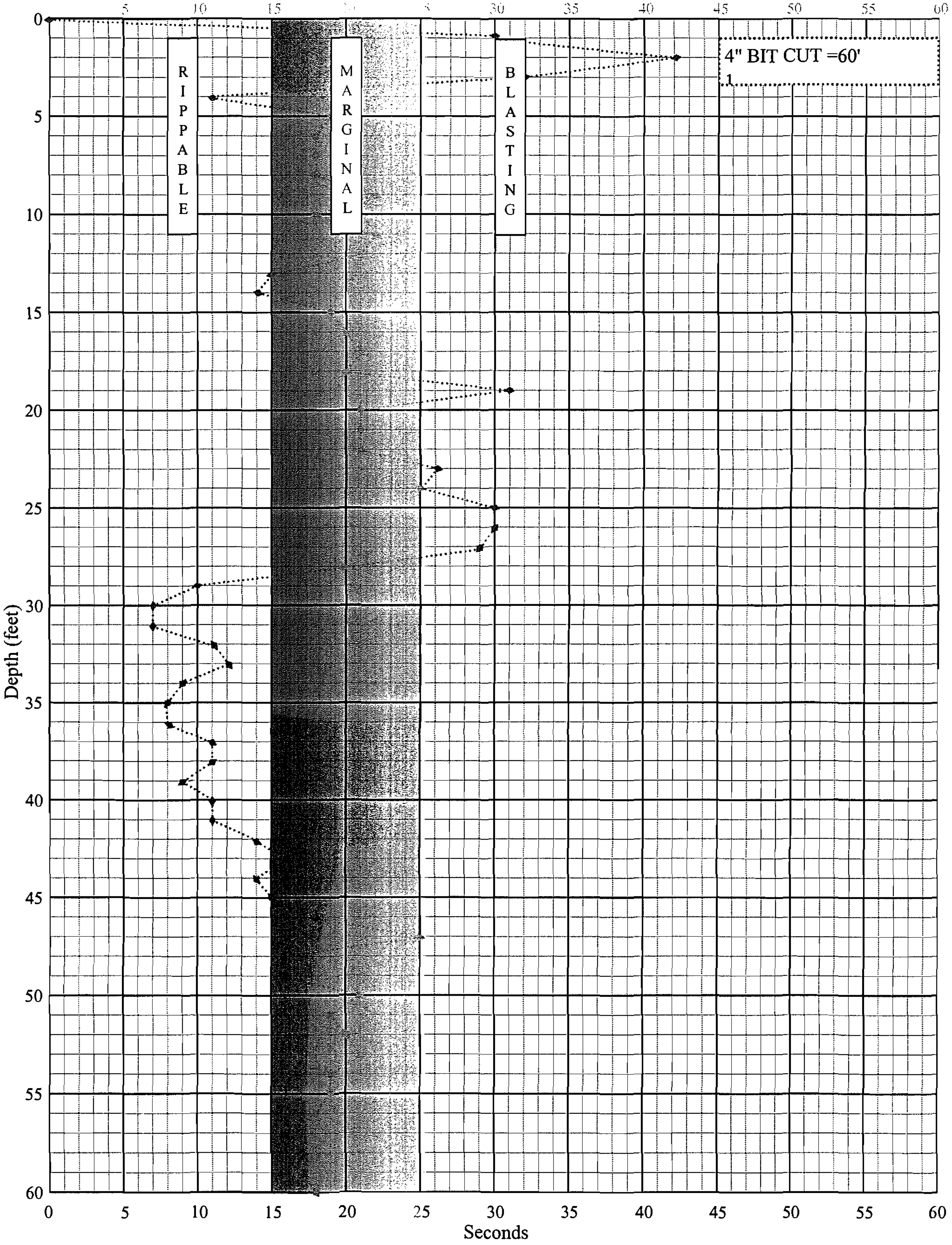
Hole # 20



E.C.M. RIVERSIDE

Date 0-Jan-00 3½": —● **Job #:** 4177

Date 11-Apr-08 4": ·····◆ **Hole # 21**



E.C.M.

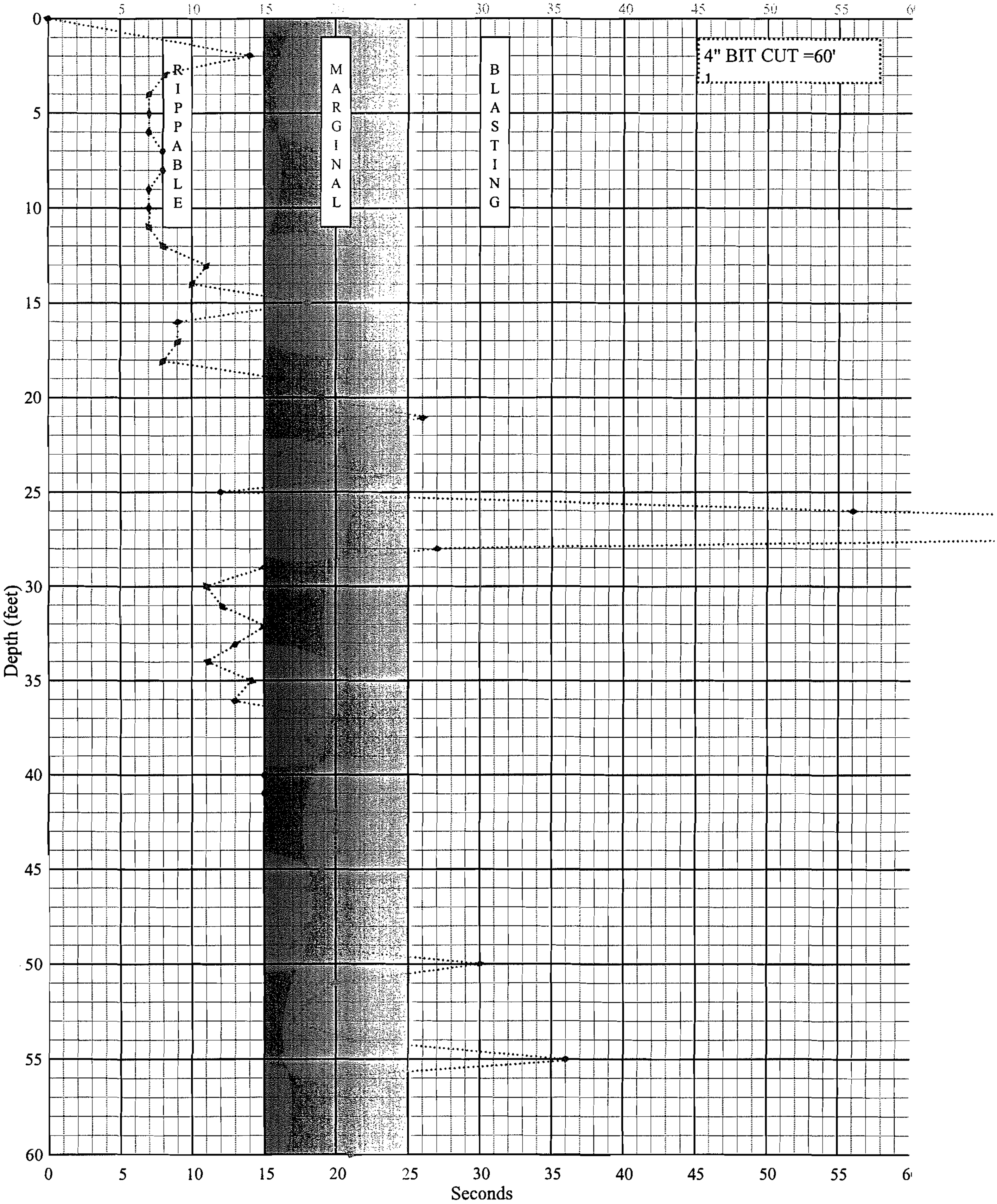
RIVERSIDE

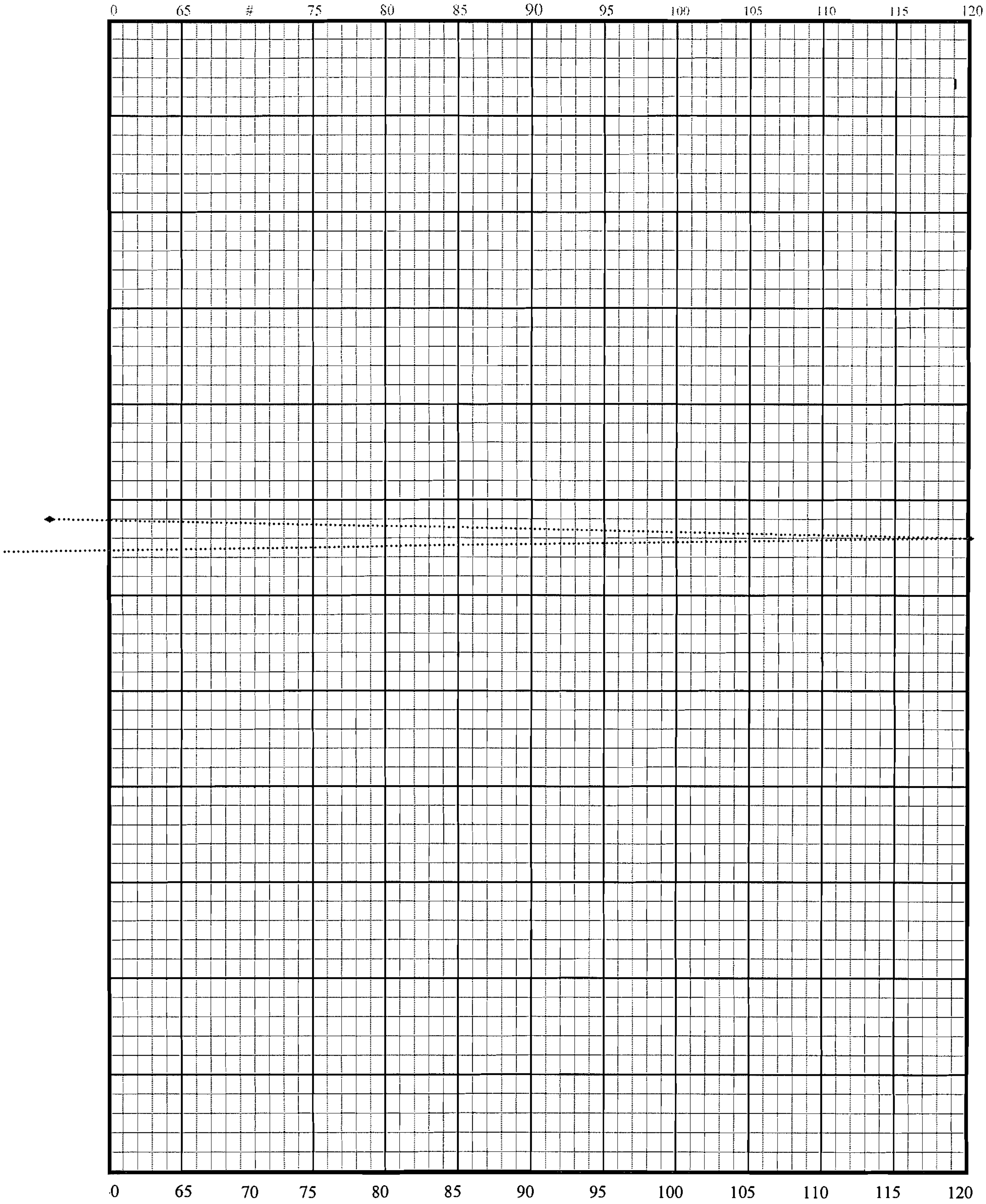
Date 0-Jan-00 3½": ——●

Job #: 4177

Date 11-Apr-08 4": ·········◆

Hole # 22

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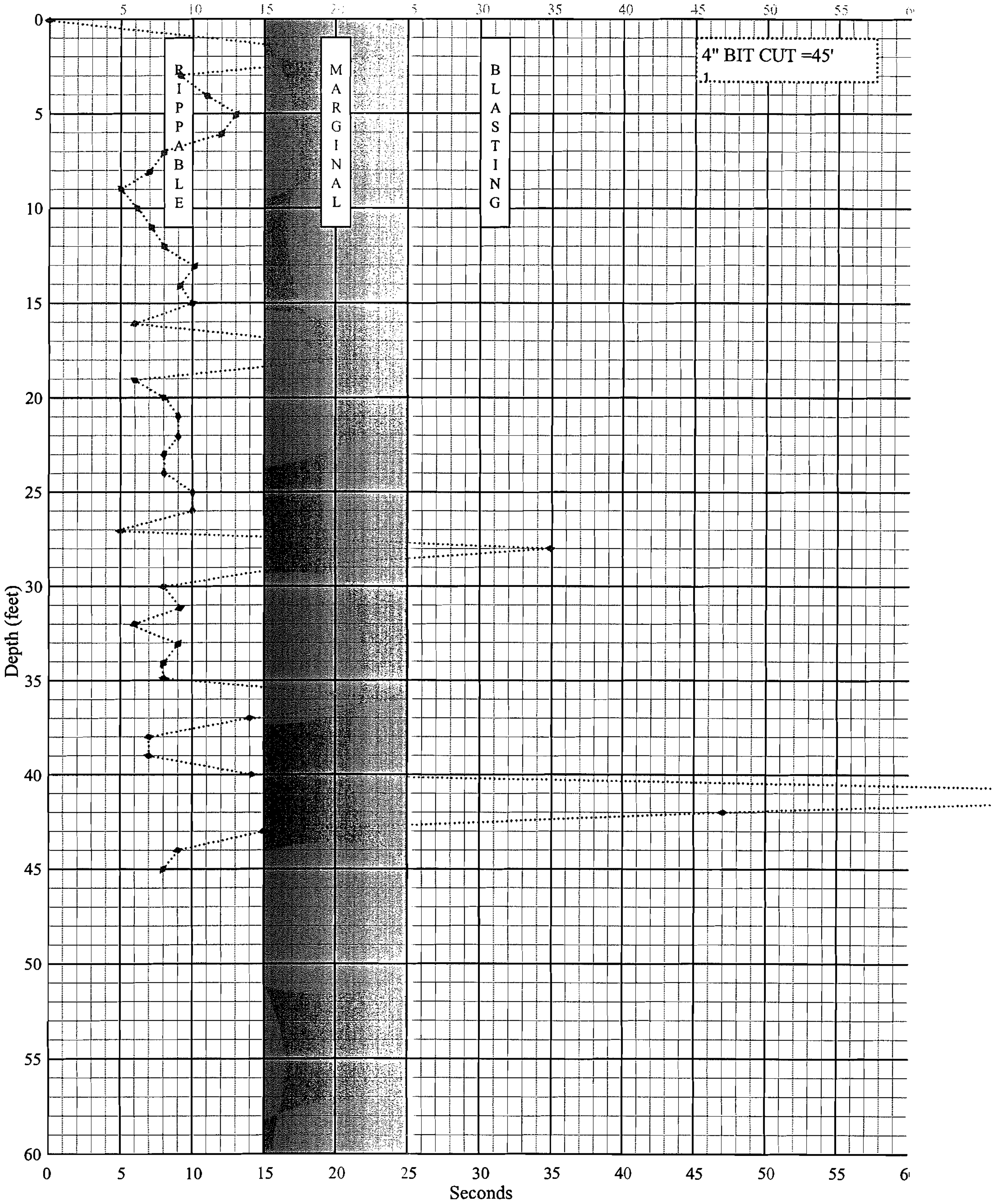
E.C.M. RIVERSIDE

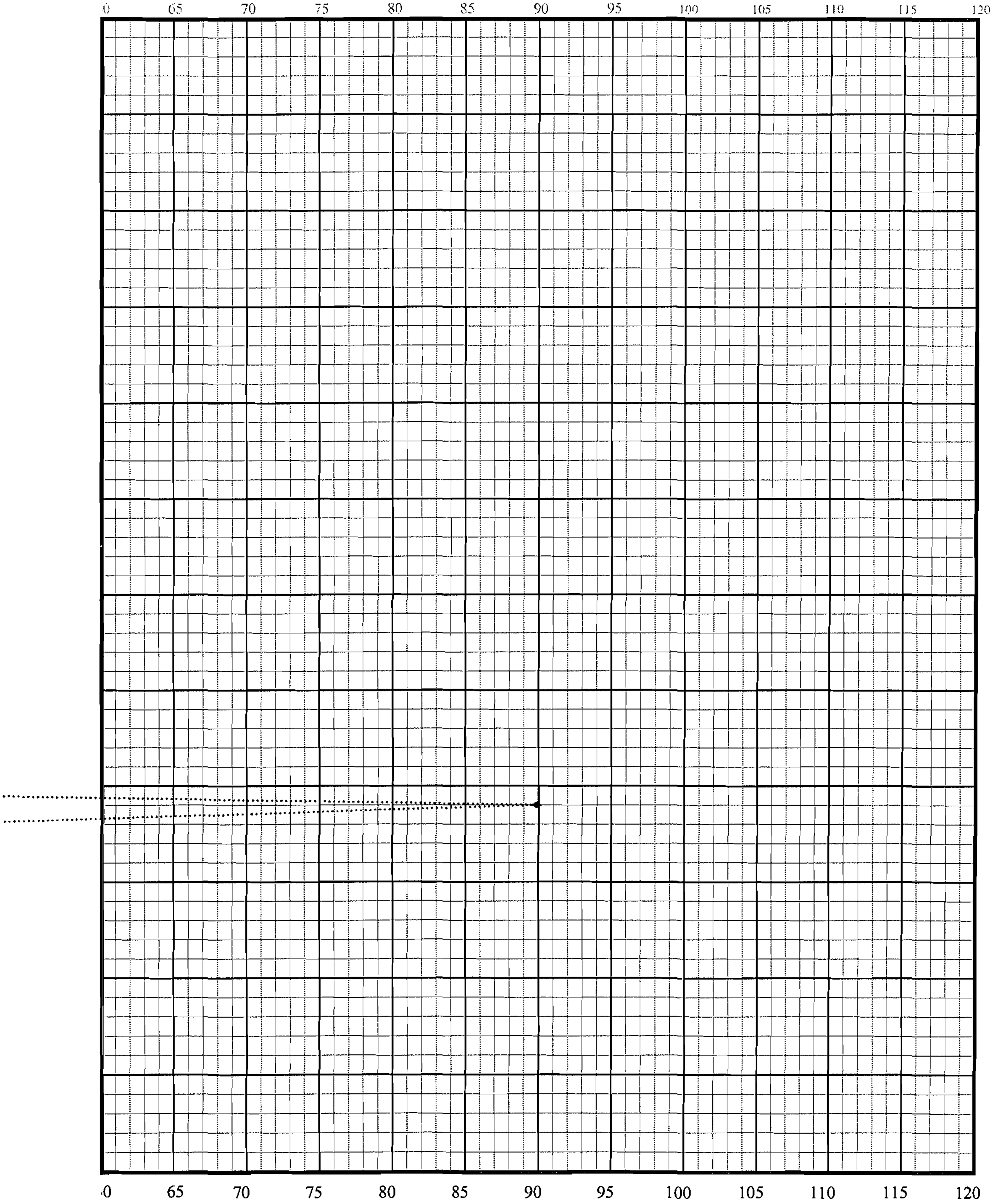
Date 0-Jan-00 3½": ——●

Date 11-Apr-08 4": ·········◆

Job #: 4177

Hole # 23

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E.C.M.

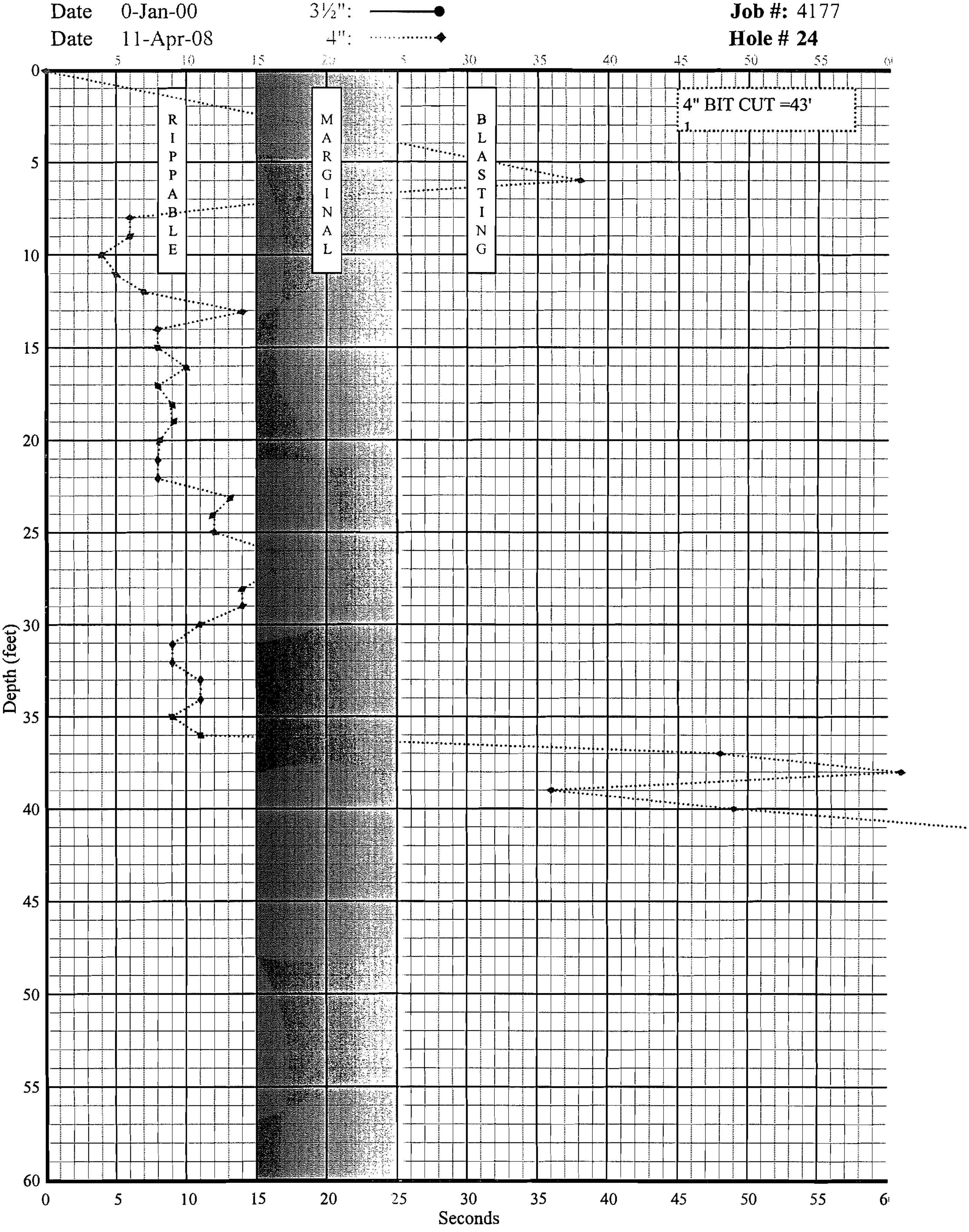
RIVERSIDE

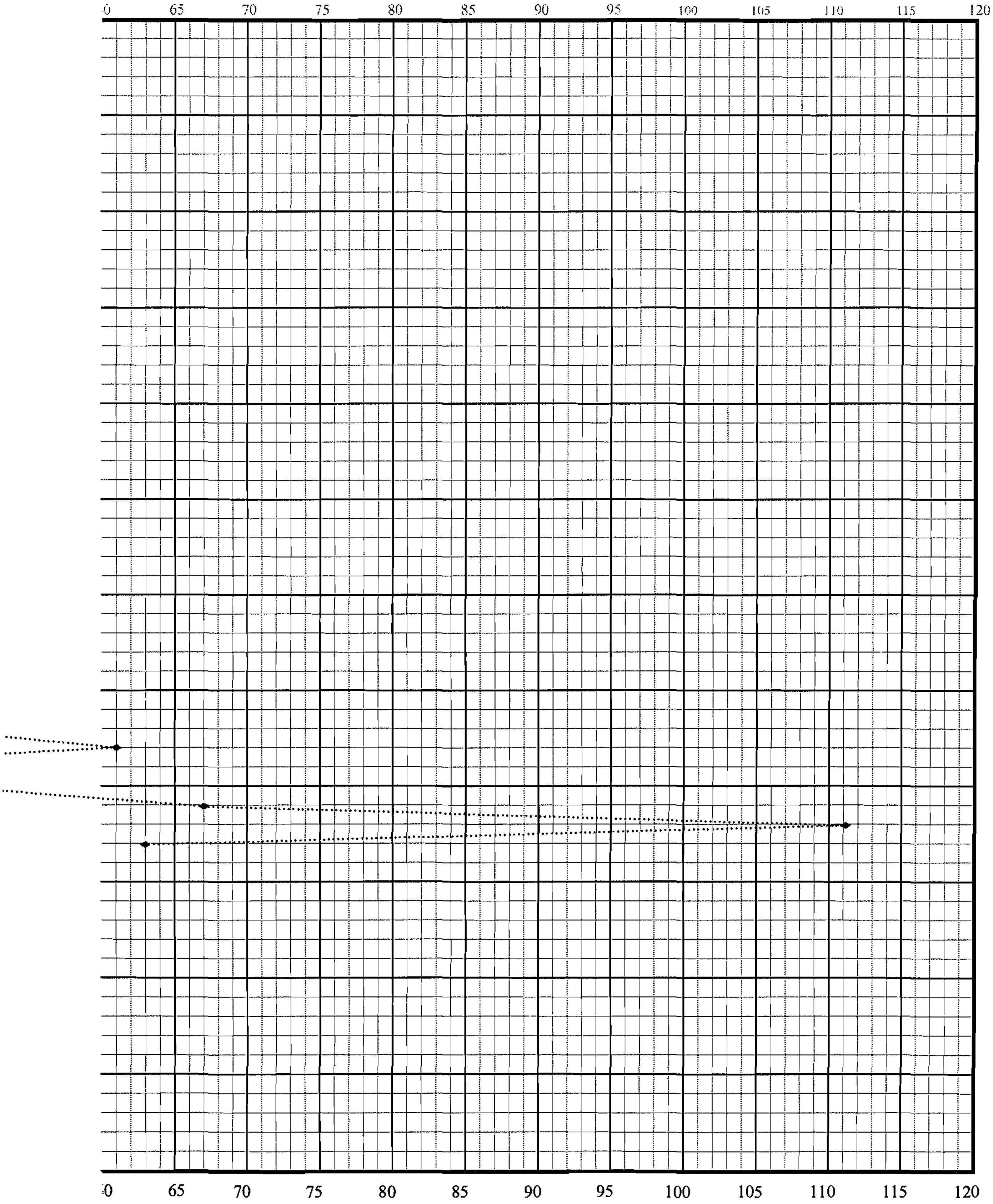
Date 0-Jan-00

Job #: 4177

Date 11-Apr-08

Hole # 24

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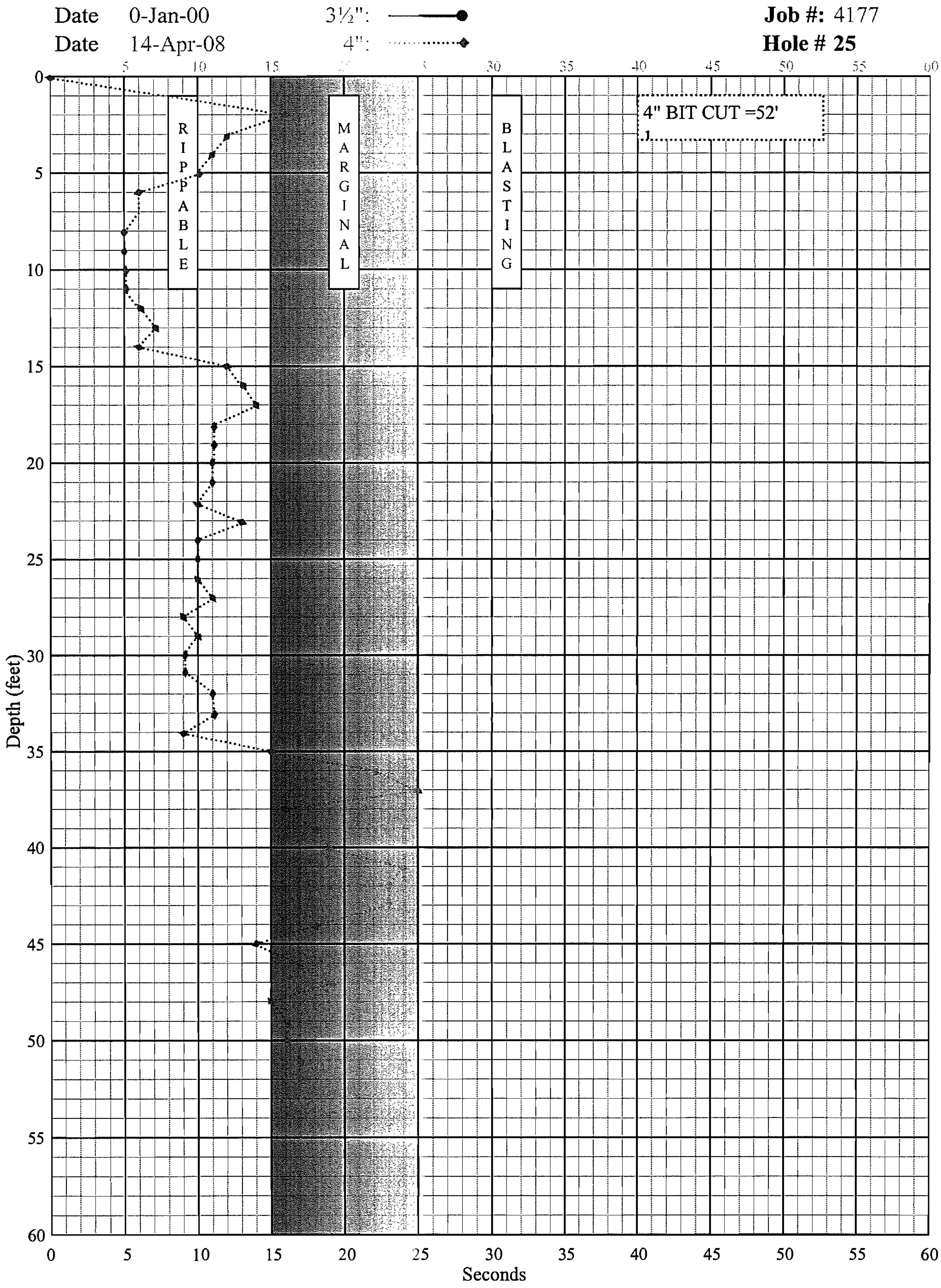
E.C.M. RIVERSIDE

Date 0-Jan-00 **Job #:** 4177

Date 14-Apr-08 **Hole # 25**



E.C.M.

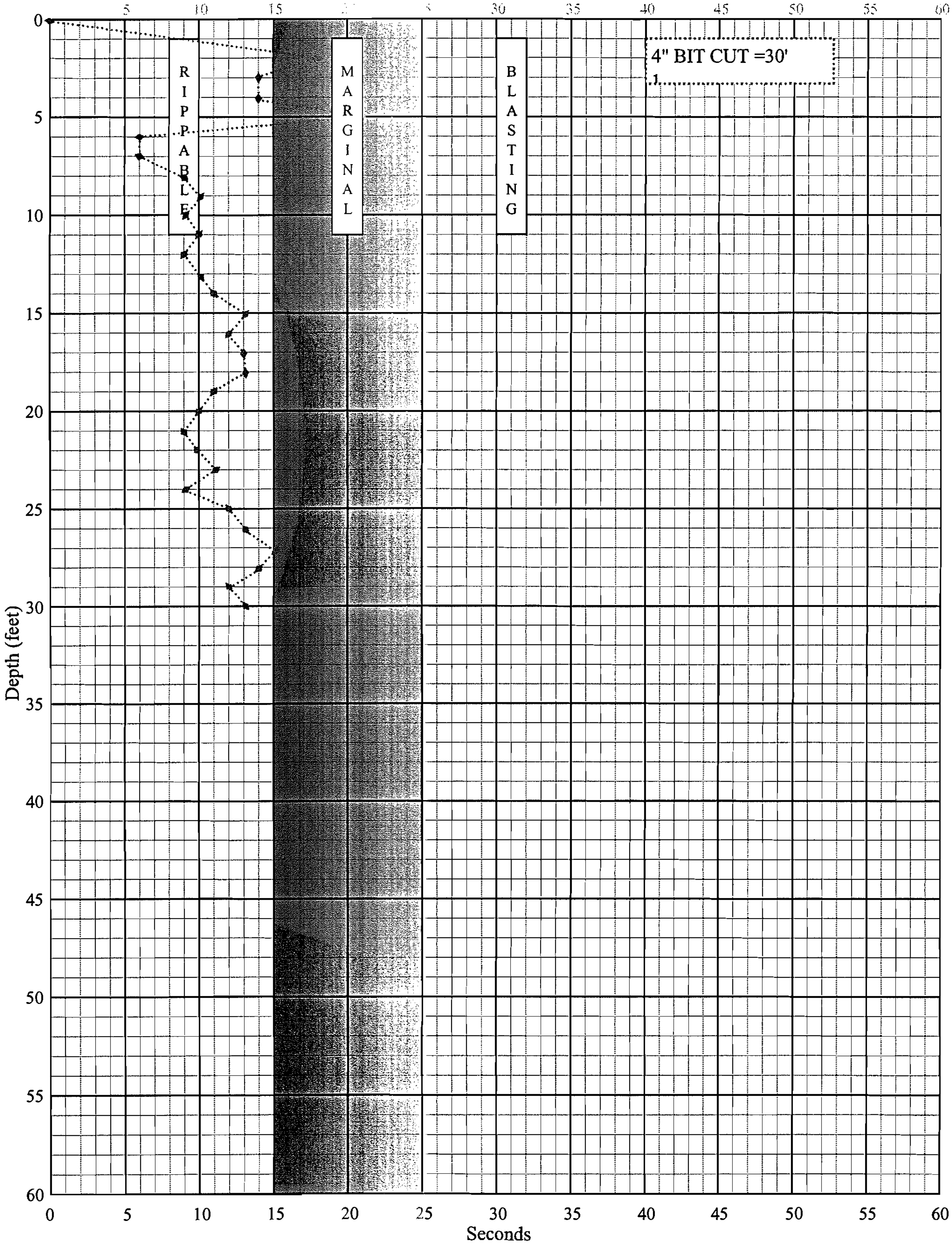
Date 0-Jan-00 3½": ——●

Date 14-Apr-08 4": ·······◆

RIVERSIDE

Job #: 4177

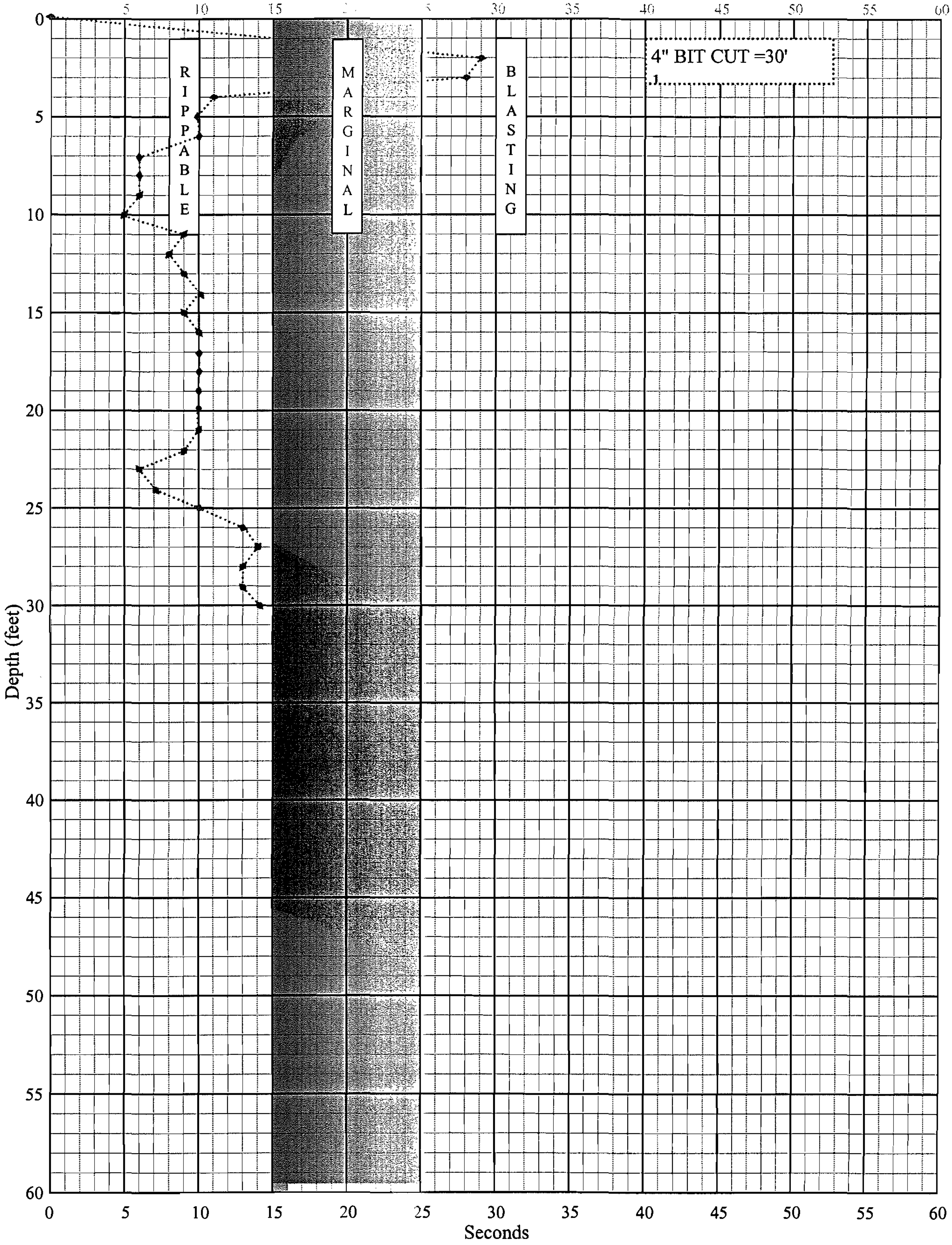
Hole # 26



E.C.M. RIVERSIDE

Date 0-Jan-00 3½": **Job #:** 4177

Date 14-Apr-08 4": **Hole # 27**



E.C.M.

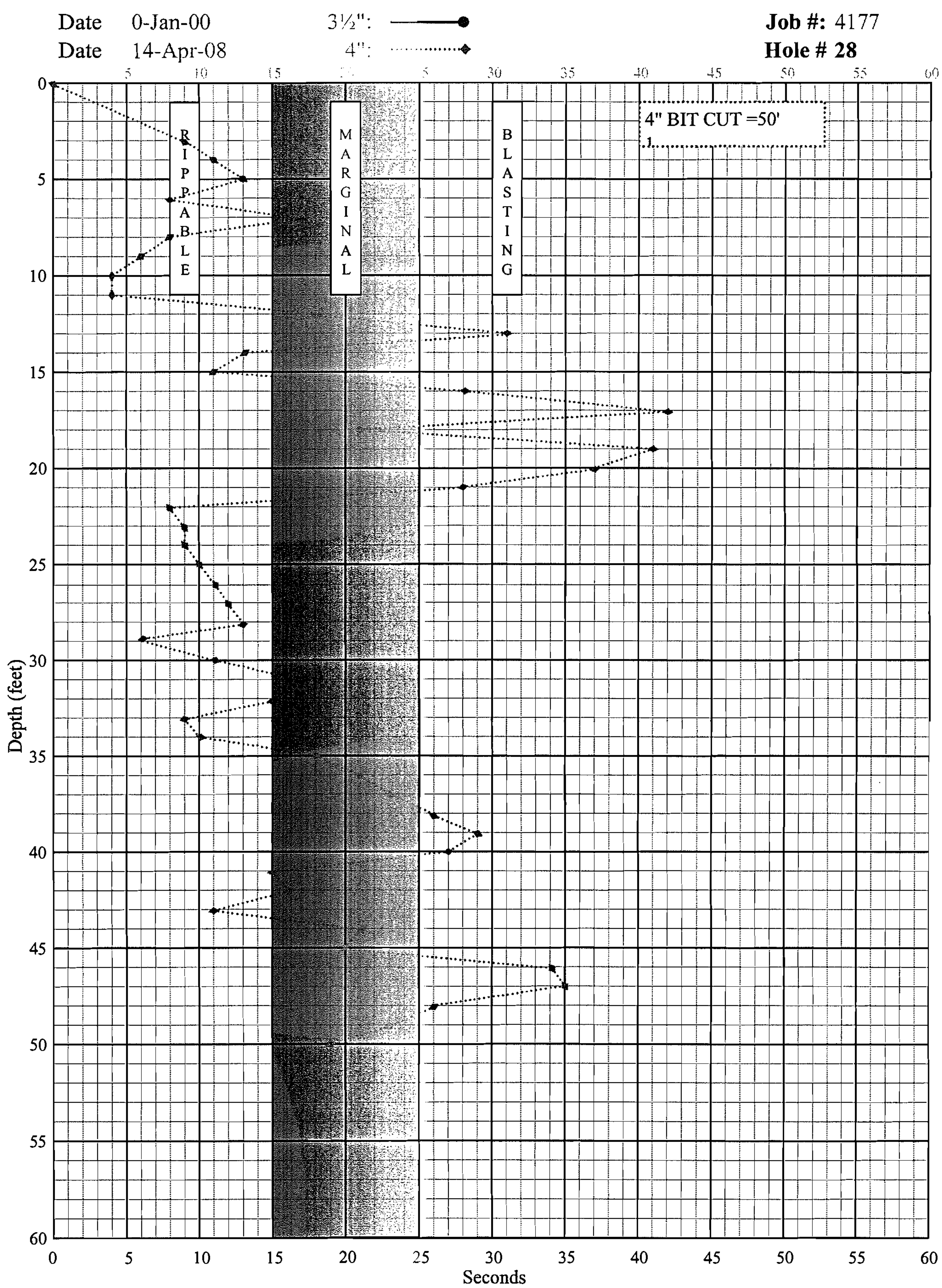
RIVERSIDE

Date 0-Jan-00

Date 14-Apr-08

Job #: 4177

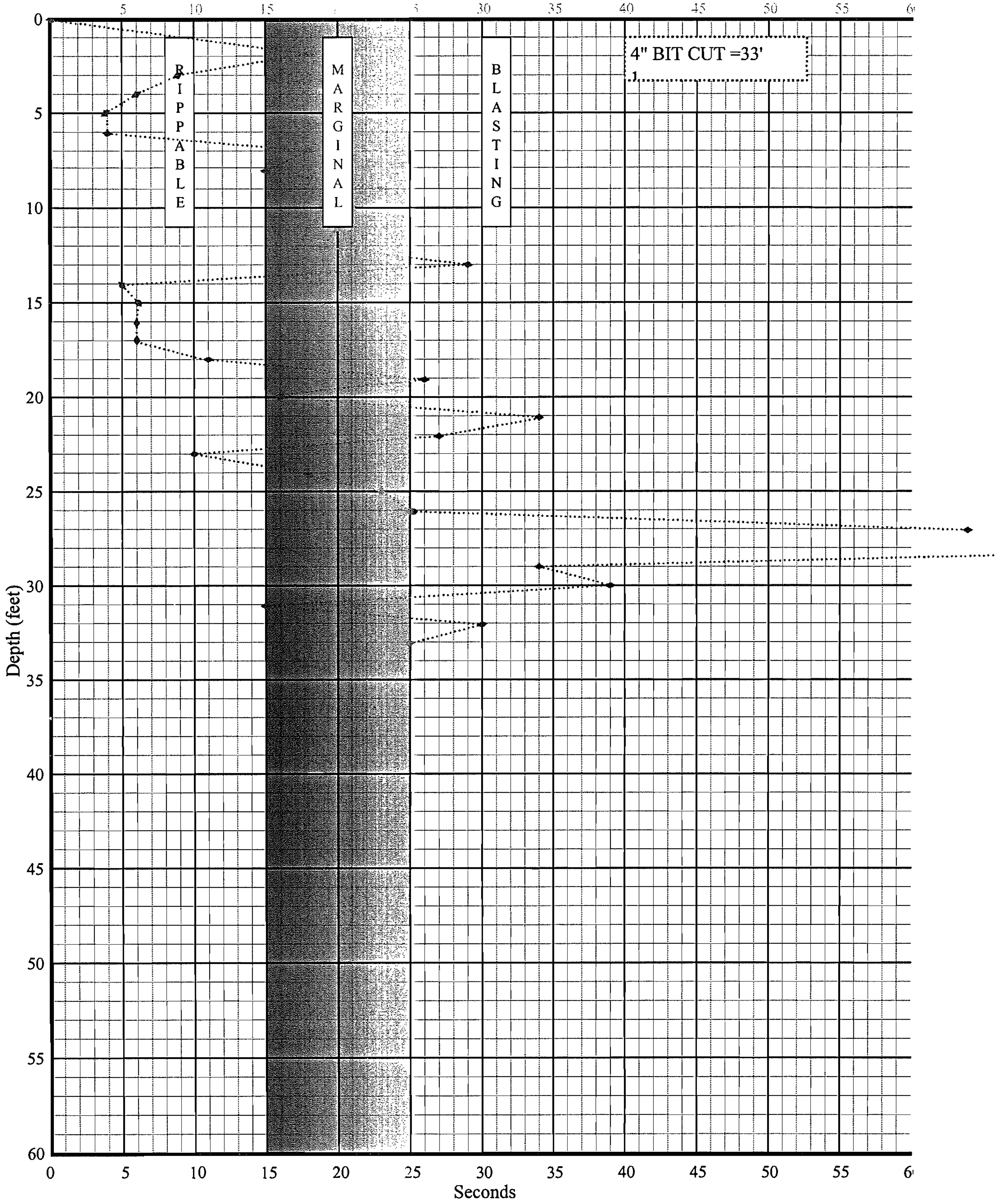
Hole # 28

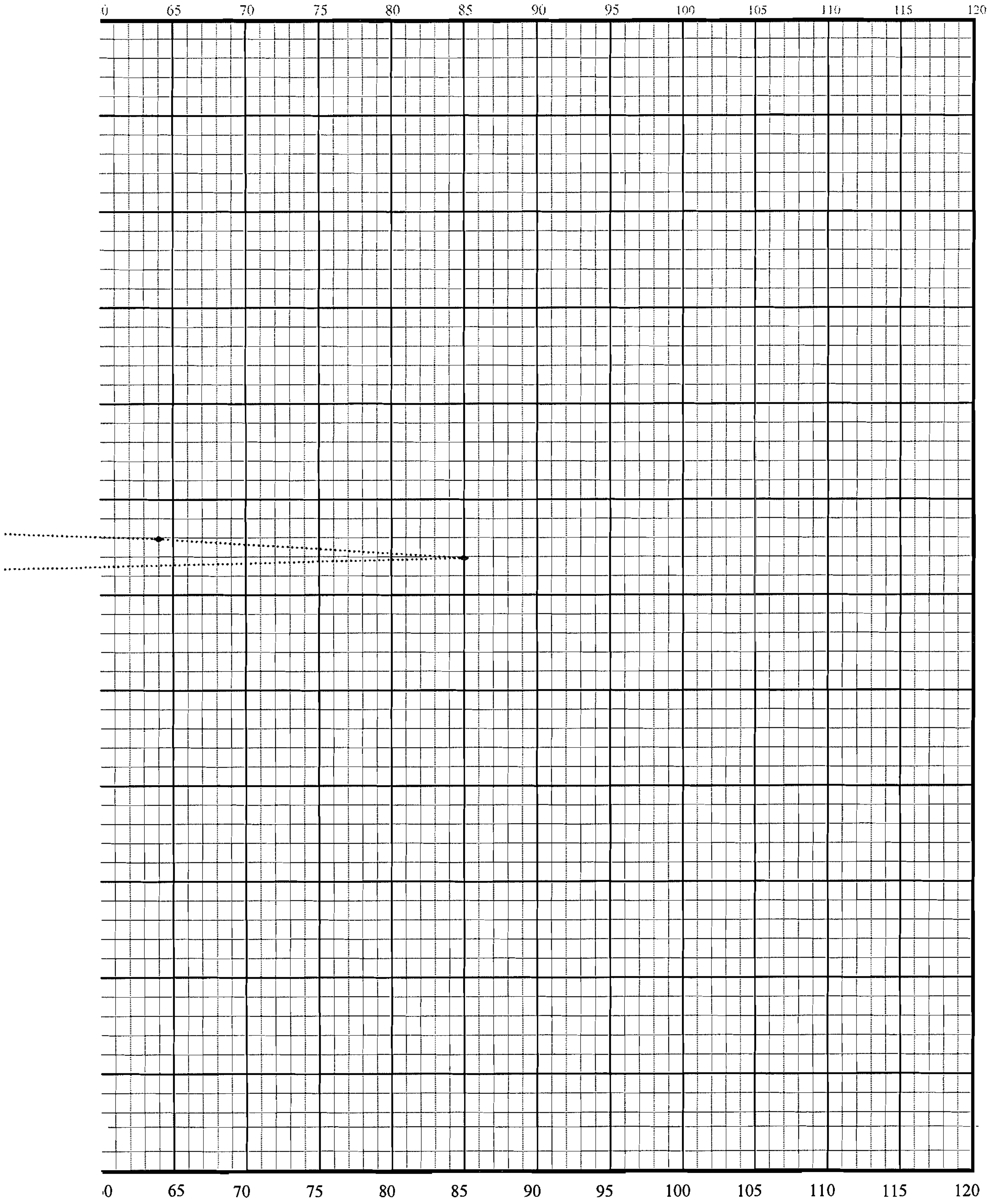


E.C.M. RIVERSIDE

Date 0-Jan-00 3½": **Job #:** 4177

Date 14-Apr-08 4": **Hole # 29**

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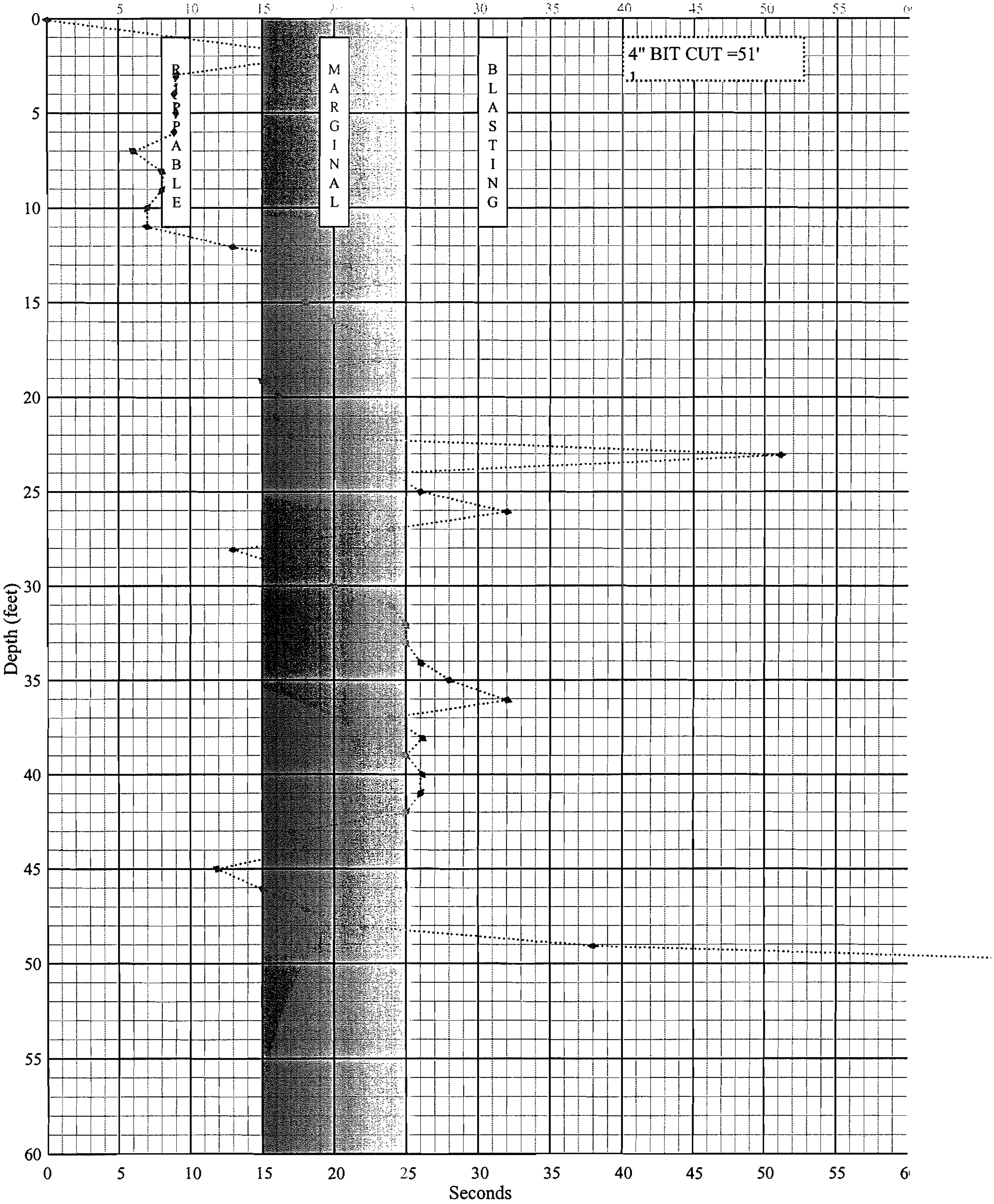
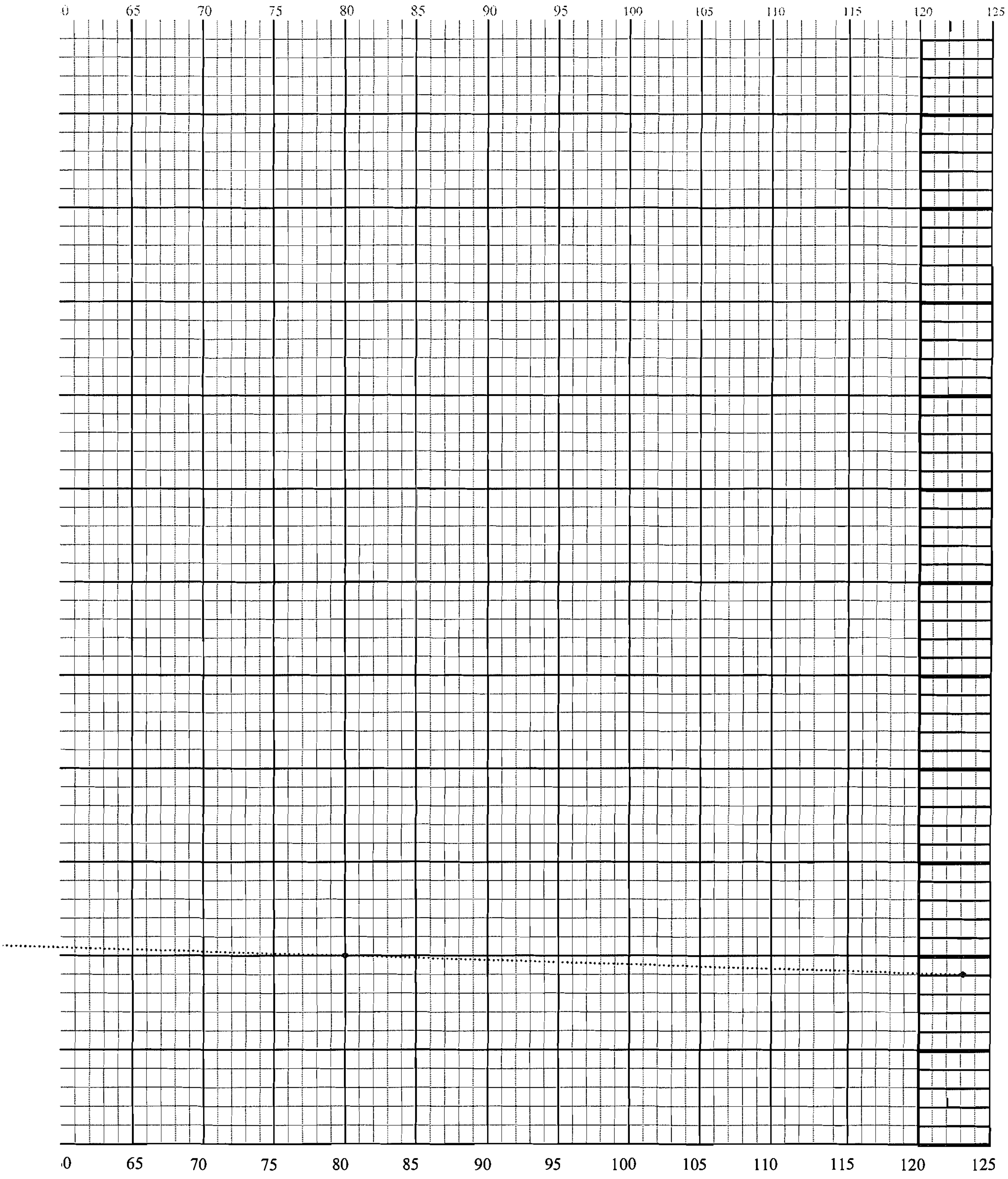
E.C.M. RIVERSIDE

Date 0-Jan-00 3½": ——● **Job #:** 4177

Date 14-Apr-08 4": ·······◆ **Hole # 30**

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E.C.M.

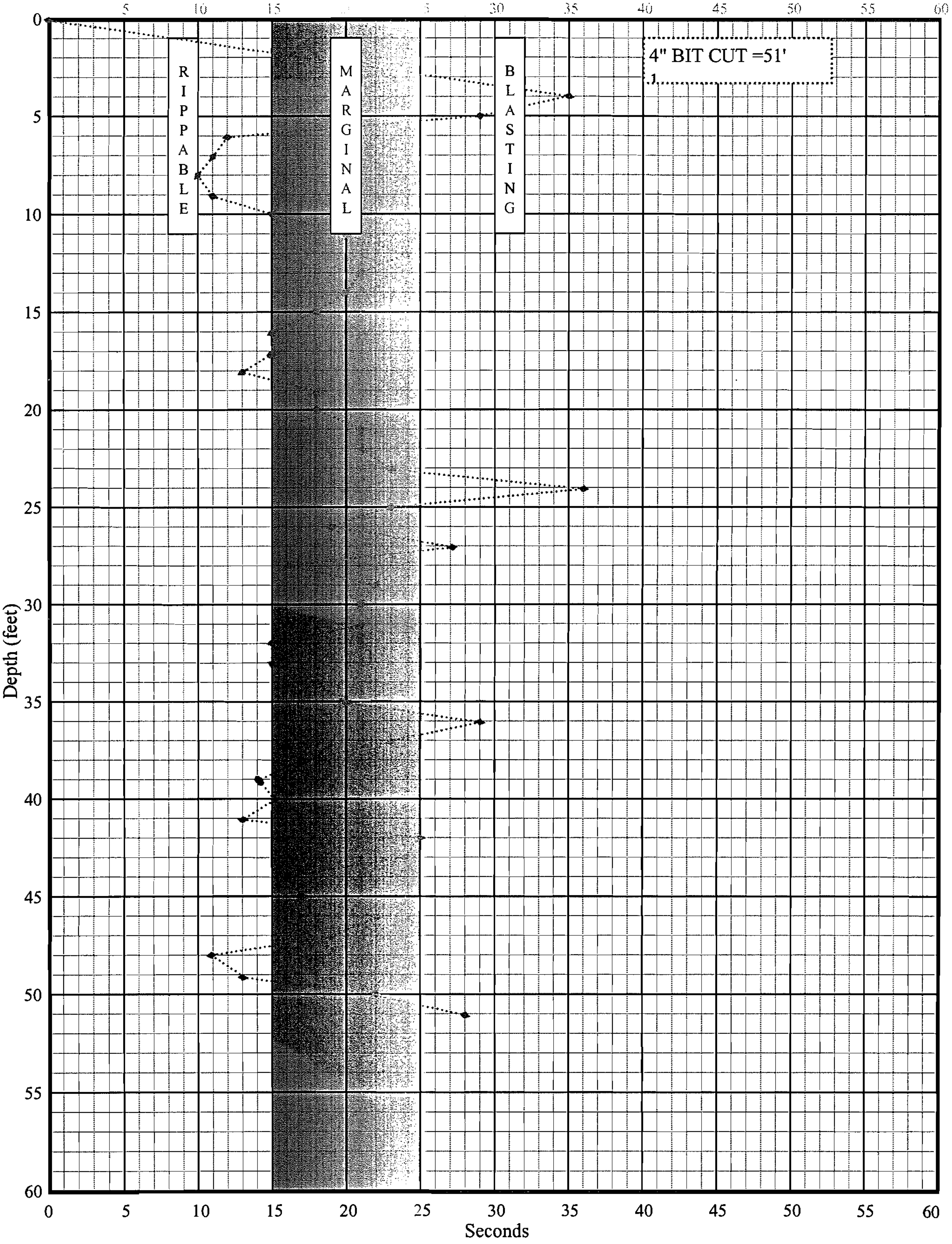
Date 0-Jan-00 3½": ——●

Date 14-Apr-08 4": ·········◆

RIVERSIDE

Job #: 4177

Hole # 31



E.C.M.

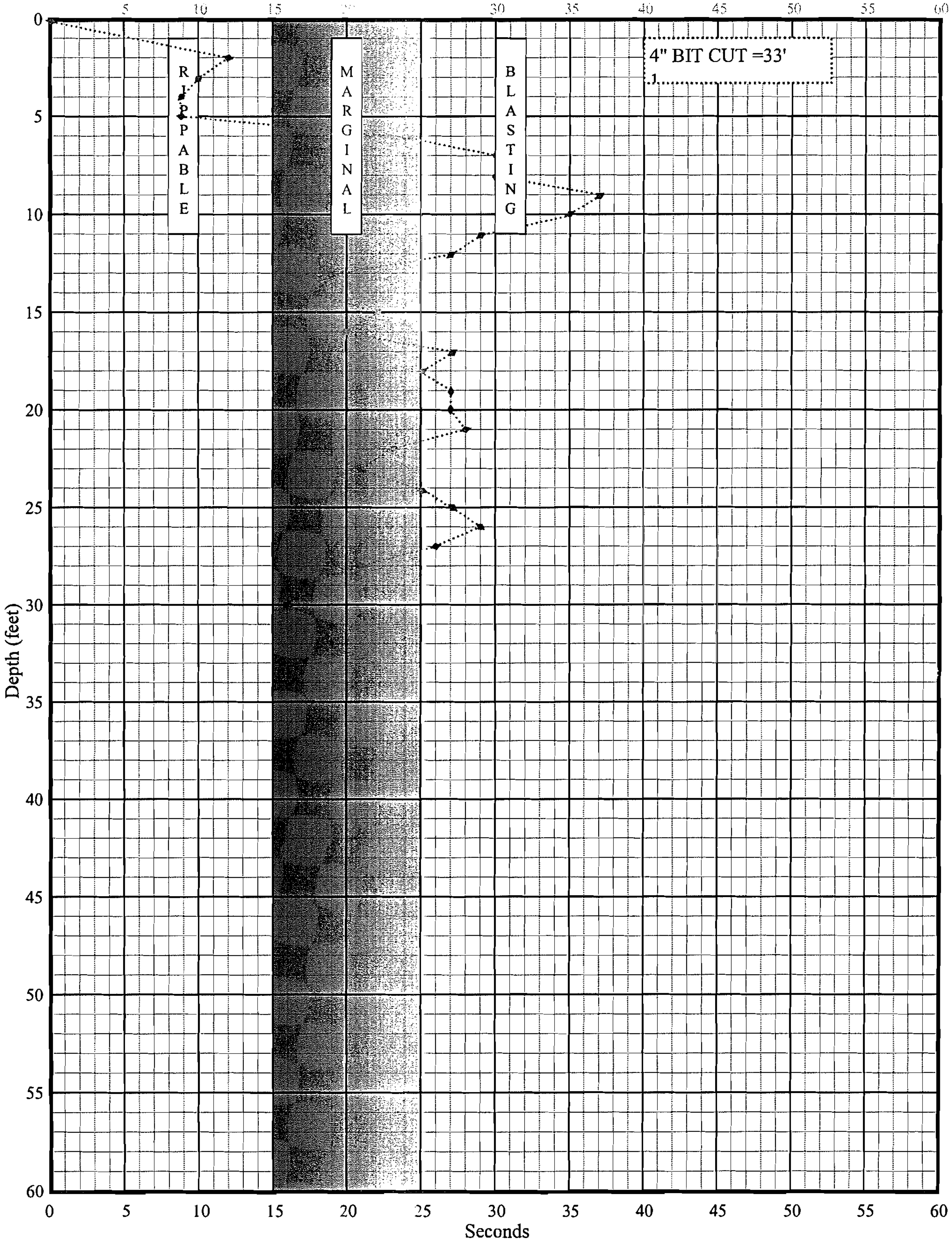
Date 0-Jan-00 3½": ——●

Date 14-Apr-08 4": ·········◆

RIVERSIDE

Job #: 4177

Hole # 32



E.C.M.

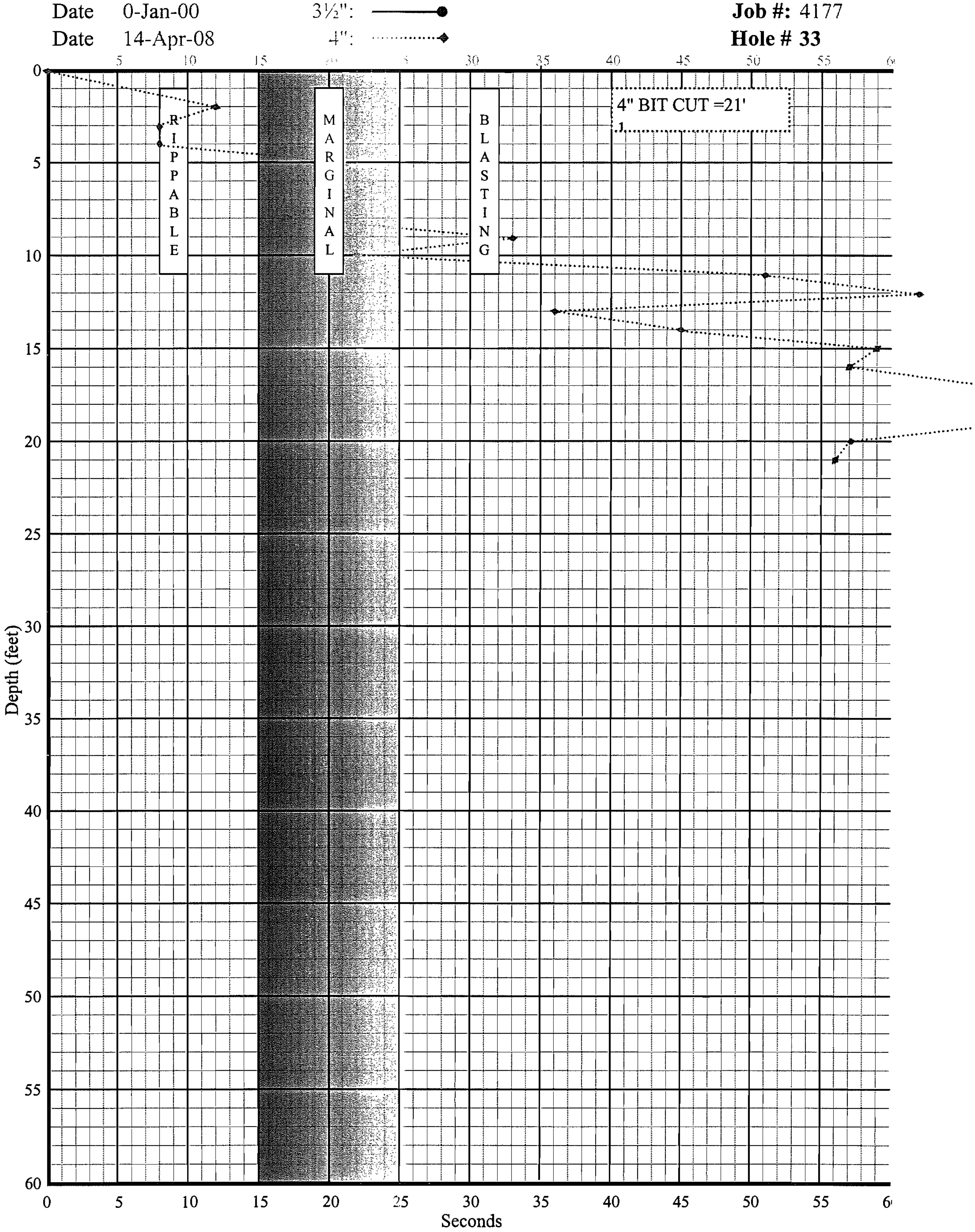
Date 0-Jan-00

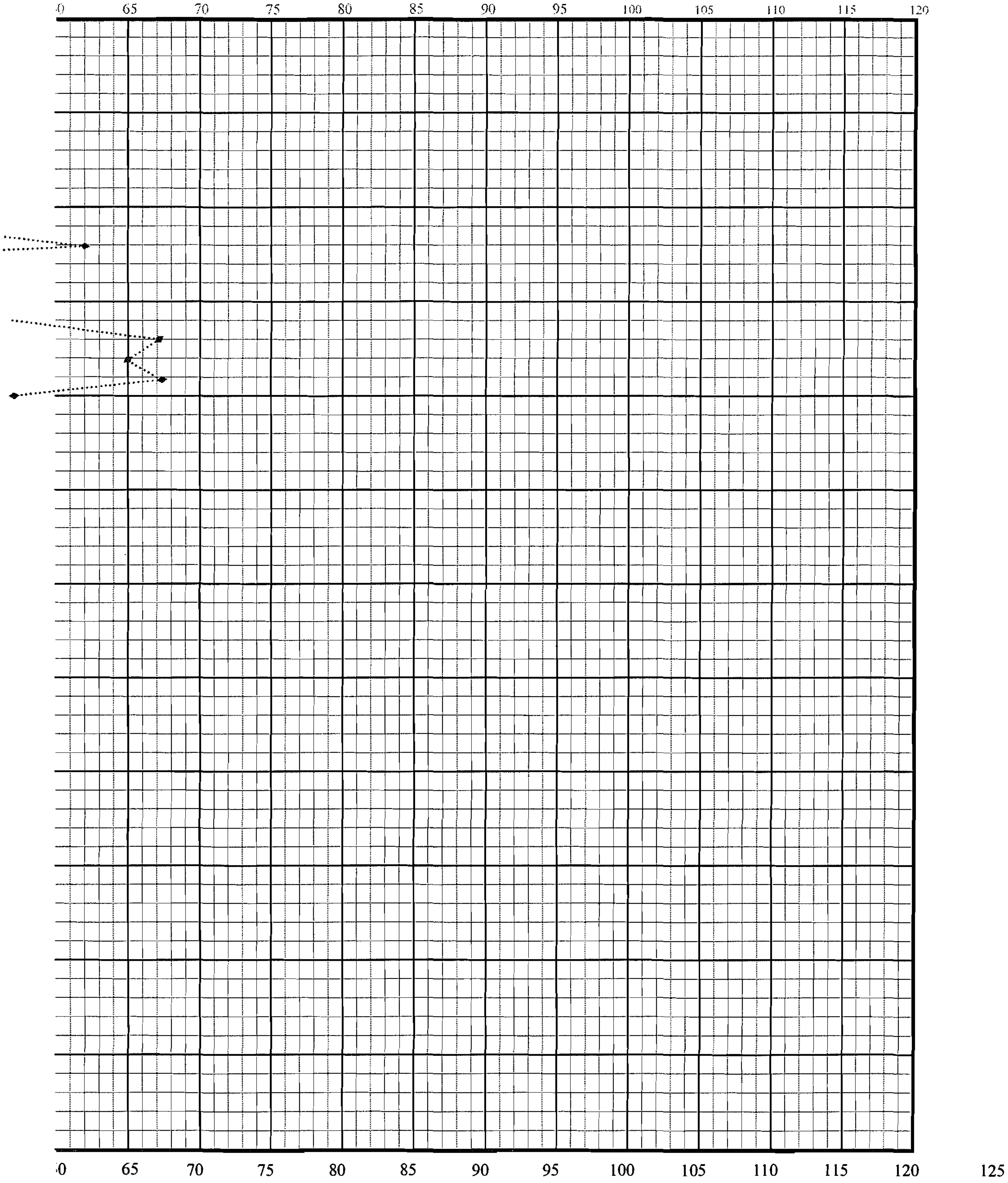
Date 14-Apr-08

RIVERSIDE

Job #: 4177

Hole # 33





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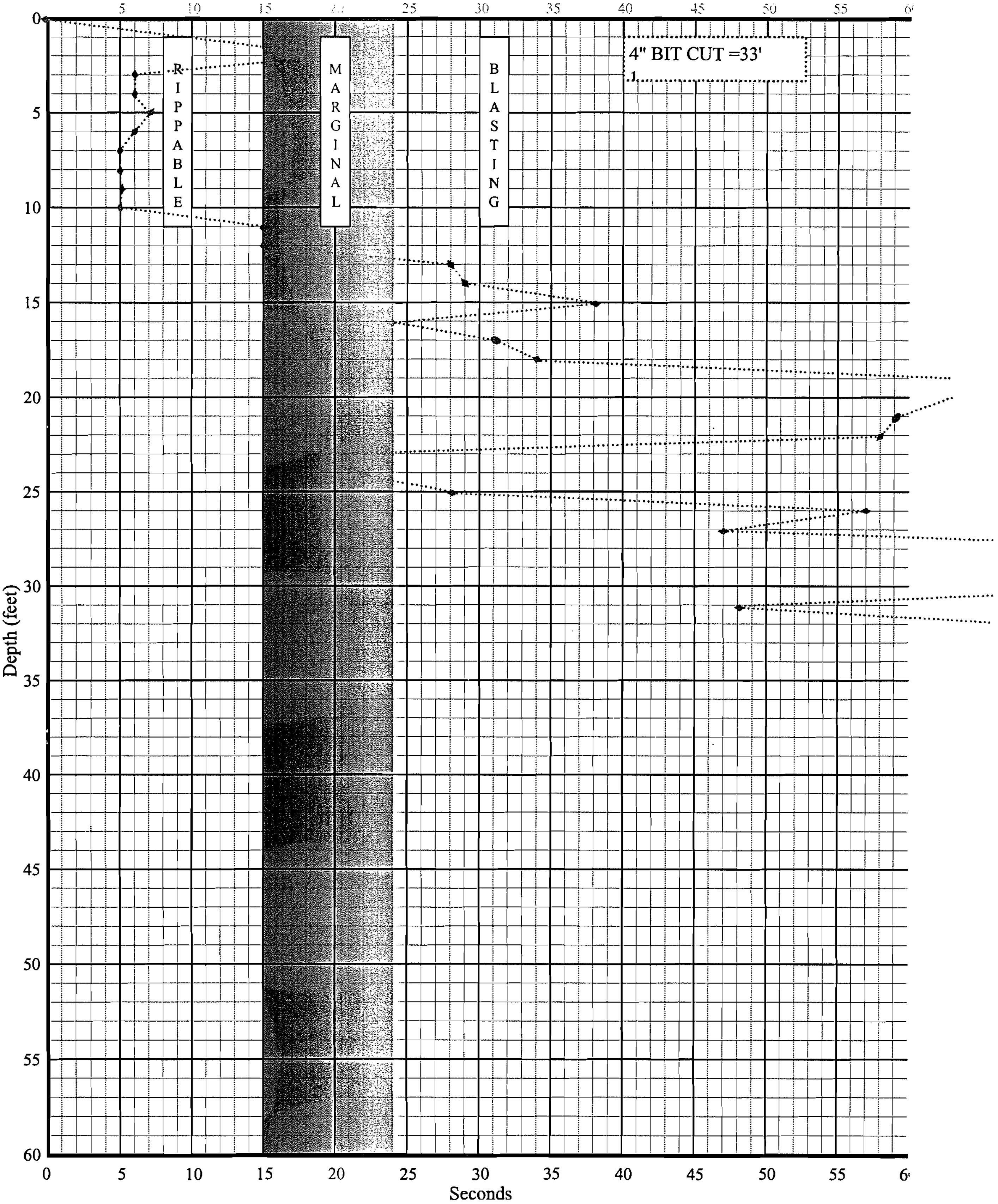
E.C.M. RIVERSIDE

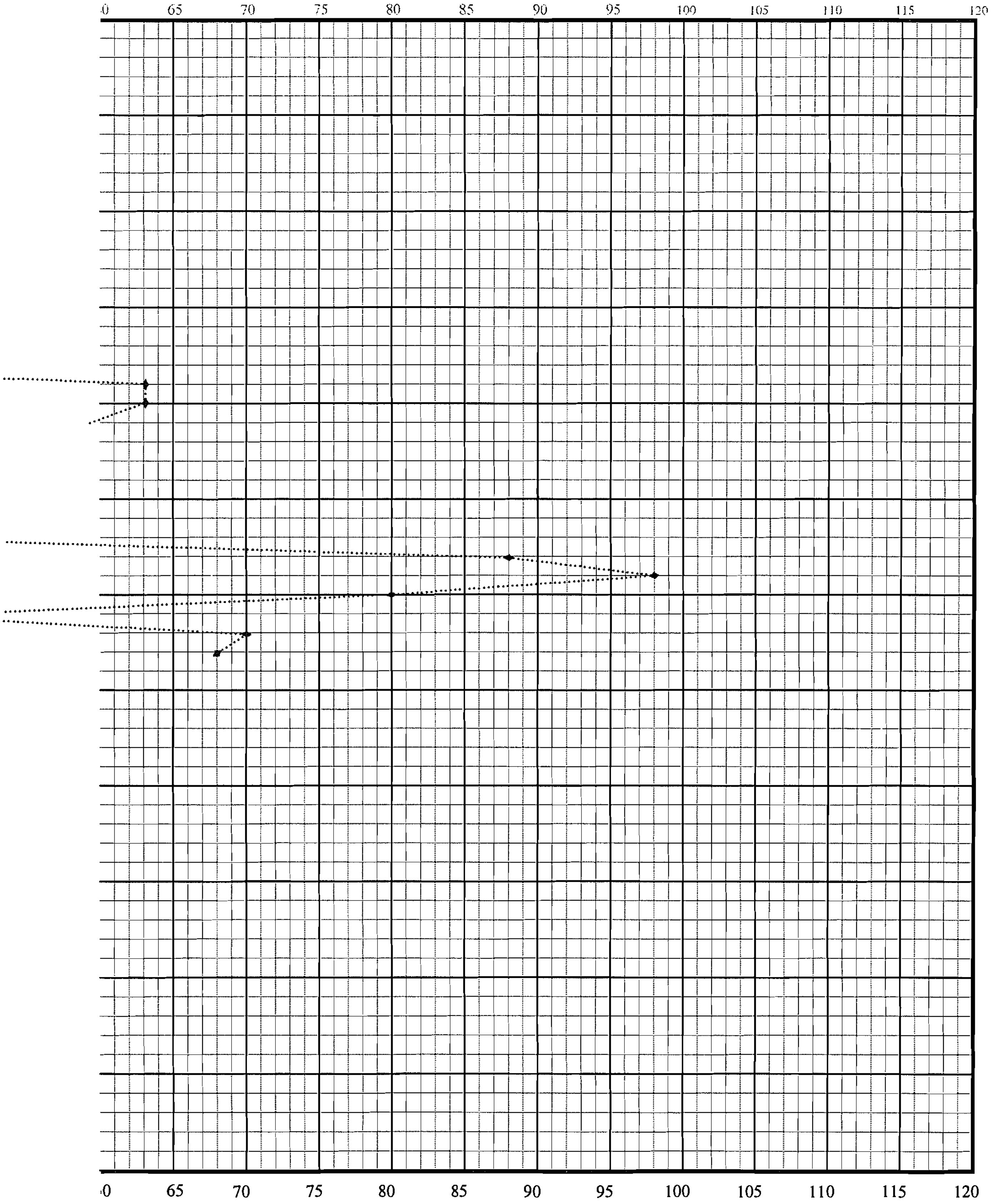
Date 0-Jan-00 3½": ——●

Date 14-Apr-08 4": ·········◆

Job #: 4177

Hole # 34

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Test Pits TP1 – TP16 Leighton, 7/20/1987

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Trench No. T - 1
Project Rose Hills
Job No. 6870318-02
Equipment Co. Bill Tice Backhoe
Type of Equip. Huddig 917
Elevation 1776±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Dark reddish-brown, (5yr 3/3), fine to medium grained with occasional coarse, moderately damp, porous, blocky soil structure, rootlets, moderately dense, hard. @ 4' minor decomposed granitics. @ 5' becoming strong brown (7.5yr 5/6) fine grained, dense, platy soil structure, abundant root casts, hard.
			■		105	7		
5								
			■		105	10		
	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated white-yellow-orange-brown, fine grained with occasional medium grains, moderately damp, abundant mica, completely to highly weathered (WC-WH), well decomposed, platy fabric form, roots to 1/4" diameter, closely spaced joints.
10								
15								TOTAL DEPTH 12' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Trench No. T - 2
Project Rose Hills
Job No. 6870318-02
Equipment Co. Bill Tice Backhoe
Type of Equip. Huddig 917
Elevation 1744±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)				87	5	SM	GRAVELLY SILTY SAND: Reddish-brown (7.5yr 4/3), fine to coarse grained, moderately moist, very poorly sorted, slightly dense, rootlets, subrounded to rounded gravels, minor subrounded cobbles.
5	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated yellow-gray-black, fine to medium grained, moderately damp, highly weathered (WH), well decomposed, amorphous fabric form, minor caliche present along fractures, moderately spaced joints, abundant mica, dense.
10								PRACTICAL REFUSAL @ 6' TOTAL DEPTH 6' NO GROUND WATER MODERATE TO HARD EXCAVATION TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 3

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1770±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Dark yellowish-brown (10yr 3/4), fine to medium grained, slightly moist, porous, rootlets, slightly blocky soil structure, slightly dense, poorly sorted.
					93	3		
		CP GS SE=17			103 (77)	3	SM	Passing #200 sieve=33%
5								Granitic boulder @ 5'.
	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated white-gray-black, fine to medium grained, slightly moist, micaceous, completely to highly weathered (WC-WH), well decomposed, amorphous fabric form, massive.
10								
								TOTAL DEPTH 8' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Trench No. T - 4
Project Rose Hills
Job No. 6870318-02
Equipment Co. Bill Tice Backhoe
Type of Equip. Huddig 917
Elevation 1710±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	OLDER ALLUVIUM(Qoal)				107	3	SM	SILTY SAND: Dark reddish-brown (5yr 3/4), fine to medium grained, moderately damp, pores, rootlets, moderately dense, poorly sorted, blocky soil structure.
5	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated white-yellow-orange-black, fine to coarse grained, highly weathered (WH), well decomposed, darks to 10%, amorphous fabric form, closely spaced joints. @ 4' becoming moderately weathered (WH)
								PRACTICAL REFUSAL @ 5' TOTAL DEPTH 5' NO GROUND WATER MODERATE TO HARD EXCAVATION TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Project Rose Hills
Equipment Co. Bill Tice Backhoe
Elevation 1638'±

Trench No. T - 5
Job No. 6870318-02
Type of Equip. Huddig 917

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)				95	3	SM	SILTY SAND: Very dark grayish-brown (10yr 3/2), fine to coarse grained, moderately moist, very poorly sorted, minor gravels, minor cobbles, granitic boulders @ 1', noncohesive, very loose, rootlets, slight to moderate caving.
5	GRANITICS (Kgr)							DECOMPOSED GRANITE: Dark gray to black, fine to medium grained, moderate moist, abundant mica, darks to 85%, highly weathered (WH), well decomposed, massive. @ 5' becoming moderately weathered (WM).
								PRACTICAL REFUSAL @ 6' TOTAL DEPTH 6' NO GROUND WATER MODERATE TO HARD EXCAVATION SLIGHT TO MODERATE CAVING TO 4' TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 6

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1605±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	Topsoil						SM	SILTY SAND: Dark reddish-brown (5yr 3/4), fine to medium grained, slightly moist, porous, rootlets, blocky soil structure, moderately dense.
5	GRANITICS (Kgr)	GS SE=51			-	4	SW-SM	DECOMPOSED GRANITE: Varigated white-orange-black, fine to coarse grained, moderately damp, completely weathered to 3' (WC), highly weathered below 3' (WH), well decomposed, darks to 20%, abundant mica, massive. Passing #200 sieve=6%
10								@ 10' becoming moderately weathered (WM), moderately decomposed.
15								TOTAL DEPTH 12' NO GROUND WATER MODERATE HARD EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T -7

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1573±'

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)						SM	SILTY SAND: Dark brown (10yr 3/3), fine to medium grained, moderately moist, micaceous, poorly sorted, noncohesive, loose, rootlets to 2'.
					90	5		@ 3' becoming dark reddish-brown, moist, fine grained with occasional medium grains, slightly cohesive, slightly sorted, loose.
5		CP GS SE=4			94 (76)	9	ML	Passing #200 sieve=63% @ 8' trace of mottling.
10	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated yellow to black, fine to medium grained, moist, highly weathered (WH), well decomposed, massive, amorphous fabric form. @ 11' becoming moderately weathered (WM), moderately decomposed.
15								PRACTICAL REFUSAL @ 12' TOTAL DEPTH 12' NO GROUND WATER MODERATE TO HARD EXCAVATION TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 8

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill'Tice Backhoe

Type of Equip. Huddig 917

Elevation 1615'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)		■		99	2	SM	SILTY SAND: Dark brown (10yr 3/3), fine to medium grained, moderately damp, micaceous, noncohesive, poorly sorted, loose, rootlets.
			■		104	13		Becoming dark reddish-brown, (5yr 3/2), moist, fine grained minor clay, cohesive, slightly dense, slightly sorted, below 7' occasional pores.
5								
10								
	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated white to olive gray, fine to medium grained, moist, completely weathered, very well decomposed, massive, amorphous fabric form.
15								TOTAL DEPTH 15' NO GROUND WATER EASY EXCAVATION NO CAVING TRENCH BACKFILLS

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 9

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1616'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)						SM	SILTY SAND: Dark brown (10yr 3/3), fine to medium grained, slightly damp, slightly dense, rootlets to 2', occasional coarse grains, poorly sorted, noncohesive, @ 3' becoming moderately moist.
5								
10	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Black (10yr 2/1), porous, slightly blocky soil structure, trace of clay, cobbles (subrounded).
15								TOTAL DEPTH 15' NO GROUND WATER EASY EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 10

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1618'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)						SM	SILTY SAND: Dark yellowish-brown (10yr 4/4), fine to coarse grained, slightly damp, poorly sorted, noncohesive, loose, occasional pores.
5								
	GRANITICS (Kgr) →							DECOMPOSED GRANITE: Varigated yellow-orange-gray-brown, fine to medium grained, slightly moist, micaceous, highly weathered (WH), well decomposed, massive.
10								TOTAL DEPTH 8' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Trench No. T - 11
Project Rose Hills
Job No. 6870318-02
Equipment Co. Bill Tice Backhoe
Type of Equip. Huddig 917
Elevation 1676'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Dark reddish-brown (5yr 3/4), fine to coarse grained, moderately damp, moderately dense, blocky soil structure, minor clay, rootlets.
			▥				SM	CLAYEY SILTY SAND: Very dark grayish-brown (2.5yr 3/2), fine grained, moist, dense, abundant caliche present, slightly sorted, hard.
5	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated, yellow-gray-black, fine to medium grained, moist, abundant mica, highly weathered (WH), darks to 60%, massive.
10								TOTAL DEPTH 8' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 12

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1628'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0 5	ALLUVIUM (Qal)	CP GS SE=8			108 (79) 104	7 10	SM	SILTY SAND: Dark reddish-brown (5yr 3/4), fine to medium grained with occasional coarse, moist, slightly dense, poorly sorted, slightly cohesive, occasional pores, rootlets. Passing #200 sieve=41%
10	GRANITICS (Kgr)							DECOMPOSED GRANITE: Varigated yellow to black, fine to coarse grained, micaceous, moist, darks to 15%, highly weathered, well decomposed, massive.
15								TOTAL DEPTH 10' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 13

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1630'±

Logged By CK

Sampled By CK

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	ALLUVIUM (Qal)				116	11	SM	SILTY SAND: Dark yellowish-brown (10yr 3/4), fine to coarse grained, moist, slightly dense, minor clay, cohesive, poorly sorted.
5 10	GRANITICS (Kgr)	GS SE=81			-	4	SW-SM	DECOMPOSED GRANITE: Varigated yellow-gray-black, fine to medium grained, moist, highly weathered (WH), slightly platy fabric form, well decomposed, massive, darks to 70%. Passing #200 sieve=5%
15								TOTAL DEPTH 11' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Trench No. T - 14

Project Rose Hills

Job No. 6870318-02

Equipment Co. Bill Tice Backhoe

Type of Equip. Huddig 917

Elevation 1598'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)		▬		89	6	SM	SILTY SAND: Dark brown (7.5yr 3/2), fine to medium grained, slightly moist, slightly dense, rootlets, poorly sorted. @ 4' minor cobbles (subrounded), minor gravels (subangular to subrounded).
5	GRANITICS (Kgr)		III					DECOMPOSED GRANITE: Varigated yellow-gray-black, fine to medium grained, moist, well decomposed, highly weathered (WH), massive, minor calicle present.
10								
15								TOTAL DEPTH 14' NO GROUND WATER EASY TO MODERATE EXCAVATION NO CAVING TRENCH BACKFILLING

GEOTECHNICAL TRENCH LOG

Date 7-20-87
Trench No. T - 15
Project Rose Hills
Job No. 6870318-02
Equipment Co. Bill Tice Backhoe
Type of Equip. Huddig 917
Elevation 1690'±

GEOTECHNICAL DESCRIPTION
Logged By CK
Sampled By CK

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	OLDER ALLUVIUM (Qoal)		▥		106	5	SM	SILTY SAND: Very dark grayish-brown (10yr 3/2), fine to coarse grained, moderately moist, porous, rootlets, blocky soil structure, moderate dense, poorly sorted.
5	GRANITICS (Kgr)		▥					DECOMPOSED GRANITE: Varigated white-yellow-black, fine to medium grained, moderately damp, highly weathered, well decomposed, moderate spaced joints, @ 9' becoming moderately weathered, hard.
10								Practical refusal @ 10' TOTAL DEPTH 10' NO GROUND WATER MODERATE TO HARD EXCAVATION TRENCH BACKFILLING
15								

GEOTECHNICAL TRENCH LOG

Date 7-20-87

Project Rose Hills

Equipment Co. Bill Tice Backhoe

Elevation 1720'±

Trench No. T - 16

Job No. 6870318-02

Type of Equip. Huddig 917

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By CK Sampled By CK
0	ALLUVIUM (Qal)		III				SM	SILTY SAND: Dark brown (7.5yr 3/4), fine to coarse grained, moist, poorly sorted, noncohesive, minor granitic cobbles, subrounded, slightly dense, minor gravels.
5	GRANITICS (Kgr)		III					DECOMPOSED GRANITE: Varigated, yellow to olive gray, fine to medium grained, moist, completely to highly weatheres (WH-WC), micaceous, darks to 30%, well decomposed, massive, trace of $CaCo_3$, below 6' darks to 60%.
10								
15								TOTAL DEPTH 15' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLING

Test Pits TP1 – TP8 Leighton, 10/29/1987

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-1

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1860'±

Logged By RLA

Sampled By RLA

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION
0	TOPSOIL		Bag 1				SC	TOPSOIL: Reddish brown, clayey sand with rootlets, slightly damp, massive, loose.
	GRANITICS (Kgr)							GRANITICS: Tan to light reddish brown, J: N78E/86N, slightly decomposed. @ 1.5', 2nd J: N71E/61N.
5								TOTAL DEPTH 3.5', NO GROUND WATER HARD EXCAVATION NO CAVING TRENCH BACKFILLED
10								
15								

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-2

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip. Case 580-E

Elevation 1870'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	TOPSOIL						SC	TOPSOIL: Dark reddish brown, clayey sand, slightly damp, moderately dense, slightly porous with rootlets.
	OLDER ALLUVIUM (Qoal)		Bag				SM	SILTY SAND: Dark reddish brown, very firm, massive, damp to dry, trace of clay.
5	GRANITICS (Kgr)							GRANITICS: Buff, contains hornblende, refused knocker, produces cobbley sand when dug, massive. @ 7', J: N88E/71N.
10								TOTAL DEPTH 8' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLED
15								

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-3

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1861'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	TOPSOIL						SC	TOPSOIL: Light to medium reddish brown, clayey sand, dense, porous, dry, massive with rootlets.
	OLDER ALLUVIUM (Qoal)		Bag			8		
							SM	SILTY SAND: Light to medium reddish brown, very dense, porous, massive, dry, trace of clay.
5								
	GRANITICS (Kgr)							GRANITICS: Buff to light reddish brown, moderately to highly decomposed, J @ 9.5' N85W/76S, dry.
10								
								TOTAL DEPTH 11' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLED
15								

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-4

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1885'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	TOPSOIL						SM	TOPSOIL: Medium brown, silty sand, loose, moist, massive with rootlets @ 0.5'.
	OLDER ALLUVIUM (Qoal)		▥				SM	SILTY SAND: Medium reddish brown, very firm, porous, dry, massive, trace of clay.
5								
	GRANITICS (Kgr)		▥					GRANITICS: Buff, dry, massive, moderately decomposed, makes medium-coarse grained sand when dug, digs easily.
10								Practical refusal @ 12.5'
15								TOTAL DEPTH 12.5' NO GROUND WATER MODERATE TO VERY HARD EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-5

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1864'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0 5 10	OLDER ALLUVIUM (Qoal)	CP	Bag {		101 (77)	6	SM	SILTY SAND: Light to dark reddish brown, porous, dry, massive, contains cobbles to 6', dense.
15								TOTAL DEPTH 12' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T-6

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1872'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	TOPSOIL						SC	TOPSOIL: Medium brown, gravely clayey sand, damp, loose, porous with rootlets.
5	GRANITICS (Kgr)							GRANITICS: F N66E/61N, very well developed joints (red) to south and soft buff to yellow brown, micaceous unit to north, joints in red units are mottled, N58E/42N and clay seen along J N18E/41S. Gouge zone is 11 inches wide and approximate attitude is N38E/59N on north side and N66E/61N on south side. North unit dips into gouge zone. @ N73E/84E. Practical refusal @ 4.5'.
10								TOTAL DEPTH 4.5' NO GROUND WATER HARD EXCAVATION NO CAVING TRENCH BACKFILLED
15								

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T- 7

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1872'±

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	TOPSOIL						SM/SC	TOPSOIL: Reddish brown, clayey silty sand, moderately dense, slightly porous, damp, rootlets to 2 inches with localized roots to 5'.
	OLDER ALLVUIUM (Qoal)						SM	SILTY SAND: Reddish brown, slightly porous, fine to coarse grained, massive, localized roots to 5', damp, very dense, trace of clay.
5	GRANITICS (Kgr)							GRANITICS: Buff to light brown, 5 to 10% dark minerals, moderately hard, slightly damp, massive, moderately decomposed.
10								
15								TOTAL DEPTH 13' NO GROUND WATER MODERATE EXCAVATION NO CAVING TRENCH BACKFILLED

GEOTECHNICAL TRENCH LOG

Date 10/29/87

Trench No. T- 8

Project Rosehills

Job No. 6870318-03

Equipment Co. Kay's Equipment Co.

Type of Equip Case 580-E

Elevation 1870'±

Trend N15W

Depth/ Feet	Earth Materials	Type of Test	Depth of Test		Dry Density, Pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	GEOTECHNICAL DESCRIPTION Logged By RLA Sampled By RLA
0	OLDER ALLUVIUM (Qoal)						SM	SILTY SAND: Light brown to medium reddish brown, fine grained, porous, massive, slightly damp, grace of clay.
			Bag &		99 (75)	7		
5								
10	GRANITICS (Kgr)							GRANITICS: Buff with 10-15% dark minerals, moderately decomposed, makes coarse cobbly sand when dug, hard, massive.
								TOTAL DEPTH 11.5' NO GROUND WATER MODERATE TO HARD EXCAVATION NO CAVING TRENCH BACKFILLED
15								

Test Pits TP1 – TP7 Leighton, 1993

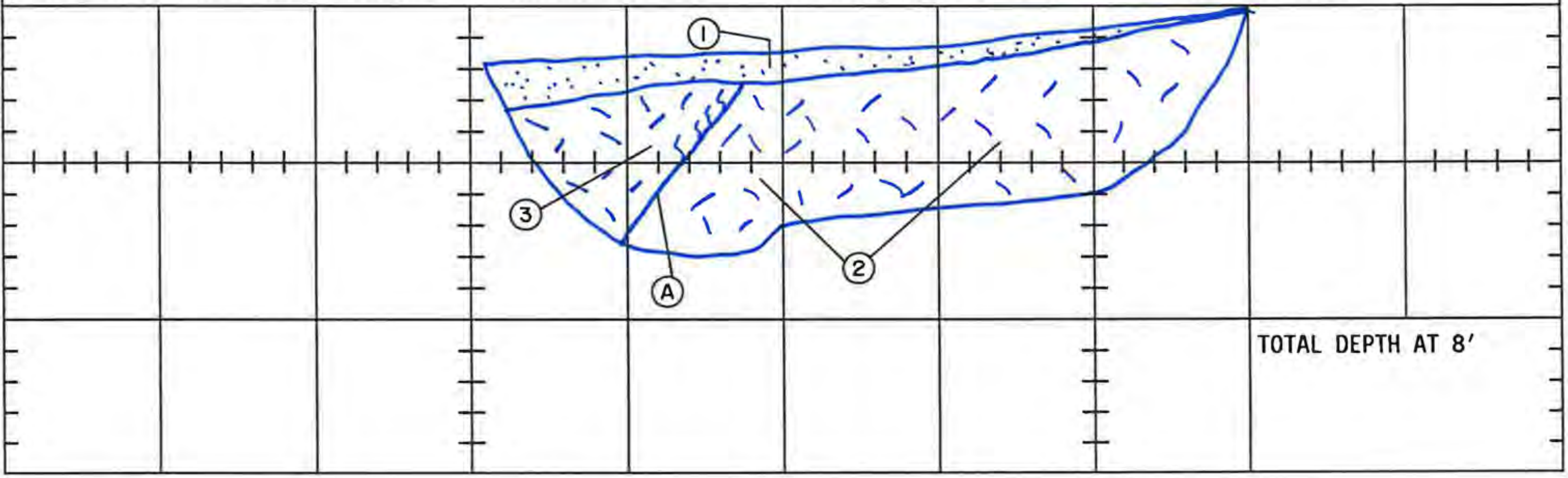
LOG OF TRENCH NO.: T-1

Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,570±'
Location: See Plate 1

GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES			
			USCS	Sample No.	Moist. (%)	Density (pcf)
A F: N30W, 51SW	1 TOPSOIL: Silty sand, grayish-brown, moist to dry, loose, soft, porous, abundant rootlets, micaceous, disturbed by cultivation, sharp organic contact.	TOPSOIL		3-4' D-1		
	2 DECOMPOSED GRANITE: Brown, damp to moist, dense, friable to moderately friable, fine to coarse grained, well graded, lenses of dark gray inclusions, less friable, very fine grained, micaceous, weathered near surface, fault confined to bedrock, fault zone 1-3" wide gouge, carbonate lined, minor fractures.	Kg		3.5-4' B-1		
	3 DECOMPOSED GRANITE: Light gray to olive-gray, damp to moist, dense, fine to coarse grained, well graded, trace of clay, moderately friable, weathered.	Kg				

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5' SURFACE SLOPE: 3-7° TREND: N55E ⟶



TOTAL DEPTH AT 8'

501-A - (10/90)

Leighton & Associates

LOG OF TRENCH NO.: T-2

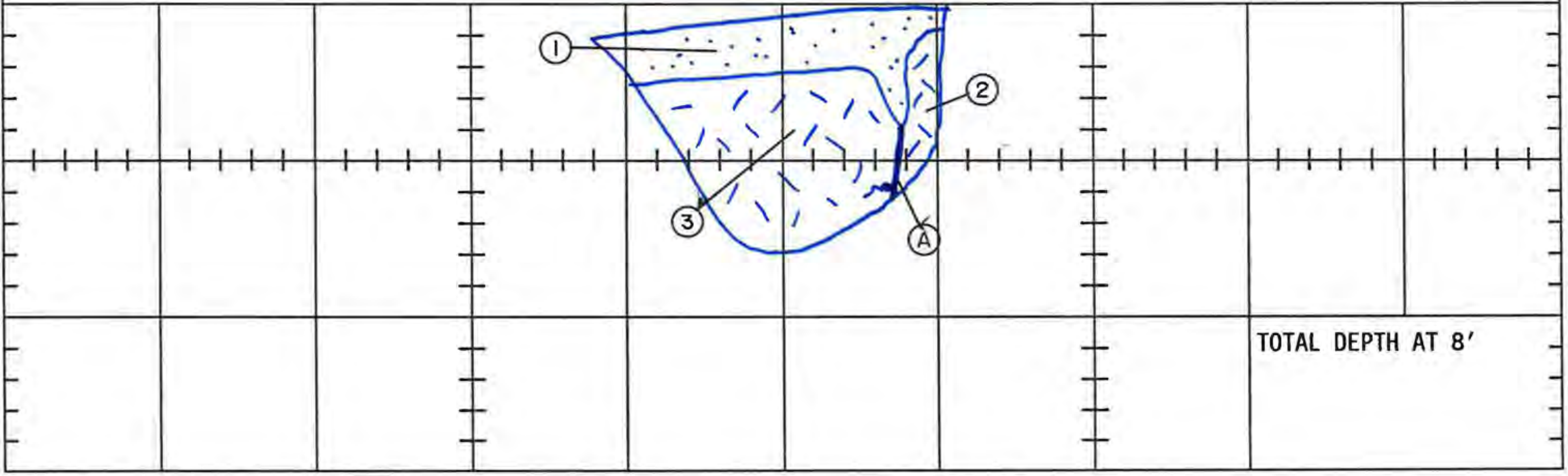
Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,600±'
Location: See Plate 1

GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moist. (%)	Density (pcf)
A F: N48E 87-89SE	1 TOPSOIL: Silty sand, brown to orangish-brown, damp, loose, porous, abundant roots, micaceous, thickens from 1 to 2.5' across fault.	TOPSOIL		0-1' B-1		
	2 GRANITIC BEDROCK: Black, wet, hard, upper 2' weathered, refusal at 3', poorly friable.	Kg		2.5-3.5' D-1		
	3 GRANITIC BEDROCK: Light yellow-buff, soft to hard, wet, highly fractured with clay linings, friable, refusal at 7.5'.	Kg		6.5-7' B-2		
	Fault Gouge 1-4" Thick - White-buff-light green, sheared clay, seepage at bottom of trench on northwest side of fault, acts as ground water barrier.					

ENGINEERING PROPERTIES

GRAPHIC REPRESENTATION SW Wall SCALE: 1" = 5' SURFACE SLOPE: 4° TREND: N44W ⟶



TOTAL DEPTH AT 8'

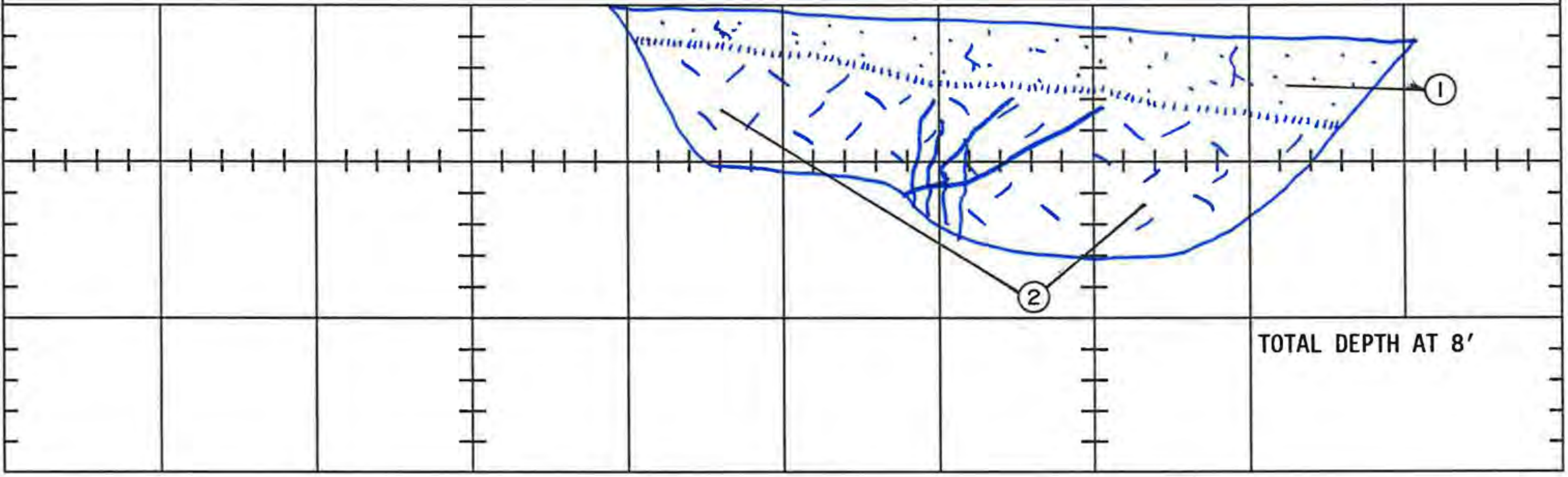
LOG OF TRENCH NO.: T-3

Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,640±'
Location: See Plate 1

			ENGINEERING PROPERTIES			
GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moist. (%)	Density (pcf)
	1 TOPSOIL: Sandy silt, reddish-brown, dry to damp, soft, porous, rootlets, gradational contact to bedrock.	TOPSOIL		3.5-4.5' D-1		
	2 GRANITIC BEDROCK: Light brown, stained orangish-brown, damp to moist, very fine to fine grained, gray to black inclusions NE of fractures, abundant inclusions southwest of fractures, refusal at 5' northeast of fractures, 7' southwest of fractures, friable to 5-7', weathered to highly weathered.	Kg		4.5-5.0' B-1		

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5' SURFACE SLOPE: 1-3° TRENCH: N49E←



TOTAL DEPTH AT 8'

LOG OF TRENCH NO.: T-4

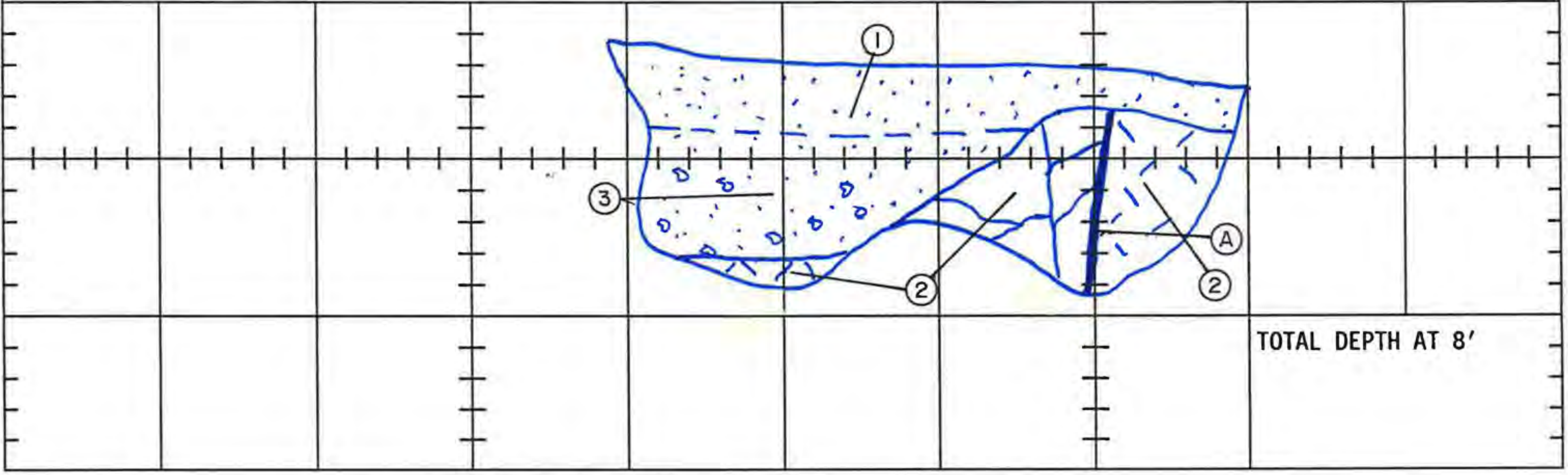
Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,620±′
Location: See Plate 1

ENGINEERING PROPERTIES

GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moist. (%)	Density (pcf)
	1 TOPSOIL: Sandy silt, brown, dry to moist, soft, porous, no agrillic horizon, thickens over alluvium.	TOPSOIL		3-4' D-1		
F: N26E, Vert.	2 GRANITIC BEDROCK: Gray to orangish-brown, moist to wet, friable to 5′ highly fractured and weathered.	Kg		4-4.5' B-1		
	Fault Zone: Sheared to 4", filled with white to green clay gouge, confined to bedrock.					
	3 ALLUVIUM: Very dark gray congolomeratic, wet, dense, indurated with clay matrix, cobbles to 2", well rounded granitic and metamorphic cobbles.	Qal				

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5′ SURFACE SLOPE: 0-9° TREND: N69W<———



TOTAL DEPTH AT 8′

501-A - (10/90)

Leighton & Associates

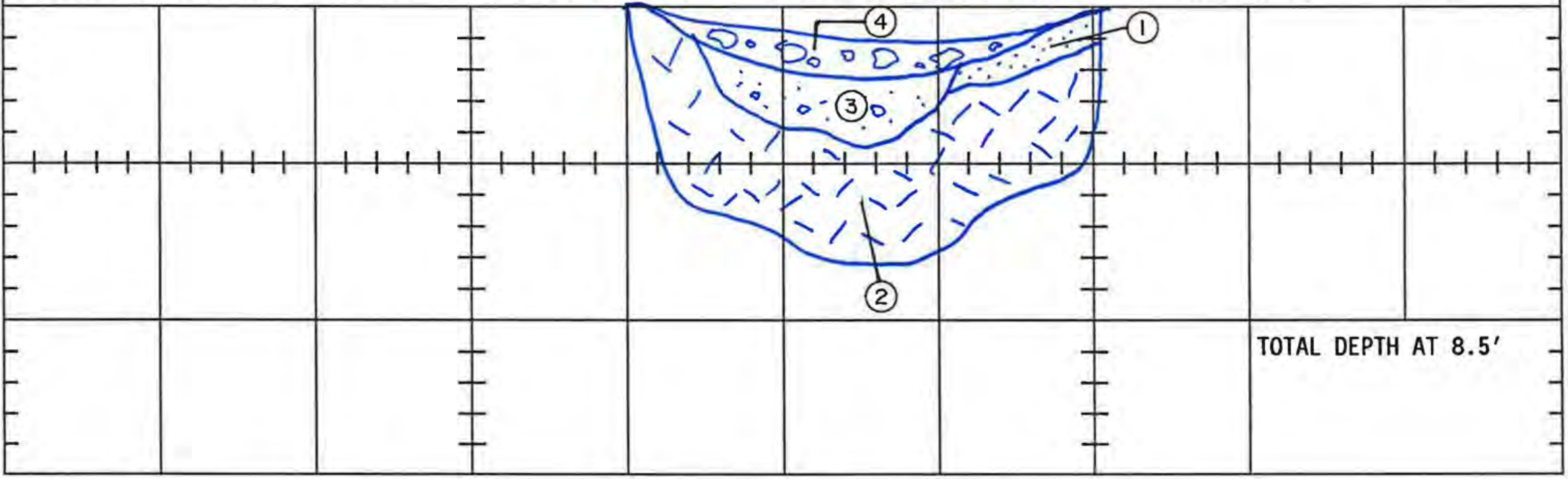
LOG OF TRENCH NO.: T-5

Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,770±'
Location: See Plate 1

GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES USCS	Sample No.	Moist. (%)	Density (pcf)
	1 TOPSOIL: Silt, grayish-brown, trace of sand, damp, soft, porous, roots, micaceous to 1'. Subangular cobbles in soil matrix, cobbles are granitic to 1', damp, loose.	TOPSOIL				
	2 GRANITIC BEDROCK: Olive-gray, friable and weathered to 6', fine grained, micaceous, few orange stained fractures, upper 1' stained orange.	Kg				
	3 ALLUVIUM: Brown silty sand matrix with gravel and cobbles to 12", damp, loose.	Qal				
	4 ARTIFICIAL FILL: Primarily rocks and boulders to 3' with brush and minor sand component, very loose.	Afu				

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5' SURFACE SLOPE: 0-28° TREND: N29E ⟶



TOTAL DEPTH AT 8.5'

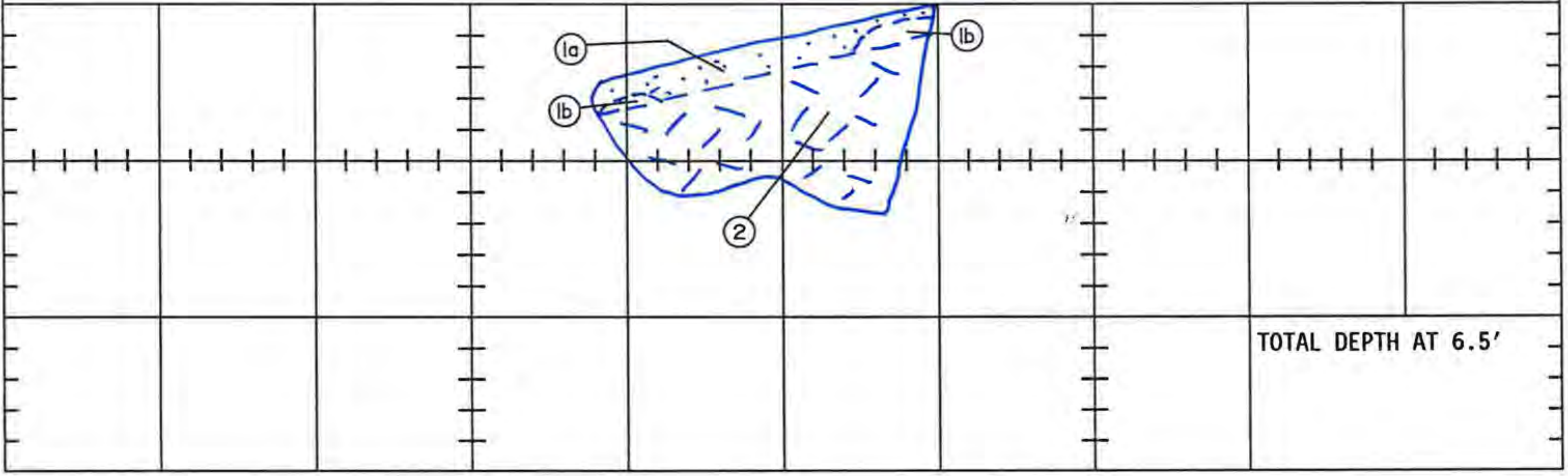
LOG OF TRENCH NO.: T-6

Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,780±'
Location: See Plate 1

			ENGINEERING PROPERTIES			
GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:	GEOLOGIC UNIT	USCS	Sample No.	Moist. (%)	Density (pcf)
	1 TOPSOIL: Sandy silt, damp, soft, very porous, roots, boulders to 2' lying on surface, soil horizon to 12" thick.	TOPSOIL		3-4' D-1		
	1b TOPSOIL: Clayey silt, orangish-brown, moist, soft, porous, roots, poorly developed angular blocky peds, locally horizon is missing.					
	2 GRANITIC BEDROCK: Light gray to olive-gray, moist, friable to 5-6', inclusions of very hard granitics to 2', fractures with some to 3", filled with white carbonate, a few orange stained fractures and random and discontinuous.	Kg				

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5' SURFACE SLOPE: 13° TRENCH: N72E ——>



TOTAL DEPTH AT 6.5'

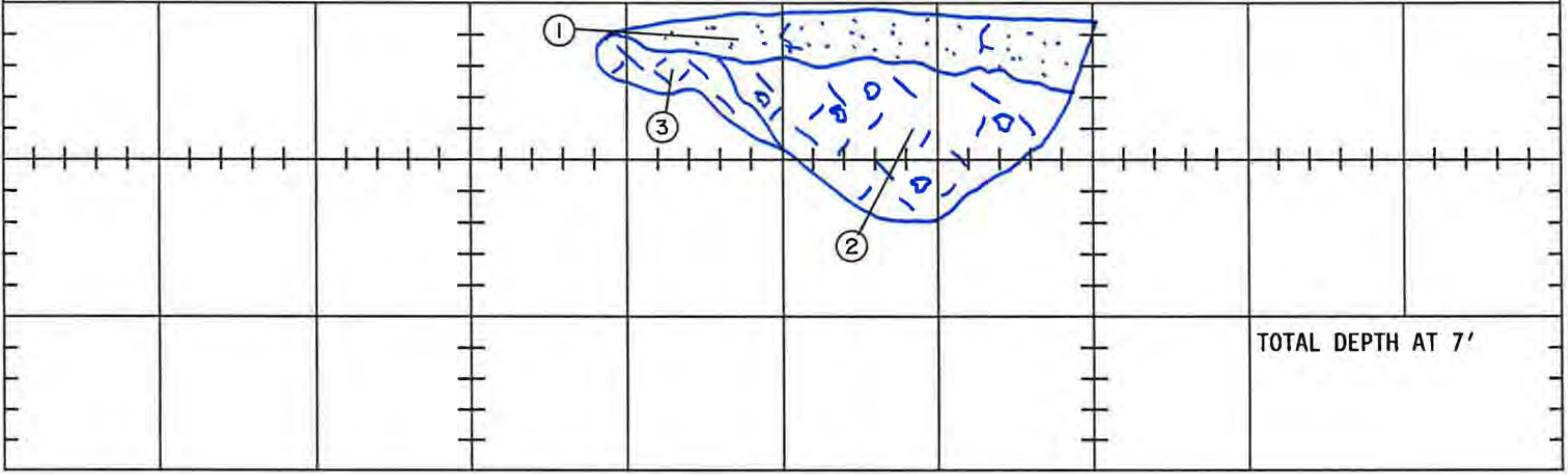
LOG OF TRENCH NO.: T-7

Project Name: Murrieta Hills
Project Number: 6870318-07
Equipment: JD 310C Sampling Backhoe

Logged by: RAW
Elevation: 1,780±′
Location: See Plate 1

				ENGINEERING PROPERTIES			
GEOLOGIC ATTITUDES	DATE: 4/21/93 DESCRIPTION:		GEOLOGIC UNIT	USCS	Sample No.	Moist. (%)	Density (pcf)
	1	TOPSOIL: Silty sand, light orangish-brown, dry to slightly damp, loose, porous, roots, highly bioturbated to 3", irregular contact (sharp) with bedrock.	TOPSOIL		3-4' D-1		
	2	GRANITIC BEDROCK: Light brown and orange with light gray inclusions of very fine grained granitics to 10", damp, friable to 6.5′, highly fractured with orange staining on fractures, fractures are discontinuous and random orientation, except mostly high angle, fractures do not offset gray inclusion boundaries.	Kg		3-4' B-1		
	3	GRANITIC BEDROCK: Well silicified aplite, dike, white, very fine grained grading to medium grained at boundary, highly fractured with silica filling, resistant ridgeline outcrop rock.	Kg				

GRAPHIC REPRESENTATION NW Wall SCALE: 1" = 5′ SURFACE SLOPE: TREND:



TOTAL DEPTH AT 7′

501-A - (10/90)

Leighton & Associates

Test Pits TP1 – TP40 Leighton, 2008

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1842

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-1**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SM	@ 0-1.0': **Topsoil;** Very Dark Gray-Brown (10YR 3/2), Silty fine-to-coarse grained SAND, with Gravel to 2", moist-to-wet, organics, roots	
			SM	@ 1.0'-2.0': **Bedrock (Kgr);** Intensely Weathered, Recovered as: Gray-Brown (10YR 5/2), Silty fine-to-coarse grained SAND, with Gravel and Clay, moist	
				@ 2.0'-3.5': Slightly Weathered, Recovered as: Gray (10YR 6/1), medium-to-coarse grained SAND, moist	
				Total Depth = 3.5 ft, No Groundwater Encountered, Backfilled With Spoils	
5					
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001

PROJECT NAME: Murrieta Hills

LOCATION: Murrieta

ELEVATION: 1910

LOGGED BY: JTD

EQUIPMENT: Cat 420 D Backhoe

DATE: 1/29/2008

TEST PIT NO.: TP-2

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-1.0': **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND, trace Gravel, moist, roots	
	☒	B-1	SM	@ 1.0'-4.5': **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 3/4), Silty fine-to-medium Grained SAND, with Clay, moist, porous, root hairs	
5			SC	@ 4.5'-6.0': **Bedrock (Kgr);** Intensely Weathered, Recovered as; Gray-Brown (10YR 5/2), Clayey fine-to-medium grained SAND, moist	
			SP	@ 6.0'-6.5': Slightly Weathered, Recovered as; Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	
				Total Depth = 6.5 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:

AL = Attiberg Limits

EI = Expansion Index

RV = R-Value Test

SA = Sieve Analysis

SR = Sulfate/Resisitivity Test

SH = Shear Testing

MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1840

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

TEST PIT NO.: TP-3

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-1.0': **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-coarse grained SAND, with Gravel and Cobbles, moist-to-wet, loose, roots	
			SP	@ 1.0'-4.0'; **Bedrock (Kgr);** Moderately Weathered, Jointed, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	Joints: N20°E, 70°NW S85°W, 60°SE
5				Total Depth = 4.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1852

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-4** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-1.0' **Topsoil;** Dark Yellow-Brown (10YR 3/4), Clayey fine-to-medium grained SAND, with Gravel, wet, organics, roots	
			SC	@ 1.0'-3.0' **Older Alluvium (Qoal);** Yellow-Brown (10YR 5/4)-to-Olive Brown (2.5Y 4/4), Clayey fine-to-medium grained SAND, trace Gravel, damp-to-moist, blocky peds, caliche stringers, porous @ 3.0'-4.5' Brown (10YR 5/3), Silty fine-to-medium grained SAND, with Clay, damp-to-moist, porous	
5			GP	@ 4.5'-5.5' **Bedrock (Kgr);** Moderately Weathered, Recovered as; Brown (10YR 5/3), Gravelly fine-to-coarse grained SAND, moist	
				Total Depth = 5.5 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1830

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-5** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	Sample Type*	Sample Number			
			GP	@ 0-3.0' **Artificial Fill (Afu);** Red-Brown (2.5YR 4/4), Gravelly fine-to-coarse grained Sand, with Silt, moist	
			SC	@ 3.0'-5.0' Gray-Brown (10YR 5/2), Clayey fine grained SAND, with Gravel, moist	
5			SM	@ 5.0'-6.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Silty fine-to-coarse grained SAND, with Gravel and Cobbles, moist	
				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1907

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

TEST PIT NO.: TP-6

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SM	@ 0-0.5' **Topsoil;** Dark Brown (10YR 3/3), Silty fine-to-coarse grained SAND, with Gravel to 1.5", wet, organics, roots	
			SC	@ 0.5'-2.5' Brown (10YR 5/3), Clayey fine-to-medium grained SAND, with Gravel and Cobble clasts to 3", moist, porous	
			SC	@ 2.5'-11.0' **Older Alluvium (Qoal);** Olive Brown (2.5Y 4/4), Clayey fine-to-medium grained SAND, with Gravel and Cobble clasts to 4", moist, porous, root hairs	
5					
10					
				Total Depth = 11.0 ft, No Groundwater Encountered, Backfilled With Spoils	
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1909
LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-7** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-3.0' **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-coarse grained SAND, wet, roots	
5 10	☒	B-2	SC	@ 3.0'-12.5' **Older Alluvium (Qoal);** Olive Brown (2.5Y 4/4), Clayey fine-to-coarse grained SAND, with angular Gravel and Cobbles to 3", damp-to-moist, porous, root hairs	
			SC	@ 12.5'-14.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Brown (10YR 5/3), Clayey fine grained SAND, few fine Gravel, moist	
15				Total Depth = 14.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1838

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-8** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	☒	B-3	SC	@ 0-4.0' **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND, wet, organics, roots	
5			SC	@ 4.0'-6.0' **Older Alluvium (Qoal);** Yellow-Brown (10YR 5/4), Clayey fine-to-medium grained SAND, moist, porous, root hairs @ 6.0'-9.0' Yellow-Brown (10YR 5/4), Clayey fine-to-medium grained SAND, with Gravel, moist, porous, root hairs	
			CL	@ 9.0'-10.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Gray-Brown (10YR 5/2), Sandy Clay, moist	
10			SP	@ 10.0'-11.0' Slightly Weathered, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, trace Clay, moist	
15				Total Depth = 11.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ◸ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1846

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

TEST PIT NO.: TP-9

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SC	@ 0-2.5' **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-coarse grained SAND, with rounded Gravel to 1.5", wet, roots	
5			SC	@ 2.5'-6.0' **Older Alluvium (Qoal);** Gray-Brown (10YR 5/2), Clayey fine-to-coarse grained SAND, damp-to-moist, porous, root hairs	
			SM	@ 6.0'-7.0' **Bedrock (Kgr);** Slightly Weathered, Recovered as: Brown (10YR 5/3), Silty fine-to-coarse grained SAND, with Gravel and Cobble, moist	
10 15				Total Depth = 7.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ◪ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1858

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-10**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SC	@ 0-2.0' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, wet, organics, roots @ 2.0'-5.0' Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, with Gravel, wet, roots	
5			SC	@ 5.0'-7.0' **Older Alluvium (Qoal);** Yellow-Brown (10YR 5/4), Clayey fine-to-medium grained SAND, with Gravel and Cobble, damp-to-moist, porous, root hairs	
			SM	@ 7.0'-8.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Gray (10YR 6/1), Silty fine-to-coarse grained SAND, moist	
				Total Depth = 8.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1888

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

TEST PIT NO.: TP-11

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SC	@ 0-2.5' **Topsoil;** Red Brown (5YR 4/4), Clayey fine-to-medium grained SAND, with Gravel to 1.5", wet, organics, roots	
			SC	@ 2.5'-5.0' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 3/4)-to-Olive Brown (2.5Y 4/4), Clayey fine-to-medium grained SAND, moist, loose, porous, root hairs	
5			SC	@ 5.0'-6.0' **Bedrock (Kgr);** Slightly Weathered, Recovered as: Yellow-Brown (10YR 5/4), Clayey fine-to-coarse grained SAND, with Gravel, moist	
10 15				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1906

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

TEST PIT NO.: TP-12

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-4.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-coarse grained SAND, with Gravel clasts to 1.5", wet, organics, roots	
5			SC	@ 4.5'-5.5' **Older Alluvium (Qoal);** Yellow-Brown (10YR 5/4), Clayey fine-to-medium grained SAND, moist, porous, root hairs	
			SM	@ 5.5'-8.5' **Bedrock (Kgr);** Moderately-to-Slightly Weathered, Recovered as: Gray-Brown (10YR 5/2), Silty fine-to-coarse grained SAND, with Gravel, moist	
10 15				Total Depth = 8.5 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1884

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/29/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-13**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SM	@ 0-1.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, wet, organics, roots	Water Seepage
			SM/SC	@ 1.5'-4.5' **Bedrock (Kgr);** Intensely-to-Moderately Weathered, Recovered as: Yellow-Red (5YR 4/6), Silty and Clayey fine-to-coarse grained SAND, moist	Joint: S55°W 89°SE
5				Total Depth = 4.5 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1624

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-14

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SM	@ 0-4.0' **Quaternary Alluvium (Qal);** Brown (10YR 4/3), Silty fine-to-coarse grained SAND, trace Clay, moist-to-wet, organics, caving	
5	☒	B-4	SP	@ 4.0'-8.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Yellow-Brown (10YR 5/4), fine-to-coarse grained SAND, with Gravel, moist	
10				Total Depth = 8.0 ft, No Groundwater Encountered, Backfilled With Spoils	
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1640

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-15** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-6.0' **Quaternary Alluvium (Qal);** Very Dark Gray-Brown (10YR 3/2), Clayey fine-to-coarse grained SAND, trace Gravel, wet, roots	
5					
			SC	@ 6.0'-9.0' **Bedrock (Kgr);** Intensely Weathered becoming Slightly Weathered at 8.0ft, Recovered as: Clayey fine-to-medium grained SAND, with Gravel, Cobbles and Boulders to 12", moist	
				Total Depth = 9.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ▆ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1820

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-16

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SC	@ 0-1.5' **Topsoil;** Very Dark Gray-Brown (10YR 3/2), Clayey fine-to-medium grained SAND, wet, organics, roots	
			SC	@ 1.5'-4.5' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, with Gravel, moist, porous, root hairs, caliche nodules	
5			GP	@ 4.5'-6.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Gray (10YR 6/1), Gravelly fine-to-coarse grained SAND, with Clay, moist	
				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1774

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-17** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-2.5' **Quaternary Alluvium (Qal);** Dark Red-Brown (5YR 3/4), Clayey fine-to-coarse grained SAND, wet, roots, organics	
			SC	@ 2.5'-4.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Gray-Brown (10YR 5/2), Clayey fine-to-coarse grained SAND, with Gravel, Cobbles and Boulders to 12", moist	
5			SM	@ 4.0'-6.0' Moderately Weathered, Recovered as: Gray (10-YR 6/1), Silty fine-to-coarse grained SAND, with Gravel, moist	
10 15				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1758

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-18

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-4.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, moist-to-wet, organics, roots	
5			SM	@ 4.5'-7.0' **Older Alluvium (Qoal);** Yellow-Brown (10YR 5/4), Silty fine-to-medium grained SAND, trace fine Gravel, damp-to-moist, porous, root hairs @ 7.0'-9.5' Yellow-Brown (10YR 5/4), Silty fine-to-medium grained SAND, with Gravel and Cobble, moist	
10			SP	@ 9.5'-10.5' **Bedrock (Kgr);** Moderate-to-Slightly Weathered, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	
15				Total Depth = 11.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1810

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-19**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SC	@ 0-3.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, moist-to-wet, roots, organics	
5			SM	@ 3.5'-6.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Yellow-Brown (10YR 5/4), Silty fine-to-coarse grained SAND, with Gravel, moist @ 6.0'-7.0' Slightly Weathered, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	
10 15				Total Depth = 7.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ◸ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1818

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES		USCS Symbol	TEST PIT NO.: TP-20	REMARKS
	Sample Type*	Sample Number		MATERIAL DESCRIPTION AND COMMENTS	
			SC	@ 0-3.5' **Topsoil;** Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace fine Gravel, moist-to-wet, roots	
5			SC	@ 3.5'-9.0' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, with angular Gravel, moist, porous, root hairs	
10				@ 9.0'-14.0' Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, with angular Gravel moist, pinhole voids, root hairs, caliche stringers	
15				Total Depth = 14.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ◺ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1838

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-21

Depth (ft)	SAMPLES Sample Type*	SAMPLES Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SC	@ 0-2.0' **Topsoil;** Red-Brown (5YR 4/4), Clayey fine-to-medium grained SAND, with fine Gravel, moist-to-wet, roots	
			GP	2.0'-5.0' **Bedrock (Kgr)** Highly Weathered, Recovered as; Yellow-Brown (10YR 5/4), Gravelly fine-to-medium grained SAND, with Clay, moist, porous, root hairs, angular gravel	
5			SP	@ 5.0'-5.5' Slightly Weathered, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	
				Total Depth = 5.5 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1800

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-22

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			CL	@ 0-1.0' **Topsoil;** Dark Brown (10YR 3/3)-to-Olive Brown (2.5Y 4/4), fine-to-medium grained Sandy CLAY, moist-to-wet, roots, organics	
			SC	@ 1.0'-3.0' Olive (5Y 4/4), Clayey fine-to-medium grained SAND, with Gravel, moist, roots	
			SM	@ 3.0'-5.0' **Bedrock (Kgr);** Slightly Weathered, Recovered as: Gray (10YR 6/1), Silty fine-to-coarse grained SAND, with Gravel and Cobble, moist	
5				Total Depth = 5.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1766

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-23

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SM	@ 0-1.5' **Topsoil;** Brown (10YR 5/3), Silty fine-to-medium grained SAND, few Gravel and Boulders to 24", moist, roots	
			SM	@ 1.5'-4.5' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Dark Gray-Brown (10YR 4/2), Silty fine-to-coarse grained SAND, with Gravel, moist	Joints: N55°W 87° NE S50°W 81° NW
5				Total Depth = 4.5 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1760

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

TEST PIT NO.: TP-24

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			CL	@ 0-1.0' **Topsoil;** Dark Brown (10YR 3/3), fine-to-medium grained Sandy CLAY, moist-to-wet, roots, organics	
			SC	@ 1.0'-5.0' **Older Alluvium (Qoal);** Olive Brown (2.5Y 4/4), Clayey fine-to-medium grained SAND, moist, pinhole voids, root hairs, caliche stringers	
5			SC	@ 5.0'-6.0' Olive Brown (2.5Y 4/4), Clayey fine-to-coarse grained SAND, with Gravel and Cobble, moist, pinhole voids, root hairs, caliche stringers	
			SM	@ 6.0'-7.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as: Gray-Brown (10YR 5/2), Silty fine-to-coarse grained SAND, moist	
10 15				Total Depth = 7.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1760

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-25** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-2.0' **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND, moist-to-wet, roots	
			SM	@ 2.0'-5.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Brown (10YR 5/3), Silty fine-to-coarse grained SAND, with Gravel, moist	
5			SP	@ 5.0'-6.0' Slightly Weathered, Recovered as: Gray (10YR 6/1), fine-to-coarse grained SAND, with Gravel, moist	
				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1734

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-26**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SM	@ 0-1.0' **Topsoil;** Dark Yellow-Brown (10YR 4/4), Silty fine-to-medium grained SAND, with Clay, moist, roots	
			SC	@ 1.0'-3.5' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Olive Gray (5Y 4/2), Clayey fine-to-coarse grained SAND, with Gravel, moist	Joints: N54°E 84° NW N10°E 32° SE
5			SM	@ 3.5'-6.0' Moderately Weathered, Recovered as: Gray-Brown (10YR 5/2), Silty fine-to-coarse grained SAND, with Gravel, moist	
10 15				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1762

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 1/30/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-27** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-1.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace fine Gravel, moist-to-wet, organics, roots	
			SC	@ 1.5'-3.0' **Bedrock (Kgr);** Intensely Weathered, Recovered as: Olive Brown (2.5Y 4/4), Clayey fine-to-coarse grained SAND, with Gravel, moist	
	☒	B-5	SM	@ 3.0'-5.0' Moderately Weathered, Recovered as: Gray (10YR 6/1), Silty fine-to-coarse grained SAND, with Gravel, moist	
5				Total Depth = 5.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ◹ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1832

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-28**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SC	@ 0-3.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	
5			SM	@ 3.5'-5.0' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2) Silty fine-to-coarse grained SAND, moist, loose, easily excavatable @ 5.0'-6.5' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2) Silty fine-to-coarse grained SAND, with gravel to 3", moist, moderately difficult to excavate, retains fabric	
10 15				Total Depth = 6.5 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1814

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

TEST PIT NO.: TP-29

Depth (ft)	SAMPLES		USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-3.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, root hairs	
5			SM	@ 3.5'-4.5' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2), Clayey fine-to-medium grained SAND, with Gravel to 1", moist, easily excavatable @ 4.5'-7.0' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 2", moist, moderately difficult to excavate	
10 15				Total Depth = 7.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1814

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

TEST PIT NO.: TP-30

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	REMARKS
			SC	@ 0-2.0' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	
5			SM	@ 2.0'-4.0' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 1", moist, easily excavatable @ 4.0'-6.5' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 3", moist, moderatey difficult to excavate, jointed	Joints: N 35° W 76° SW N 66°E 70° NW
10 15				Total Depth = 6.5 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1828

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-31** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-2.0' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	
				@ 2.0'-2.5' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Clay and Gravel to 1", moist, easily excavatable @ 2.5'-3.5' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 2", moist, moderately difficult to excavate	
				Total Depth = 3.5 ft, No Groundwater Encountered, Backfilled With Spoils	
5					
10					
15					

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1902

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-32** **MATERIAL DESCRIPTION AND COMMENTS**	Dry Density (pcf)	Moisture (%)
			SC	@ 0-5.0' **Topsoil;** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots		
	▨	S-1			106.6	6.6
5	▨	S-2	SC	@ 5.0'-10.0' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, moist, porous, blocky peds	110.5	7.6
	▨	S-3			113.5	11.5
10				@ 10.0'-11.0' Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, with Gravel, moist, caliche stringers		
				@ 11.0'-14.0' Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND, few fine Gravel, moist		
			SM	@ 14.0'-15.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 6", moist, moderately difficult to excavate		
15				Total Depth = 15.0 ft, No Groundwater Encountered, Backfilled With Spoils		

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ◺ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1904
LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

TEST PIT NO.: TP-33

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Dry Density (pcf)	Moisture (%)
			SC	@ 0-1.0' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots		
			SC	@ 1.0'-6.5' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, moist, porous, root hairs		
	▨	S-4			107.5	7.7
5	▨	S-5			112.2	13.6
				@ 6.5'-7.5' Olive Brown (2.5Y 4/4), Clayey fine-to-medium grained SAND, few Gravel, moist		
				@ 7.5'-9.0' **Bedrock (Kgr);** Slightly Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 8", moist, retains fabric, difficult to dig		
10				Total Depth = 9.0 ft, No Groundwater Encountered, Backfilled With Spoils		
15						

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1906

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

TEST PIT NO.: TP-34

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Dry Density (pcf)	Moisture (%)
	▨	S-6	SC	@ 0-4.5' **Topsoil;** Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	107.7	13.3
5	▨	S-7		@ 4.5'-7.0' **Older Alluvium (Qoal);** Dark Yellow-Brown (10YR 4/4), Clayey fine-to-medium grained SAND, few Gravel, moist	108.9	9.2
10	▨	S-8		@ 7.0'-11.0' Dark Brown (10YR 3/3), Clayey fine-to-medium grained SAND and GRAVEL, moist, difficult to excavate	116.7	6.6
				@ 11.0'-12.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2) Silty medium-to-coarse grained SAND, with Gravel to 6", moist, difficult to excavate		
15				Total Depth = 12.0 ft, No Groundwater Encountered, Backfilled With Spoils		

LEGEND

Sample Type: ▨ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1858

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-35** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	Sample Type*	Sample Number			
			SM	@ 0-4.0' **Topsoil;** Dark Red-Brown (5YR 3/4), Silty fine-to-medium grained SAND, trace Gravel and Clay, moist-to-wet, organics, roots	
5			SM	@ 4.0'-6.0' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 3", moist, easily excavatable @ 6.0'-8.0' Moderately Weathered, Recovered as; Gray-Brown (10Yr 6/2), Silty fine-to-coarse grained SAND, with Gravel to 6", moist, moderately difficult to excavate	
10 15				Total Depth = 8.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1852

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-28** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
5			SC	@ 0-5.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	
			SM	@ 5.5'-8.0' **Bedrock (Kgr);** Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 8", moist, very difficult to excavate	
10 15				Total Depth = 8.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1842

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES Sample Type*	 Sample Number	USCS Symbol	**TEST PIT NO.: TP-37** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
			SC	@ 0-1.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, with Gravel and Cobble to 6", moist-to-wet, organics, roots	
			SM	@ 1.5'-4.5' **Bedrock (Kgr);** Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel and Cobbles to 10", moist, moderately difficult to excavate	
5 10 15				Total Depth = 4.5 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ◸ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1858

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-38**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SC	@ 0-2.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, moist-to-wet, organics, roots	
5			SM	@ 2.5'-4.0' **Bedrock (Kgr);** Highly Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 3", moist, easily excavatable @ 4.0'-6.0' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 6", moist, moderately difficult to excavate	
				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧅ ---Chunk

Laboratory Testing: AL = Attiberg Limits EI = Expansion Index RV = R-Value Test
SA = Sieve Analysis SR = Sulfate/Resisitivity Test SH = Shear Testing MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1784

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-39** **MATERIAL DESCRIPTION AND COMMENTS**	REMARKS
	Sample Type*	Sample Number			
			SC	@ 0-1.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-coarse grained SAND, trace Gravel, moist-to-wet, organics, roots	
			SC	@ 1.5'-2.0' **Bedrock (Kgr);** Highly Weathered, Recovered as; Brown (10YR 3/4), Clayey fine-to-coarse grained SAND, with Gravel to 4", moist, easily excavatable	
			SM	@ 2.0'-4.0' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 8", moist, moderately difficult to excavate	
5				Total Depth = 4.0 ft, No Groundwater Encountered, Backfilled With Spoils	
10					
15					

LEGEND

Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

LOG OF TEST PIT

PROJECT NO.: 112262-001
PROJECT NAME: Murrieta Hills
LOCATION: Murrieta
ELEVATION: 1780

LOGGED BY: JTD
EQUIPMENT: Cat 420 D Backhoe
DATE: 3/4/2008

Depth (ft)	SAMPLES		USCS Symbol	**TEST PIT NO.: TP-40**	REMARKS
	Sample Type*	Sample Number		**MATERIAL DESCRIPTION AND COMMENTS**	
			SC	@ 0-1.5' **Topsoil;** Dark Red-Brown (5YR 3/4), Clayey fine-to-medium grained SAND, trace Gravel, moist-to-wet, organics, roots	
			SC	@ 1.5'-2.5' **Bedrock (Kgr);** Highly Weathered, Recovered as; Brown (10YR 3/4), Clayey fine-to-coarse grained SAND, with Gravel to 3", moist, easily excavatable	
			SM	@ 2.5'-5.0' Moderately Weathered, Recovered as; Gray-Brown (10YR 6/2), Silty fine-to-coarse grained SAND, with Gravel to 8", moist, moderately difficult to excavate	
5 10 15				Total Depth = 6.0 ft, No Groundwater Encountered, Backfilled With Spoils	

LEGEND

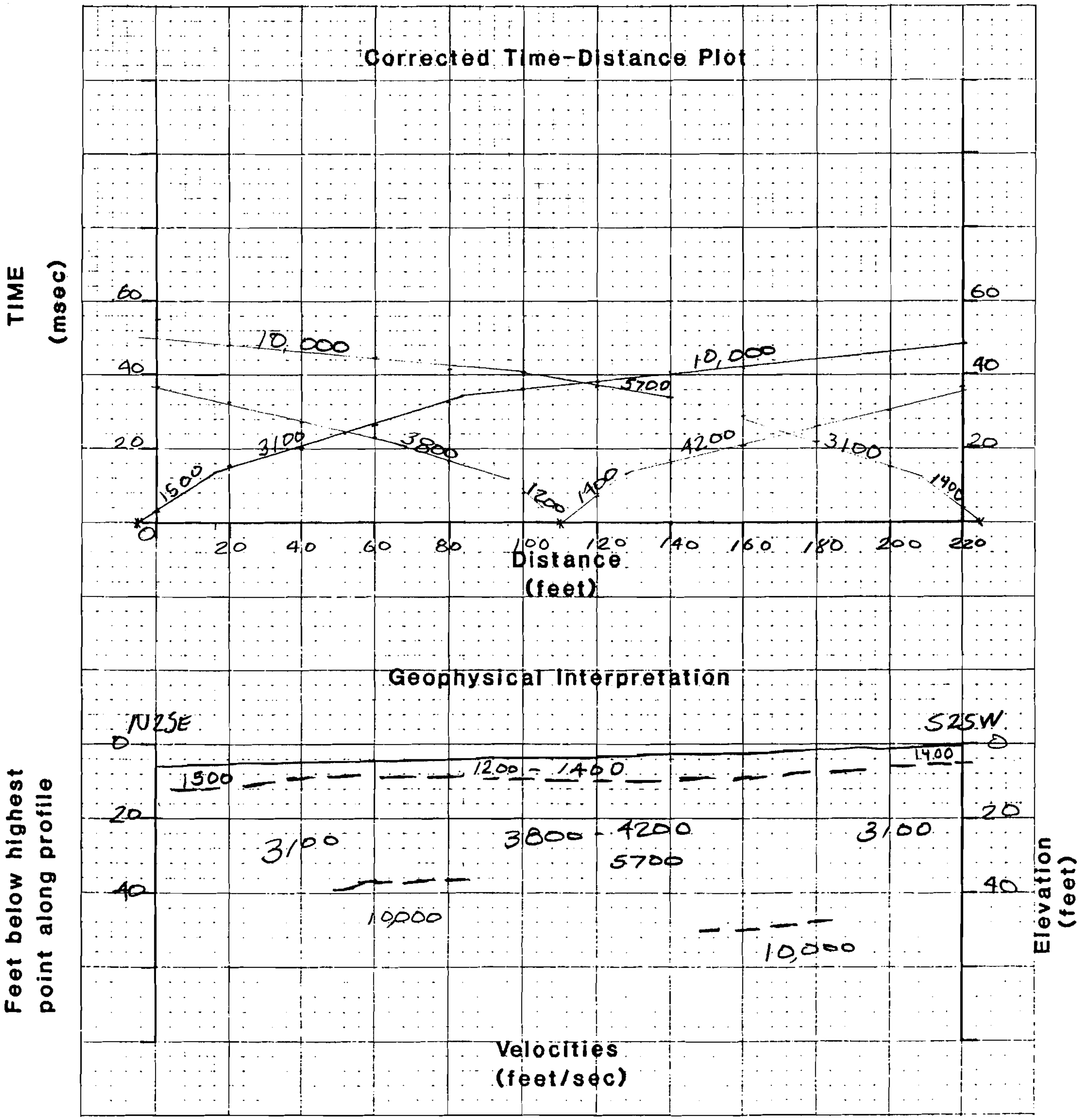
Sample Type: ■ ---Small Bulk ☒ ---Large Bulk ⧄ ---Chunk

Laboratory Testing:
AL = Attiberg Limits
EI = Expansion Index
RV = R-Value Test
SA = Sieve Analysis
SR = Sulfate/Resisitivity Test
SH = Shear Testing
MD = Maximum Density

Seismic Lines S1-S4, Leighton, 1987b

RIPPABILITY SURVEY

S-1

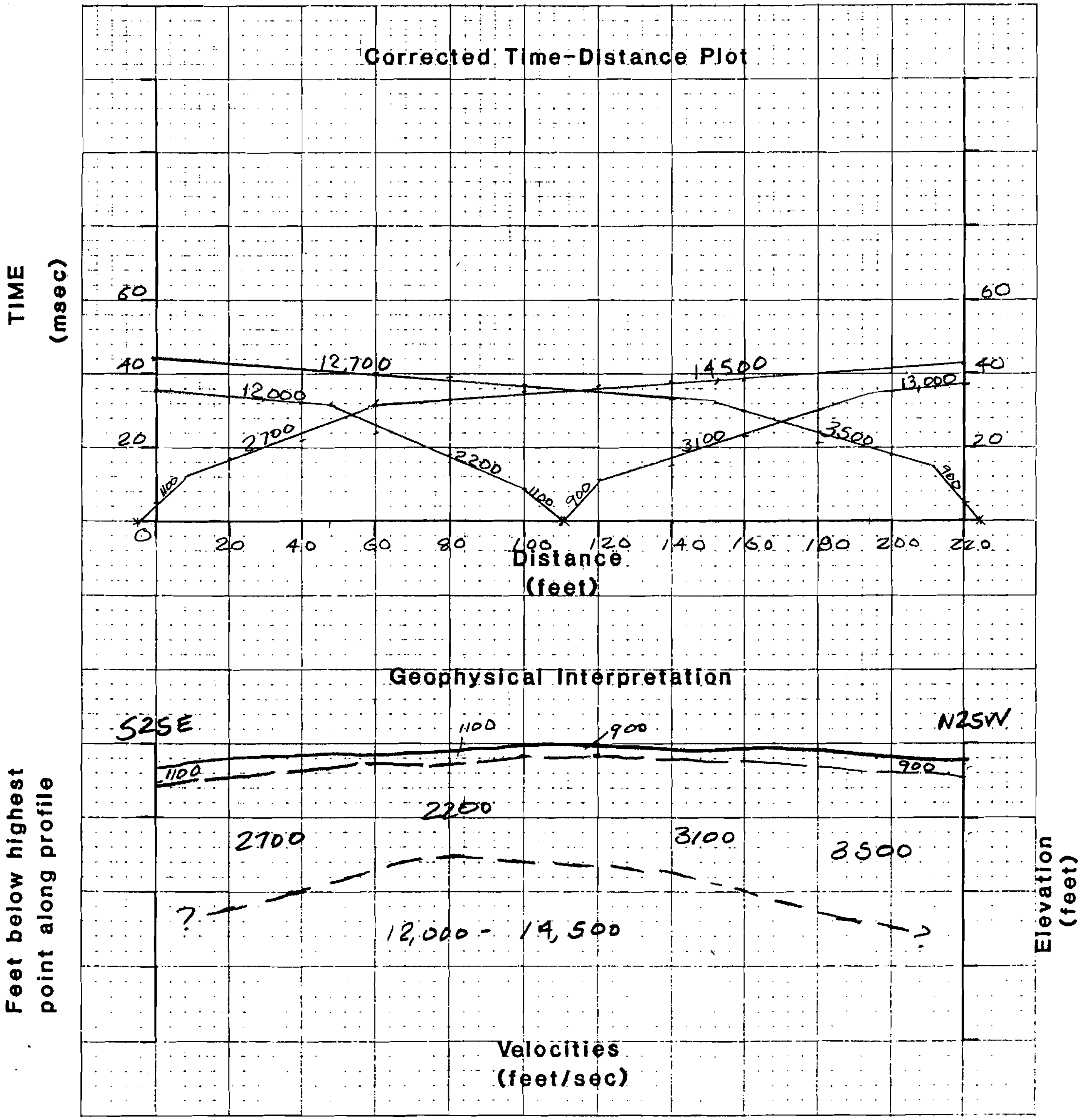


Project #: 6870318-02
Line #: S1
Date: 7/24/87
Field Work By: GOC, OSS, CK
Interpretation By: OSS

LEIGHTON and ASSOCIATES
INCORPORATED

S-2

RIPPABILITY SURVEY



Project #: 687038-02
Line #: S2
Date: 7/24/87
Field Work By: GDC, DSS, CK
Interpretation By: DSS

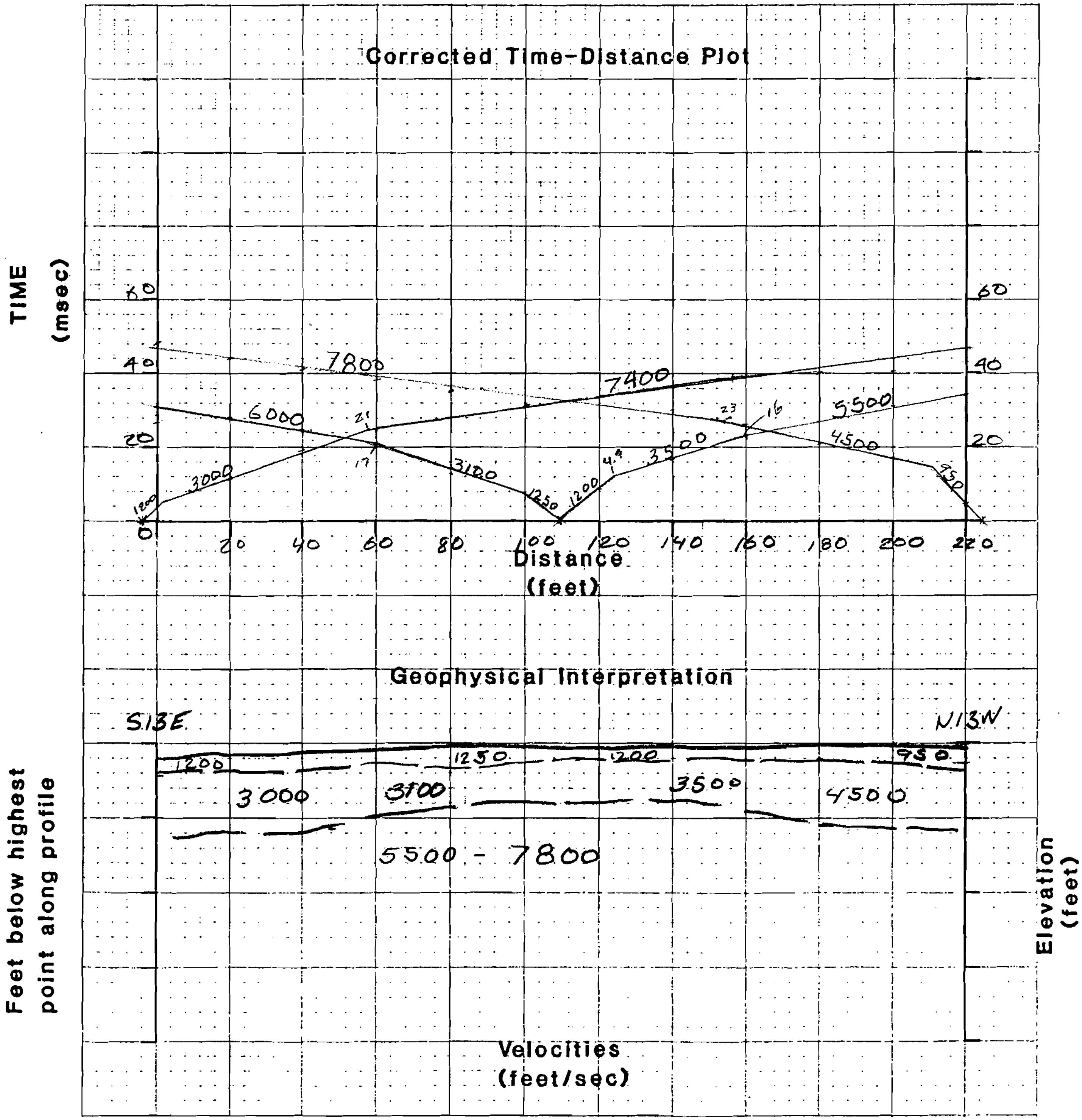
LEIGHTON and ASSOCIATES
INCORPORATED

A-v

SOIL ENGINEERING GEOLOGY GEOPHYSICS 'OUND WATER HAZARDOUS WASTES

S-3

RIPPABILITY SURVEY



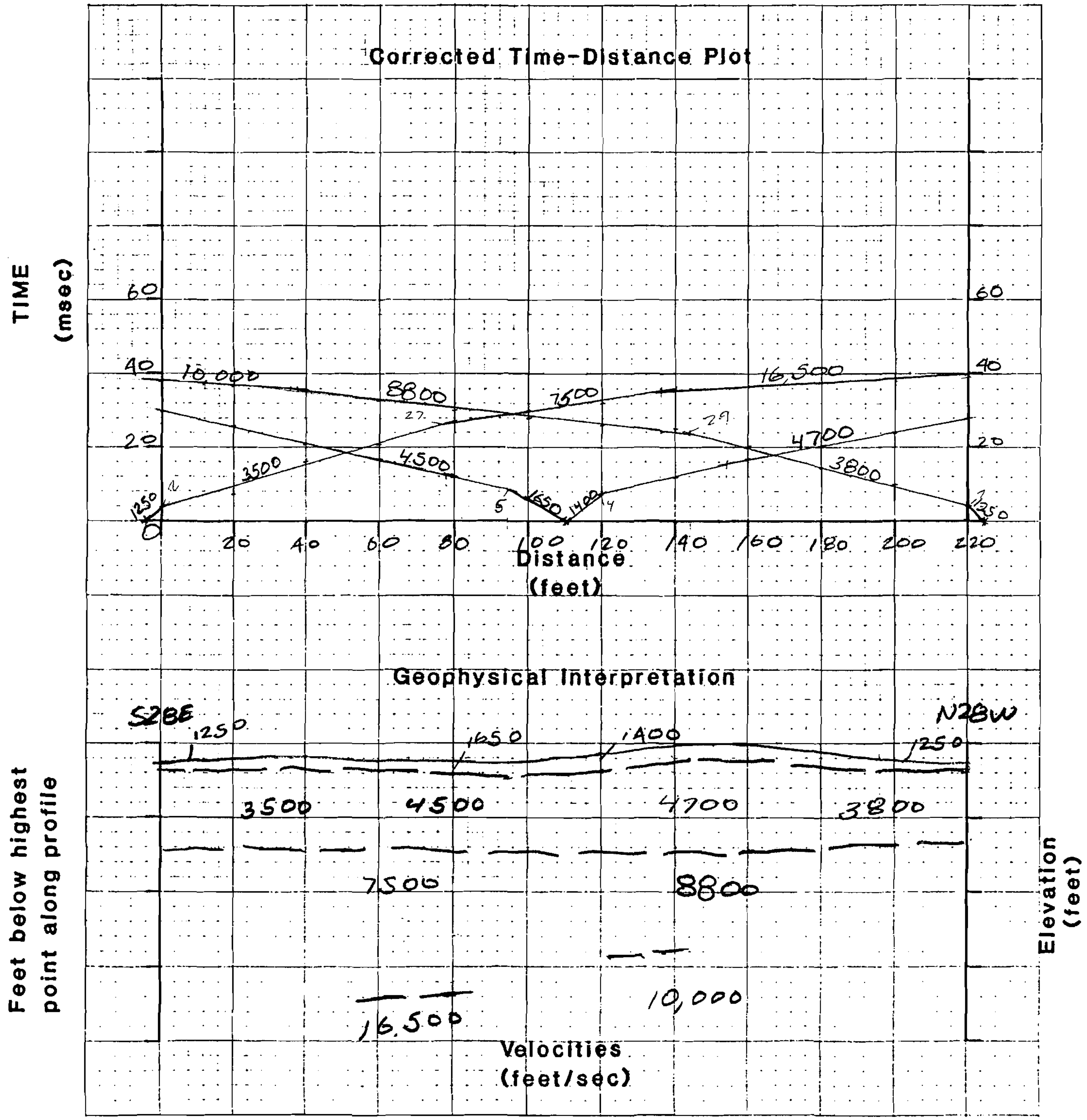
Project #: 6870318-02
Line #: S-3
Date: 7/24/87
Field Work By: GOC, DSS, CK
Interpretation By: DSS

LEIGHTON and ASSOCIATES
INCORPORATED

SOIL ENGINEERING GEOLOGY GEOPHYSICS GROUND WATER HAZARDOUS WASTES

RIPPABILITY SURVEY

S-4



Project #: 6870318-02
Line #: S4
Date: 7/24/87
Field Work By: GOC, OSS, CK
Interpretation By: OSS

LEIGHTON and ASSOCIATES
INCORPORATED

A-vii

SOIL ENGINEERING GEOLOGY GEOPHYSICS GROUND WATER HAZARDOUS WASTES

Seismic Lines SL1 - SL5, Leighton, 1992

APPENDIX E

Seismic Refraction Survey

Introduction

This appendix presents the findings of a seismic refraction survey conducted for The Murrieta Hills development site located in Murrieta, California. Proposed earthwork will require excavations into granite bedrock. The purpose of this survey was to evaluate the rippability characteristics of this material.

Accompanying Illustrations

Figures F1 through F6 - Time-Distance Plot and Geophysical Interpretation - Lines 1-6

Methodology

The refraction method uses first-arrival times of refracted seismic waves to determine the thicknesses and seismic velocities of subsurface materials. Seismic waves generated at the surface are reflected and refracted from boundaries separating materials of contrasting velocities, and are detected by a series of surface geophones. The travel times of the seismic waves are used in conjunction with the shot-geophone distances to obtain thickness and velocity information.

The seismic refraction technique requires that velocities increase with depth, which is usually the case. A layer having a velocity lower than that of the layer above will not be detectable by seismic refraction, and will lead to errors in the depth computations to any subsequent layers.

Instrumentation and Field Procedure

A total of 930 lineal feet of data was collected along six survey lines. Line lengths were chosen to provide velocity information for the upper 35-40 feet of material. The locations of these lines are shown on the geotechnical map (Plate 1) as Lines 1 through 6.

Seismic waves were initiated at the ends of each survey line by striking an aluminum plate with a 16 pound sledge. Direct and refracted waves were detected by a series of 8 Hz geophones and recorded with a Geometrics Model ES-1225 12-channel signal enhancement seismograph.

Rock Rippability Classification

In order to group the materials to be excavated in terms of difficulty of excavation, Leighton and Associates, Inc. has adopted a five-fold classification scheme, the independent variable being seismic velocity. This classification is based on our experience with similar rocks in the Riverside County area, and assumes single shank D9L or equivalent equipment. The rocks are classified as follows:

Up to 2000 feet/second:	Easy ripping
2000 to 4000 feet/second:	Moderately difficult ripping
4000 to 5500 feet/second:	Difficult ripping, possible local blasting
5500 to 7000 feet/second:	Very difficult ripping, probable local general blasting
Greater than 7000 feet/second:	Blasting required

"Difficult ripping" refers to rocks in which it becomes difficult to achieve tooth penetration, sharply reducing ripping production. Local blasting may be necessary in order to maintain a desired ripping production rate. "Very difficult ripping" refers to rocks in which the use of heavy machinery is likely to cease being a cost-effective method of excavation, necessitating the use of explosives to maintain a desired excavation rate. We emphasize that the cutoffs in this classification scheme are approximate and that rock characteristics, such as fracture spacing and orientation, play a major role in determining rock rippability. These characteristics may also vary with location and depth in the rock mass.

Findings

The results of the seismic survey are summarized in Table 1. Time-distance plots and associated geophysical interpretations for the seismic lines are provided in Figures F1 through F6, respectively. Note that the measured seismic velocities represent average velocities of the subsurface materials, and significant local variations related to locally unfractured zones or other causes may be present at any level.

Based on the results of this investigation the site was found to exhibit fairly consistent rippability characteristics. In general, seismic velocities measured indicate between 1 and 10 feet of surficial material with a velocity between 1200 and 1600 feet/second overlying material with a velocity between 2900 and 3600 feet/second. The layer 1 velocities measured fall within the "Easy" rippability range while the layer 2 velocities are classified as "Moderately difficult".

Measured seismic velocities indicate that material to be excavated at proposed cut locations should be rippable using single shank D9L or equivalent equipment. The only exception to this was in the vicinity of line 3 where material with a seismic velocity of 6300 feet/second should be expected at depths greater than 30 feet. Local to general blasting will likely be necessary to facilitate excavation of this material and to achieve desired ripping production rates.

TABLE 1

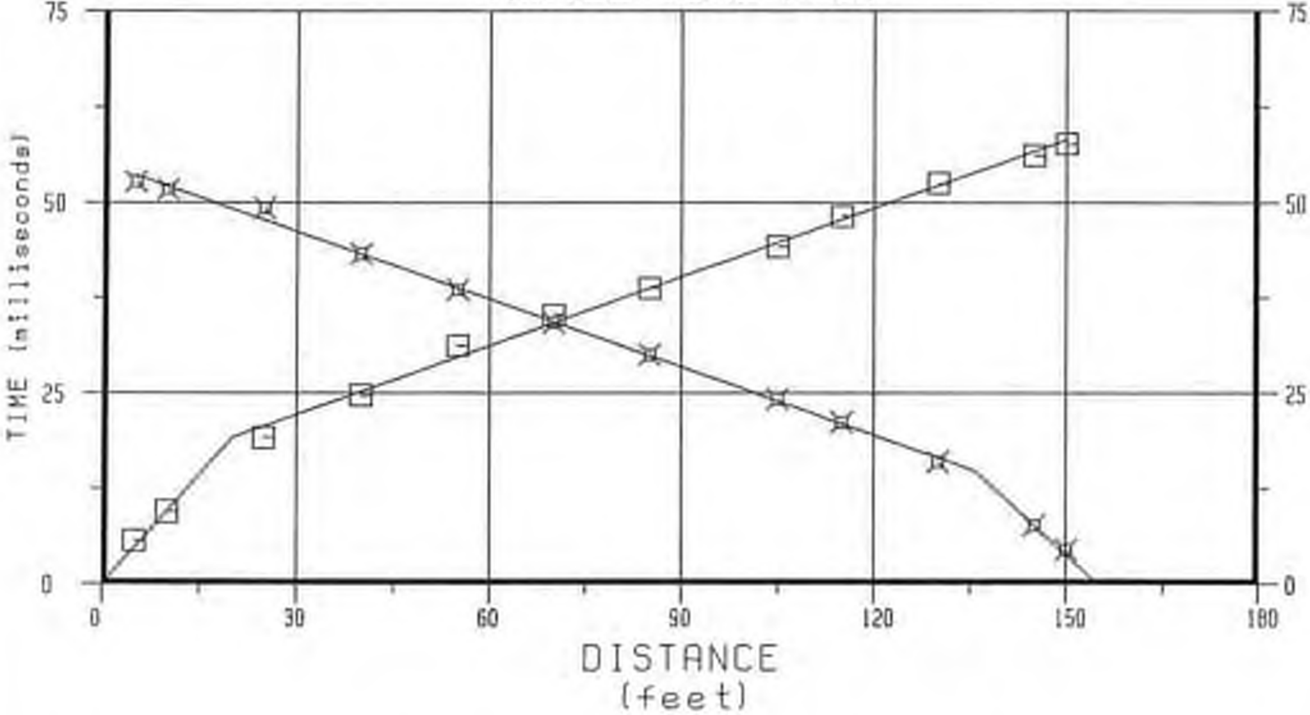
Summary of Seismic Refraction Results

Line No.	Velocities (ft./sec.)	Estimated Thickness (ft.)	Approximate Depth to Top of Layer (ft.)	Rippability
1	1200	5-8	--	Easy
	3400	--	5-8	Moderately Difficult
2	1200	5-6	--	Easy
	3200	--	5-6	Moderately Difficult
3	1200	3-5	--	Easy
	3000	25-37	3-5	Moderately Difficult
	6300	--	30-40	Very Difficult
4	1300	1-6	--	Easy
	2900	--	1-6	Moderately Difficult
5	1200	5-9	--	Easy
	2800	--	5-9	Moderately Difficult
6	1600	3-10	--	Easy
	3600	00	3-10	Moderately Difficult

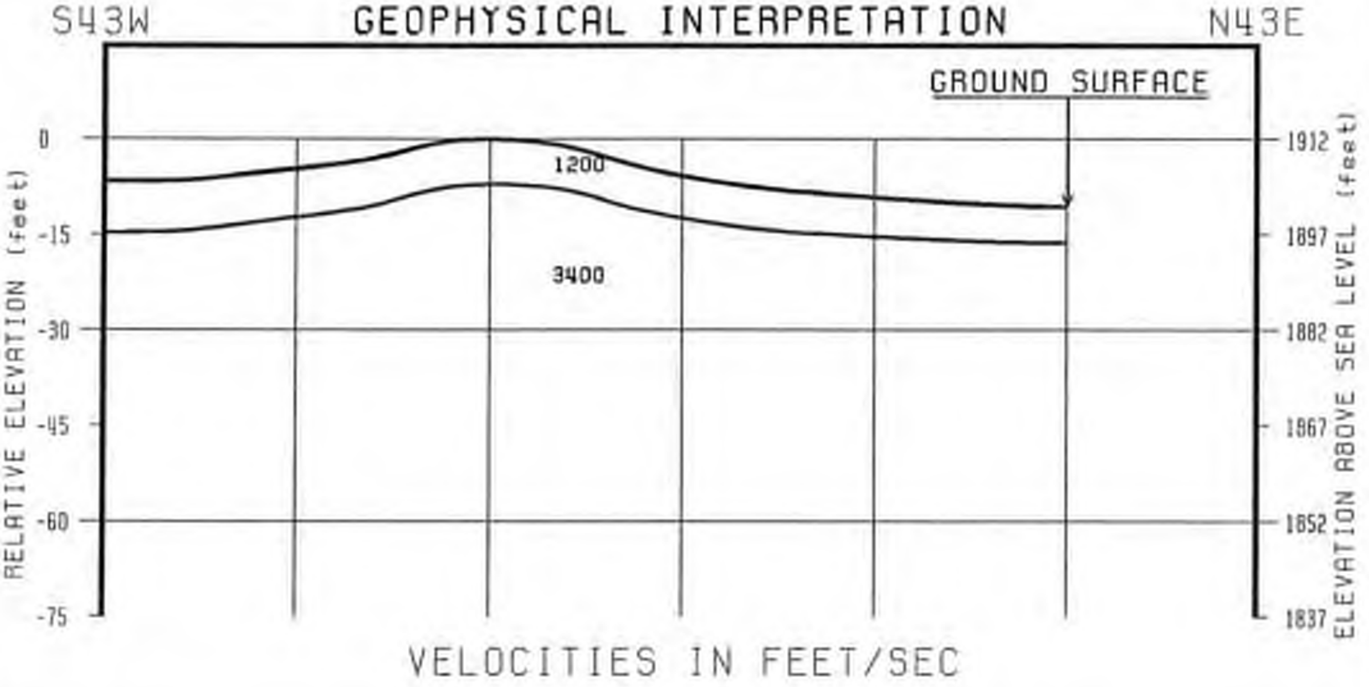
SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1200
V2=3400

TRAVEL-TIME PLOT



GEOPHYSICAL INTERPRETATION



TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 1

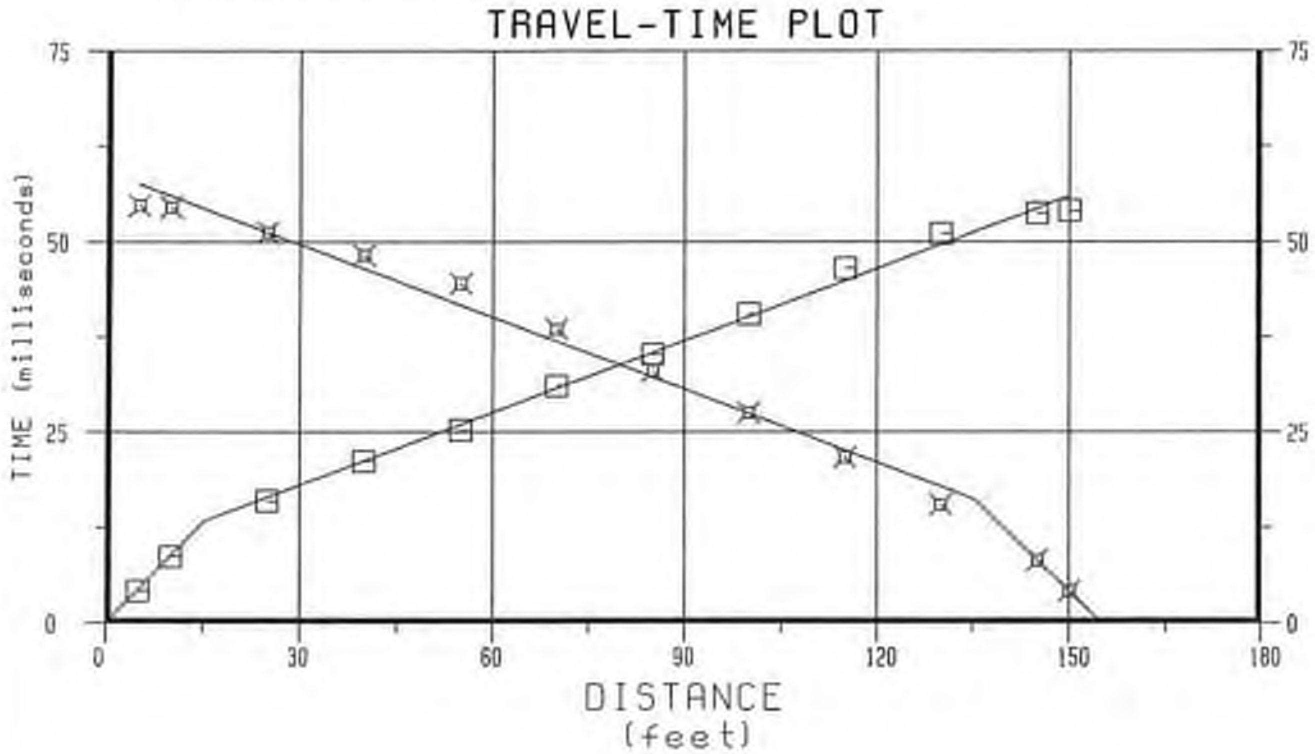
Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

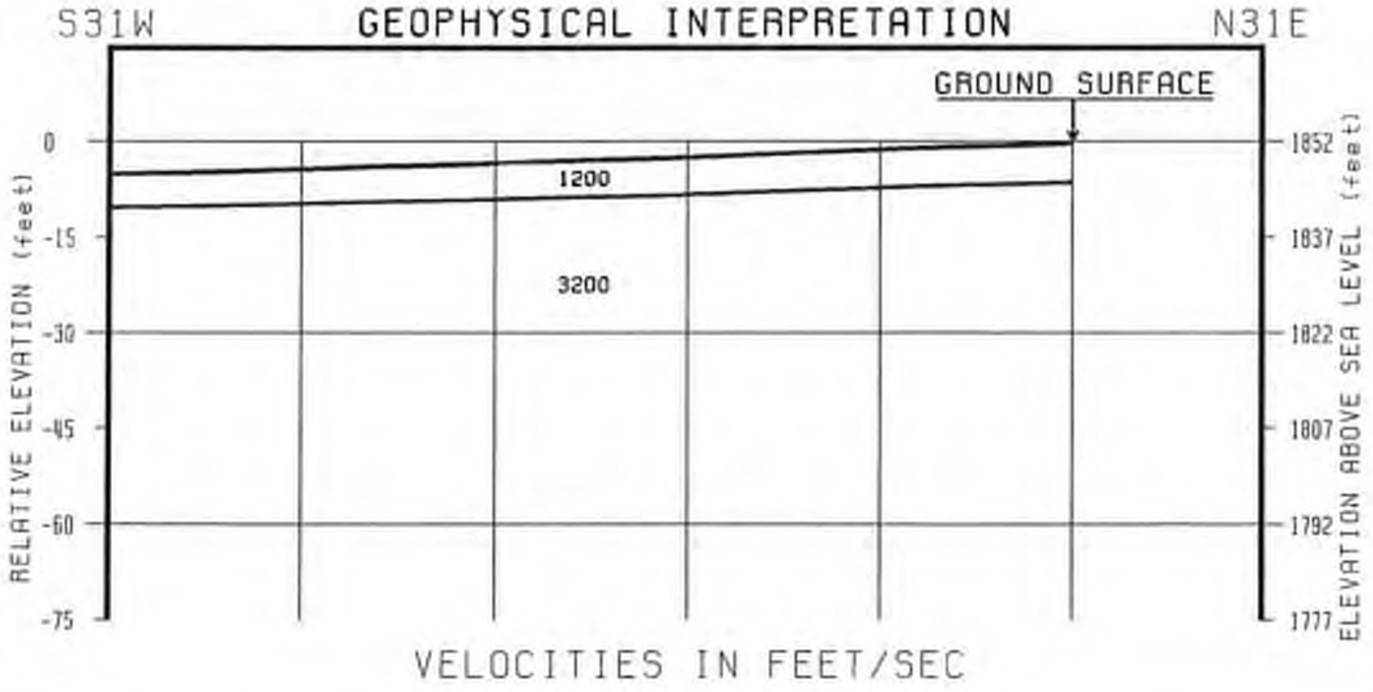
Figure No. E1

SEISMIC SOURCE: HAMMER AND PLATE

INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1200
V2=3200





TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 2

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 8870318-06
Location: MURRIETA
County: RIVERSIDE

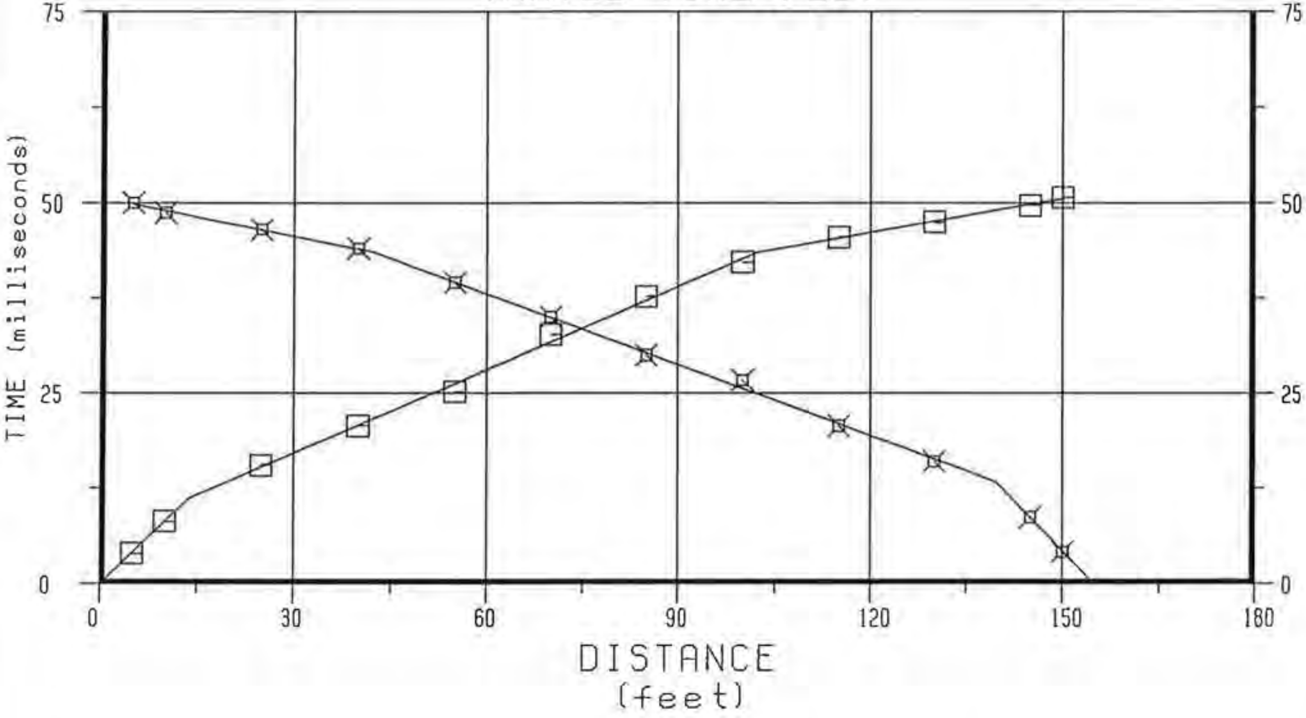
Figure No. E2

SEISMIC SOURCE: HAMMER AND PLATE

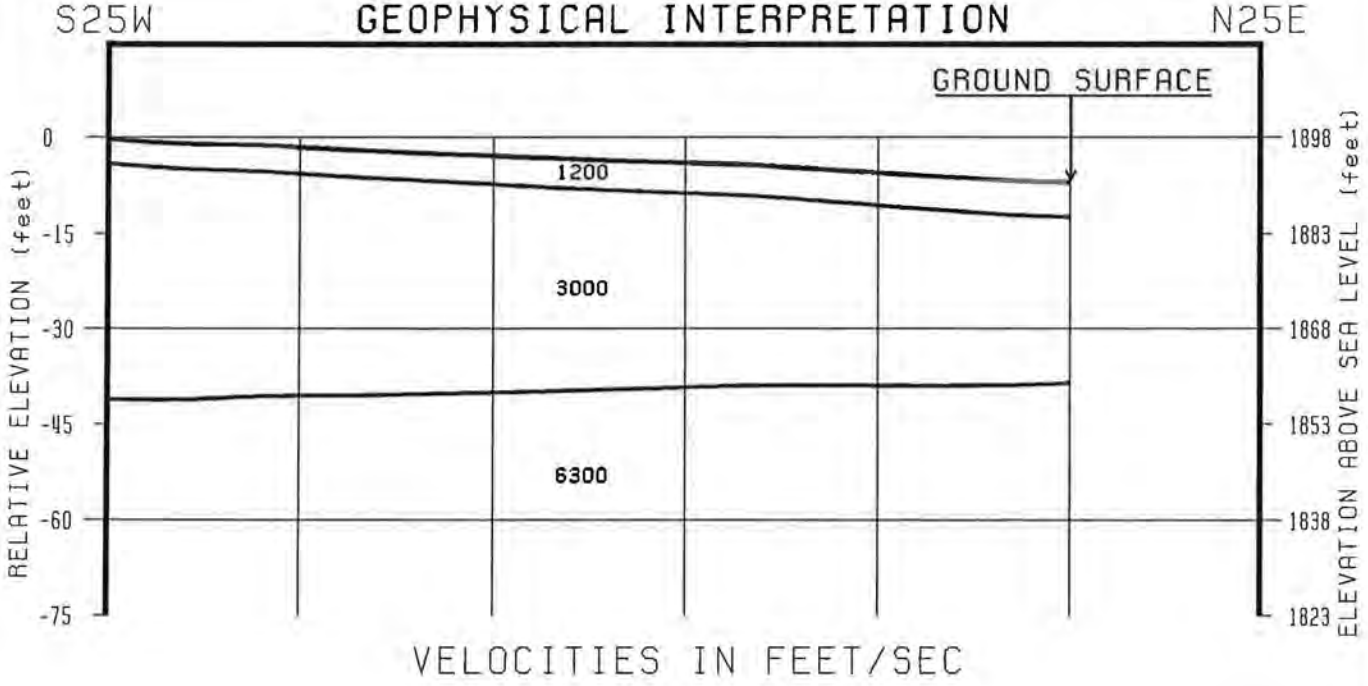
INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1200
V2=3000
V3=6300

TRAVEL-TIME PLOT



GEOPHYSICAL INTERPRETATION



TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 3

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

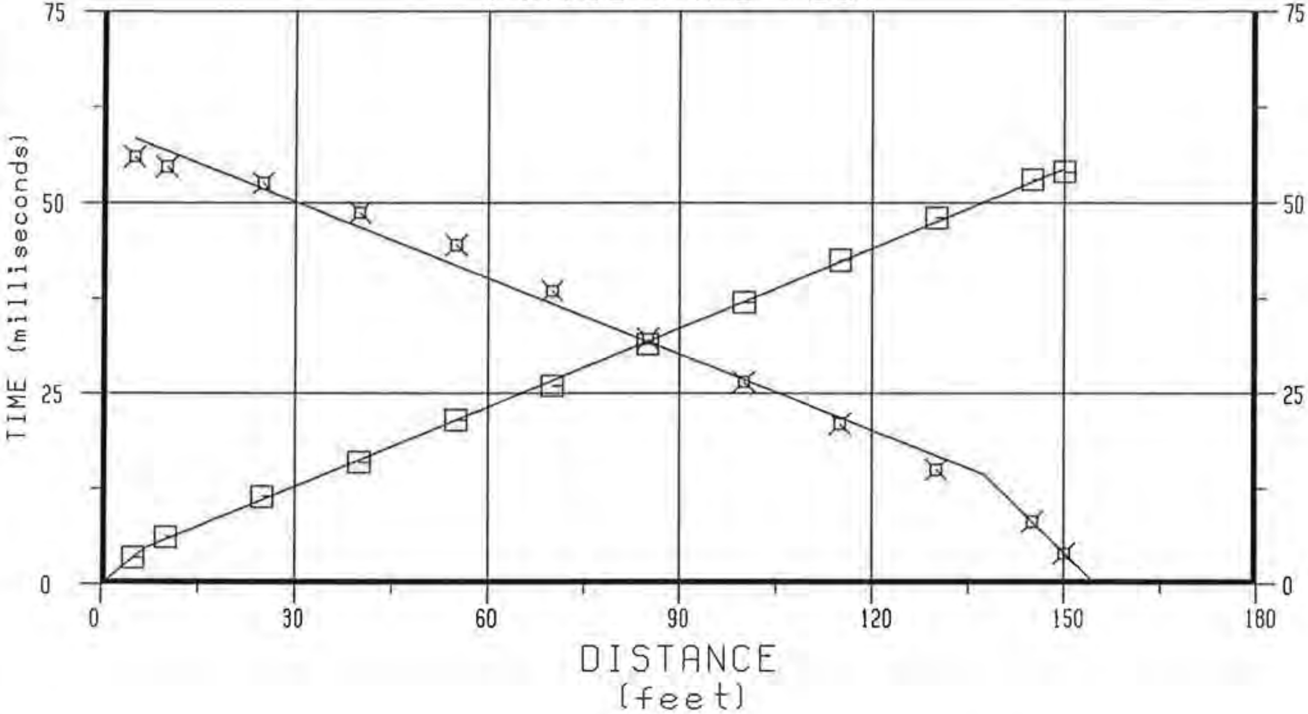
Figure No. E3

SEISMIC SOURCE: HAMMER AND PLATE

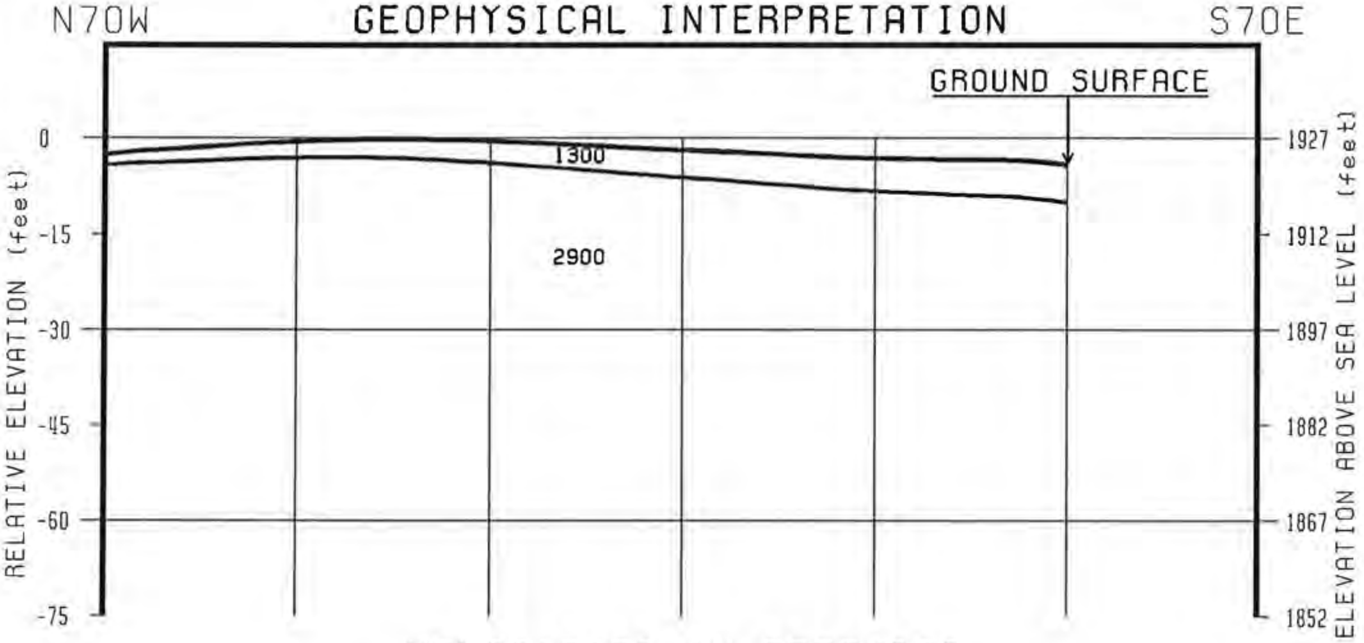
INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1300
V2=2900

TRAVEL-TIME PLOT



GEOPHYSICAL INTERPRETATION



VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 4

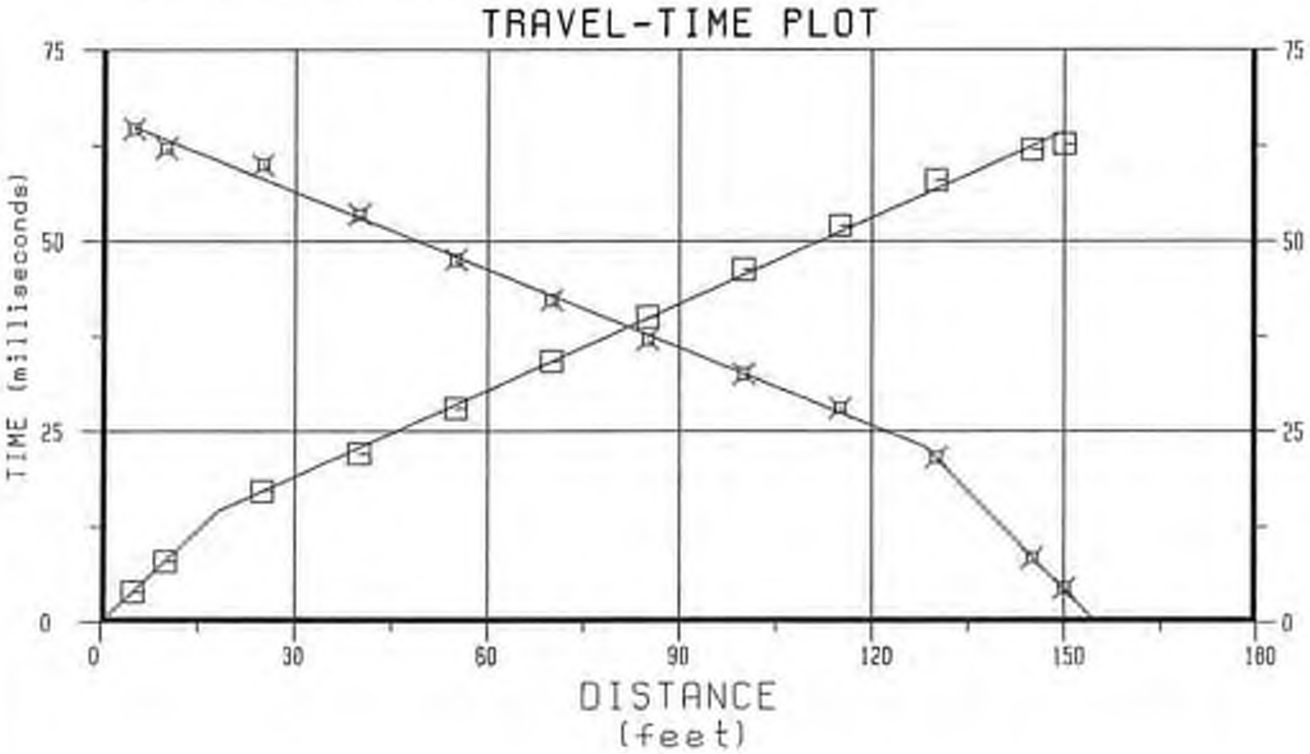
Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

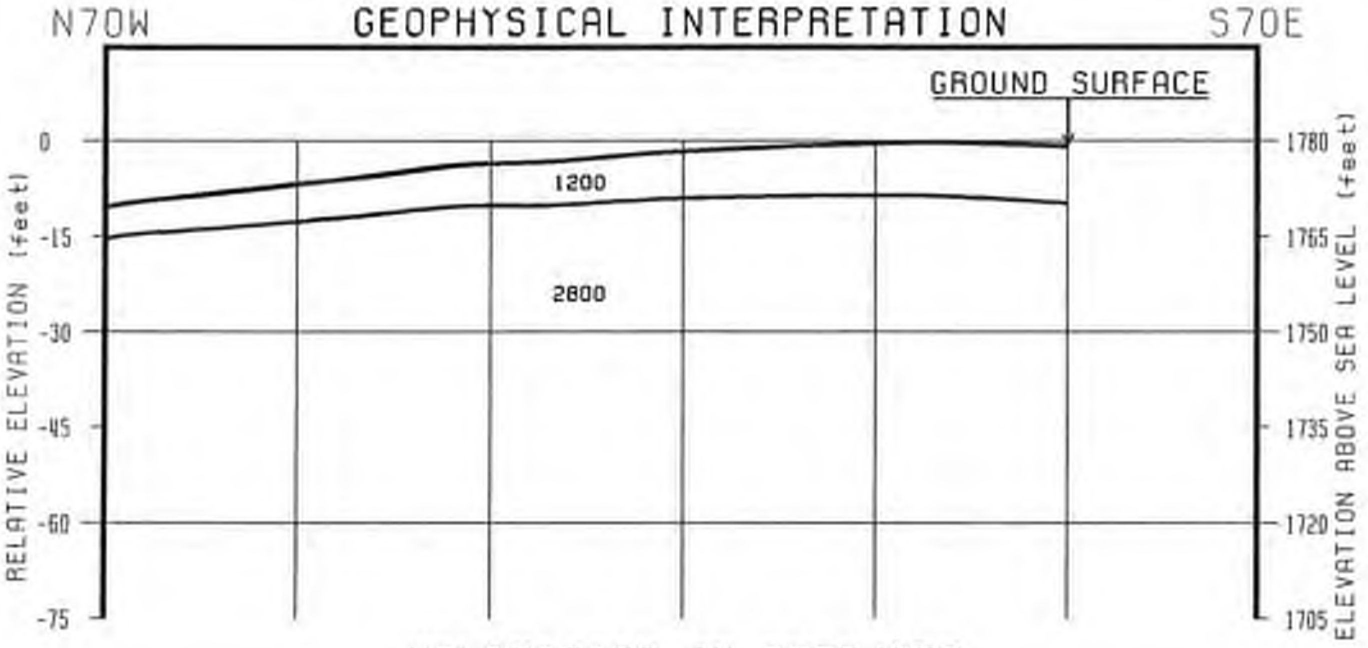
Figure No. E4

SEISMIC SOURCE: HAMMER AND PLATE

INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1200
V2=2800





VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 5

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

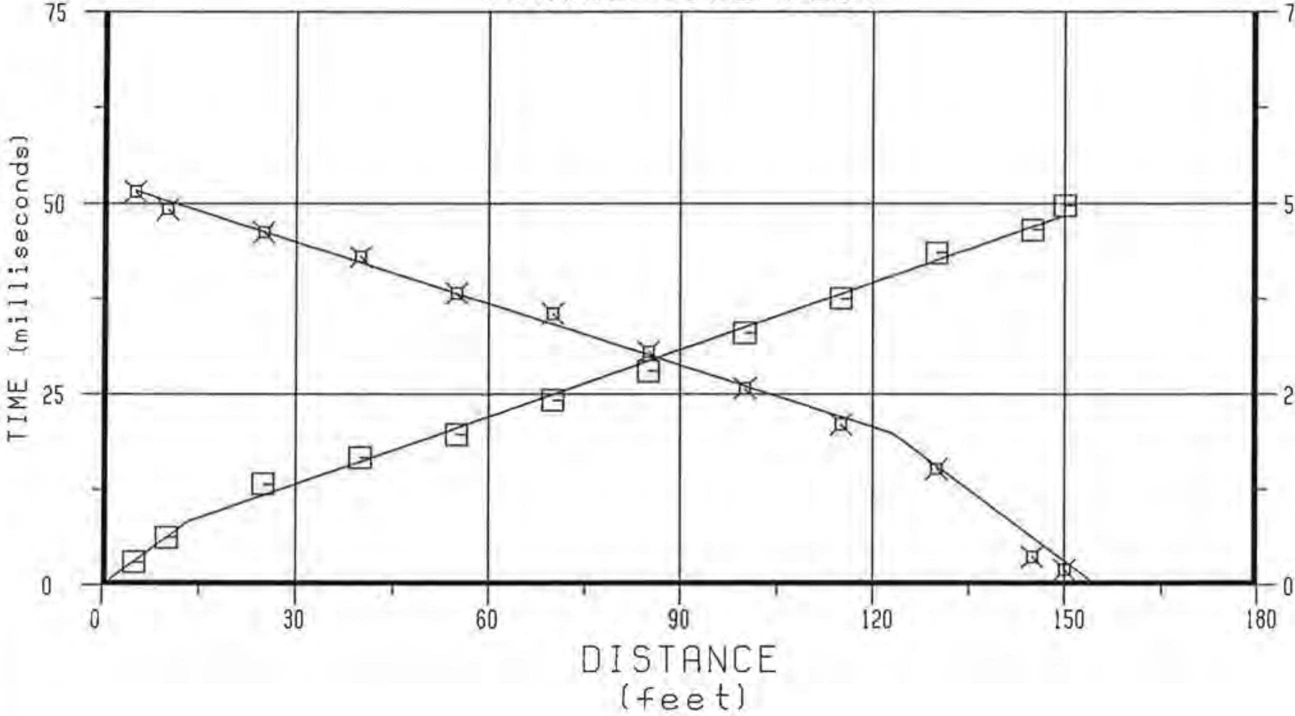
Figure No. E5

SEISMIC SOURCE: HAMMER AND PLATE

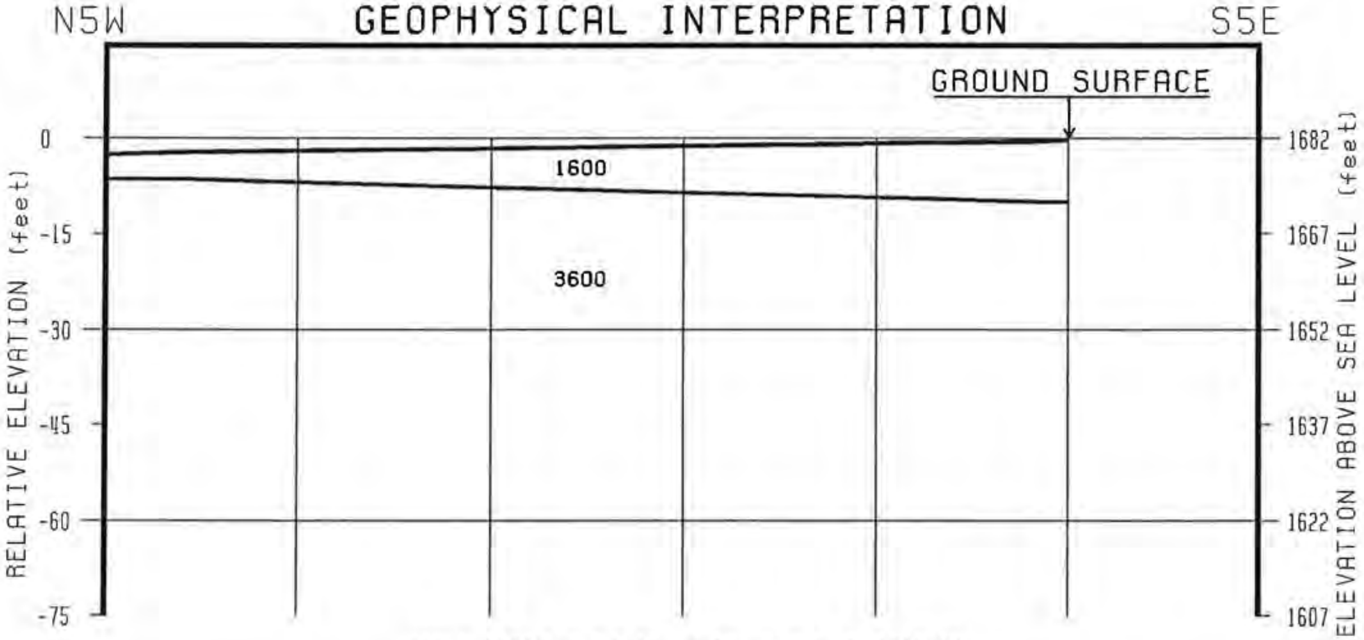
INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1600
V2=3600

TRAVEL-TIME PLOT



GEOPHYSICAL INTERPRETATION



VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 6

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

Figure No. E6

Seismic Lines L1, Leighton, 1999

Sub
Surface
Surveys

215 So.Highway 101, Suite 203   P.O. Box 1152   Solana Beach, CA 92075
Telephone: (619) 481-8949   Facsimile: (619) 481-8998

March 19, 1999

Leighton & Associates
41769 Enterprise Circle North, Suite 102
Temecula, CA 92590

Attn: Bob Riha   re: Seismic refraction survey, Murrieta Hills, CA

This brief letter report is to present the results of a geophysical seismic refraction survey carried out in the Murrieta Hills on the north side of Murrieta, California (Fig. 1) on March 12, 1999. The site was among the granite knobs on the east side of Zeiders Road. Purpose of the survey was to determine depth to bedrock, weathered and unweathered, and its rippability. These values were determined utilizing seismic refraction methodolgy.

A Bison 9024 24 channel seismograph system was applied to the task. This instrument has DIFP, digital instantaneous floating point. This translates into a computer-controlled seismograph that records incoming signals at all instrument settings, and these are analyzed by the computer, which then outputs optimum, balanced traces with maximum informational content.

Survey Design - Locations of the four spreads constituting lines 1 through 4 are illustrated (Fig. 2). The first one is along the axis of a north-south elongate granite hill nearly 1/2 mile north of the remaining three, which are more or less clustered. The latter three are also along topographic axes; line 2 particularly, is draped over the crown of a hill.

Distance from shot to far offset geophone was 240 feet for all spreads; Geophone interval was 10 feet, and there was a 10 foot offset from off end shots to nearest geophone. There is a 20 foot space between geophones 12 and 13 where the split spread shot was fired. These spread lengths allow for an investigation to depths of approximately 75 feet. The spreads were shot forward, split spread and reverse. This redundacy aids in determining dip and undulations in layer boundaries.

Source was a heavy duty sledge hammer equipped with an inertial trigger. The accelerated weight drop source was available but it was not needed. Vertical stacking was carried out as a noise abatement strategy, and to build energy. Elevations for all shot and geophone locations were surveyed in, as relative elevations, and then approximately tied to absolute elevations picked on a detailed topographic map furnished.

The site was away from freeways and busiest streets; consequently, Sub Surface Surveys

SITE LOCATION MAP

FIGURE 1

SEISMIC LINE LOCATION MAP

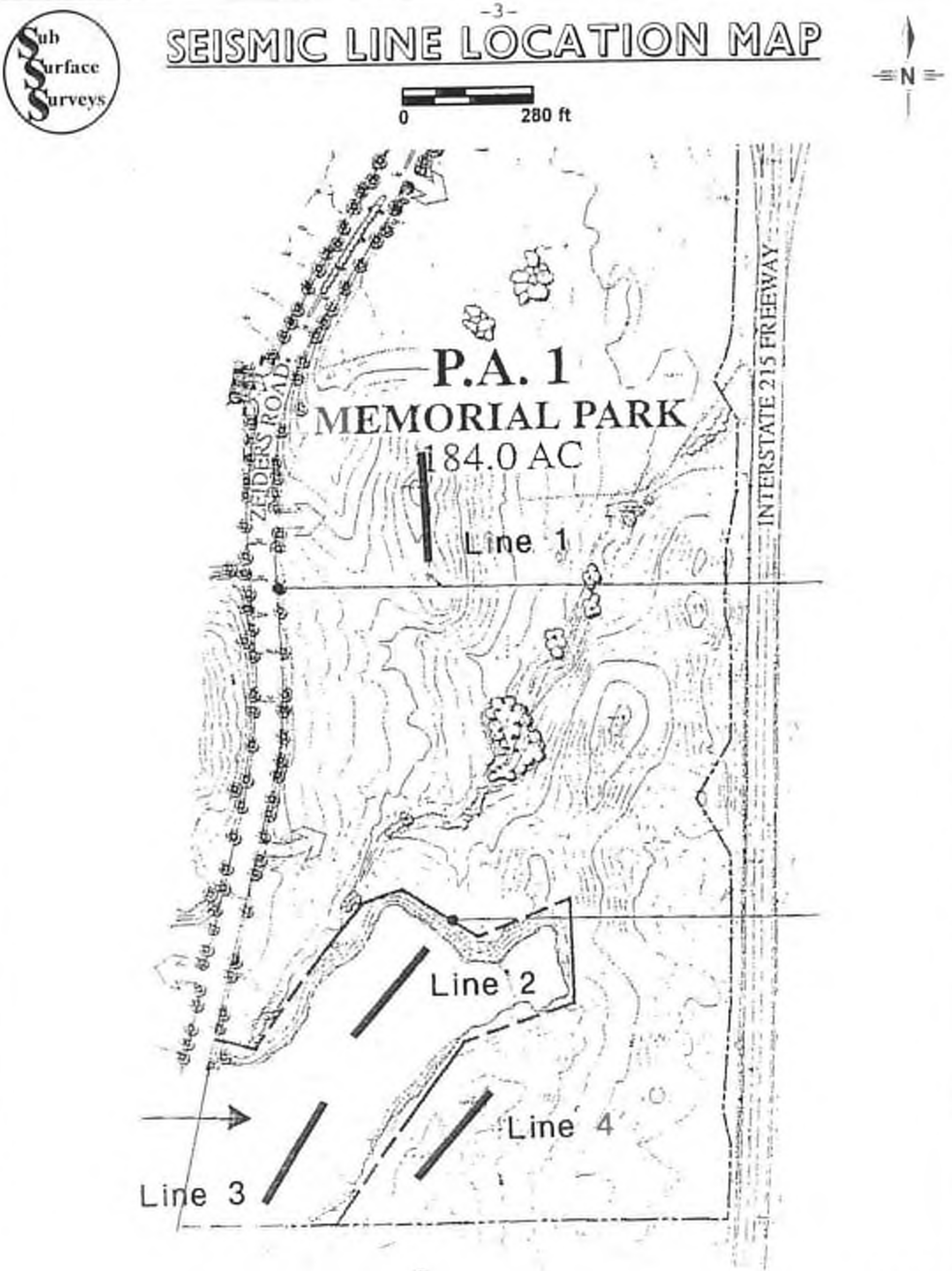


FIGURE 2

traffic noise was usually low. Wind noise was a minor problem.. Rain fell during the survey, and there were waits during heaviest showers. Picking first arrival energy, particularly with the computer picking program that has filtering, AGC, trace balancing, etc. was reliably accomplished.

Geologic Setting - The site is on the Peninsular Ranges Batholith consisting of a composite of individual Mesozoic intrusive bodies, mostly granitic clan rocks. The intrusives are bimodal in that there are rare, small basic intrusives found among the granites. Limited exposures of the metamophosed host rocks, metasediments and metavolcanics, are seen occasionally as bounding masses and roof pendants.

Siesmic surveys in this batholithic setting have virtually always revealed a three layer case. The topmost layer is commonly thin and is composed of soil and colluvium. The second layer is weathered granite and the deepest layer is unweathered granite clan rocks.

Brief Description of Geophysical Methods Applied - Seismic refraction investigates the subsurface by generating arrival time and offset distance information to determine the path and velocity of an elastic disturbance in the ground. The disturbance is created by shot, hammer, weight drop or some comparable method of putting impulsive energy into the ground. Detectors are laid out at regular intervals in a line to measure the first arrival energy and the time of its arrival. The data are plotted in time-distance graphs, from which velocity of, and depth to, layers can be calculated. This is possible because rays (a continuum point on an expanding wave front) of the disturbance wave follow the direct route, or are refracted across layer boundaries where there is a difference in elastic and density properties. The critically refracted rays travel along the layer interfaces and continuously "feed" energy back to the surface.

Shots are normally reversed, from one end of the line to the other, to determine whether or not the layering is horizontal or dipping. The acquired data are computationally intense. A ray-tracing computer program, SIPT2 in this instance, was used to iteratively honor all detector information to determine dip and irregularities in the refracting surfaces, velocities, and to be able to consider a large number of layers, where they are present. A first energy arrival picking program, with such features as zoom, filtering, time stretching, separation of traces, and AGC, was also used.

Interpretation - Monitor records are produced in the field with each shot. These are prints of the raw data as it comes in to the recorder. They show the quality of the data, so that the operator can determine whether or not the data are pickable, or shots need to be repeated. Two representative monitor records, one a forward shot from line 2, and a split spread shot also from line 2 (Fig. 3), are illustrated.

First energy arrivals are seen to be quite sharp on the raw records, although some minor wind noise is coming in on the far offset traces. This is not uncommon for off end shot records. Even so, with use of a computer picking program, with zoom, amplification, filter, gain, separation of traces, etc., there was, as aforementioned, no difficulty in picking the first energy arrivals. There should not be significant variation in picked arrival times should the first breaks be picked by several persons independently.

More of the shooting parameters are listed below the monitor records (Fig. 3).

The first pick information, geophone locations, and geometry of the spreads, are input to a routine that produces a time-distance plot (e.g. Fig. 4, from line 1, all shots). The four curves reflect the shots at the three positions along the line, as previously outlined. The split shot, however, produces two curves going in opposite directions. The data show a 3-layer case, as is illustrated by generalized straight lines drawn through the forward curve of line 1 (Fig. 4). It is obvious that the topmost layer is quite thin. Minor undulations in the curves, based on the raw data, are mostly explained by the fact that elevation corrections were not yet applied to the data in the time-distance plot, and perhaps small disturbances from noise, and low energy at far offset geophones. Minor variations in the positions of the "dog legs" in the curves are an expression of the laterally changing thicknesses of the uppermost layers.

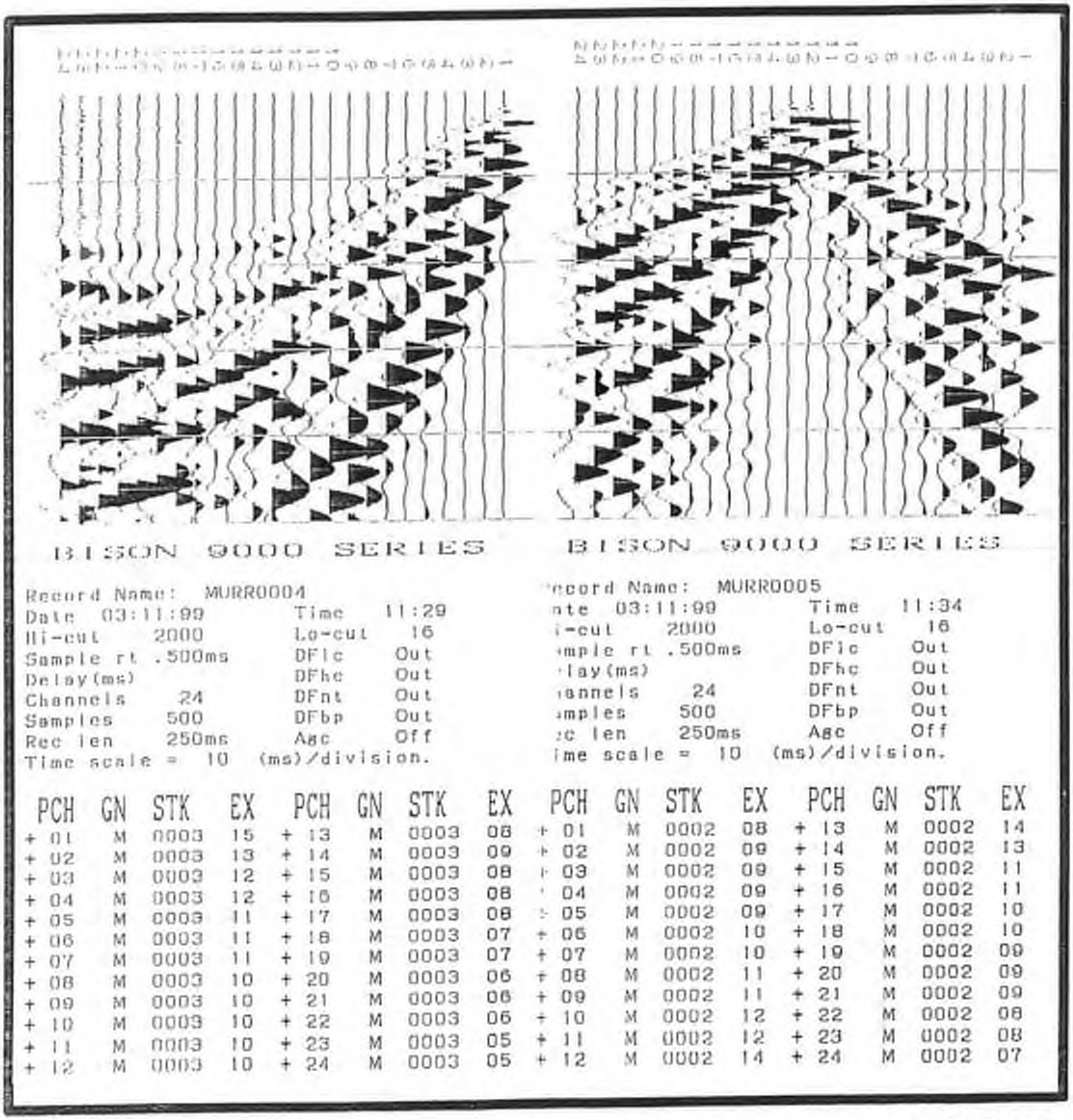
The models were calculated utilizing the SIPT2 program which includes an iterative ray tracing procedure. With the processing of the "corrected" data, including elevation corrections, a geologic model was developed for the four lines (Fig. 5-8). Boundaries appear to be somewhat undulating; however, some vertical exaggeration in the structure sections, approximately 2:1, makes this appear to be more than it is.

In general the layer boundaries mimic the surface topography which is typical of weathering phenomena. Thickness of the soil/colluvium layer averages approximately 7 feet, but varies from 16 feet to feather edge. Average velocity is 1350 ft/sec. This is typical. Layer 2 thickness is in the order of 48 feet with a medium range of thickness variation (layers 2 and 3 are combined for this determination for line 2). Average velocity for layer 2 is approximately 4100 ft/sec. This also is typical for the weathered granitic layer. Range of velocities for layer 2 is fairly large, however; maximum velocity measured is 5100 ft/sec.

Finally, thickness of layer 3 was not determined; presumably it extends

Sub Surface Surveys

MONITOR RECORDS



BISON 9000 SERIES

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Hi-cut 2000 Lo-cut 16
Sample rt .500ms DFlc Out
Delay(ms) DFhc Out
Channels 24 DFnt Out
Samples 500 DFbp Out
Rec len 250ms Agc Off
Time scale = 10 (ms)/division.

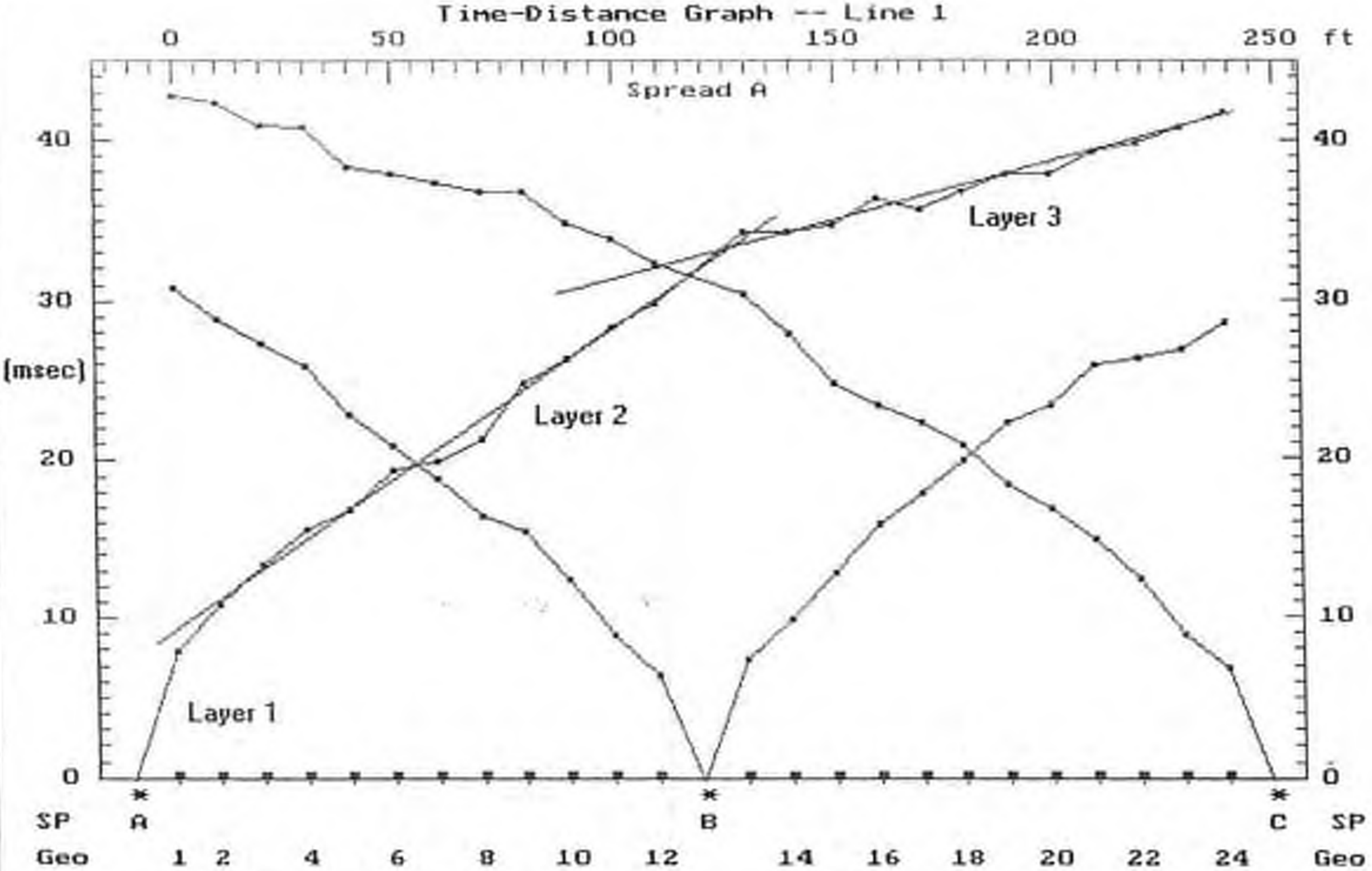
PCH	GN	STK	EX	PCH	GN	STK	EX
+ 01	M	0003	15	+ 13	M	0003	08
+ 02	M	0003	13	+ 14	M	0003	09
+ 03	M	0003	12	+ 15	M	0003	08
+ 04	M	0003	12	+ 16	M	0003	08
+ 05	M	0003	11	+ 17	M	0003	08
+ 06	M	0003	11	+ 18	M	0003	07
+ 07	M	0003	11	+ 19	M	0003	07
+ 08	M	0003	10	+ 20	M	0003	06
+ 09	M	0003	10	+ 21	M	0003	06
+ 10	M	0003	10	+ 22	M	0003	06
+ 11	M	0003	10	+ 23	M	0003	05
+ 12	M	0003	10	+ 24	M	0003	05

BISON 9000 SERIES

ecord Name: MURR0005
ate 03:11:99 Time 11:34
i-cut 2000 Lo-cut 16
mple rt .500ms DFlc Out
lay(ms) DFhc Out
annels 24 DFnt Out
mples 500 DFbp Out
c len 250ms Agc Off
ime scale = 10 (ms)/division.

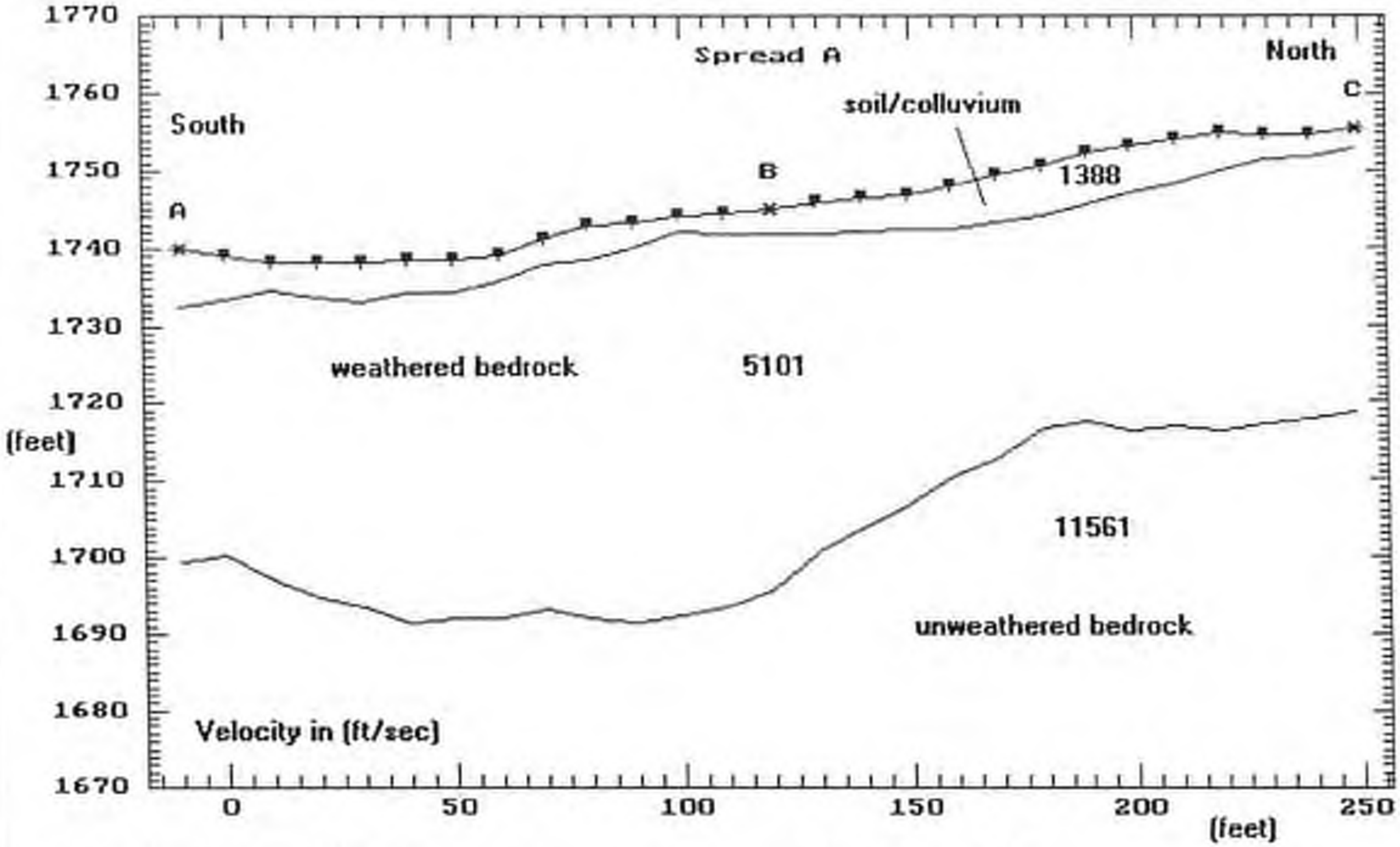
PCH	GN	STK	EX	PCH	GN	STK	EX
+ 01	M	0002	08	+ 13	M	0002	14
+ 02	M	0002	09	+ 14	M	0002	13
+ 03	M	0002	09	+ 15	M	0002	11
04	M	0002	09	+ 16	M	0002	11
+ 05	M	0002	09	+ 17	M	0002	10
+ 06	M	0002	10	+ 18	M	0002	10
+ 07	M	0002	10	+ 19	M	0002	09
+ 08	M	0002	11	+ 20	M	0002	09
+ 09	M	0002	11	+ 21	M	0002	09
+ 10	M	0002	12	+ 22	M	0002	08
+ 11	M	0002	12	+ 23	M	0002	08
+ 12	M	0002	14	+ 24	M	0002	07

FIGURE 3



Seismic Refraction Survey	Performed by
Murrieta Hills, Project 870318-007	Subsurface Surveys
Murrieta, California	March 11, 1999

FIGURE 4


Line 1

Seismic Refraction Survey

Murrieta Hills, Project 870318-007

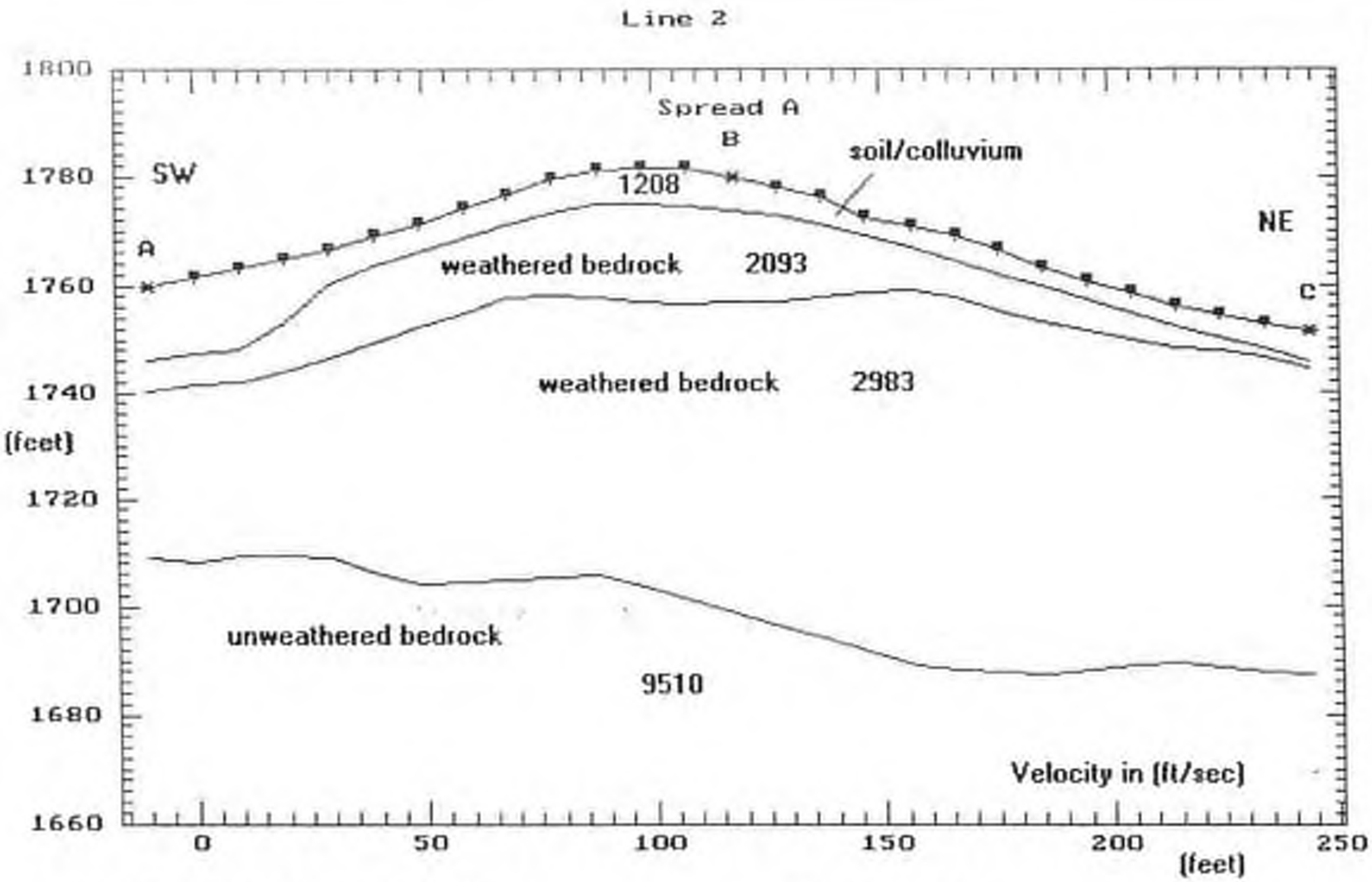
Murrieta, California

Performed by

Subsurface Surveys

March 11, 1999

FIGURE 5



Seismic Refraction Survey

Murrieta Hills, Project 870318-007

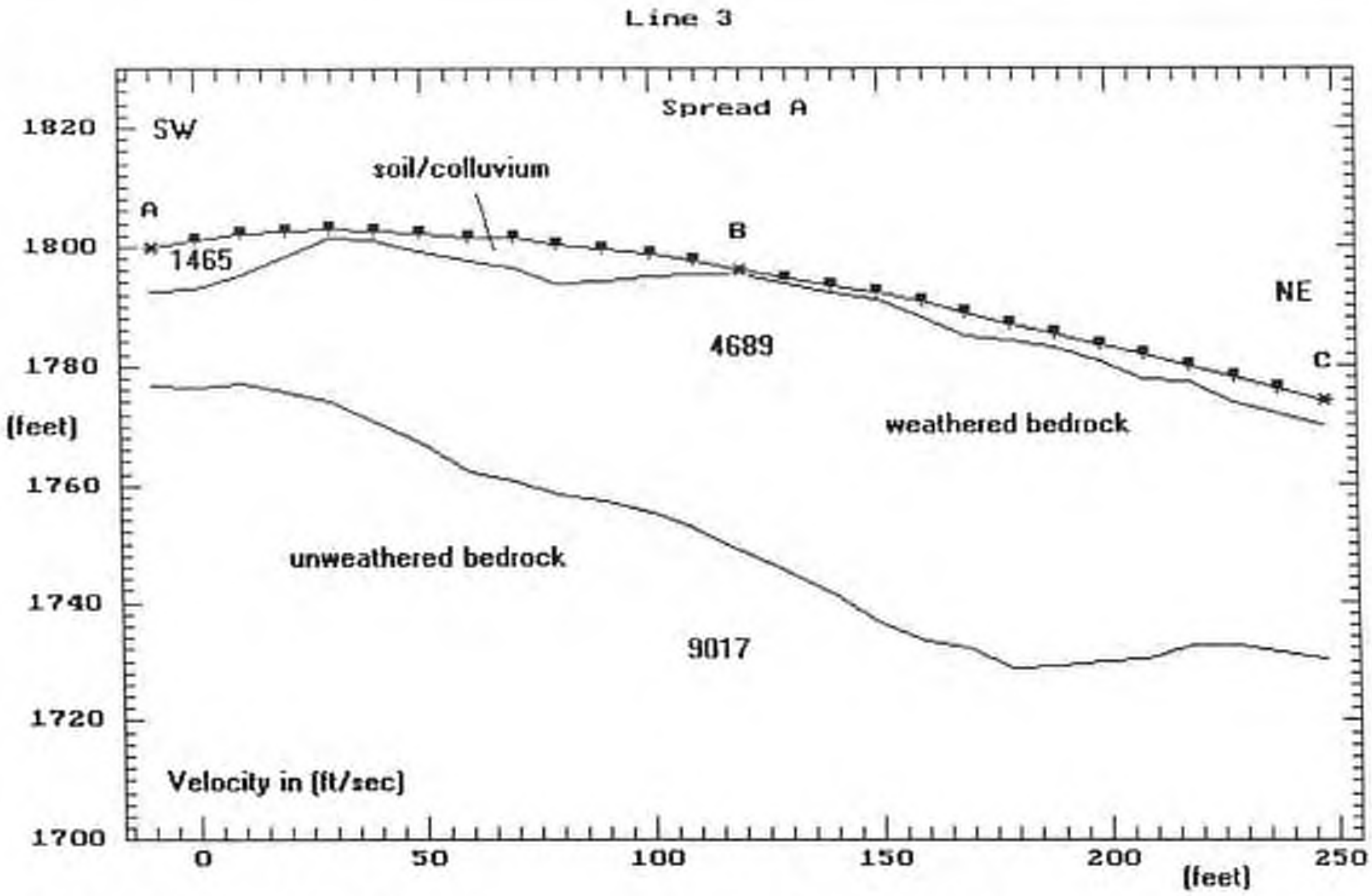
Murrieta, California

Performed by

Subsurface Surveys

March 11, 1999

FIGURE 6



Seismic Refraction Survey

Murrieta Hills, Project 870318-007

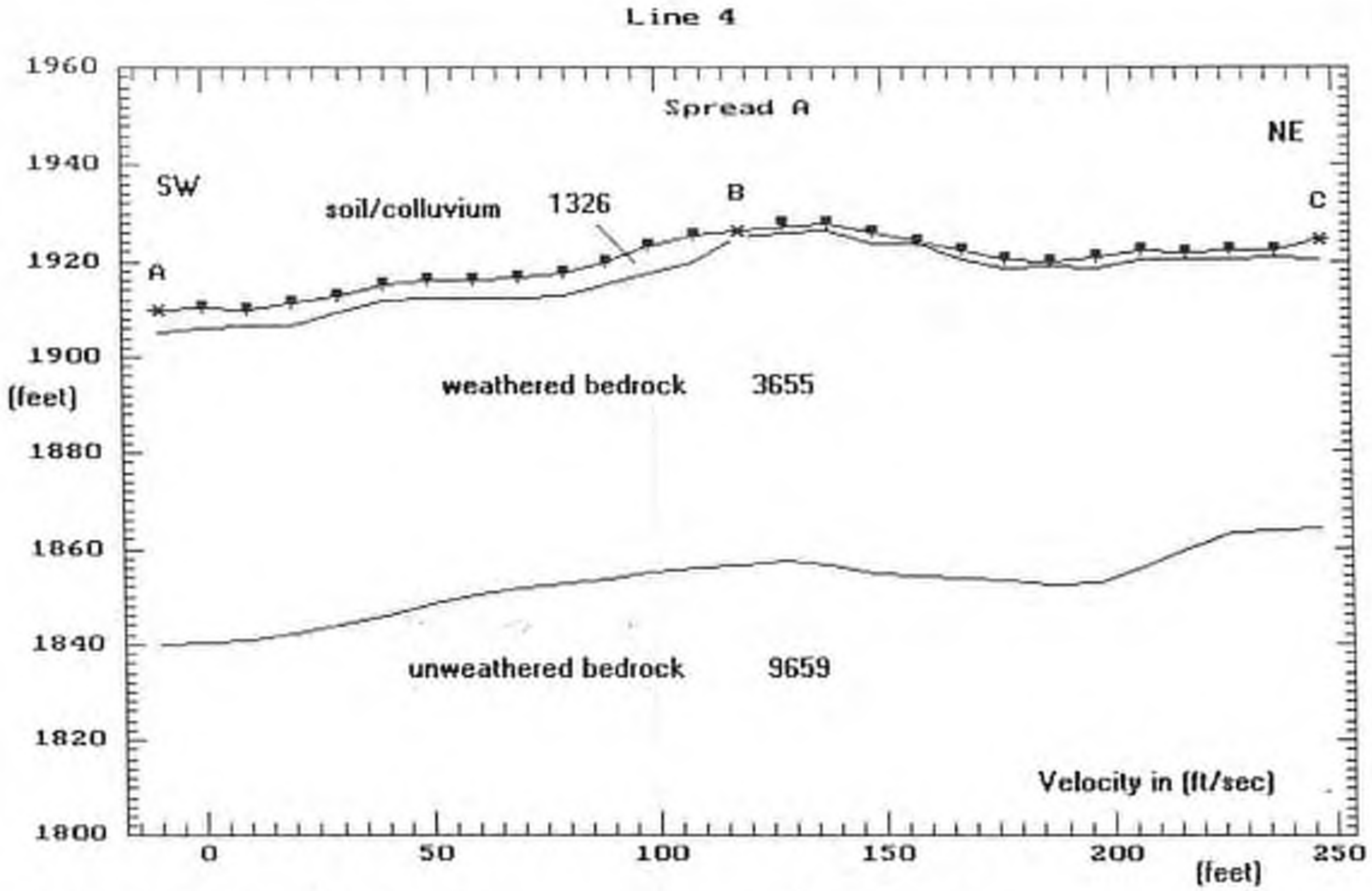
Murrieta, California

Performed by

Subsurface Surveys

March 11, 1999

FIGURE 7



Seismic Refraction Survey

Murrieta Hills, Project 870318-007

Murrieta, California

Performed by

Subsurface Surveys

March 11, 1999 FIGURE 8

to great depth. Its seismic velocity is in the order of 10,000 ft/sec. This is a "bulk" velocity in that it includes inhomogeneities of the rock, such as fracture zones and chilled borders with microcracks. Any small statistically homogeneous sample would doubtlessly be characterized by a higher velocity.

Line 2 is an anomalous case. There are four layers. Although the two middle layers do not vary much in velocity, the computer program consistently output a four layer case. It will be noted that the topography is sharpest on this line, the thickest part of the "second" layer is directly beneath the crest of the prominence, and that this layer appears to pinch out toward the lower elevations in both directions. Further, the average of the combined velocities of the two anomalous layers is well below the average for the middle layer on the other models. It appears that air and water have relatively freer access to the shallow subsurface here than on the other lines, to explain the more advanced weathering. Outcrop inspection might reveal geologic features that reconcile with this speculation, but fracturing is probably part of the explanation, at least.

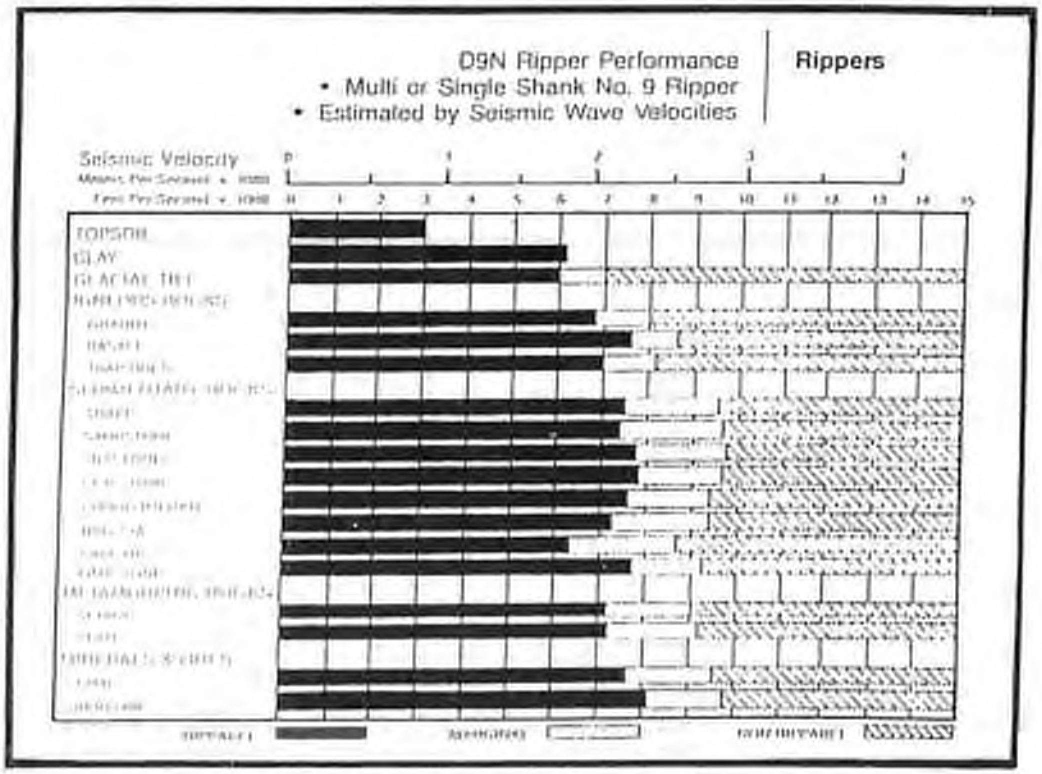


Figure 9. Caterpillar rippability chart by rock classes

The Caterpillar rippability chart is illustrated to provide an estimate of the relative difficulty in ripping the layers in the near subsurface (Fig. 9). Layers 1 and 2 rocks are rippable everywhere, insofar as sampling is representative. Layer 3 rocks appear to be non-rippable everywhere. The nearest these non-rippable rocks come to the surface, beneath the lines shot, is 24 feet beneath the southwest end of line 3.

Conclusions - The picture that appears to emerge from the geophysical data, together with some surface observations, is that rock in layers 1 and 2 may be considered, for planning purposes, to be easily rippable everywhere, to the extent of sampling. Layer 3 appears to be non-rippable everywhere. Generally the non-rippable rocks are deeper than planned cuts.

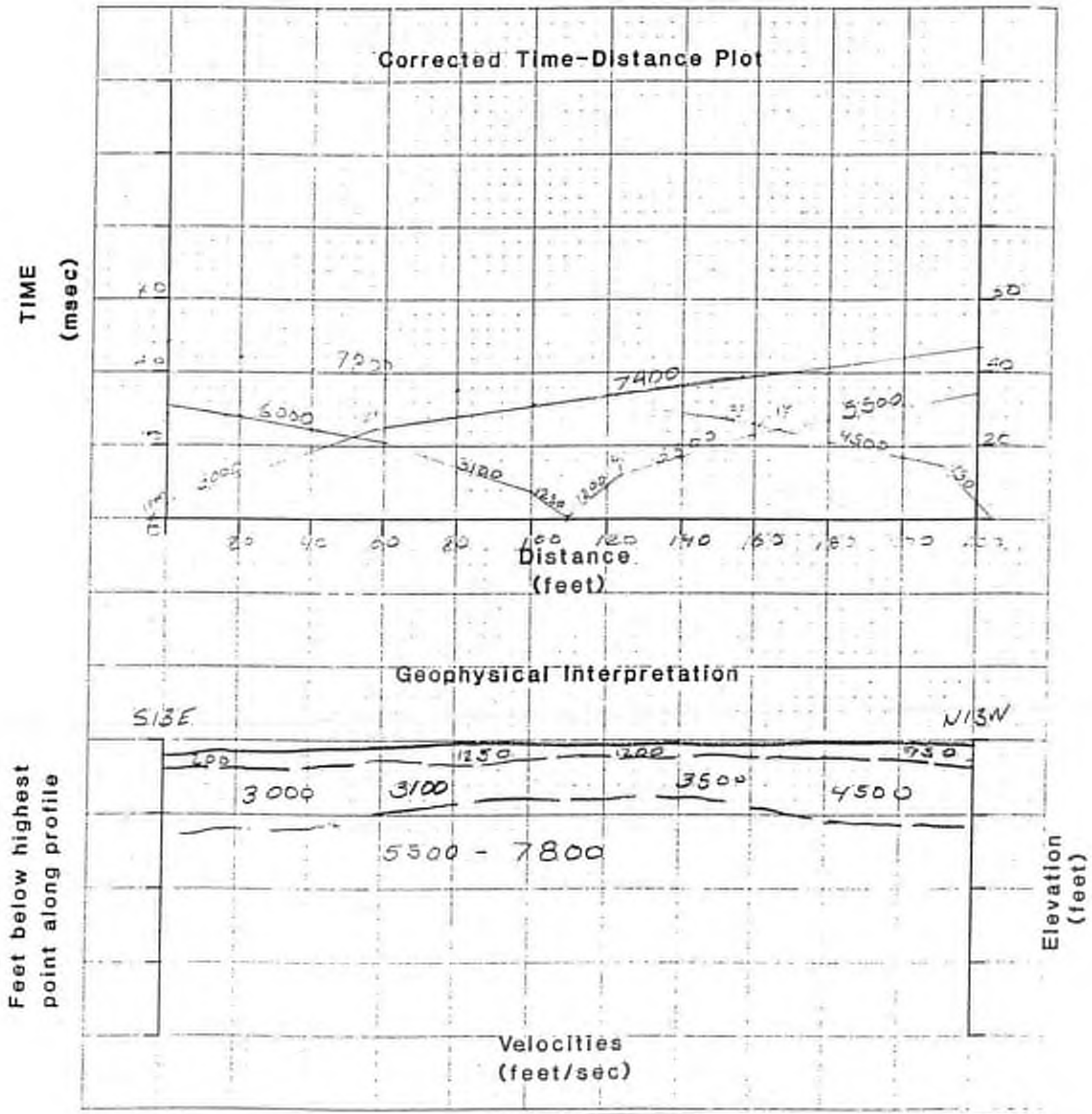
All data acquired in this project are in confidential file in this office, and are available for review at any time. The opportunity to participate in this project is very much appreciated. Please call, if there are questions.

Gary W. Crosby

Gary W. Crosby, PhD, GP 960

GWC:arr

RIPPABILITY SURVEY



Project #: [illegible]
Line #: [illegible]
Date: [illegible]
Field Work By: [illegible]
Interpretation By: [illegible]

LEIGHTON and ASSOCIATES
INCORPORATED

Seismic Lines 1-8, Leighton, 2008

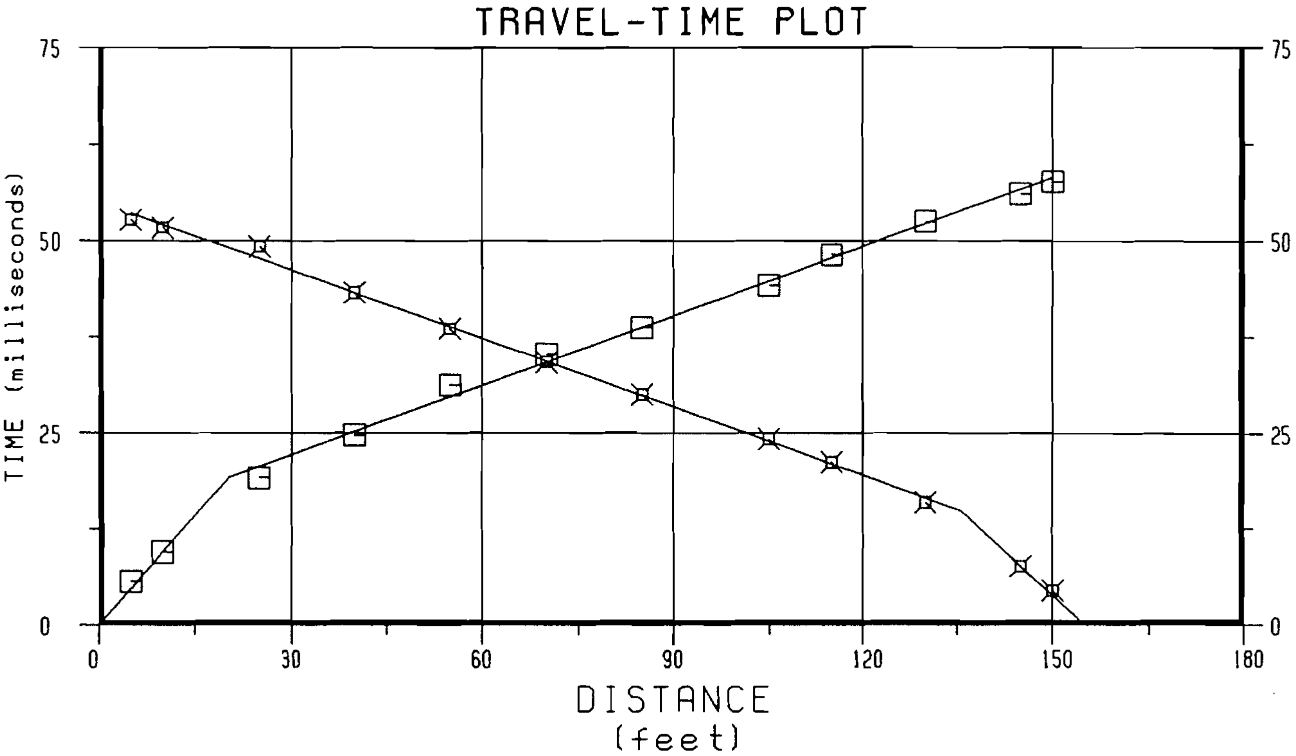
SEISMIC REFRACTION SURVEY RESULTS

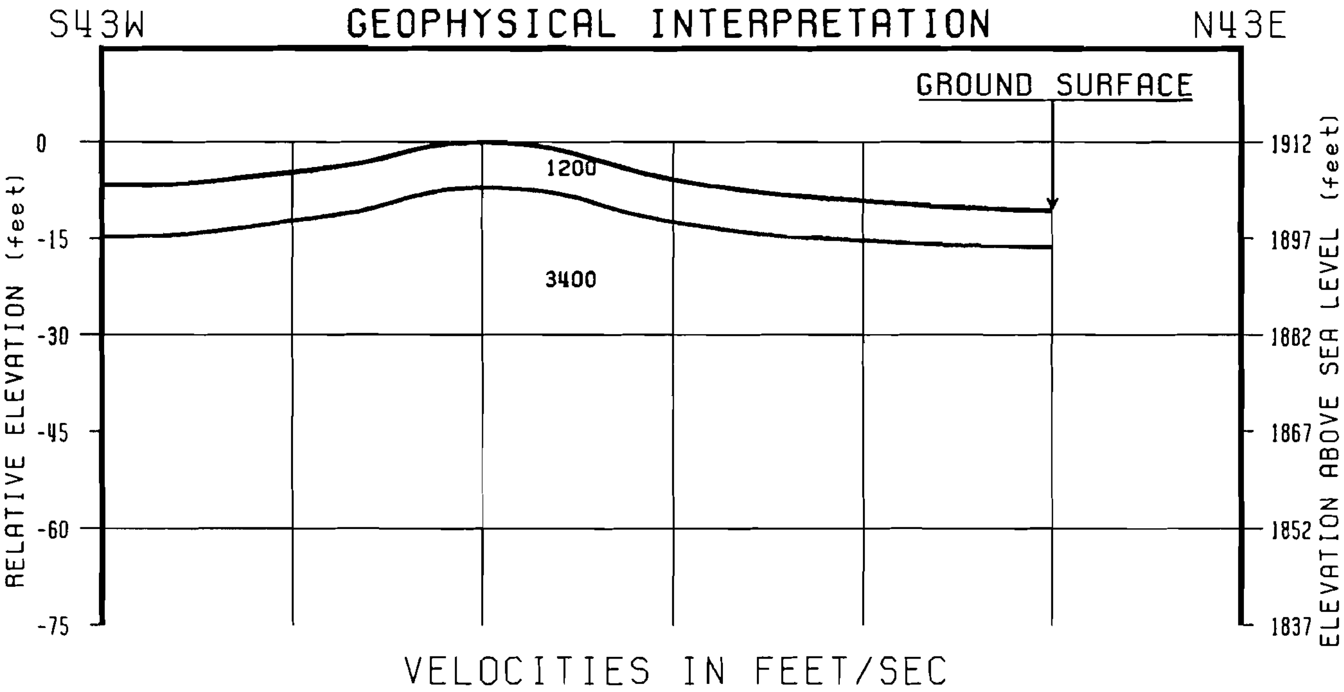
Survey Line No.	Velocity of Layer Ft/Sec	Inferred Earth Materials	Approximate Depth to Top of Layer (ft)	Estimated Layer or Thickness	Potential Rippability	Approximate Depth to Nonrippable Material (ft)
S1	1200-1500	Topsoil	-	5	Rippable	
	3100-5700	Weathered Granitics	5	24-46	Marginal	29
	10,000	Fresh Granitics	29-51	-	Nonrippable	-
S2	900-1100	Topsoil	-	4	Rippable	
	2700-3500	Weathered Granitics	4	25-40	Rippable	29
	12,000-14,500	Fresh Granitics	29-44	-	Nonrippable	-
S3	950-1200	Topsoil	-	5	Rippable	
	3000-4500	Weathered Granitics	5	12-16	Rippable	17
	5500-7800	Moderately Weathered Granitics	17-21	-	Marginal Nonrippable	-
S4	1250-1650	Topsoil	-	4	Rippable	
	3500-4700	Older Alluvial Weathered Granitics	4	22	Rippable	26
	7500-8800	Moderately Weathered Granitics	26-48	-	Nonrippable	-
	10,000-16,500	Fresh Granitics	-	-	Nonrippable	-

SL-1

V1=1200
V2=3400

SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F





TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 1

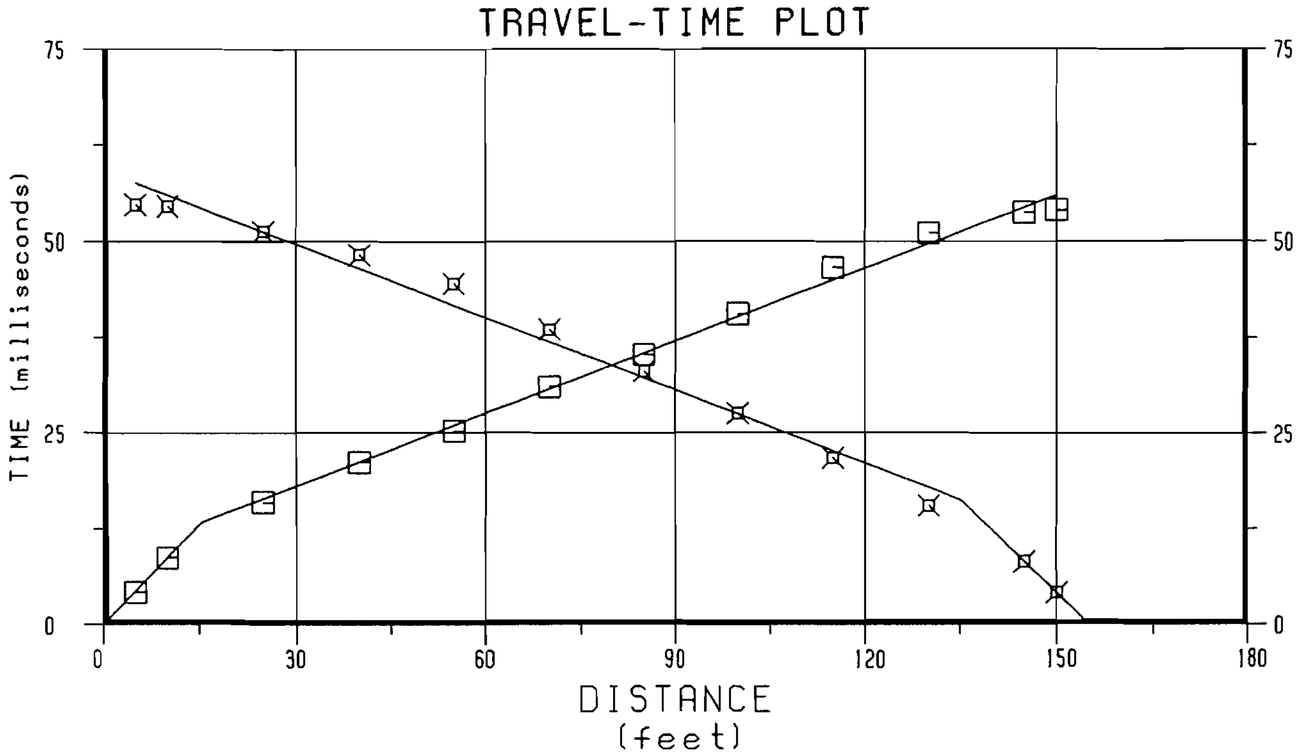
Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

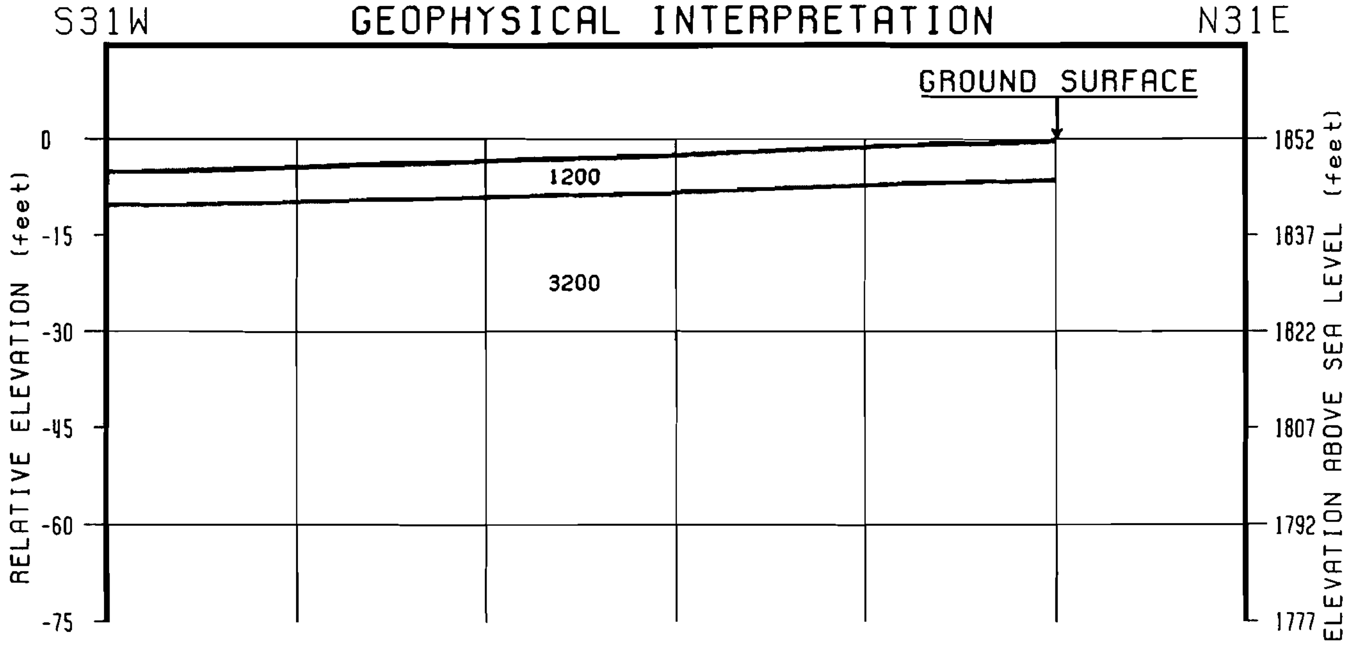
Figure No. E1

SL-2

V1=1200
V2=3200

SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F





VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 2

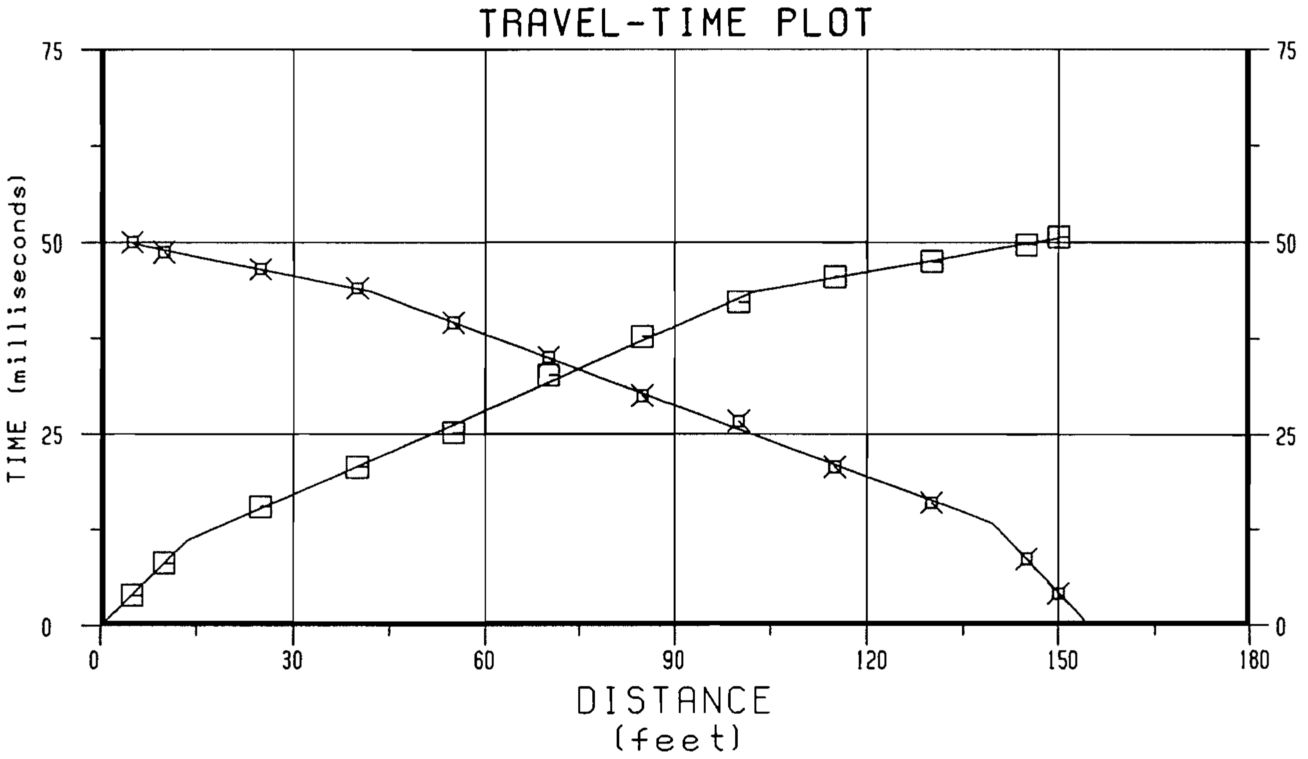
Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

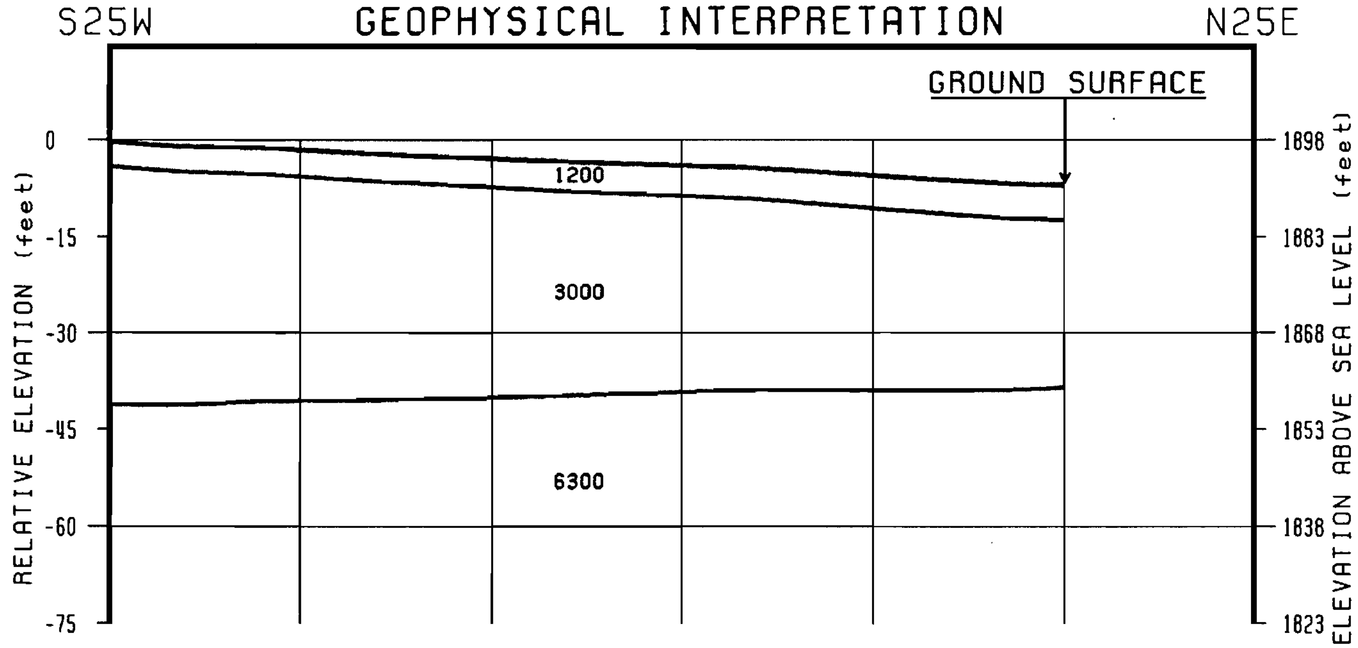
Figure No. E2

SL-3

SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F

V1=1200
V2=3000
V3=6300





VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 3

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

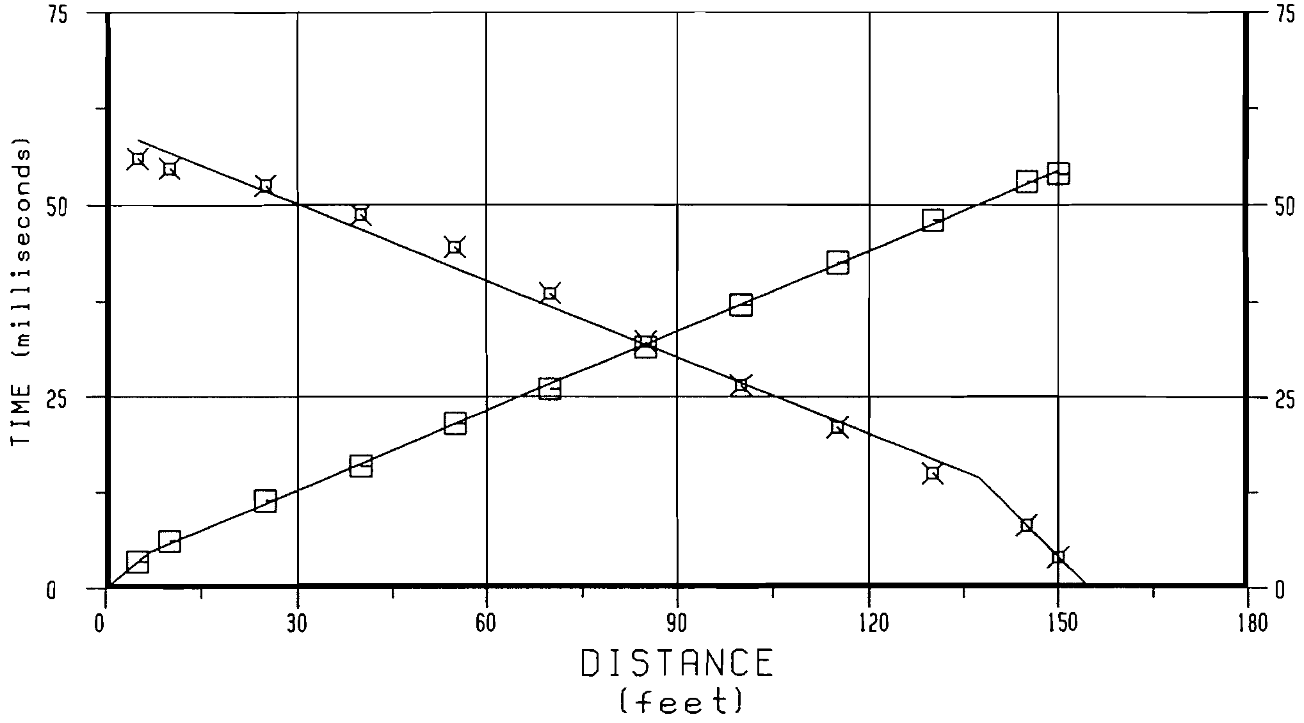
Figure No. E3

SL-4

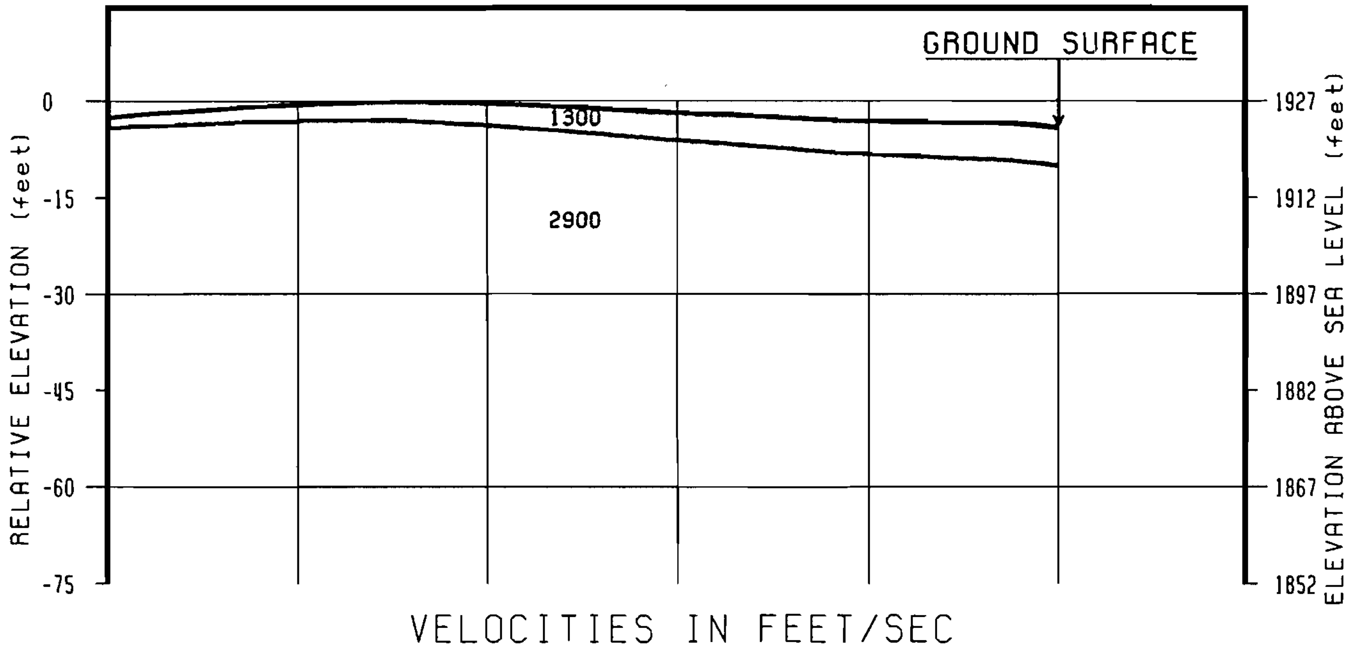
V1=1300
V2=2900

SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F

TRAVEL-TIME PLOT



N70W GEOPHYSICAL INTERPRETATION S70E



TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 4

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

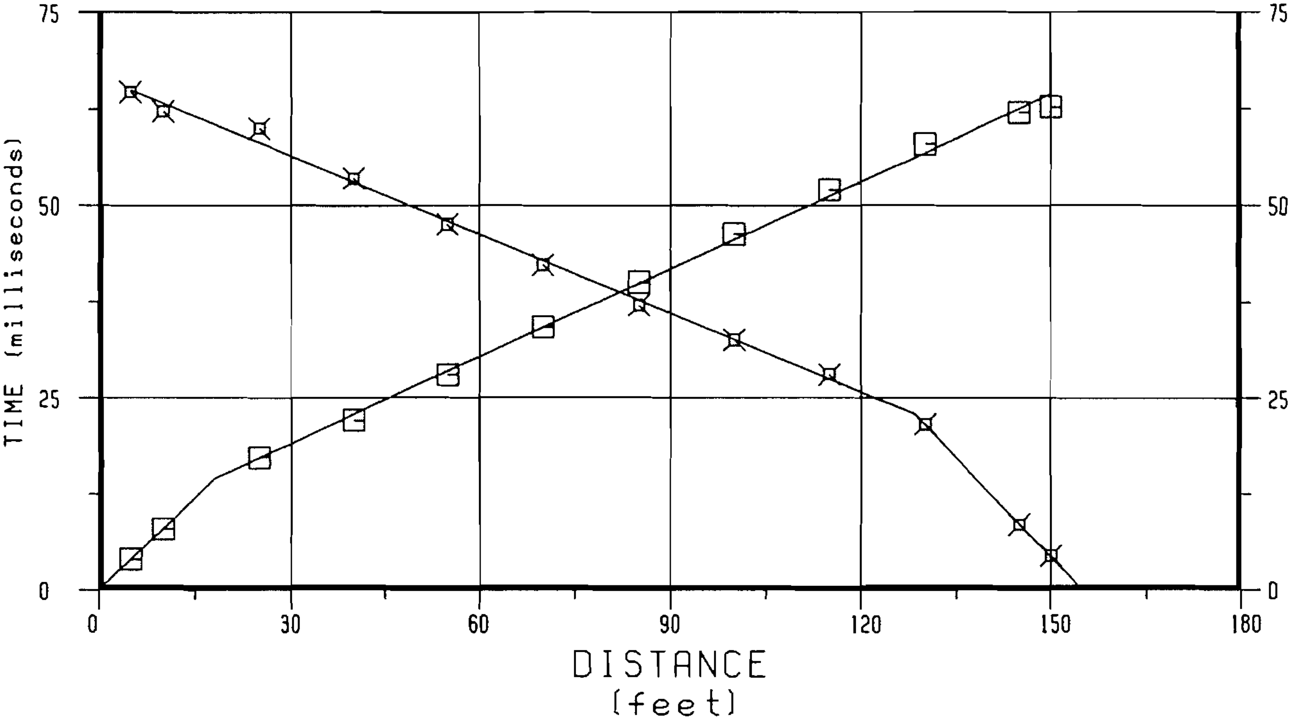
Figure No. E4

SL-5

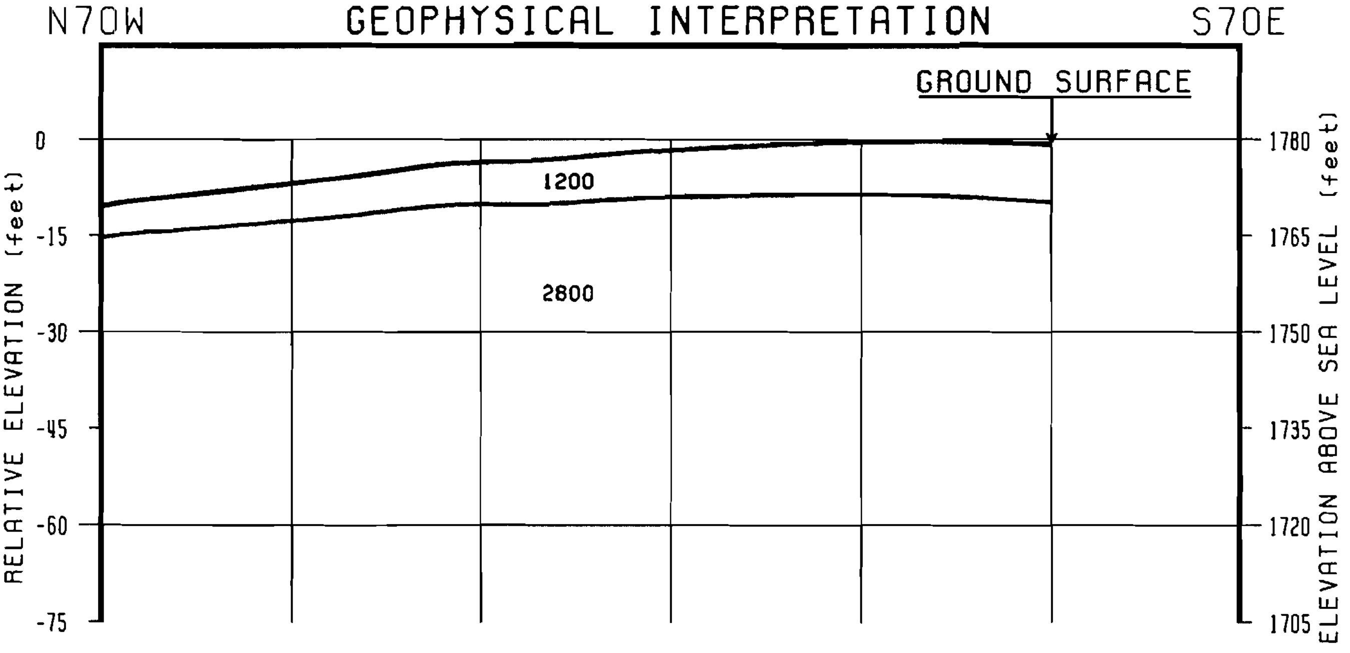
V1=1200
V2=2800

SEISMIC SOURCE: HAMMER AND PLATE
INSTRUMENTATION: GEOMETRICS ES-1225F

TRAVEL-TIME PLOT



GEOPHYSICAL INTERPRETATION

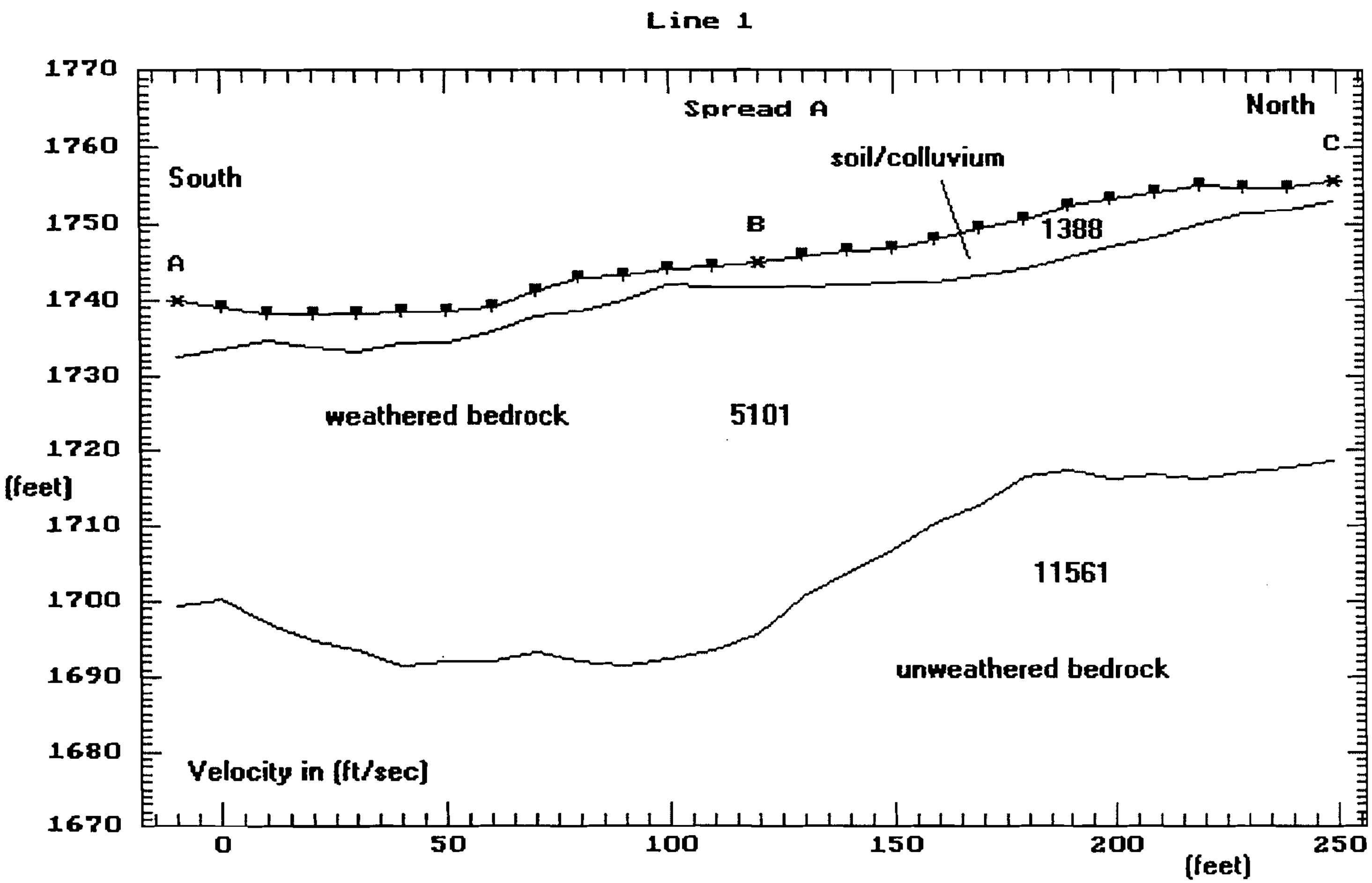


VELOCITIES IN FEET/SEC

TRAVEL-TIME PLOT
AND
GEOPHYSICAL INTERPRETATION
LINE 5

Client: MURRIETA HILLS INC.
Project: MURRIETA HILLS
Project Number: 6870318-06
Location: MURRIETA
County: RIVERSIDE

Figure No. E5



Seismic Refraction Survey

Murrieta Hills, Project 870318-007

Murrieta, California

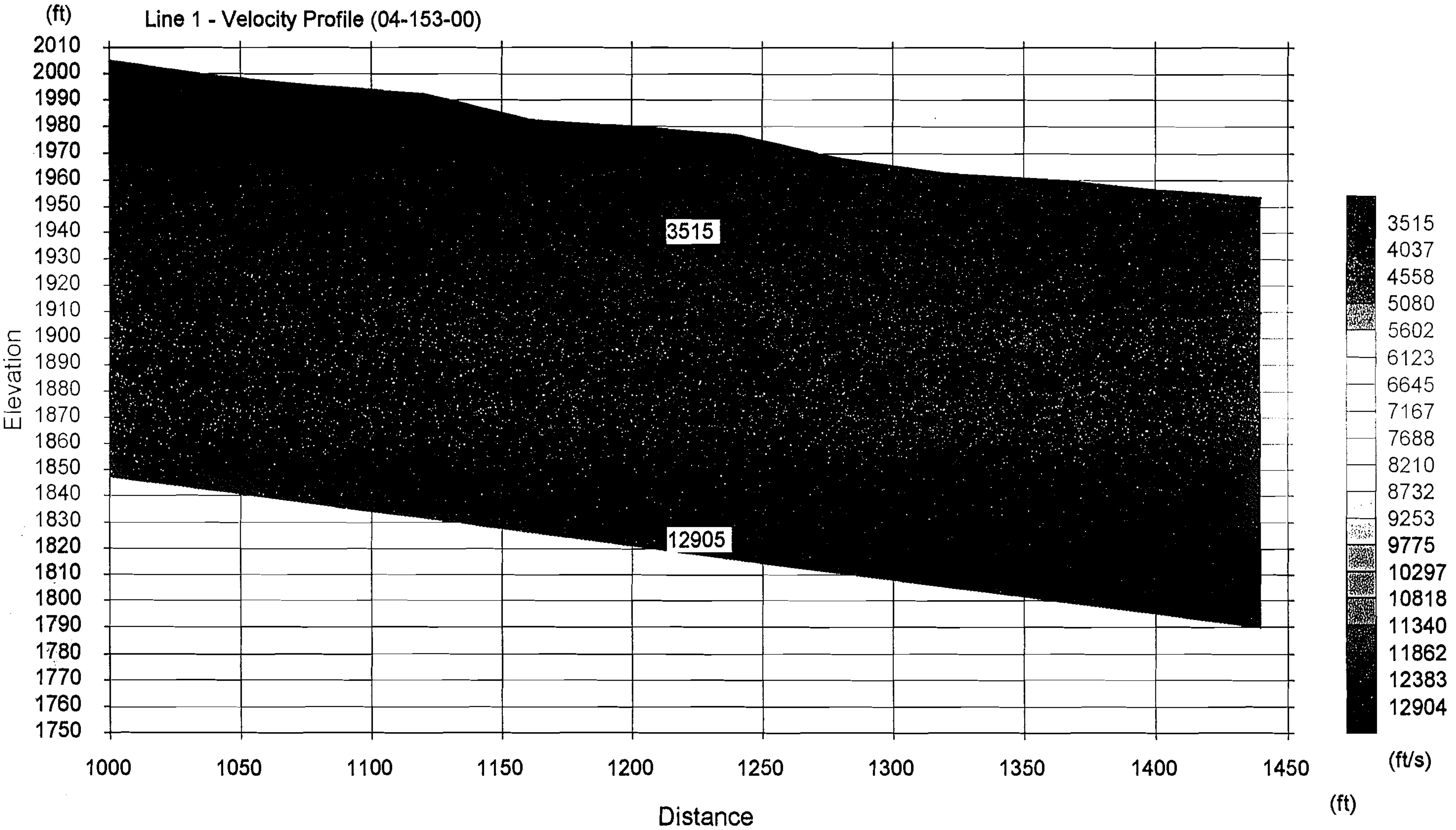
Performed by

Subsurface Surveys

March 11, 1999

FIGURE 5

1-7



Line 1 - Velocity Profile (04-153-00)

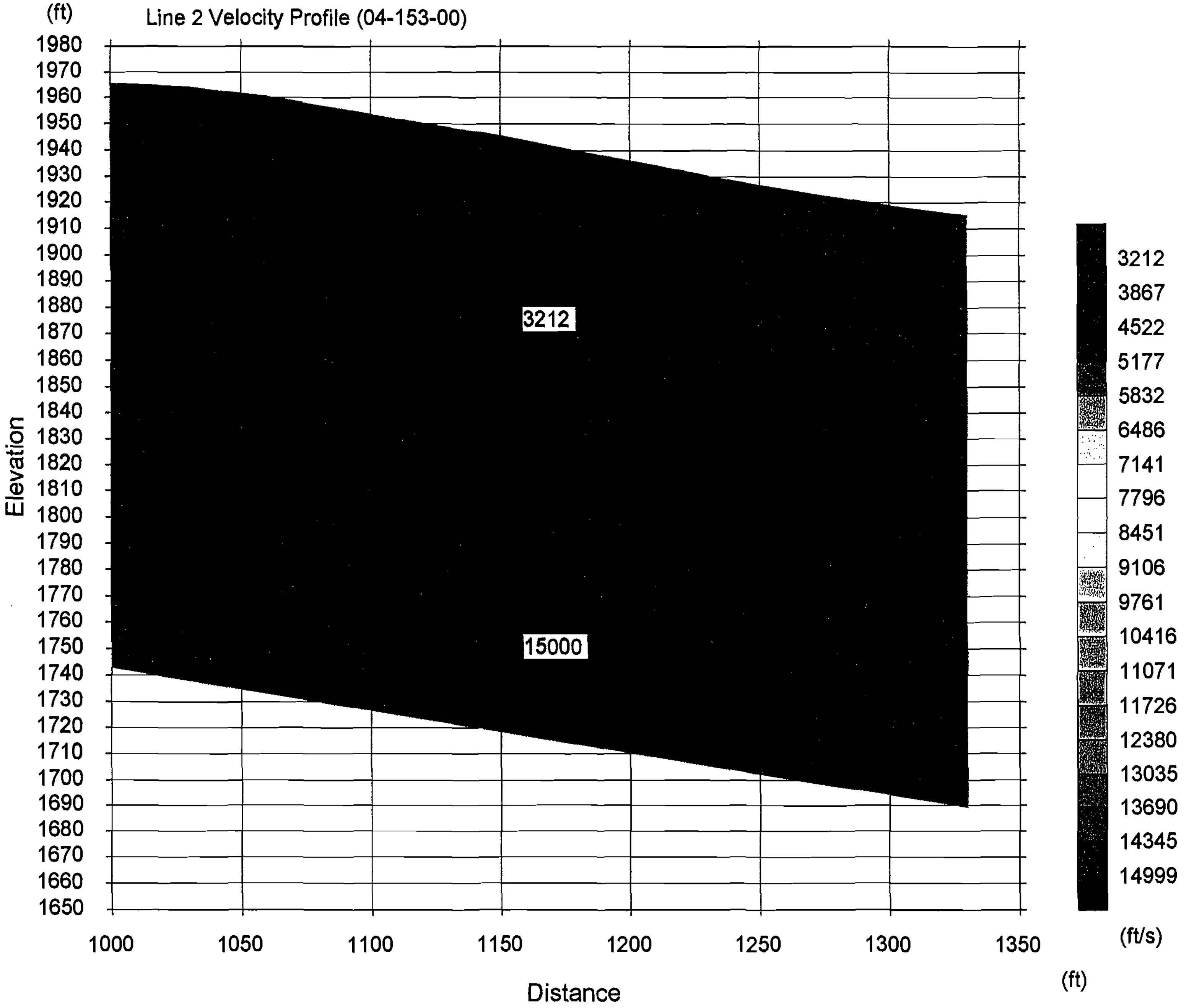
1001_1.vs

Scale = 1 / 2222

Line-1
GMU, 2005

PLATE 5.1

Line 2 Velocity Profile (04-153-00)



2001_1_model_1.vs

Scale = 1 / 2222

PLATE 5.2

Line-2
GMU 2005

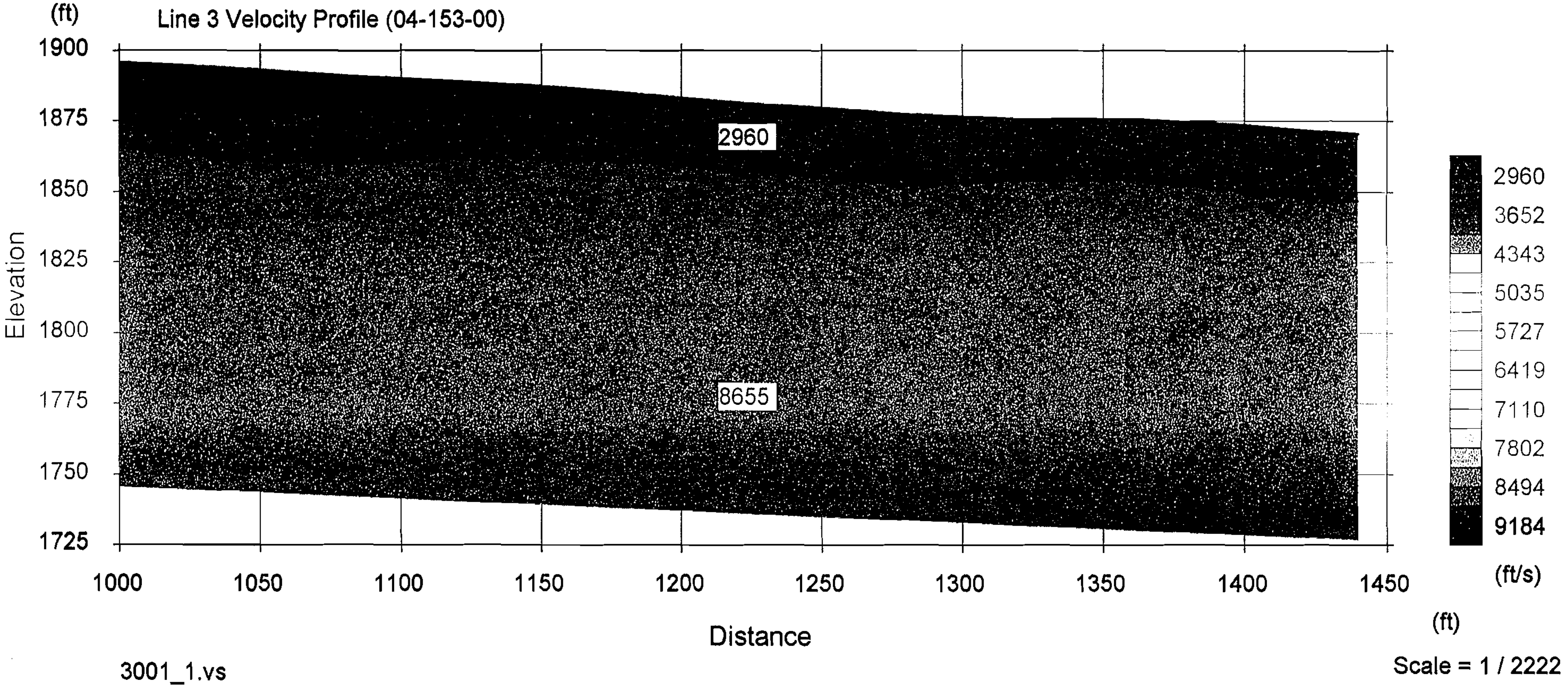

Line 3 Velocity Profile (04-153-00)

PLATE 5.3

Line 3
GMU, 2005

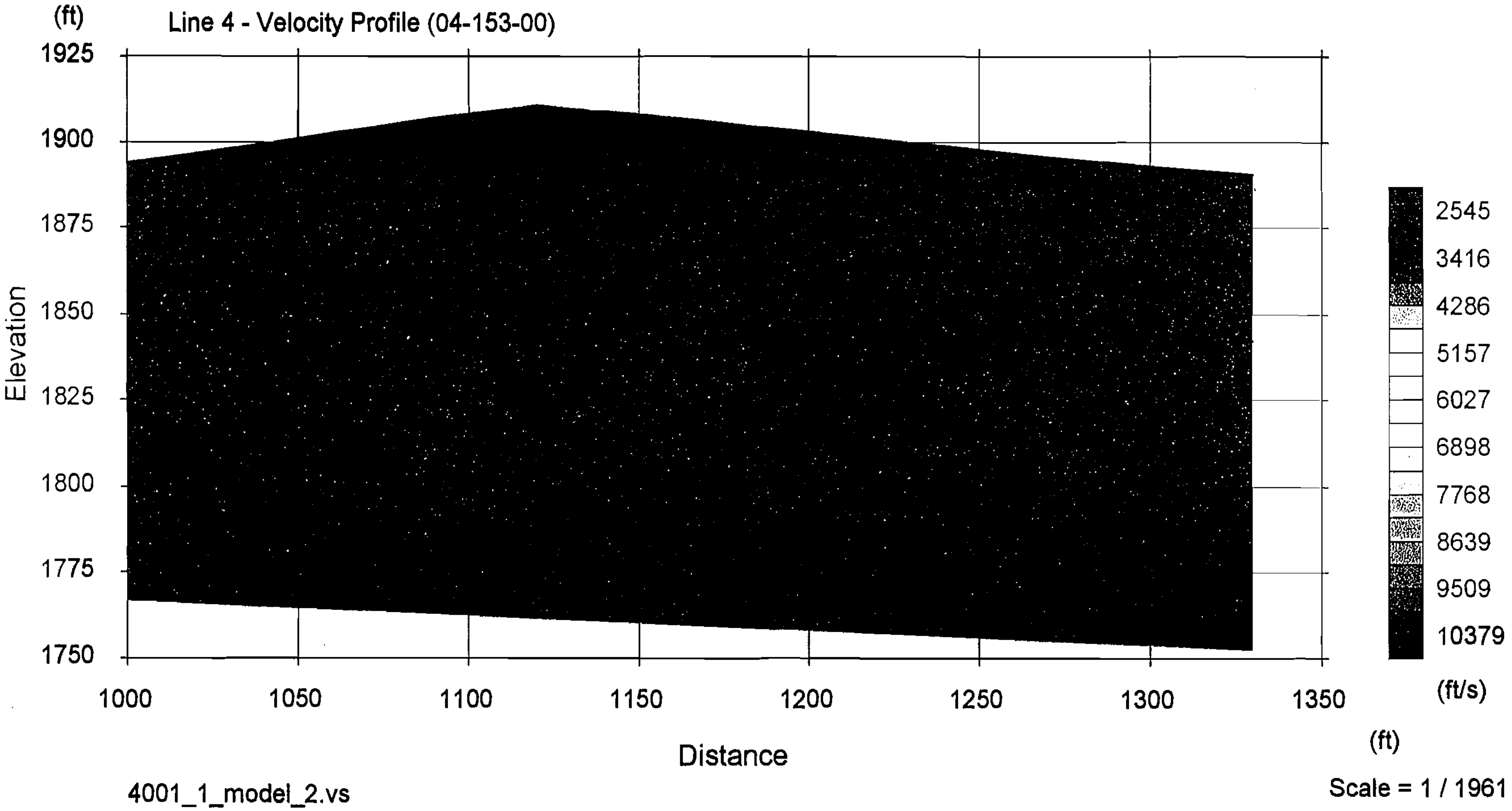


PLATE 5.4

Line 4
GMU, 2005

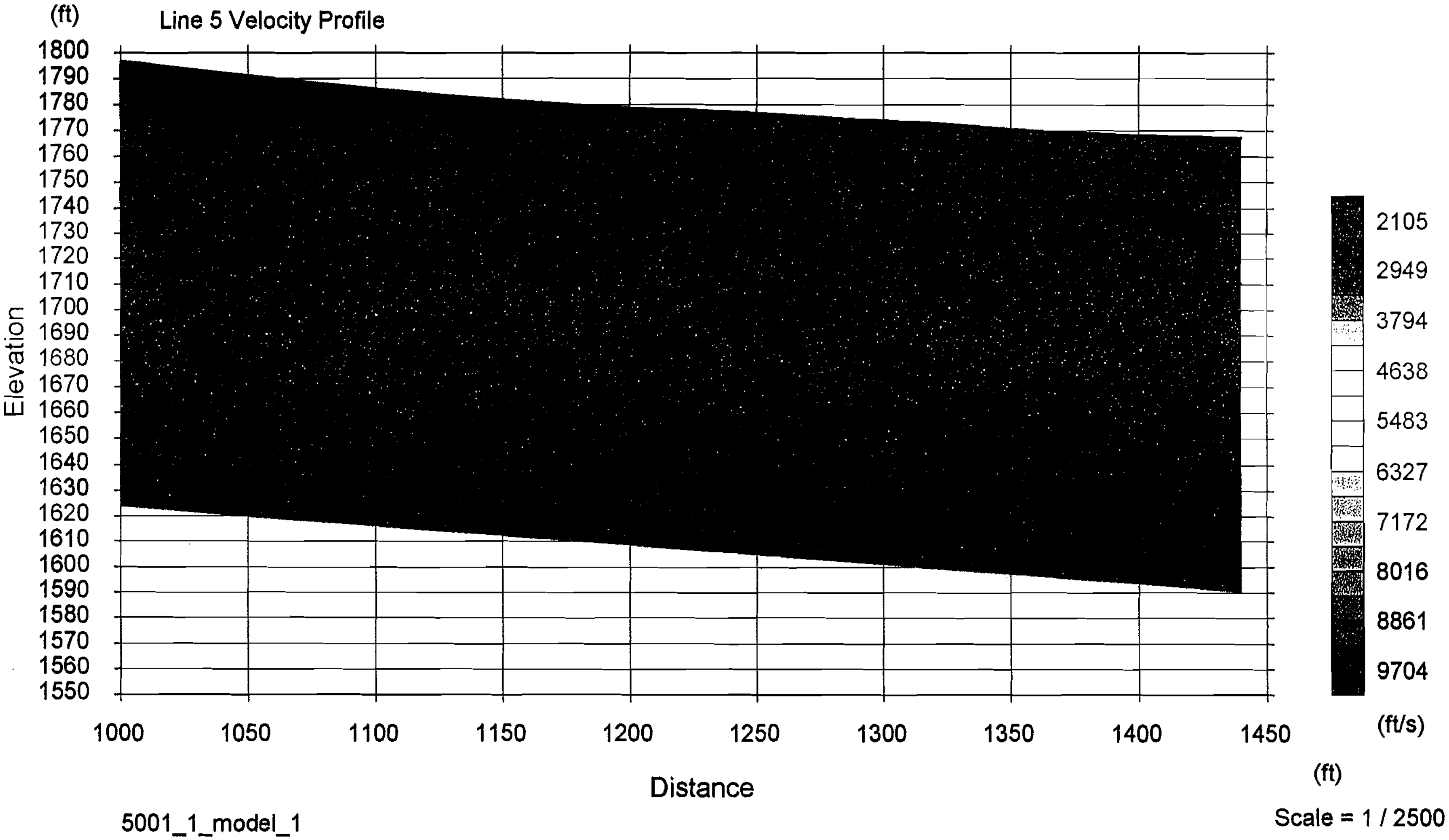
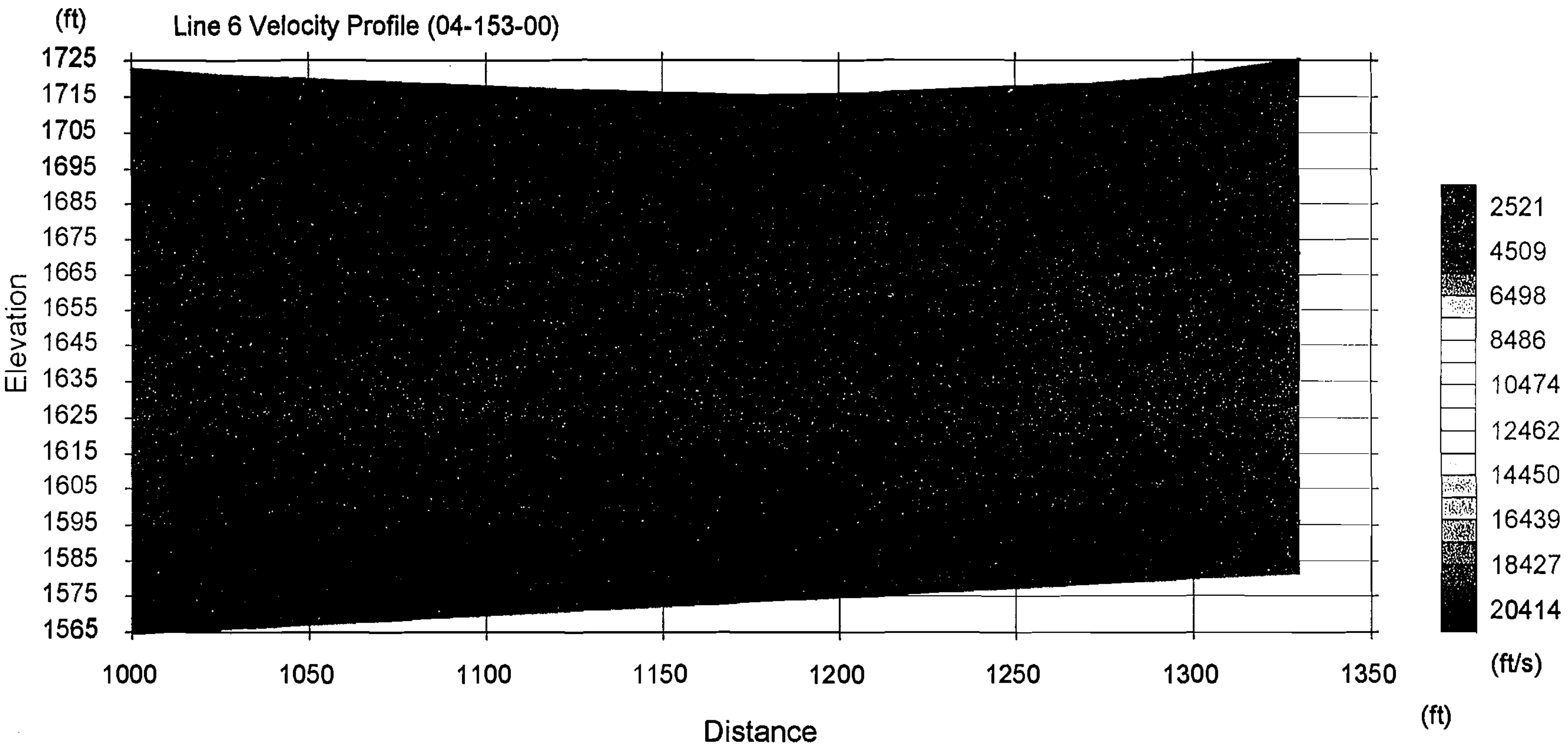


PLATE 5.5

Line 5
GMU, 2005



Line 6 Velocity Profile (04-153-00)

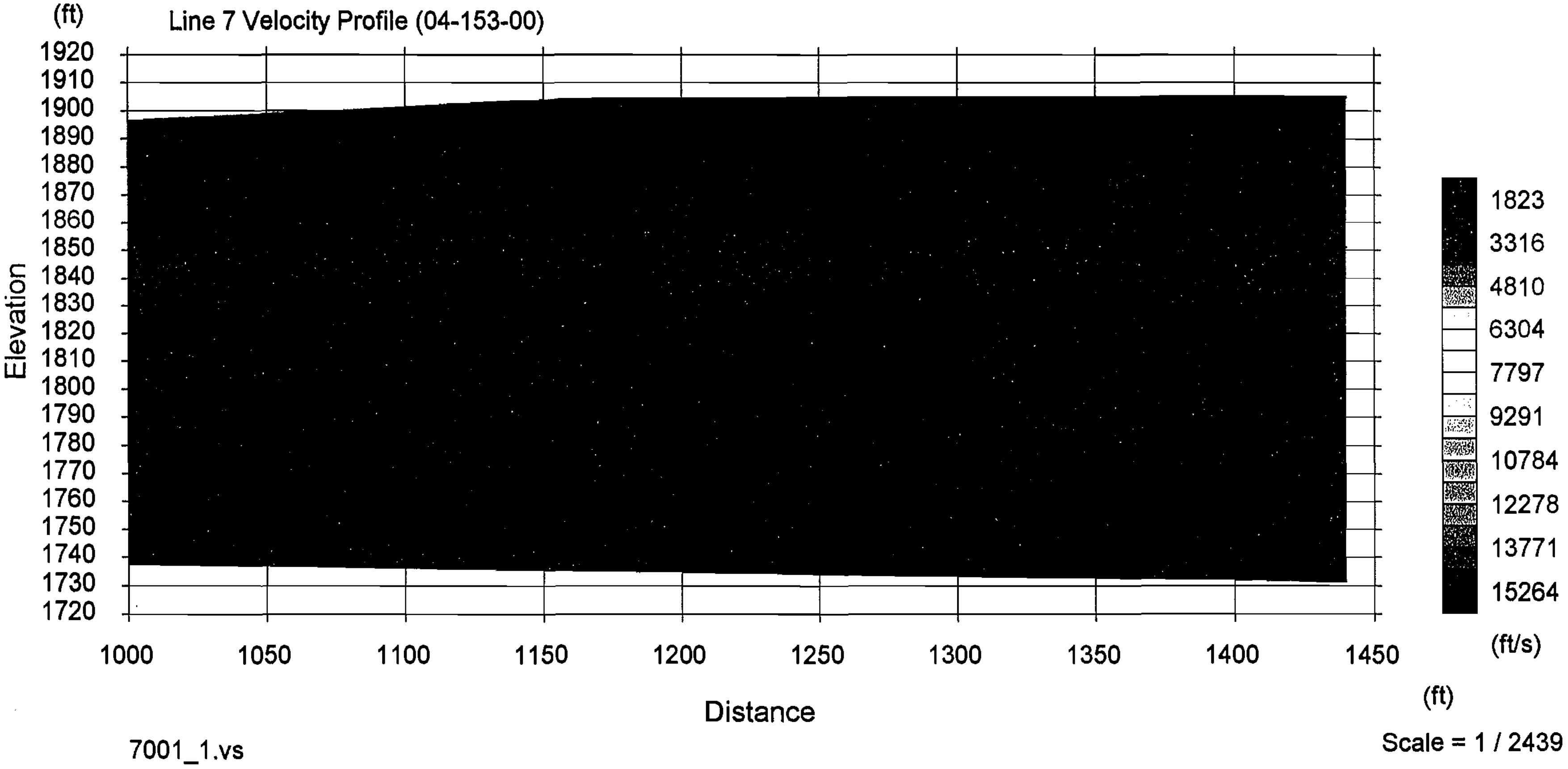
6001_1.vs

Scale = 1 / 1961

Line 6

GMU, 2005

PLATE 5.6



Line 7
GMU 2005

PLATE 5.7

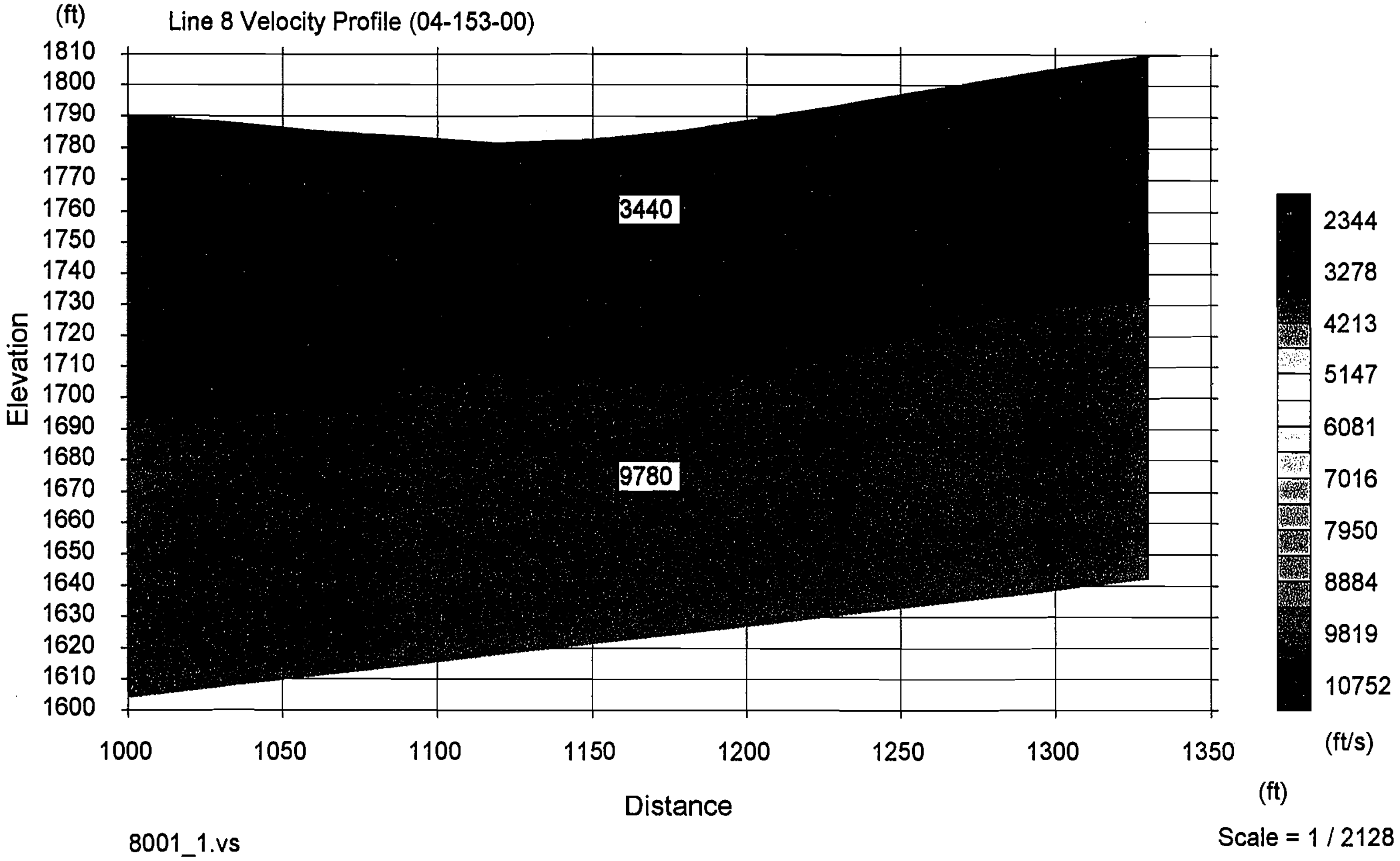


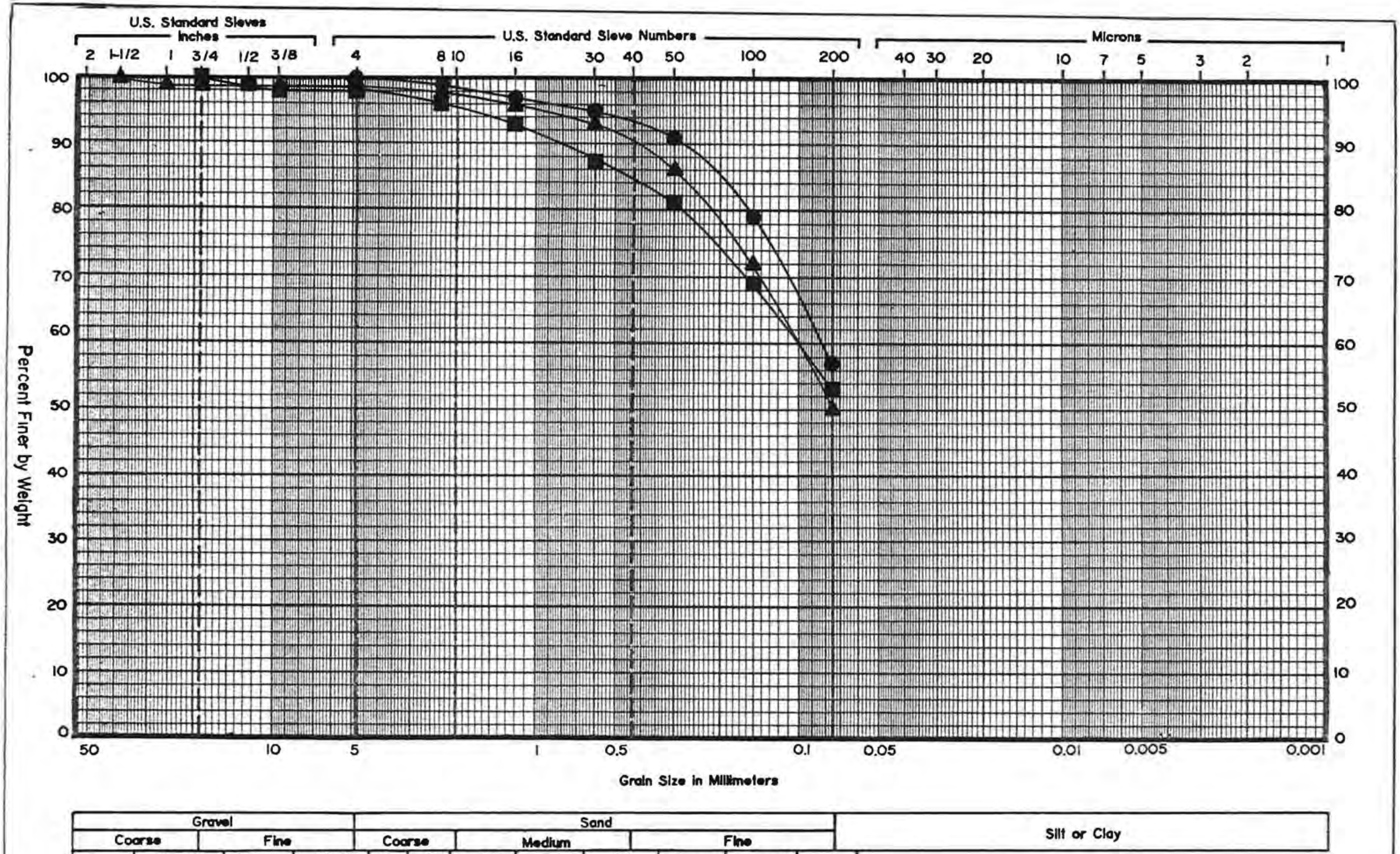
PLATE 5.8

Line 8
GMU 2005

APPENDIX B

Laboratory Tests Results

Laboratory Test Results, Leighton, 1992



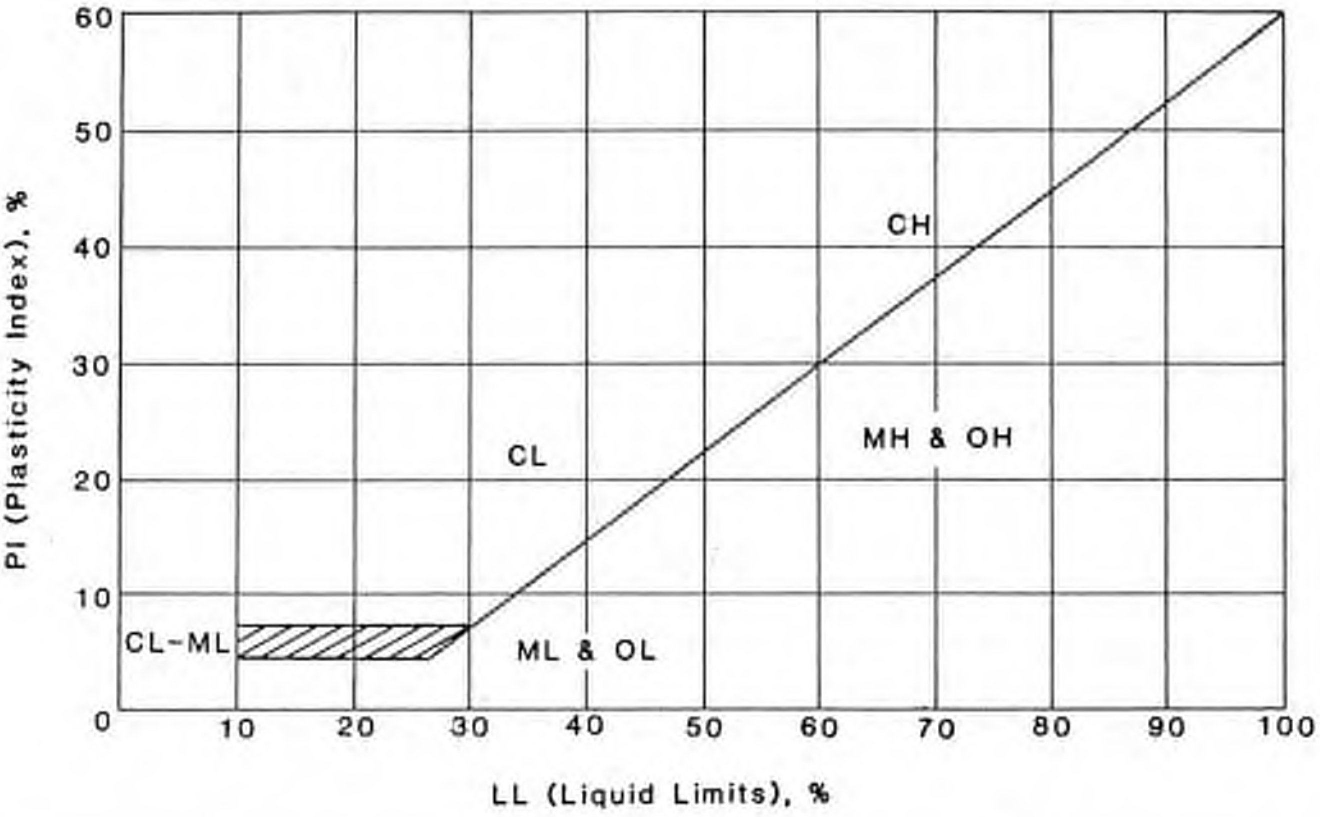
Symbol	Sample Location	Sample No.	Field Moisture (%)	LL (%)	PI (%)	Activity PI/-2u	Cu D_{60}/D_{10}	Cc $\frac{(D_{30})^2}{D_{10} \times D_{60}}$	Percent Passing No.200	Percent Passing 2u	U.S.C.S.
●	B-2 @ 0'	R-1							57		ML
▲	B-3 @ 0-1'	B-1							50		ML
■	B-4 @ 9-15'	B-1							53		CL

GRADATION TEST RESULTS

Project No. 6870318-06
Project Name Murrieta Hills
Date 10/19/92 **Figure No.** D-1

3035 289

SYMBOL	HOLE NO.	SAMPLE NO.	DEPTH	FIELD MOISTURE (%)	LL (%)	PL (%)	PI (%)	U.S.C.S.
	B-6	S-1	2'	5.7			NP	SP



ATTERBERG LIMITS TEST RESULTS

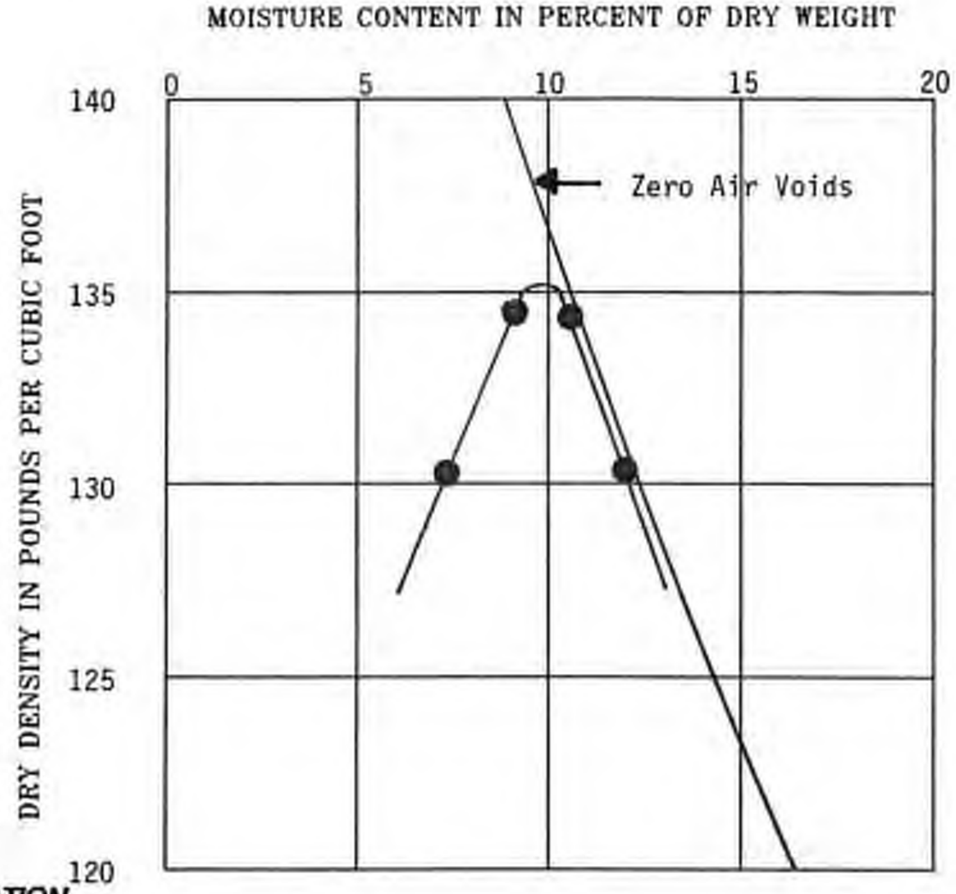
Project No. 6870318-06

Project Name Murrieta Hills

Date 10/19/92 Figure No. D-2

3005188

COMPACTION TEST DATA



LOCATION

Boring or Test Pit B-3
Depth, in Feet 0-2
Representative For Bag 1

SOIL CLASSIFICATION

Grain Sizes in Percent of Dry Weight
Coarse (Retained on #200 Sieve) 50
Fines (Passing #200 Sieve) 50

Atterberg limits, in Percent of Dry Weight
Liquid Limit --
Plasticity Index --

Soil Type and Description Silt and Sand (ML-SM)

COMPACTION PROPERTIES

Method of Compaction
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.T.O. Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 inches, 25 Blows Per Layer)

Optimum Moisture Content, in Percent of Dry Weight 9.5

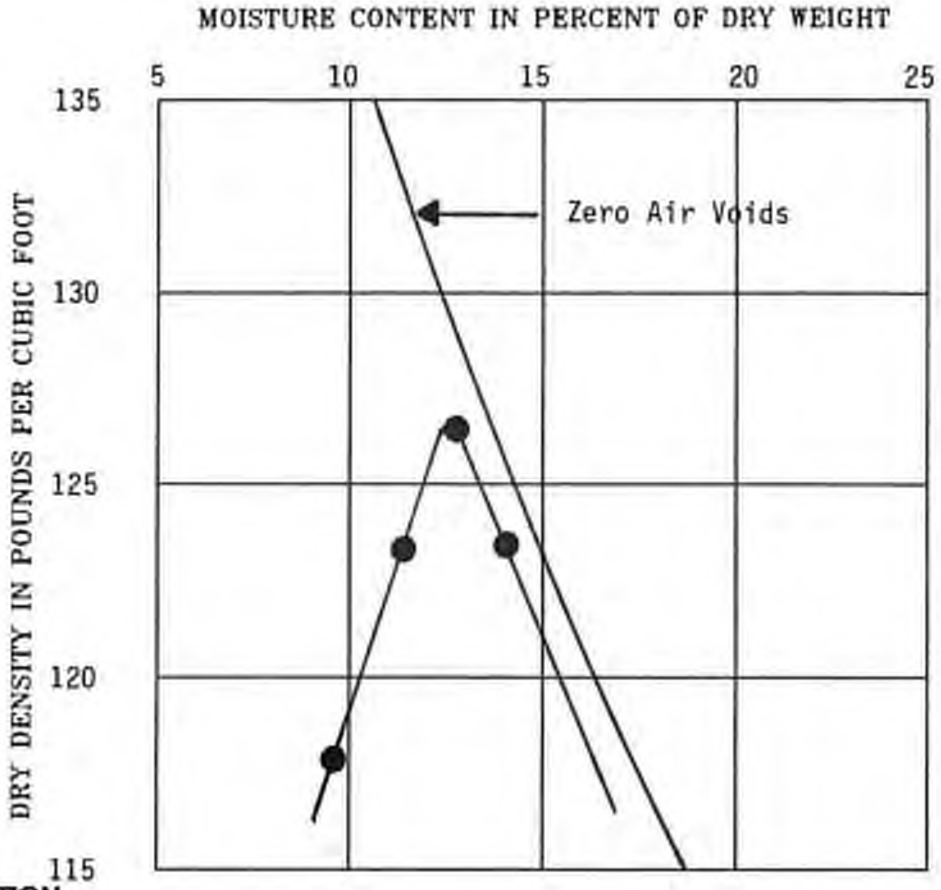
Maximum Dry Density, in Pounds per Cubic Foot 135.0

Project No. 6870318-06

Figure No. D-3

LEIGHTON AND ASSOCIATES, INC.

COMPACTION TEST DATA



LOCATION

Boring or Test Pit B-4
Depth, in Feet 9-15
Representative For Bag 1

SOIL CLASSIFICATION

Grain Sizes in Percent of Dry Weight
  Coarse (Retained on #200 Sieve) 47
  Fines (Passing #200 Sieve) 53

Atterberg limits, in Percent of Dry Weight
  Liquid Limit --
  Plasticity Index --

Soil Type and Description Sandy Clay (CL)

COMPACTION PROPERTIES

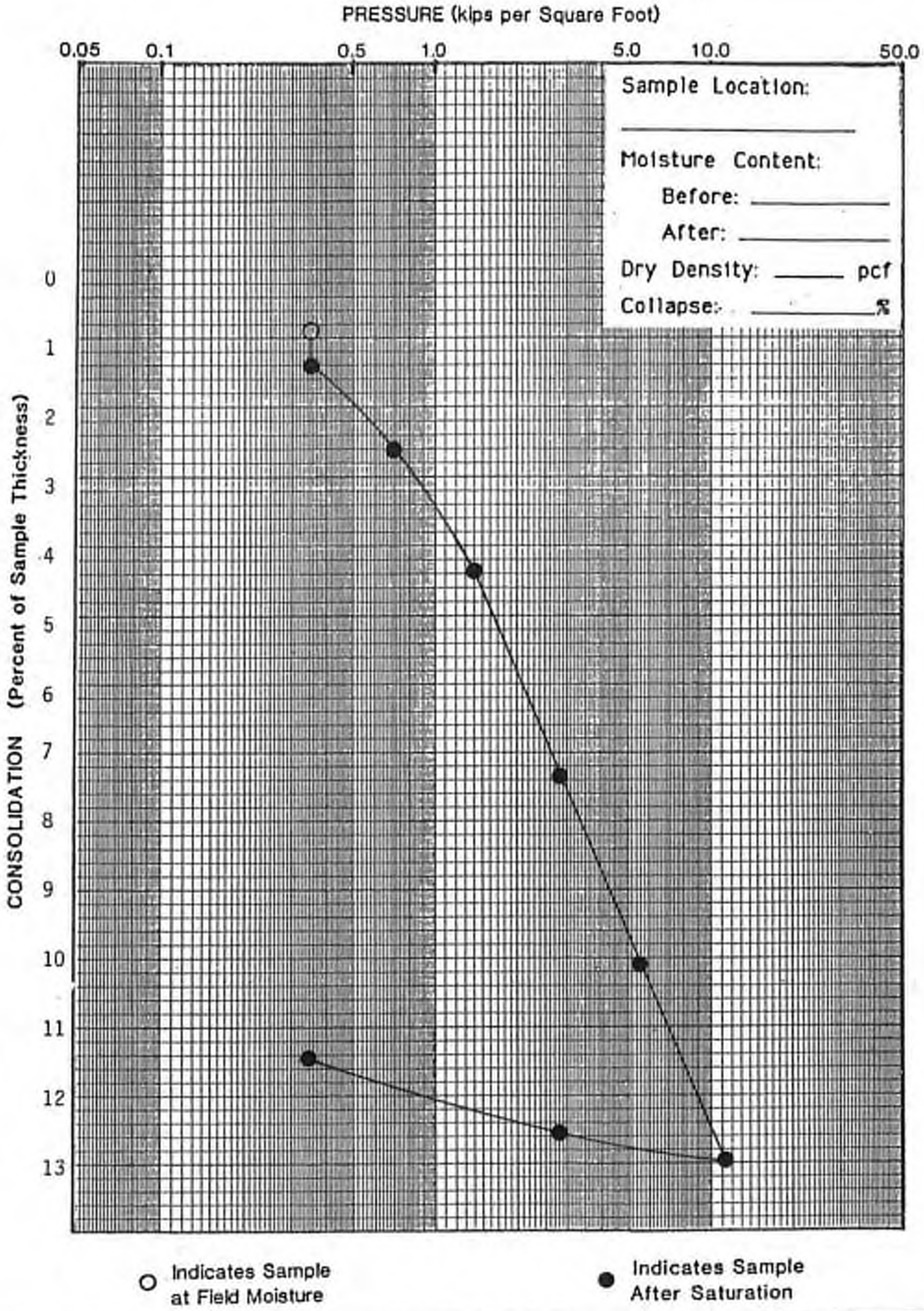
Method of Compaction
  ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.T.O. Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 inches, 25 Blows Per Layer)

Optimum Moisture Content, in Percent of Dry Weight 12.5

Maximum Dry Density, in Pounds per Cubic Foot 126.5

Project No. 6870318-06 Figure No. D-4

LEIGHTON AND ASSOCIATES, INC.



Sample Location: ____________

Moisture Content:

Before: ____________

After: ____________

Dry Density: ______ pcf

Collapse: ____________ %

CONSOLIDATION – PRESSURE CURVE

Project No. ____________

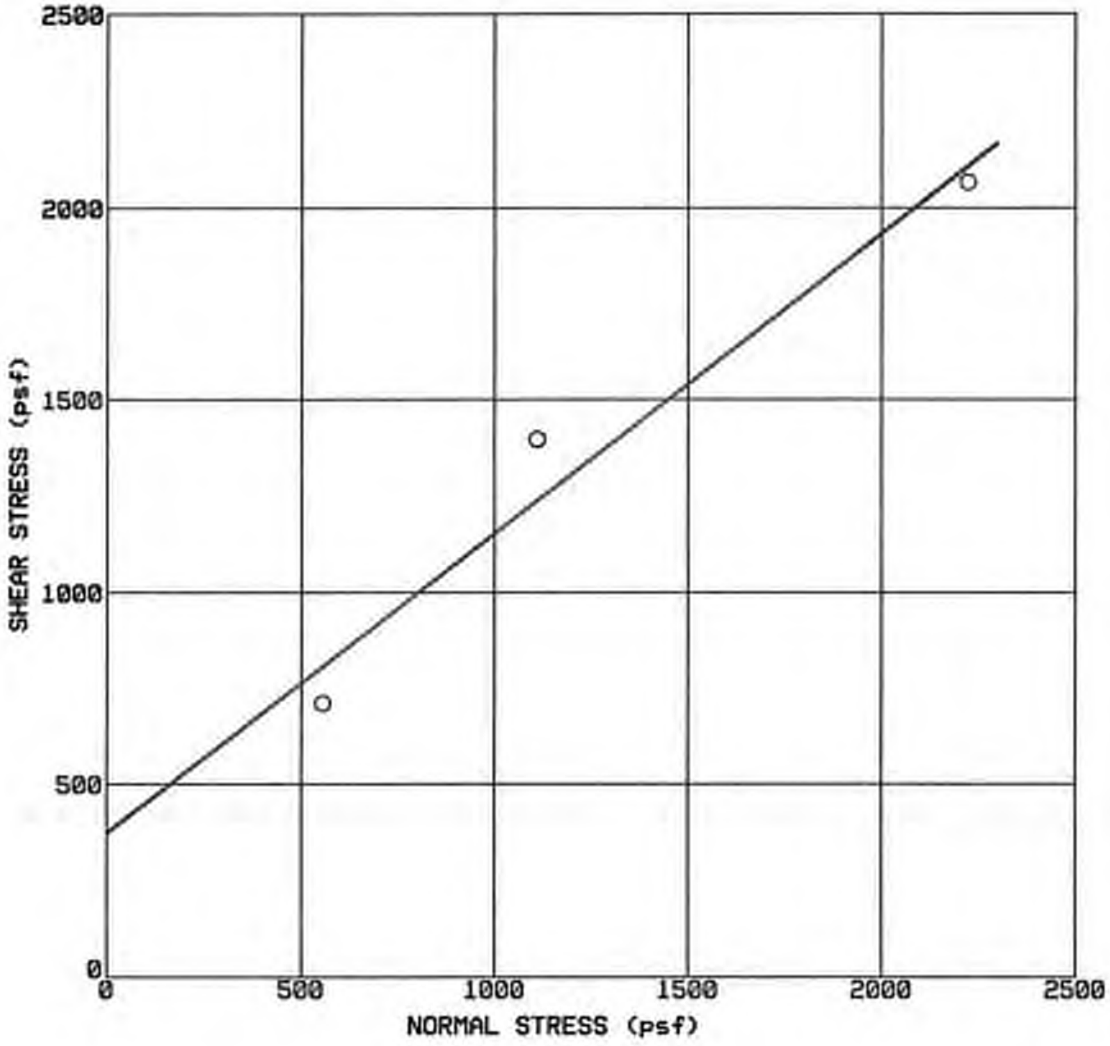
Project Name ____________

Date 10/19/92 Figure No. D-5

L&A

3010 188

Laboratory Test Results, Leighton, 1993



Log No. T-6

Sample No. D 1

Depth (ft) 3.0

Soil Type

Type of Sample Undisturbed

Before Test:

Dry Density (psf) 122.8

Moisture Content (%): 6.9

Friction Angle (deg.) 38.0

Cohesion (psf) 375.0

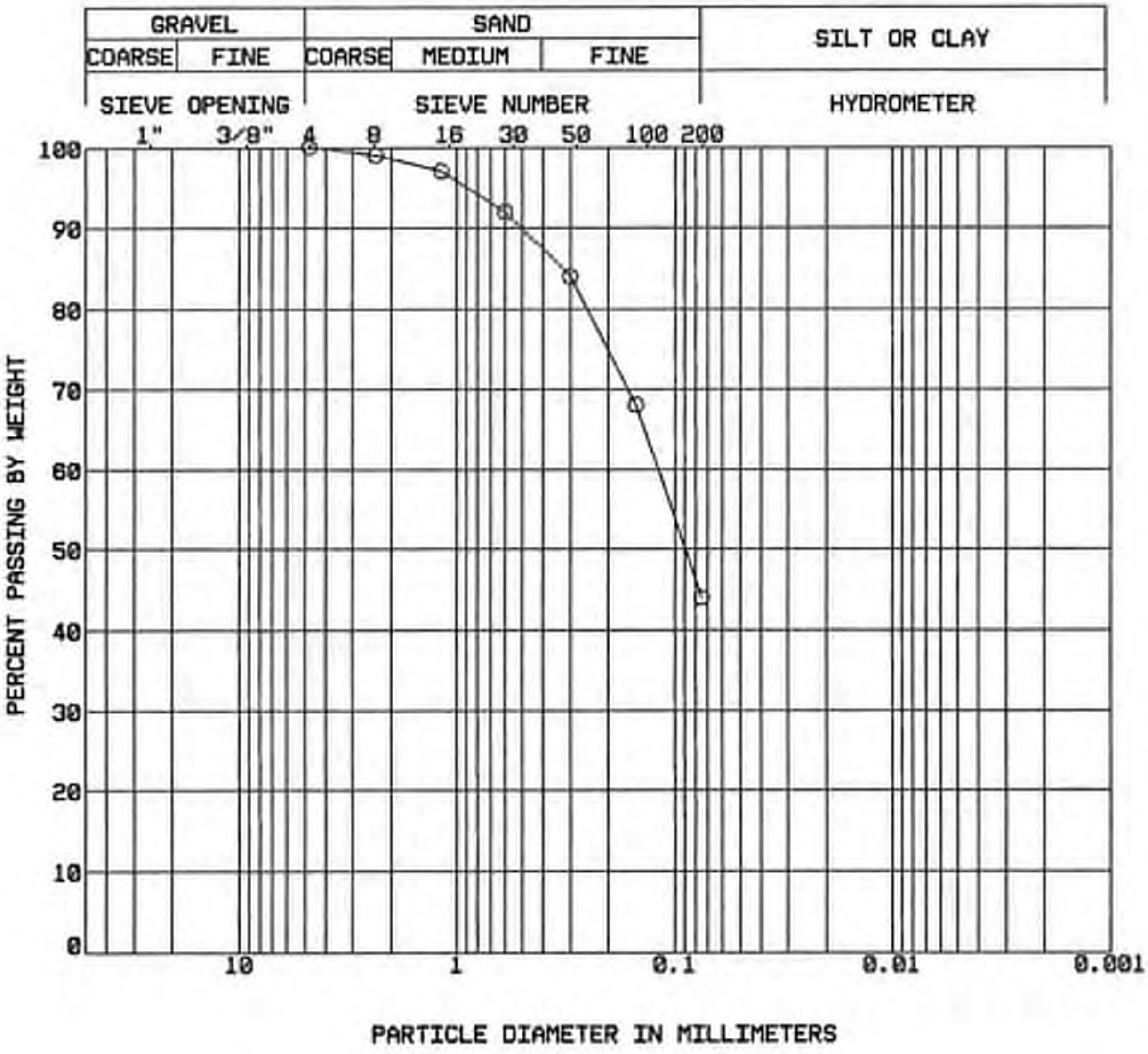
DIRECT SHEAR

Project No. 6870318-07

Project Name Murrieta Hills

Date 5/18/93

Figure No. D-1



Symbol	Log Number	Sample Number	Sample Depth (feet)	Field Moisture (%)	Soil Type
○	*T-2*	*B 1*	*5.0*		

GRAIN SIZE DISTRIBUTION CURVE

Project No. *6870318-07*

Project Name *Murrieta Hills*

Date 5/18/93 **Figure No.** D-2

Laboratory Test Results, Leighton, 2008

Leighton

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name: MURRIETA HILLS
Tested By: JAP
Date: 5/1/08

Project No. : 112262-001
Checked By: JMB
Date: 5/2/08

Boring No: TP-7
Depth (ft.) 7.0

Sample No. : B-2
Location: **

Sample Description: (ML)s, REDDISH BROWN SILT WITH SAND.

Dry Wt. of Soil + Cont. (gm.)	3600.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	3600.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0467
Wt. Comp. Soil + Mold (gm.)	588.2	633.0
Wt. of Mold (gm.)	189.9	189.9
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-19	E-19
Wet Wt. of Soil + Cont. (gm.)	323.2	633.0
Dry Wt. of Soil + Cont. (gm.)	294.7	360.5
Wt. of Container (gm.)	23.2	189.9
Moisture Content (%)	10.5	22.9
Wet Density (pcf)	120.1	133.5
Dry Density (pcf)	108.7	108.6
Void Ratio	0.551	0.623
Total Porosity	0.355	0.384
Pore Volume (cc)	73.5	83.2
Degree of Saturation (%) [S meas]	**51.5**	**99.4**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
5/1/08	11:27	1.0	0	0.5000
5/1/08	11:37	1.0	10	0.5000
	Add Distilled Water to the Specimen			
5/2/08	6:00	1.0	1103	0.5467
5/2/08	7:00	1.0	1163	0.5467

Expansion Index (EI meas) =	((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	46.7
Expansion Index (Report) =	Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	**47**

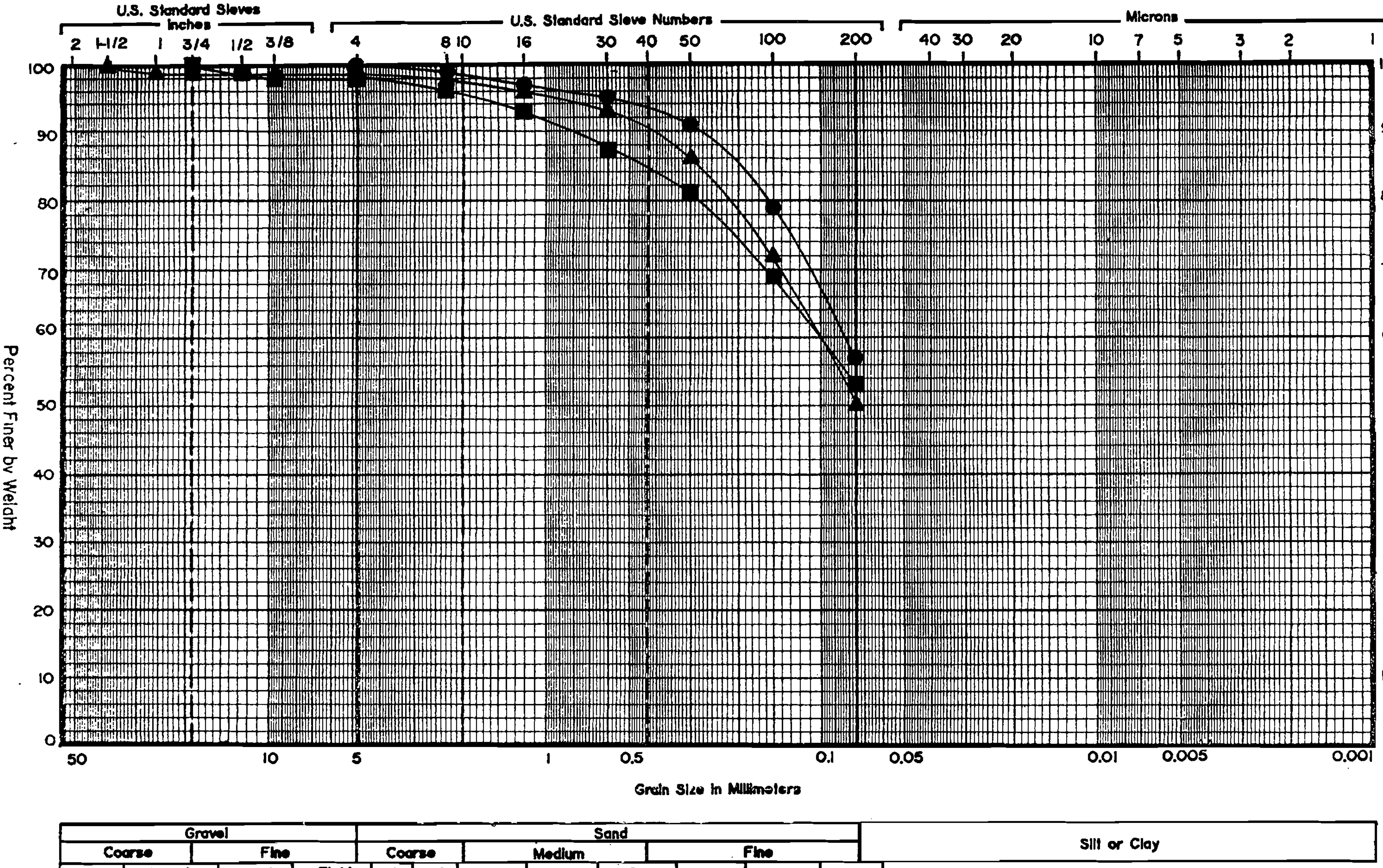
Leighton

Moisture Content
ASTM D 2216

Project Name: MURRIETA HILLS
Tested By: JAP
Project No. : 112262-001
Date: 3/6/2008

Container Number:	XLT	X-3	JUAN	X-1	RAE	SR5
Sample Type:	SPT	SPT	SPT	SPT	SPT	SPT
Boring No.:	TP-32	TP-32	TP-32	TP-33	TP-33	TP-34
Sample No.:	S-1	S-2	S-3	S-4	S-5	S-6
Depth: (ft.)	2.5	5.0	7.5	2.5	5.0	2.5
Soil Type:	(SC-SM)	(CL-ML)s	(CL-ML)s	(CL)g	(CL-ML)	(SC-SM)
Moisture Content (%)	**6.6**	**7.6**	**11.5**	**7.7**	**13.6**	**13.3**
Wt. Wet Soil+Container (g)	569.9	1135.5	478.8	574.2	709.1	661.4
Wt. Dry Soil+Container (g)	542.2	1074.8	440.3	543.1	643.1	602.8
Weight Container (g)	123.3	279.1	106.9	140.0	157.9	162.1

Container Number:	EDGE	F150				
Sample Type:	SPT	SPT				
Boring No.:	TP-34	TP-34				
Sample No.:	S-7	S-8				
Depth: (ft.)	5.0	7.5				
Soil Type:	(ML)s	(SM)g				
Moisture Content (%)	**9.2**	**6.6**				
Wt. Wet Soil+Container (g)	767.9	759.3				
Wt. Dry Soil+Container (g)	716.0	722.4				
Weight Container (g)	152.0	163.0				



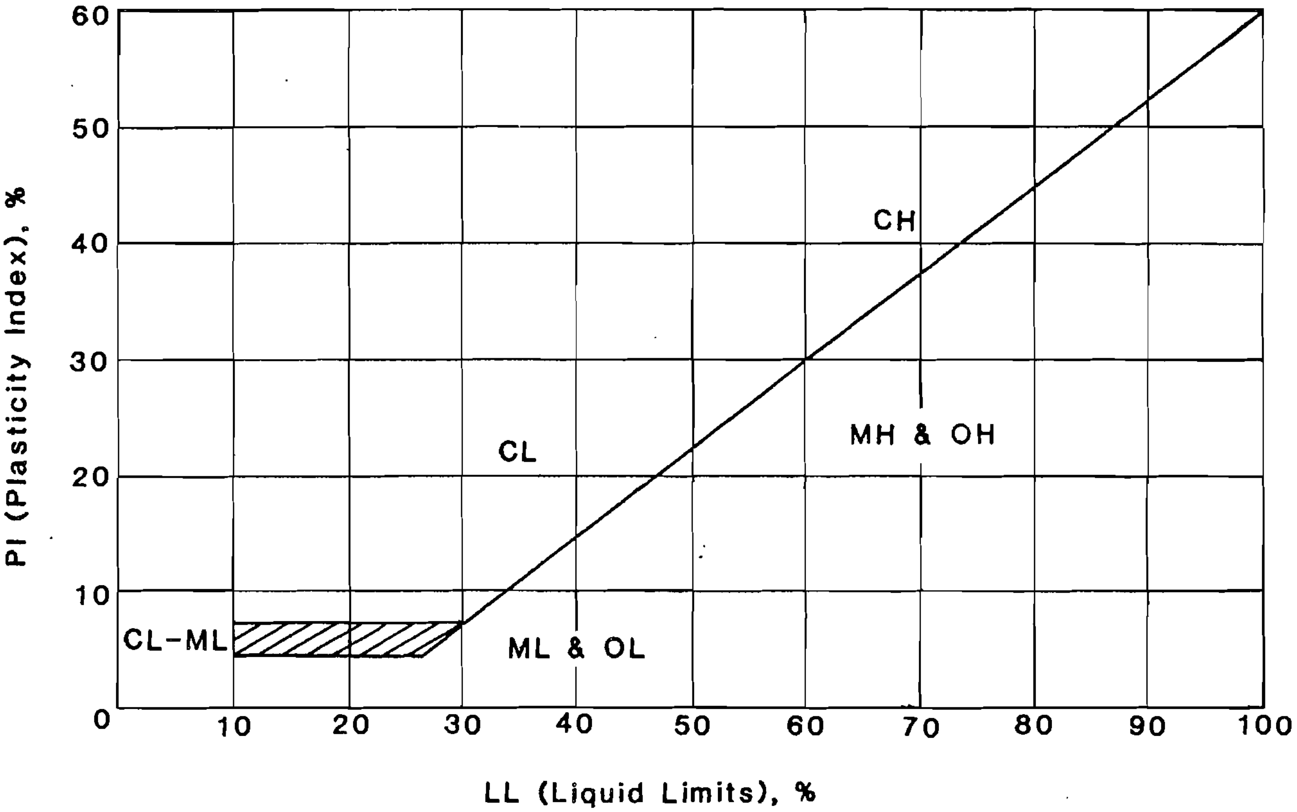
Symbol	Sample Location	Sample No.	Field Moisture (%)	LL (%)	PI (%)	Activity PI/-2u	Cu D_{60}/D_{10}	Cc $\frac{(D_{30})^2}{D_{10} \times D_{60}}$	Percent Passing No.200	Percent Passing 2u	U.S.C.S.
●	B-2 @ 0'	R-1							57		ML
▲	B-3 @ 0-1'	B-1							50		ML
■	B-4 @ 9-15'	B-1							53		CL

GRADATION TEST RESULTS

Project No. 6870318-06
Project Name Murrieta Hills
Date 10/19/92 **Figure No.** D-1

3035 289

SYMBOL	HOLE NO.	SAMPLE NO.	DEPTH	FIELD MOISTURE (%)	LL (%)	PL (%)	PI (%)	U.S.C.S.
	B-6	S-1	2'	5.7			NP	SP



ATTERBERG LIMITS TEST RESULTS

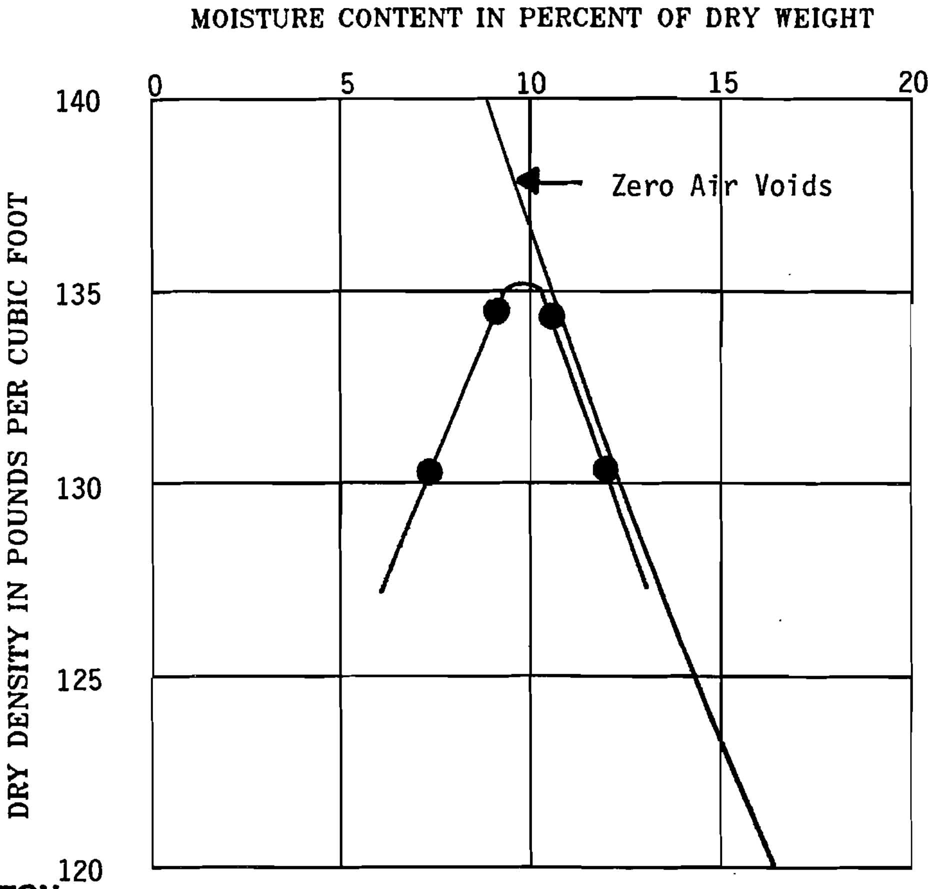
Project No. 6870318-06

Project Name Murrieta Hills

Date 10/19/92 Figure No. D-2

3005 188

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	B-3
Depth, in Feet	0-2
Representative For	Bag 1

SOIL CLASSIFICATION

Grain Sizes in Percent of Dry Weight	
Coarse (Retained on #200 Sieve)	50
Fines (Passing #200 Sieve)	50
Atterberg limits, in Percent of Dry Weight	
Liquid Limit	--
Plasticity Index	--

Soil Type and Description   Silt and Sand (ML-SM)

COMPACTION PROPERTIES

Method of Compaction

ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.T.O. Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 inches, 25 Blows Per Layer)

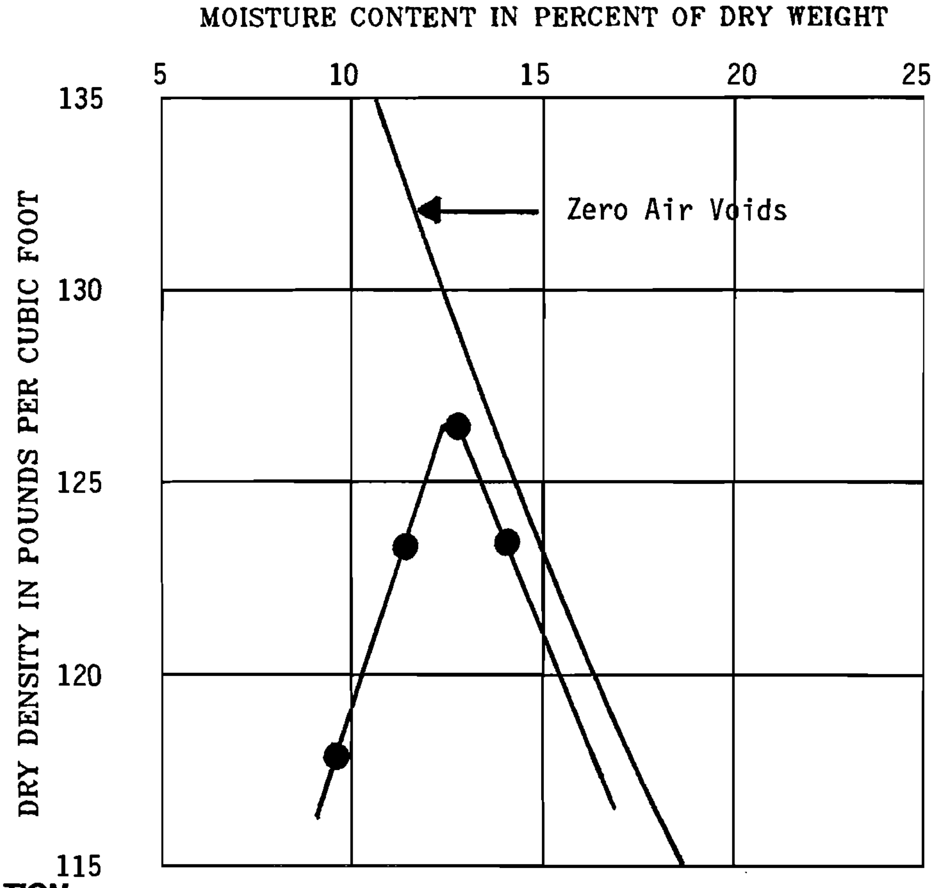
Optimum Moisture Content, in Percent of Dry Weight	9.5
Maximum Dry Density, in Pounds per Cubic Foot	135.0

Project No. 6870318-06

Figure No. D-3

LEIGHTON AND ASSOCIATES, INC.

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	B-4
Depth, in Feet	9-15
Representative For	Bag 1

SOIL CLASSIFICATION

Grain Sizes in Percent of Dry Weight

Coarse (Retained on #200 Sieve)	47
Fines (Passing #200 Sieve)	53

Atterberg limits, in Percent of Dry Weight

Liquid Limit	--
Plasticity Index	--

Soil Type and Description Sandy Clay (CL)

COMPACTION PROPERTIES

Method of Compaction

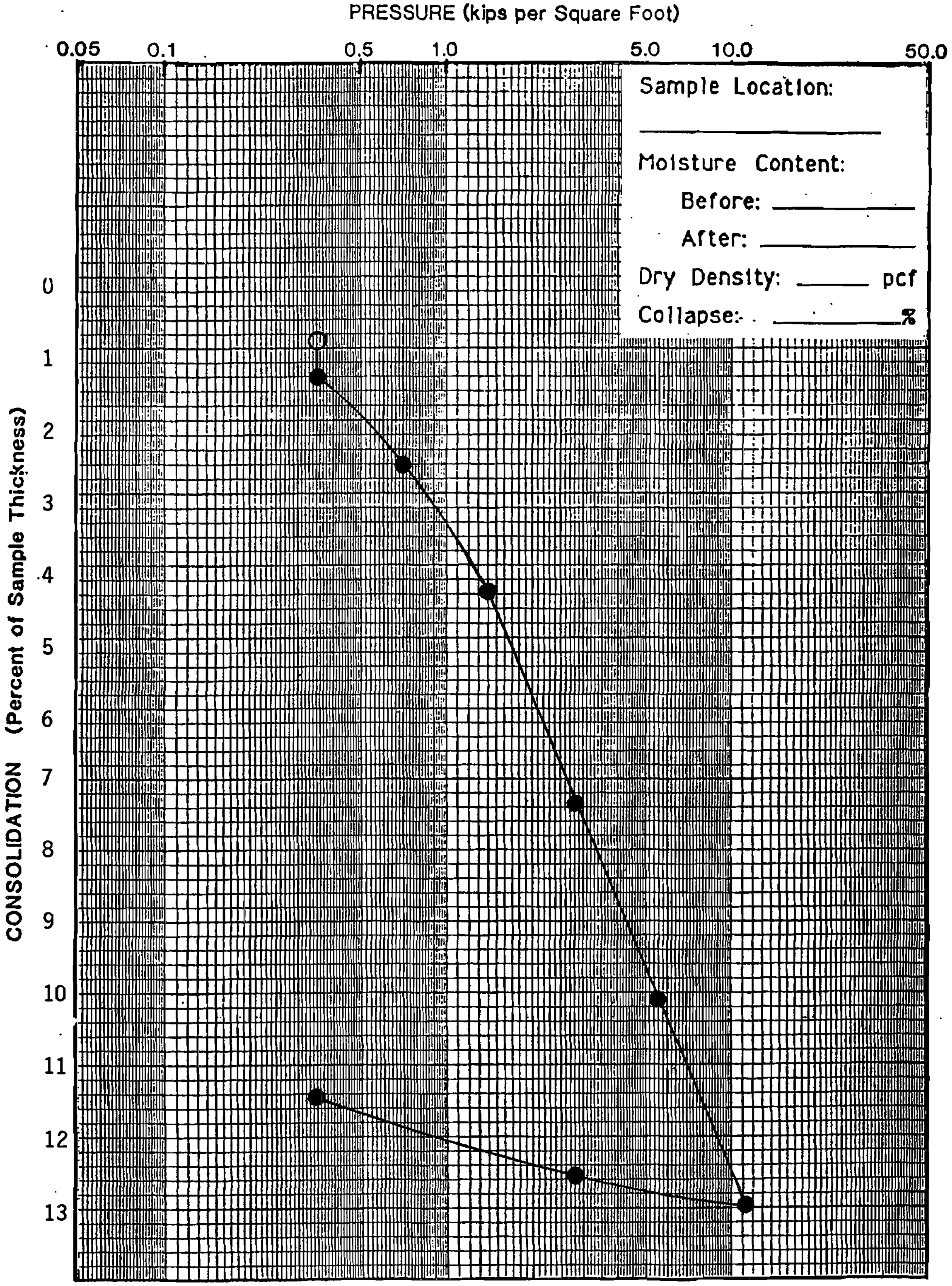
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.T.O. Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 inches, 25 Blows Per Layer)

Optimum Moisture Content, in Percent of Dry Weight	12.5
Maximum Dry Density, in Pounds per Cubic Foot	126.5

Project No. 6870318-06

Figure No. D-4

LEIGHTON AND ASSOCIATES, INC.



Sample Location: ______________

Moisture Content:

Before: ______________

After: ______________

Dry Density: ______ pcf

Collapse: ______ %

○ Indicates Sample at Field Moisture

● Indicates Sample After Saturation

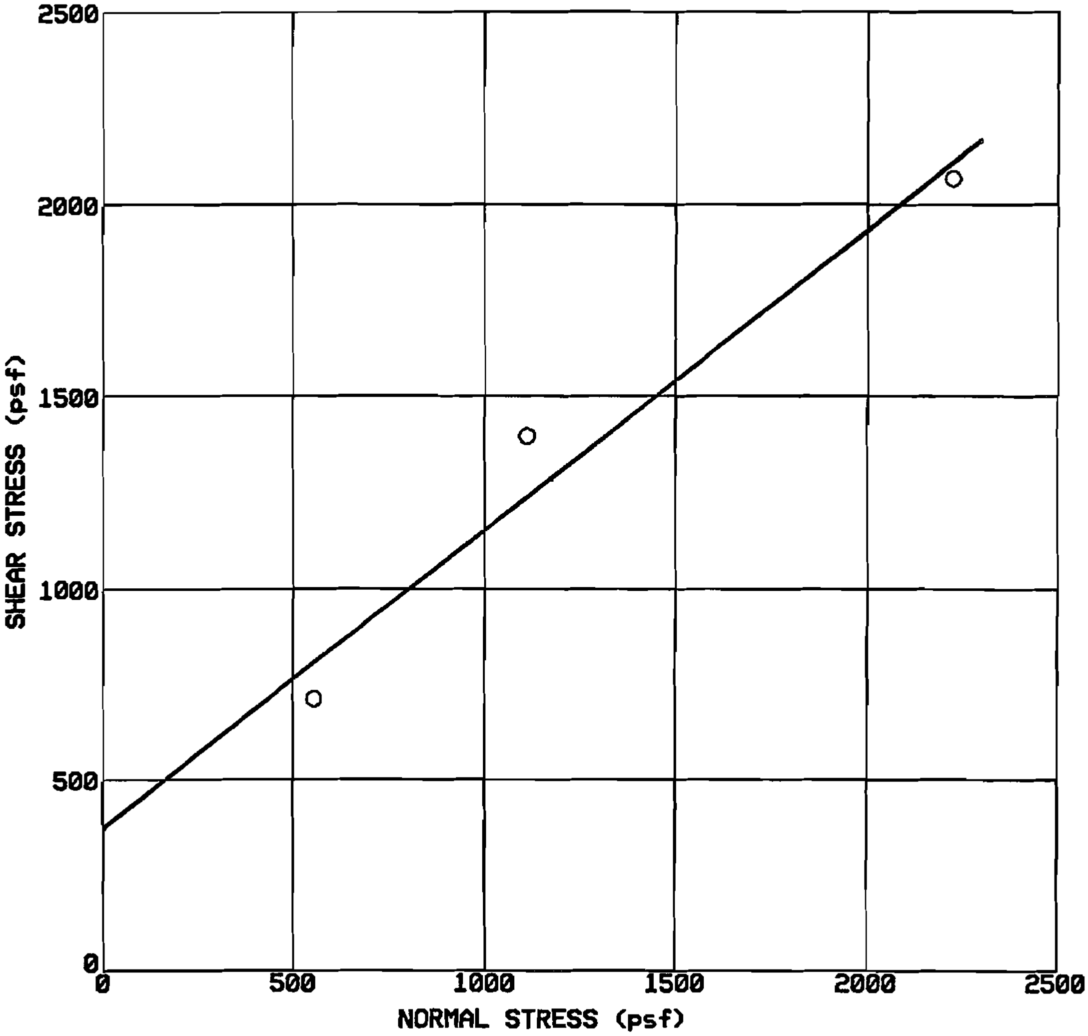
CONSOLIDATION - PRESSURE CURVE

Project No. ______________

Project Name ______________

Date 10/19/92 Figure No. D-5

3010 188



Log No. T-6

Sample No. D1

Depth (ft) 3.0

Soil Type

Type of Sample Undisturbed

Before Test:

Dry Density (psf) 122.8

Moisture Content (%): 6.9

Friction Angle (deg.) 38.0

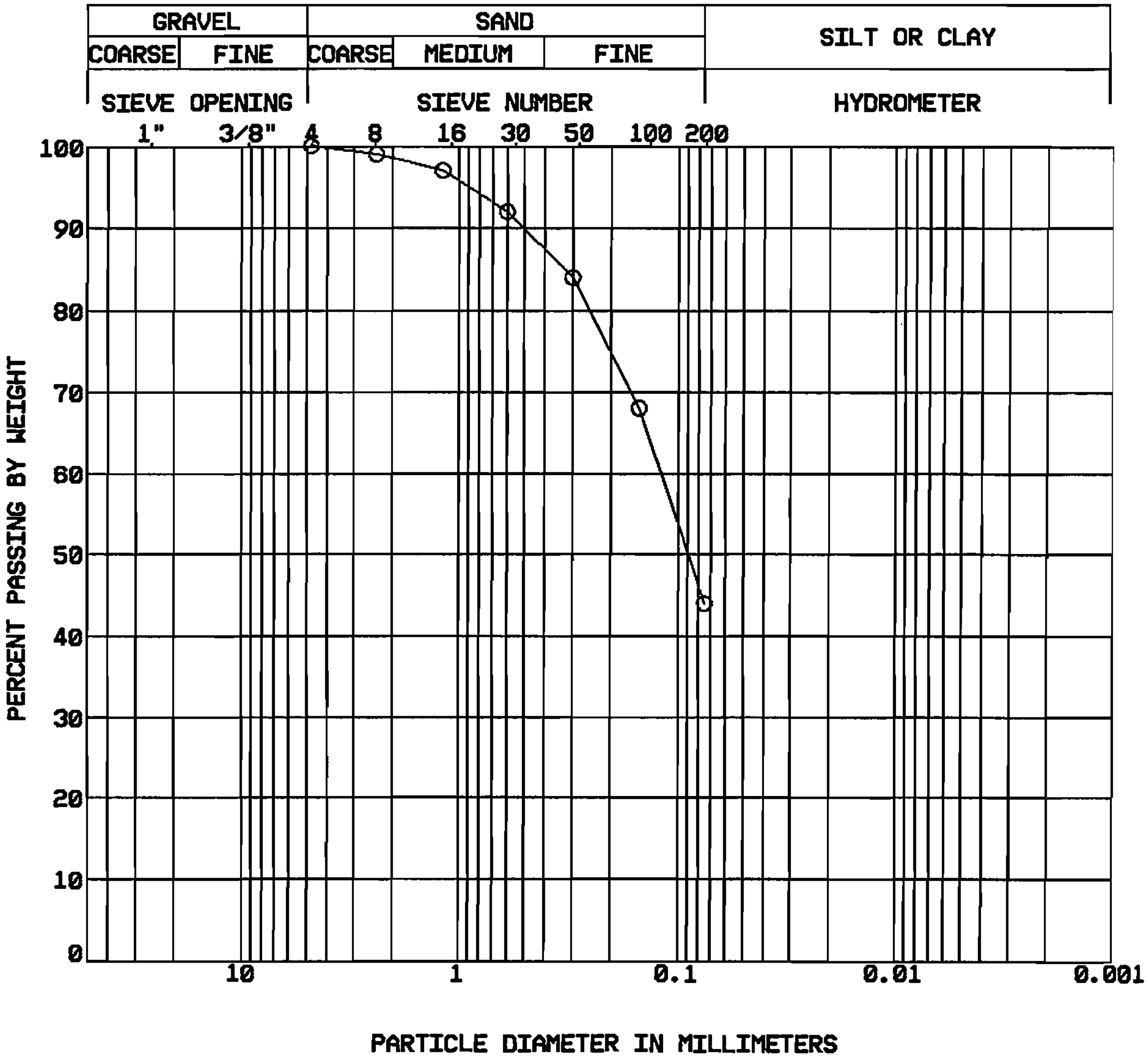
Cohesion (psf) 375.0

DIRECT SHEAR

Project No. 6870318-07

Project Name Murrieta Hills

Date 5/18/93 **Figure No.** D-1



Symbol	Log Number	Sample Number	Sample Depth (feet)	Field Moisture (%)	Soil Type
○	*T-2*	*B 1*	*5.0*		

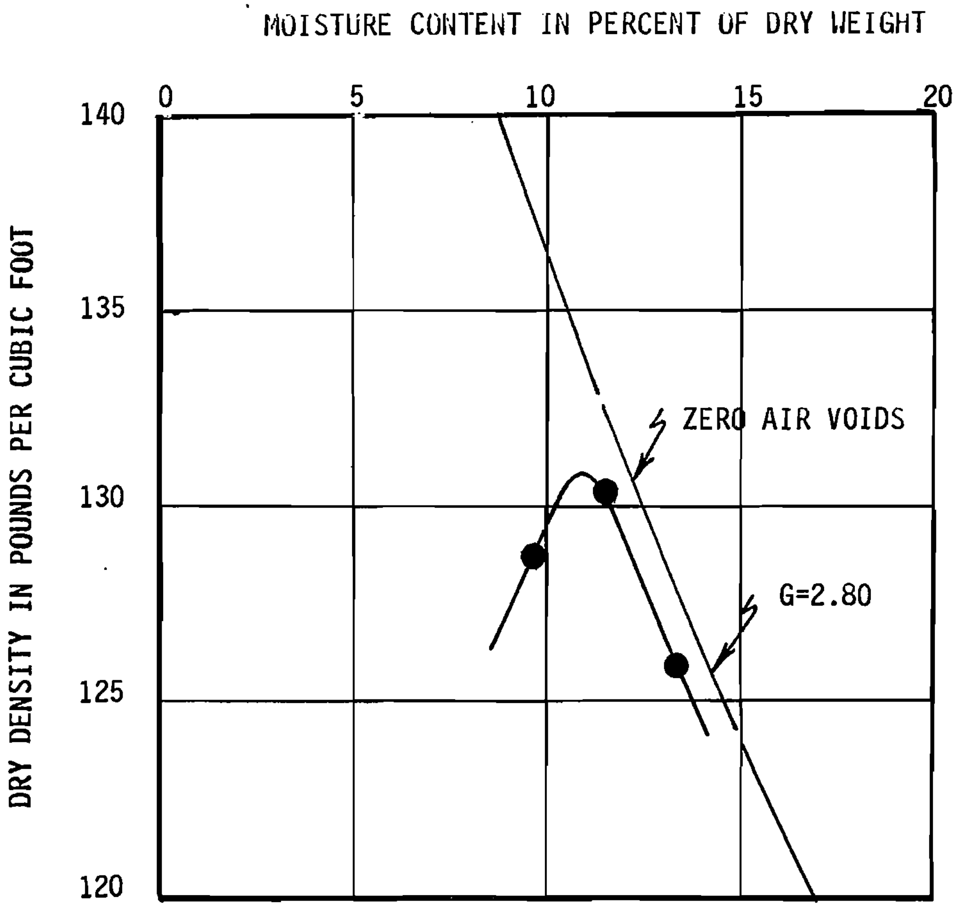
GRAIN SIZE DISTRIBUTION CURVE

Project No. *6870318-07*

Project Name *Murrieta Hills*

Date 5/18/93 **Figure No.** D-2

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	T-5
Depth, in Feet	2'
Representative For	Older Alluvium (Qoal)

SOIL CLASSIFICATION

Grain sizes in Percent of Dry Weight

Sand (Retained on #200 Sieve)	-
Fines (Passing #200 Sieve)	-

Atterberg Limits, in Percent of Dry Weight

Liquid Limit	-
Plasticity Index	-

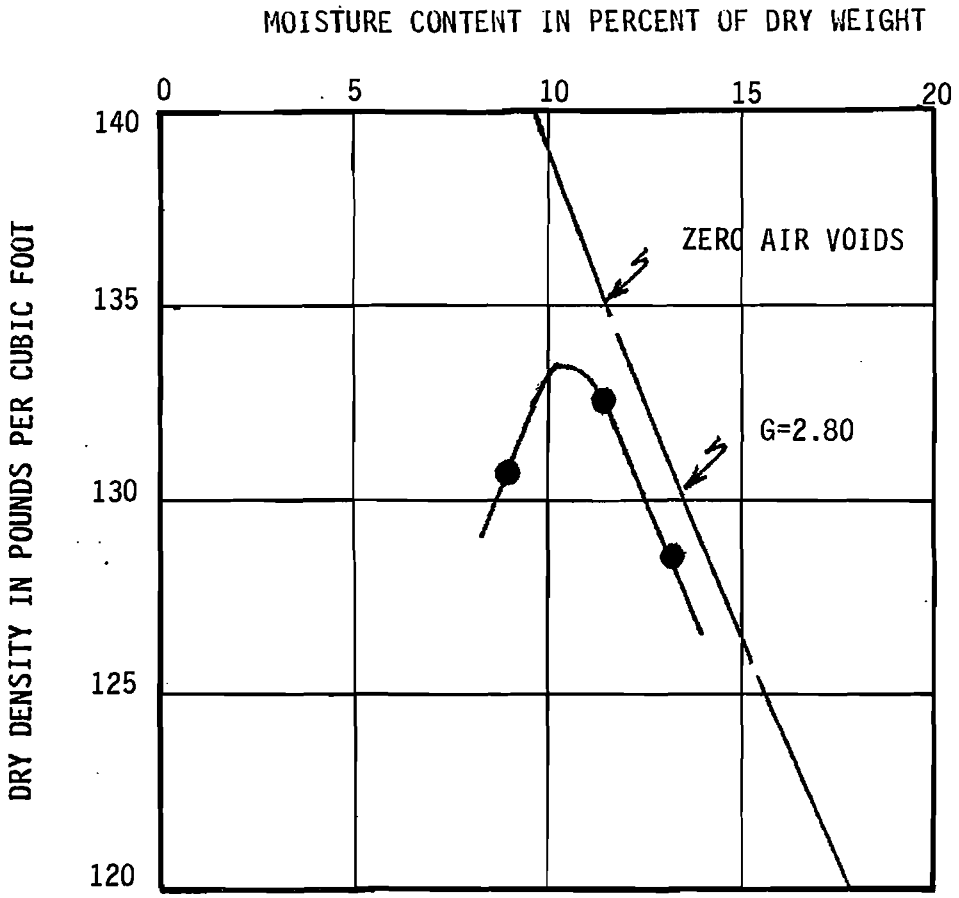
Soil Type and Description SILTY SAND (SM): Light to dark reddish brown.

COMPACTION PROPERTIES

Method of Compaction
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.O.
Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 Inches, 25 Blows Per Layer)

Optimum Moisture Content, in percent of Dry Weight	11.0
Maximum Dry Density, in pounds per Cubic Foot	131.0

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	B-2
Depth, in Feet	1'-2'
Representative For	Older Alluvium (Qoal)

SOIL CLASSIFICATION

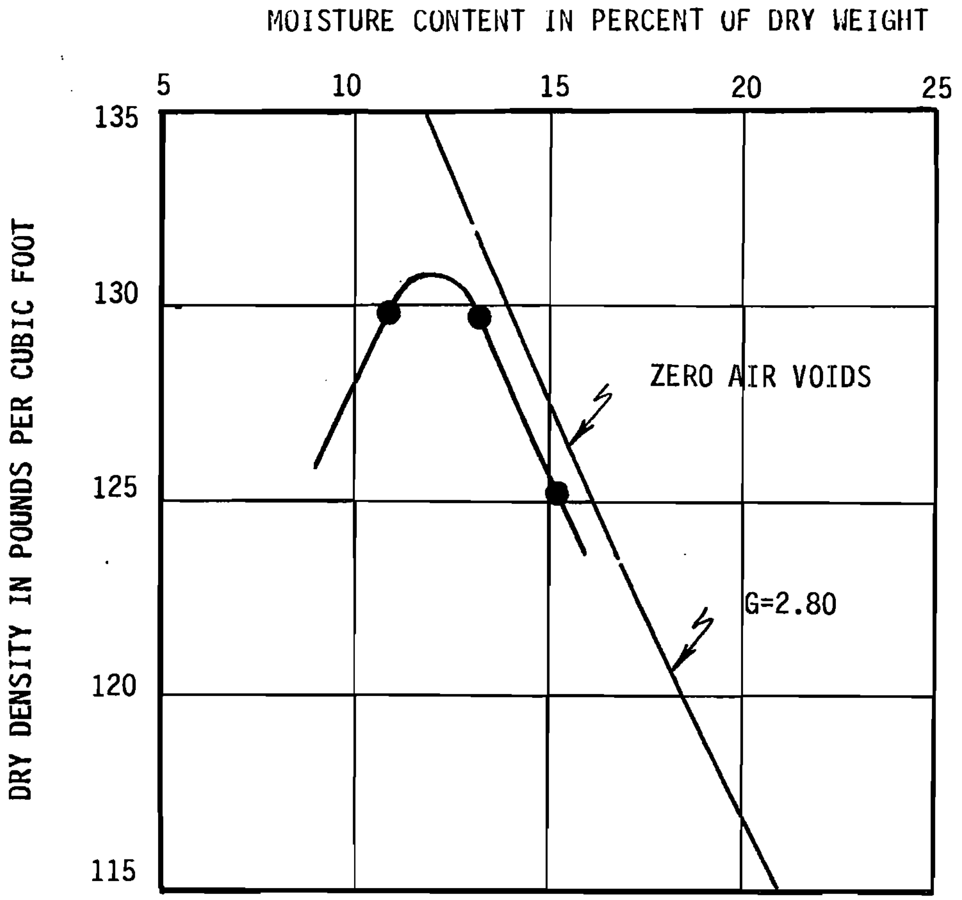
Grain sizes in Percent of Dry Weight	
Sand (Retained on #200 Sieve)	-
Fines (Passing #200 Sieve)	-
Atterberg Limits, in Percent of Dry Weight	
Liquid Limit	-
Plasticity Index	-
Soil Type and Description	SILTY SAND (SM): Reddish brown, fine to medium grained.

COMPACTION PROPERTIES

Method of Compaction
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.O.
Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer
Falling 18 Inches, 25 Blows Per Layer)

Optimum Moisture Content, in percent of Dry Weight	10.5
Maximum Dry Density, in pounds per Cubic Foot	133.5

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	B-5
Depth, in Feet	3'-4'
Representative For	Granitics (Kgr)

SOIL CLASSIFICATION

Grain sizes in Percent of Dry Weight

Sand (Retained on #200 Sieve)	-
Fines (Passing #200 Sieve)	-

Atterberg Limits, in Percent of Dry Weight

Liquid Limit	-
Plasticity Index	-

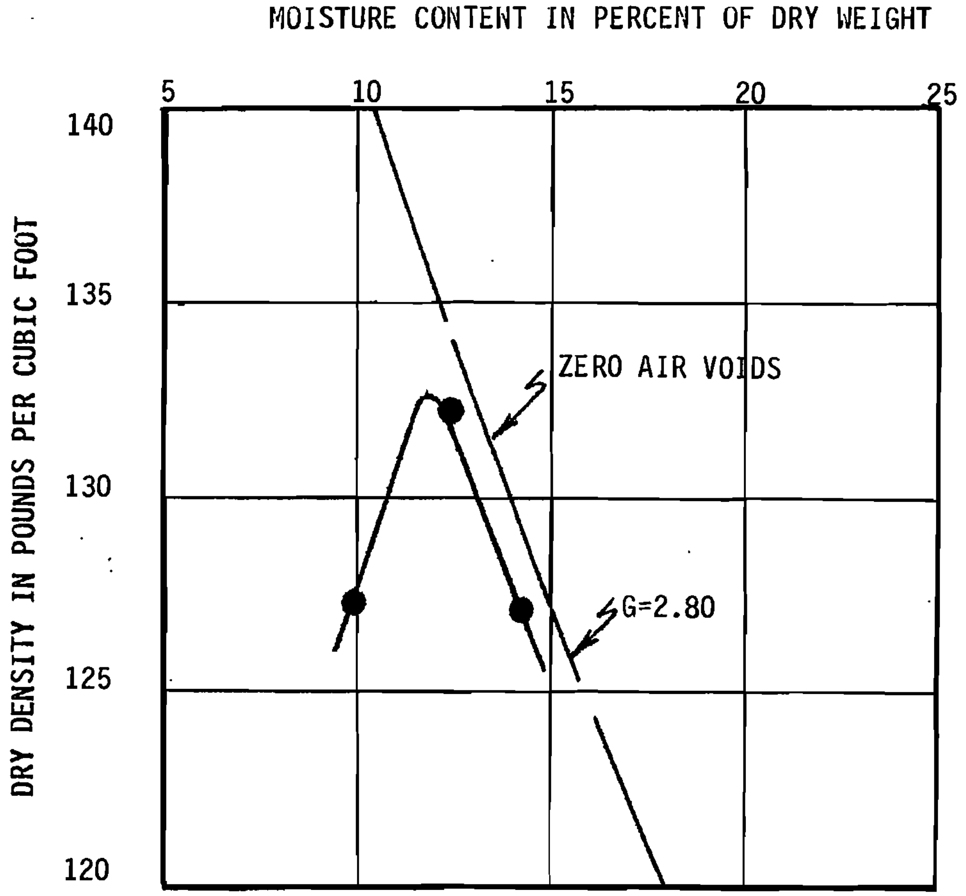
Soil Type and Description SILTY SAND (SM): Tan-brown to gray, very fine grained. (Decomposed Granitics)

COMPACTION PROPERTIES

Method of Compaction
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.O.
Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer
Falling 18 Inches, 25 Blows Per Layer)

Optimum Moisture Content, in percent of Dry Weight	12.0
Maximum Dry Density, in pounds per Cubic Foot	131.0

COMPACTION TEST DATA



LOCATION

Boring or Test Pit	B-6
Depth, in Feet	0'-1'
Representative For	Colluvium (Qcol)

SOIL CLASSIFICATION

Grain sizes in Percent of Dry Weight

Sand (Retained on #200 Sieve)	-
Fines (Passing #200 Sieve)	-

Atterberg Limits, in Percent of Dry Weight

Liquid Limit	-
Plasticity Index	-

Soil Type and Description SILTY SAND (SM): Dark brown, coarse silty sand with some clay

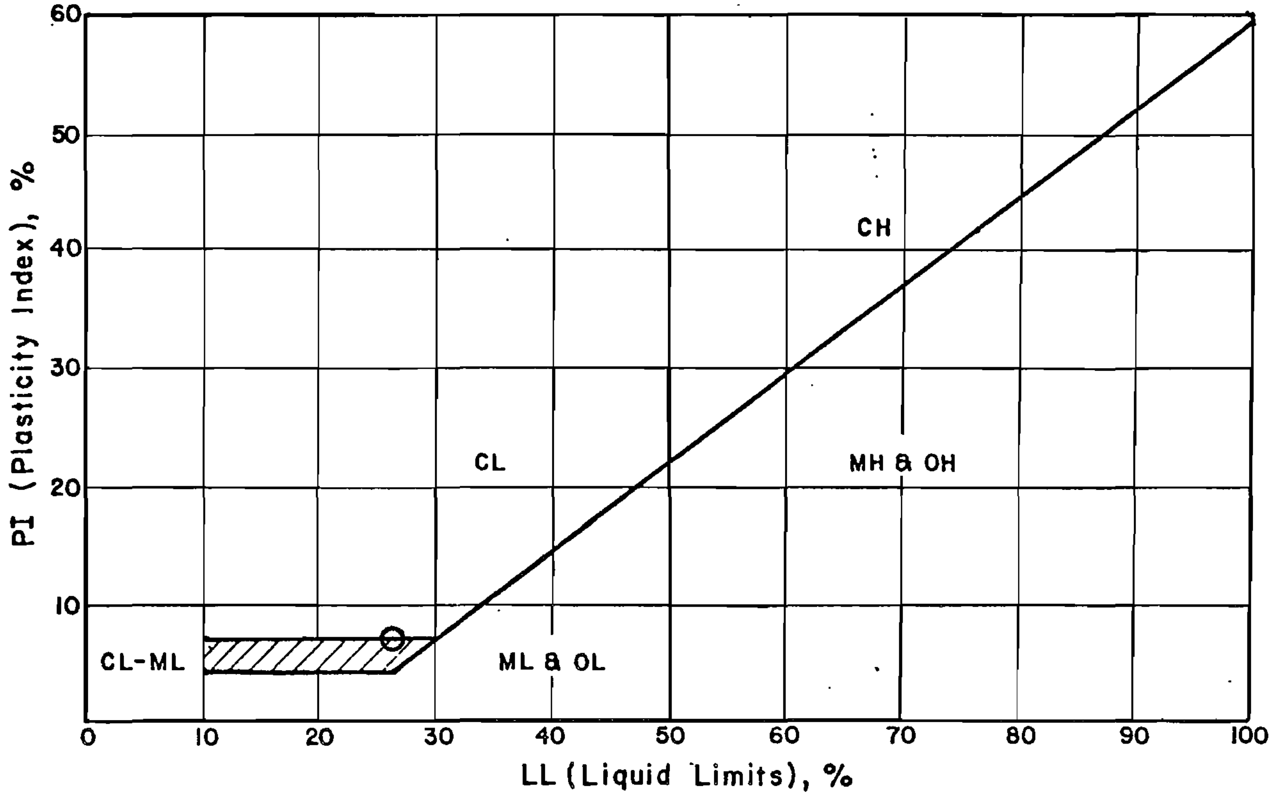
COMPACTION PROPERTIES

Method of Compaction
ASTM Standard Test Method D1557-78 Equivalent to A.A.S.H.O. Soil Compaction Test T180-57 (1/30 Cubic Foot Mold 10 Pound Hammer Falling 18 Inches, 25 Blows Per Layer)

Optimum Moisture Content, in percent of Dry Weight	12.0
Maximum Dry Density, in pounds per Cubic Foot	123.5

ATTERBERG LIMITS TEST RESULTS

SYMBOL	HOLE NO.	DEPTH	FIELD MOISTURE (%)	LL (%)	PL (%)	PI (%)	U. S. C. S.
○	T-3	1'-2'	8.0	27	19	8	CL-ML



Project No.: 6870318-03

Plate No.: B-V

Leighton & Associates

APPENDIX C

Slope Stability Analysis

A generalized slope stability evaluation was performed under static and pseudostatic loading conditions using GSTABL7. The GSTABL7 program provides a general solution of the slope stability problems using a two-dimensional limit equilibrium method. For pseudostatic analysis, a static lateral force equivalent to 0.15 times the acceleration due to gravity was used. No correction for increased shear strength under seismic loading was applied for these analyses.

Our analysis utilized shear strength parameters based on conservatively assumed soil and bedrock shear strengths obtained from published shear strength parameters for bedrock and soils (AGI, 1989). Shear strength parameters used in the analysis are as follows:

	Friction Angle	Cohesion (psf)
Weathered Granitic Bedrock	35	250
Compacted Fill	32	200

Slope Section	Factor of Safety	
	Gross Stability Static	Gross Stability Pseudostatic
Fill slope – 111 feet at 2:1	1.87	1.31
Cut slope – 91 feet at 2:1	1.75	1.27

A surficial analysis was also performed for the anticipated design slopes. For these analyses, an assumed 4-foot depth of saturation was utilized along with the soil strength parameters indicated above.

Slope Section	Factor of Safety for Surficial Stability
Cut Slope at 2:1	1.9
Fill Slope at 2:1	1.6

APPENDIX D

General Earthwork and Grading Specifications

LEIGHTON AND ASSOCIATES, INC.
GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

TABLE OF CONTENTS

Standard Details

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

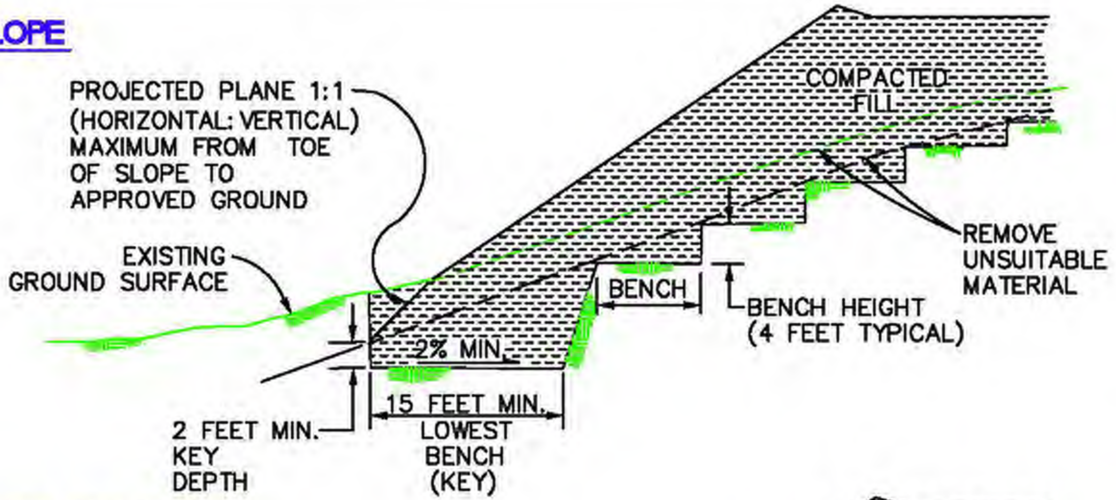
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

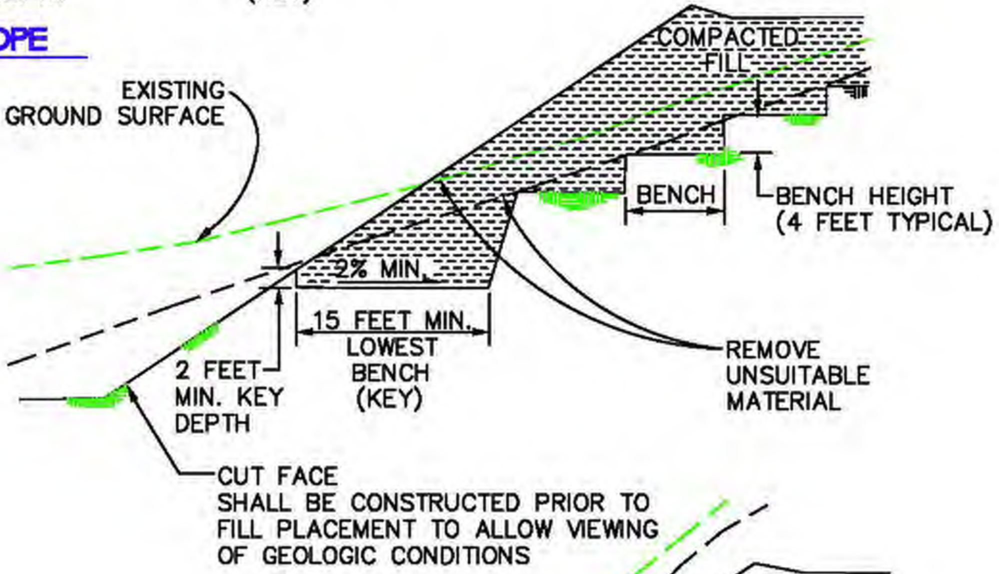
7.4 Observation and Testing

The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

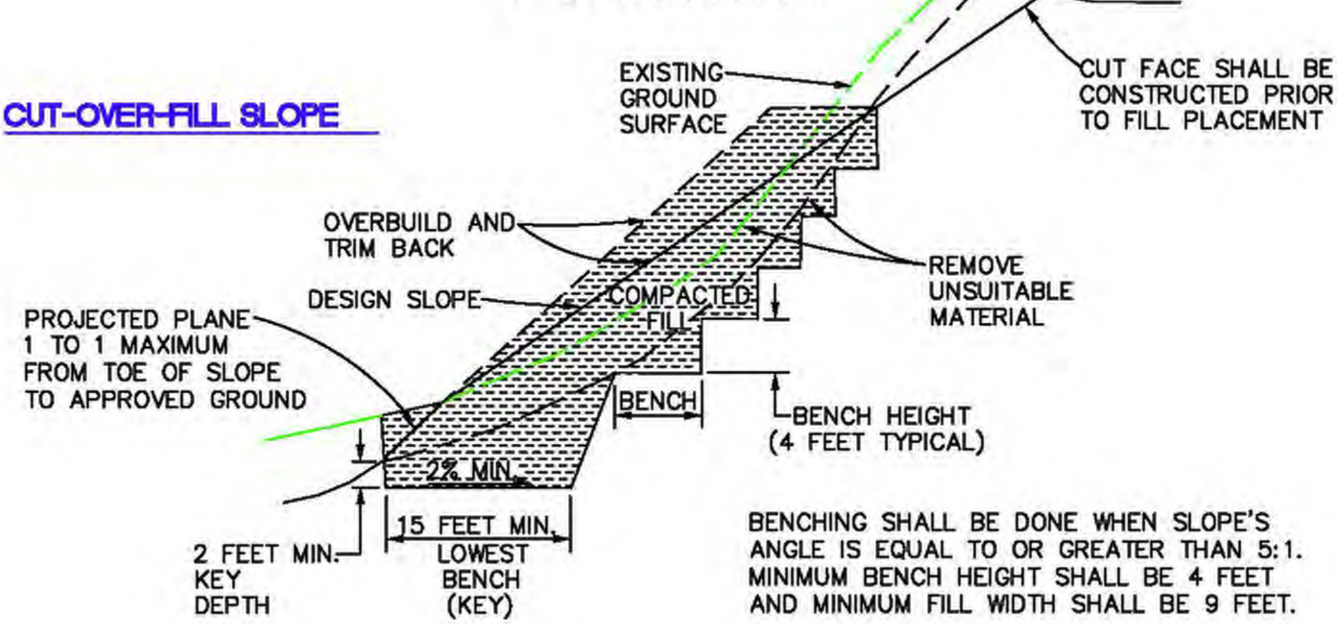
FILL SLOPE



FILL-OVER-CUT SLOPE

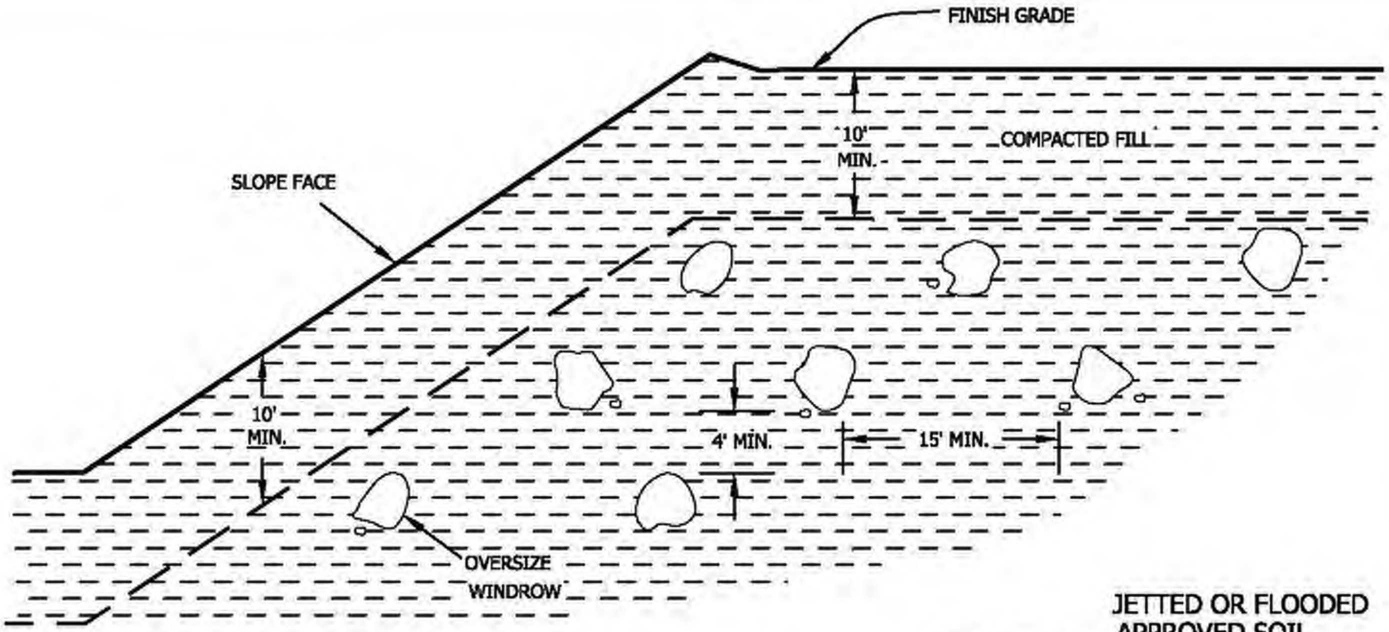


CUT-OVER-FILL SLOPE

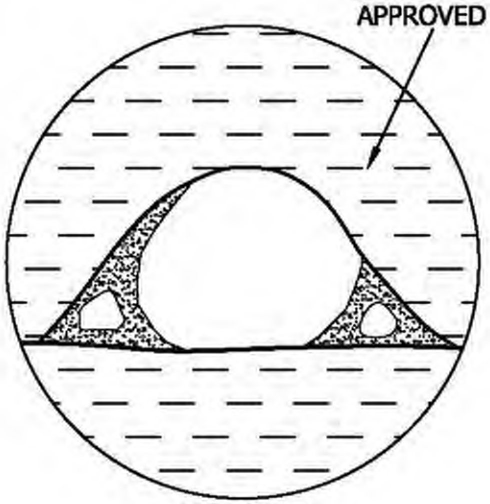


BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS A	Leighton

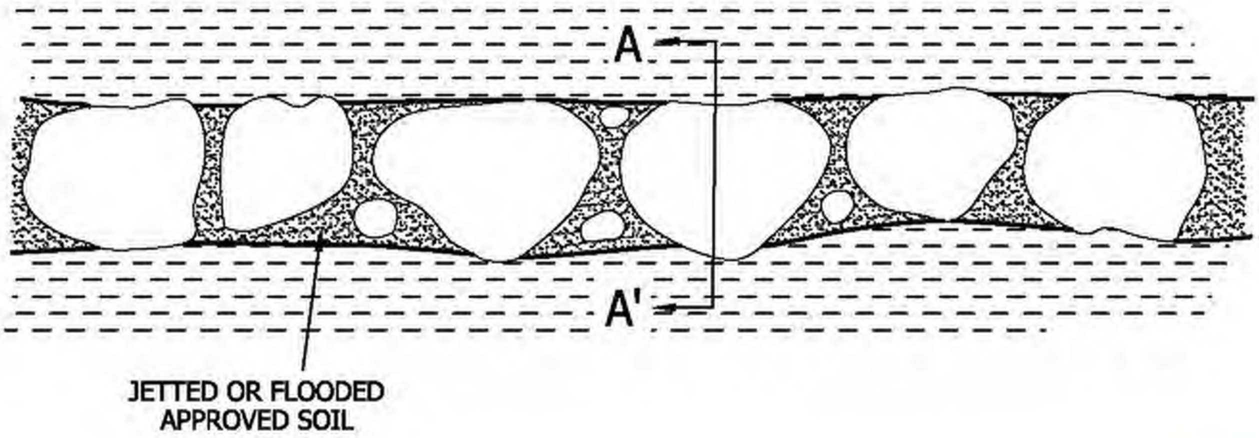


- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.



SECTION A-A'

PROFILE ALONG WINDROW



OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS B

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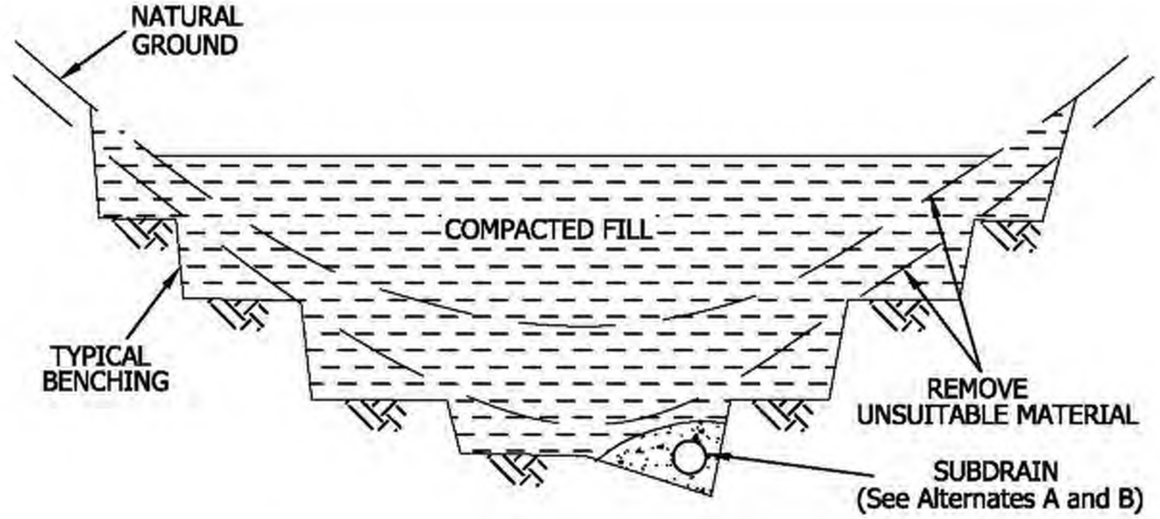
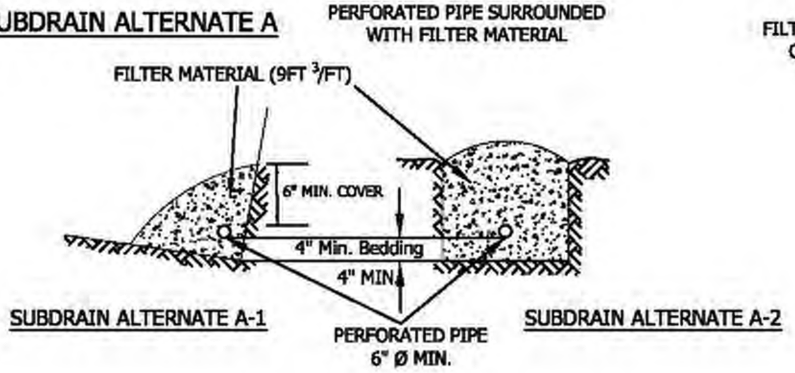


SUBDRAIN ALTERNATE A

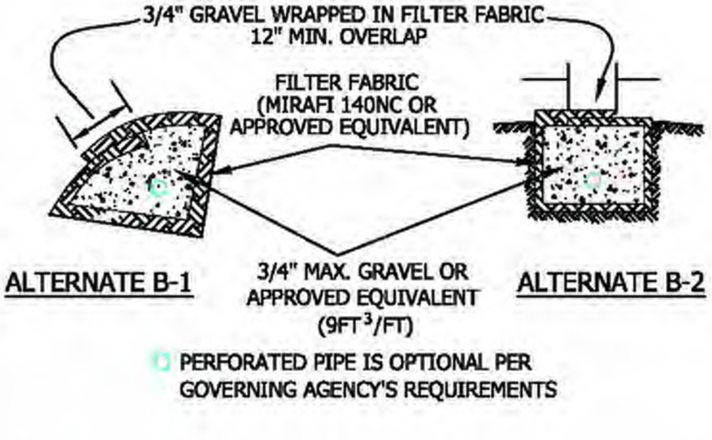


FILTER MATERIAL

FILTER MATERIAL SHALL BE CLASS 2 PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION, OR APPROVED ALTERNATE. CLASS 2 GRADING AS FOLLOWS:

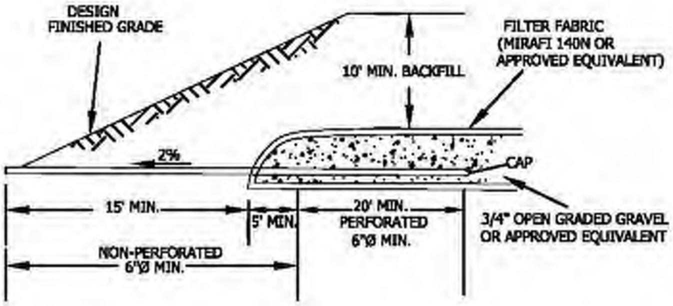
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

SUBDRAIN ALTERNATE B



○ PERFORATED PIPE IS OPTIONAL PER GOVERNING AGENCY'S REQUIREMENTS

DETAIL OF CANYON SUBDRAIN TERMINAL



CANYON
SUBDRAIN

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS C

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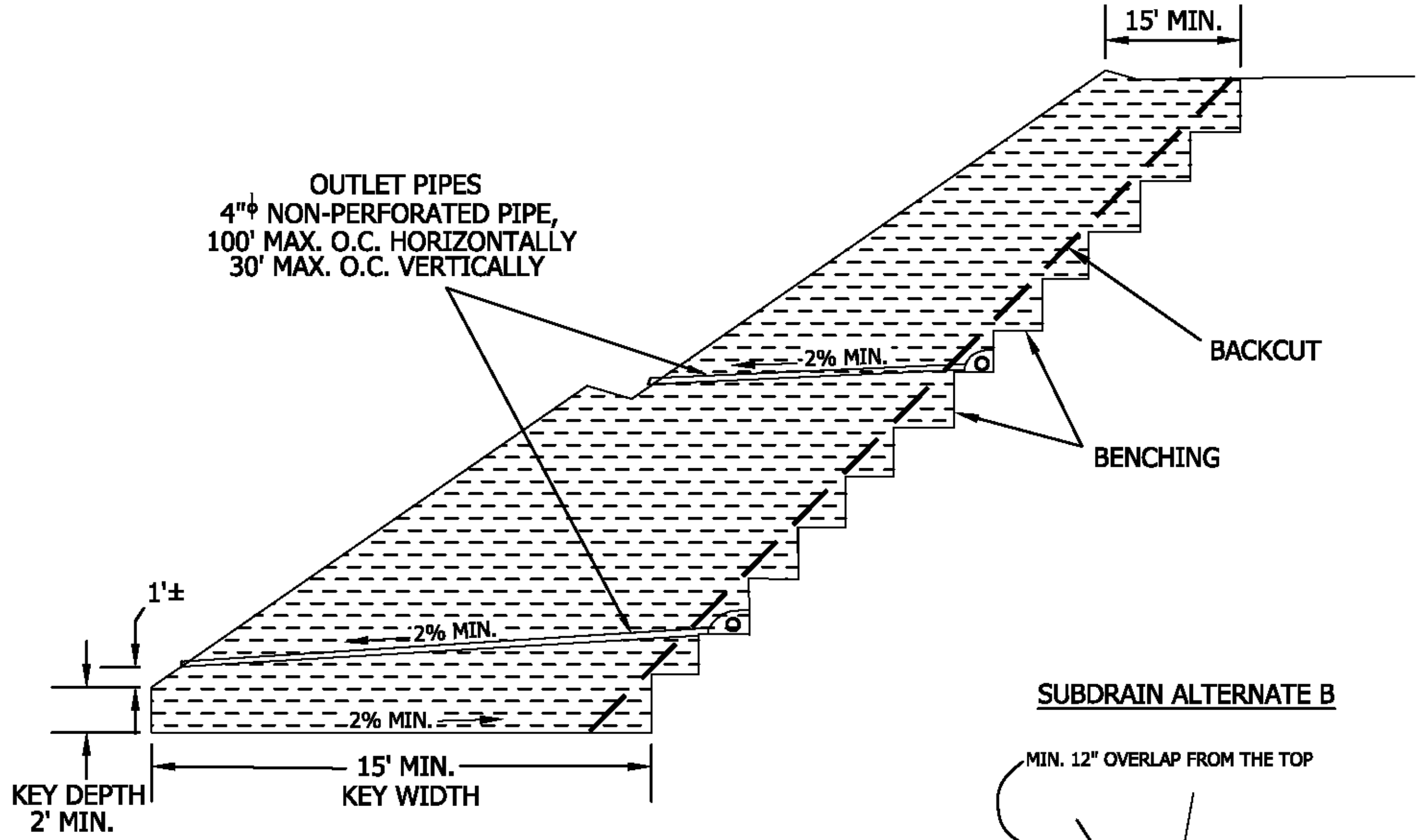
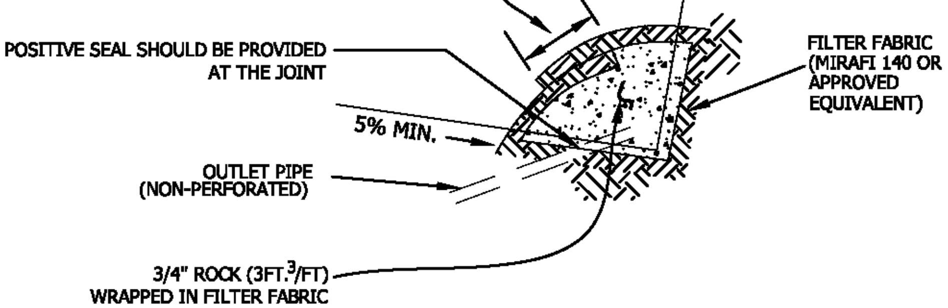
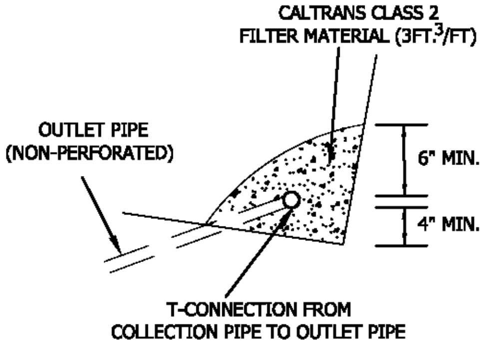


SUBDRAIN ALTERNATE B



SUBDRAIN ALTERNATE A



- SUBDRAIN INSTALLATION - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drilled holes are used. All subdrain pipes shall have a gradient at least 2% towards the outlet.
- SUBDRAIN PIPE - Subdrain pipe shall be ASTM D2751, ASTM D1527 (Schedule 40) or SDR 23.5 ABS pipe or ASTM D3034 (Schedule 40) or SDR 23.5 PVC pipe.
- All outlet pipe shall be placed in a trench and, after fill is placed above it, rodded to verify integrity.

BUTTRESS OR
REPLACEMENT FILL
SUBDRAINS

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS D

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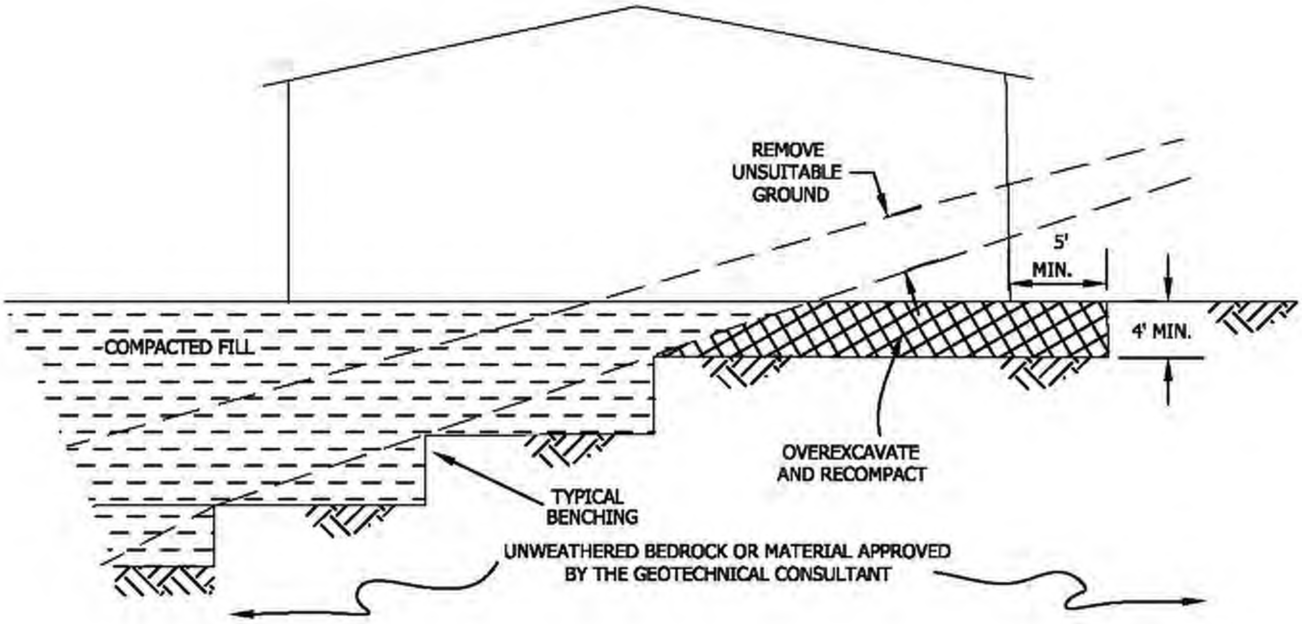
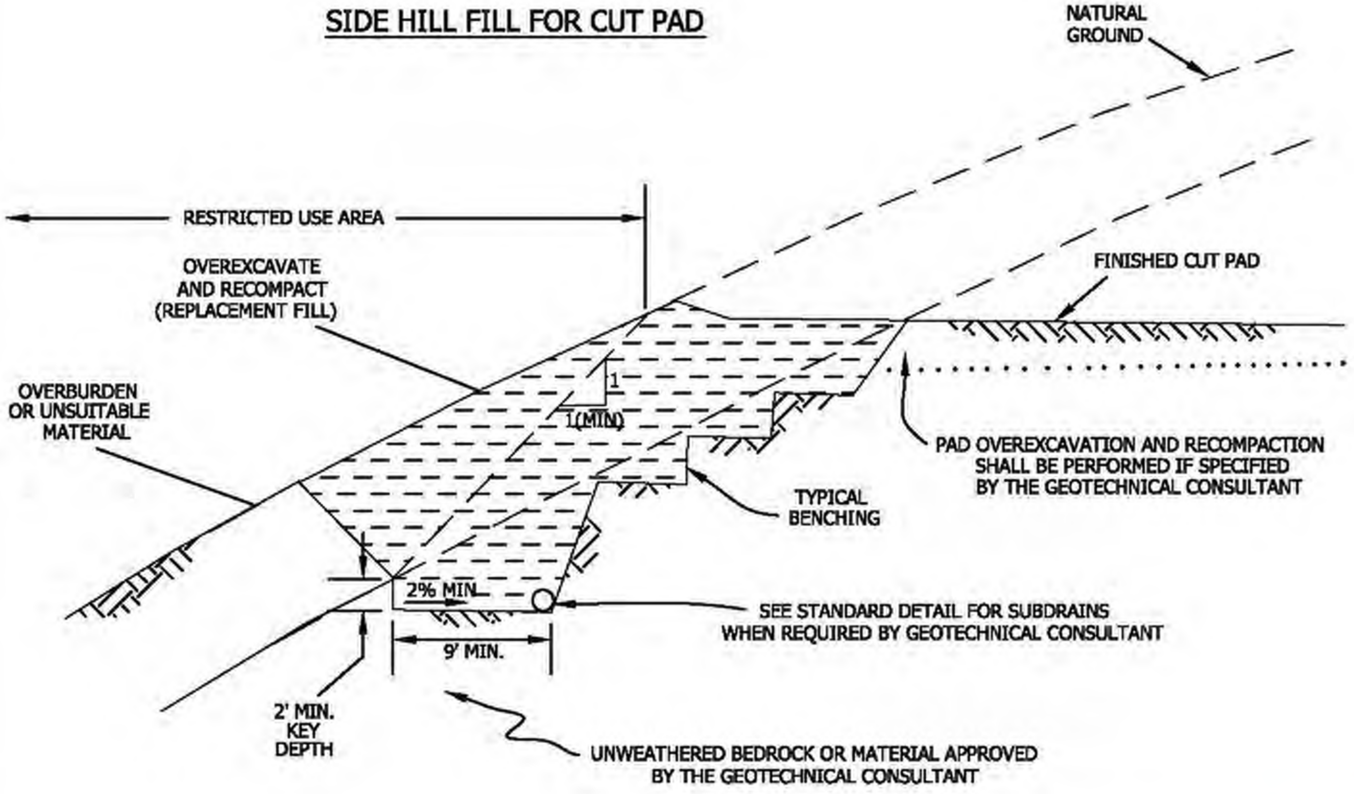
CUT-FILL TRANSITION LOT OVEREXCAVATION



SIDE HILL FILL FOR CUT PAD



TRANSITION LOT FILLS AND SIDE HILL FILLS

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS E

Leighton

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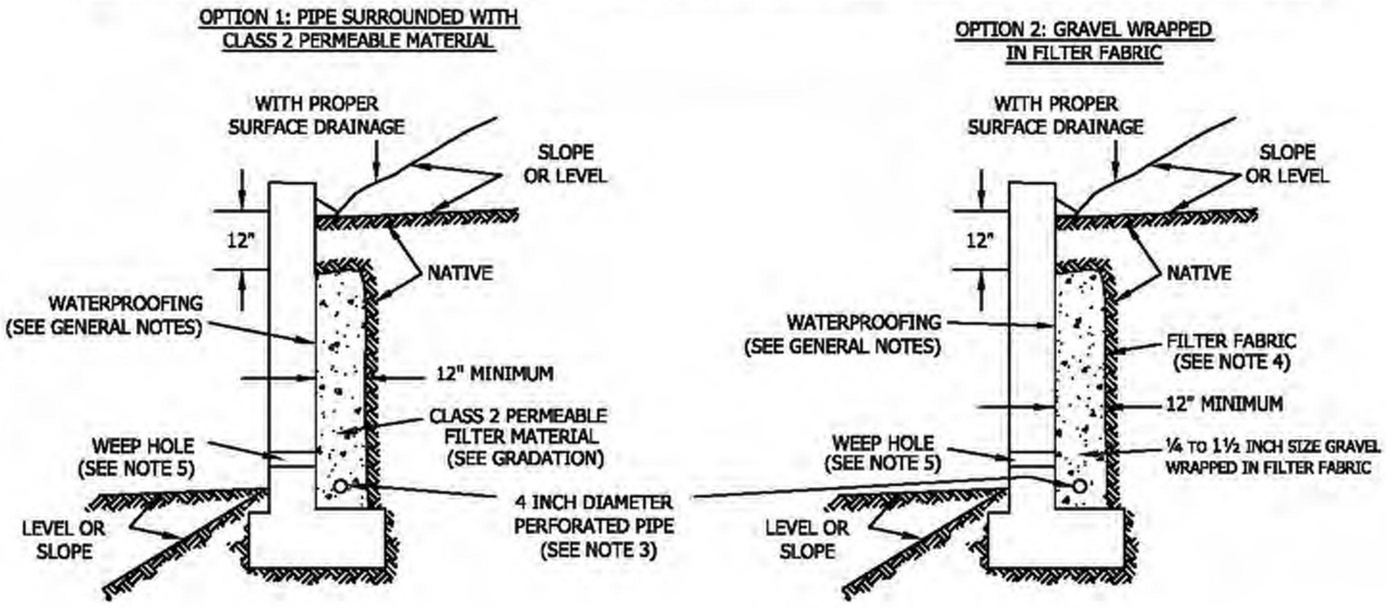
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50



OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC

Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure

APPENDIX E

ASFE, Information Regarding Geotechnical Engineering

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

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GEOTECHNICAL/GEOLOGIC REVIEW
PORTION OF TENTATIVE TRACT MAP NO. 35853
MURRIETA HILLS SPECIFIC PLAN, MCELWAIN ROADWAY
CITY OF MURRIETA, CALIFORNIA

Prepared for

PULTE/BP MURRIETA HILLS, LLC
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Project No. 10642.003

October 28, 2014

Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

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A LEIGHTON GROUP COMPANY

October 28, 2014

Project No. 10642.003

Pulte/BP Murrieta Hills, LLC
550 Laguna Drive, Suite B
Carlsbad, California 92008

Attention: Mr. Richard Robotta

Subject: **Geotechnical/Geologic Review**
Portion of Tentative Tract Map No. 35853
Murrieta Hills Specific Plan, McElwain Roadway
City of Murrieta, California

In accordance with your request and authorization, Leighton and Associates, Inc. (Leighton) has completed this geotechnical review for the proposed Murrieta Hills Specific Plan - Tentative Tract Map (TTM) No. 35853. More specifically, this report/review addresses the portion of the property containing future McElwain Roadway located in southeast corner of the project site (Figure 1).

Based on our review, it is our opinion that the proposed roadway alignment is suitable from a geologic/geotechnical perspective. However, additional reviews/evaluations should be performed as site development plans become available.

The opportunity to be of continued service on this project is greatly appreciated. Please call the undersigned if you have any questions.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

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1.0 INTRODUCTION

1.1 Purpose and Scope

Our scope of work for this geotechnical review included the following:

- Review of published geologic maps and in-house geotechnical reports relevant to this site,
- Review of geotechnical issues such as areas of rock, rockfall hazards, large cut slopes, etc., in view of the provided site plans (Pangaea, 2014),
- Site reconnaissance to review current surficial geologic conditions,
- Preparation of this report summarizing our findings, conclusions and recommendations.

Additional geotechnical evaluations/reviews will be required as site development and/or grading plans become available.

1.2 Site Location and Description

The proposed McElwain Road alignment is located within 5 parcels of land (APN's 392-280-001, -002, -003, -004 and -007) located along the west side of I-215, north of Linnel Lane in the City of Murrieta, California (see Figure 1). The overall site is bounded to the north by open undeveloped land (Tentative Tract 35853), to the south by Linnel Lane, to the east by I-215, and to the west by undeveloped land to large residential lots. The location and approximate limits of the proposed road alignment is depicted on Plate 1.

The majority of the site was vacant at the time of our site reconnaissance with an existing residence located within one parcel. Topographically, the overall site consists of steep hillsides and ridges to the west and north with low-lying southeast-trending valleys in the central and southern portions. The site elevations vary from a high of approximately 1,940 feet above sea level (msl) at a northern ridge top to a low elevation of approximately 1,560 feet (msl) at the southeastern corner (Pangaea, 2013).

1.3 Proposed Development

Based on provided site plan (Pangaea, 2014), the proposed McElwain Road alignment will connect the planned residential development (TTM 35853) to existing Linnel Lane. Conventional cut and fill grading will be utilized to construct the roadway alignment. Cut and fill slopes are proposed at a 2:1 (horizontal to vertical) inclination with a maximum height of 45 feet. The elevations along the planned roadway alignment vary from approximately 1,645 near the northerly end to 1,580 near the southerly end at Linnel Lane.

2.0 SUMMARY OF GEOTECHNICAL/GEOLOGIC CONDITIONS

2.1 Regional Geologic Setting

The subject site is located within a prominent natural geomorphic province in southwestern California known as the Peninsular Ranges. This province is characterized by steep, elongated ranges and valleys that generally trend northwestward. Tectonic activity along the numerous faults in the region has created the geomorphology present today.

Specifically, the site is situated in the southern portion of the Perris Block, a stable, eroded mass of Cretaceous and older crystalline and metamorphic rock. Thin sedimentary, metamorphic and volcanic units locally mantle the bedrock with alluvial deposits filling in the lower valley and drainage areas. The Perris Block is bounded by the San Jacinto fault zone to the northeast, the Elsinore fault zone to the southwest, the Cucamonga fault zone to the northwest and the poorly-defined northern boundary of the Temecula basin to the southeast. The Temecula segment of the active Elsinore Fault Zone is approximately 5 miles to the southwest of the site.

2.2 Site Geologic Units

Our field observations and review of pertinent literature (see References) indicate that subsurface materials within the site are composed of undocumented artificial fill, surficial topsoil/colluvium, younger and older alluvium and granitic bedrock (see Plate 1) as further described below.

2.2.1 Undocumented Artificial Fill (not a mapped unit)

Undocumented artificial fill is observed in isolated areas, primarily associated with existing dirt access roads, residential building pads and some motorcycle dirt track berms/trails. All undocumented artificial fill is considered to be unsuitable for the support of additional fills or structural improvements.

2.2.2 Surficial Soils/Colluvium (not a mapped unit)

Deposits of topsoil and colluvium are present throughout the site. These deposits are expected to extend to 2 to 3 feet, but they can be locally thicker. These soils consist of relatively loose sand silt to silty sand and are considered to be unsuitable for the support of additional fills or structural improvements.

2.2.3 Young Alluvium (Qal)

Deposits of unconsolidated Holocene-age alluvium are present in the central drainage channels and in the relatively low-lying southeastern corner of the site. The young alluvium is considered to be unsuitable for the support of additional fills or structural improvements.

2.2.4 Older Alluvium (Qalo)

Local deposits of older (Late to Middle Pleistocene) alluvial deposits overlie the bedrock along the alignment. It is anticipated that most of the older alluvium will be suitable for support of additional fills or structural improvements in its current condition.

2.2.5 Granitic Bedrock (Kgr)

The Cretaceous-age granitic bedrock within the site includes gabbro, granodiorite, and granophyre (Morton, 2006). The granitic rock contains numerous planar dikes and sills of quartz and granite. When excavated, these units will generate silty sand with varying percentages and sizes of gravel, and boulders. The bedrock is light gray in color, generally massive, fine- to medium-grained, and moderately to deeply weathered.

2.3 Soil Compressibility

The surficial soils, young alluvium, and weathered older alluvium are expected to be relatively compressible and unsuitable for the support of additional fills or settlement-sensitive improvements. The mitigation for such geologic hazard is presented in Section 4 of this report.

2.4 Expansive Soils

Based on our previous nearby explorations and on our experience with similar materials in the vicinity of the subject site, we anticipate that onsite soils will generally have a very low to low expansion index (Expansion Index ≤ 50 per ASTM D4829). Additional testing should be performed before or during grading to confirm the expansion potential of the soils. The mitigation for such geologic hazard is presented in Section 4.

2.5 Surface Water and Groundwater

No surface water was observed during our site reconnaissance, however could be present during inclement weather in the ephemeral drainages crossing the site. No other significant surface water features were observed during our review.

The Department of Water Resource data for two local wells (Well 06S03W34J001S & 06S03W34H001S) indicate a groundwater elevation to be approximately of 25 to 30 feet below site ground elevations. However, it should be noted that local perched water conditions may occur in the future, and may fluctuate seasonally, depending on rainfall conditions.

2.6 Landslides/Debris Flow and Rockfalls

No evidence of landslides/debris flow was observed within the alignment area during our field investigation or in review of California Geologic Survey landslide inventory maps (CGS, 2012). However, the potential for rockfall due to either erosion or seismic ground shaking is considered possible in the elevated portions located west of the proposed roadway, where rock outcrops and exposed boulders are present. The roadway alignment is not within the areas of earthquake-induced landslide or rock-fall concern.

2.7 Rippability and Excavation Characteristics

Based on our findings, non-rippable rock should be anticipated generally below depths ranging from 20 to 50 feet. In addition, localized non-rippable rock core stones may be encountered within 5 feet of the ground surface. Specialized rock excavation and reduction methods will likely be required in the deeper cut and exposed boulder outcrop areas. For excavations in hard rock, it is our experience that the followings factors, and combination thereof, determine production rates and dictate the need for other rock reduction techniques. These include: 1) fracture pattern and spacing; 2) frequency of solid boulders in decomposed matrix; 3) regularity or irregularity of rippable overburden; 4) equipment type and condition; and finally 5) skill of equipment operators.

In areas where heavy ripping is required for excavation, consideration should be given to undercutting street areas. Discussion of these recommended undercuts are contained in section 4.1 of this report. Oversize rock will be generated during excavation. Oversize rock may be placed in deeper fill areas as outlined in Section 4 of this report.

2.8 Faulting

2.8.1 Regional Faulting

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

The subject site is not included within an Earthquake Fault Zone as created by the Alquist-Priolo Earthquake Fault Zoning Act (Hart, 2007). Additionally, the site is not within a County of Riverside Fault Hazard Zone (Riverside, 2004). The nearest zoned active faults are the Temecula segment of the Elsinore Fault Zone, located approximately 5.2 miles (8.3 km) southwest of the site, the Glen Ivy segment of the Elsinore Fault Zone, located approximately 9.3 miles (15.0 km) northwest of the site the San Jacinto Valley segment of the San Jacinto Fault Zone, approximately 17.0 miles (27.4 km) northeast of the site, and the Anza segment of the San Jacinto Fault Zone located approximately 17.7 miles (28.5 km) east of the site (Blake, 2000).

2.9 Ground Shaking

Strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. This is common to virtually all of Southern California. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. The site-specific seismic coefficients based on the 2013 California Building Code (CBC) are provided in following table:

Table 1. 2013 CBC Site-Specific Seismic Coefficients

CBC Categorization/Coefficient		Value (g)
Site Longitude (decimal degrees)	-117.17570	
Site Latitude (decimal degrees)	33.62465	
Site Class Definition	**D**	
Mapped Spectral Response Acceleration at 0.2s Period, S_s		**1.64**
Mapped Spectral Response Acceleration at 1s Period, S_1		**0.71**
Short Period Site Coefficient at 0.2s Period, F_a		**1.0**
Long Period Site Coefficient at 1s Period, F_v		**1.5**
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}		**1.64**
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}		**1.06**
Design Spectral Response Acceleration at 0.2s Period, S_{DS}		***1.1***
Design Spectral Response Acceleration at 1s Period, S_{D1}		***0.71***

* g- Gravity acceleration

2.10 Secondary Seismic Hazards

Secondary seismic hazards generally associated with severe ground shaking during an earthquake include ground rupture, lurching, ridgetop shatter, landsliding and rockfall, liquefaction and dynamic settlement, and flooding due to seiches and tsunamis. These hazards are discussed in the following sections.

2.10.1 Ground Rupture

Ground rupture is generally considered most likely to occur along pre-existing active faults. Based on our review of available maps and the conclusions of previous investigations, there are no known active faults within the site. The potential for ground rupture is considered very low to non-existent on this site.

2.10.2 Lurching

Soil lurching refers to the rolling motion on the ground surface by the passage of seismic surface waves. Effects of this nature are likely to be most severe where the thickness of soft sediments varies appreciably under structures. The potential for lurching can be reduced if the potentially compressible soils present on the site are removed and properly compacted in accordance with the recommendations of this report.

2.10.3 Ridgetop Shatter

The focused effects of strong ground shaking during earthquakes can result in the shattering of certain geologic deposits where they form elevated ridges. Given the distance of the site from known active fault zones, and the granitic bedrock in the onsite ridgetop areas, the risk of ridgetop shatter at the site is considered to be low. Furthermore, and most significantly, the currently proposed area of development does not include the ridgetop areas.

2.10.4 Liquefaction and Dynamic Settlement

The subject site contains loose surficial soils and alluvial deposits. Assuming that these soils will be removed and recompacted in accordance with the recommendations of Section 4.0 of this report, it is our opinion the potential for liquefaction due to the design earthquake event at this site is very low.

2.10.5 Flooding

The site is not within a flood plain and potential for flooding is considered low for this site. However, in the event of strong persistent inclement weather, some local flooding could occur along the slopes of the adjacent hillsides.

2.10.6 Seiches and Tsunamis

Due to the inland location and distance from major bodies of water, the site is not at significant risk from seiches or tsunamis.

3.0 CONCLUSIONS

It is our opinion that the proposed development is feasible from a geotechnical standpoint, provided that the recommendations presented herein are incorporated into the design and construction phases of development. Additional geotechnical exploration and analysis may be required based on final rough grade/development plans. The following is a summary of the major geotechnical constraints or opportunities associated with this site:

- The site contains undocumented artificial fills, surficial soils, young alluvium, and weathered older alluvium that are potentially compressible. Thus, these materials should be removed and compacted prior to placing any additional fills.
- The onsite soils are geotechnically suitable for re-use as compacted fill during proposed grading, provided they are relatively free of organic matter, other deleterious material or oversize rock fragments.
- Onsite near surface soils are anticipated to generally be very low to low expansive. Medium or higher expansive soils may be encountered in localized deposits.
- The shallow soils and upper 5 to 20 feet of bedrock in most areas of the site can be excavated with heavy-duty conventional grading equipment in good working condition.
- Nonrippable rock may be encountered at the surface and in cuts deeper than 5 to 20 feet. A significant amount of oversized rock will be generated from the bedrock cuts.
- Surface water was not encountered. Perched groundwater may be encountered locally during grading and utility construction. Seepage may occur after grading.
- Evidence of active faulting was not identified within the subject site.
- The liquefaction potential is considered very low for this site.
- Cut and fill slopes are proposed at 2:1 inclinations (H:V) to maximum heights of approximately 45 and 20 feet, respectively. These slopes are considered globally stable.
- Cut slopes excavated in younger or older alluvium is considered unstable and should be constructed as a replacement fill as depicted in Appendix A.

4.0 PRELIMINARY RECOMMENDATIONS

4.1 General

The proposed development is considered feasible from a geotechnical viewpoint provided our recommendations included in this report are implemented during design and construction phases of development. However, these recommendations should be further evaluated based on site-specific geotechnical evaluation, review of rough grading plans and prevailing geologic conditions during construction.

4.2 Earthwork Considerations

Earthwork should be performed in accordance with the General Earthwork and Grading Specifications included in Appendix A and as per the following recommendations. The recommendations contained in Appendix A, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix A. Additional site specific evaluation of the proposed roadway alignment should be performed when the specific design is determined.

4.2.1 Site Preparation and Removal

Prior to grading, the proposed structural improvement areas (i.e. all-structural fill areas, pavement areas, etc.) of the site should be cleared of surface and subsurface obstructions and organic material. Heavy vegetation, roots, and debris should be disposed of offsite. Septic tanks and cesspools, if encountered, should be removed or abandoned in accordance with the local regulations. Voids created by removal of buried material should be backfilled with properly compacted soil in general accordance with the recommendations of this report.

The near surface soils comprised of undocumented artificial fill, surficial soils, young alluvium, low density older alluvium, and highly weathered bedrock are considered unsuitable for structural fill support and should be removed to expose competent material as determined by the geotechnical consultant during grading. After removal of unsuitable materials, the excavated soils may be cleared of organic matter and other deleterious material, and re-used as compacted fill.

The remedial removal depths will vary with location and expected to range from approximately 2 to 3 feet below existing grade over most of the site. Deeper removals will be required in areas of deep younger/older alluvium.

4.2.2 Subgrade Overexcavation

To facilitate utility construction in cut areas, we recommend that street subgrade be overexcavated to a depth of 1 foot below the deepest utility during rough grading and then brought back up to design grades with compacted fill containing rocks fragments no greater than 8 inches in diameter. The street pavement area should be overexcavated to a minimum of 12 inches below the street design subgrade elevation and replaced with compacted fill to provide a uniform subgrade condition.

4.2.3 Structural Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris and organic matter. Rocks over 12 inches in maximum dimension may be placed within the compacted fill in accordance with the recommendations in Section 5.2.5. Utility area fill zones (pads and street overexcavation areas) should be relatively free of rocks greater than 8 inches.

Areas to receive structural fill and/or other surface improvements should be scarified to a minimum depth of 8 inches, moisture conditioned to at least optimum moisture content, and compacted. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and at near or above optimum moisture content. Fill soils placed at depths over 50 feet below finish grade should be compacted to a minimum of 95 percent relative compaction and at or above optimum moisture content.

Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of Leighton. 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 thickness.

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix A for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times.

Fill slopes should be overbuilt a minimum of 2 feet and trimmed back to the compacted core. In areas where overbuilding is not practical, slope faces may be compacted by rolling with weighted sheepsfoot compaction rollers as the fill slope height increases in maximum 5 foot increments.

4.2.4 Oversize Rock

Based on our observations, we anticipate that grading will produce oversized rock (greater than 12 inches in maximum dimension). No rock in excess of 12 inches in maximum dimension should be placed in any fill within 10 feet of finish grade without review by Leighton and approval by the local regulatory agency. Oversized rock may be placed in fills deeper than 10 feet below finish grade, if placed in accordance with the following guidelines and the specifications contained in Appendix A.

Within the upper 5 feet of rough grade or 1 foot below utility overexcavation zones, fill soils should not contain rock greater than 6 inches in maximum dimension in order to facilitate utility trench excavation and compaction procedures. For fill soils between 5 and 10 feet below finish grade or below utilities, the fill may contain rock up to 12 inches in maximum dimension if mixed with sufficient soil to eliminate voids. Below a depth of 10 feet (or deeper utility), rocks up to a maximum dimension of 36 inches may be incorporated into the fill provided adequate fines to fill all voids are present. Rocks greater than 36 inches in diameter may be placed on a case-by-case basis, if encountered.

4.2.5 Trench Excavations and Backfill

The onsite soils are generally suitable as trench backfill provided they are screened of rocks over 6 inches in diameter (or per governing agency requirements) and organic matter. Trench backfill should be compacted in uniform lifts (not exceeding 8 inches in compacted thickness) by mechanical means to at least 90 percent relative compaction (ASTM Test Method D1557).

Excavation of utility trenches should be performed in accordance with the project plans, specifications, and all applicable OSHA requirements. The contractor should be responsible for providing the "competent person" required by OSHA standards. Contractors should be advised that sandy soils (such as native site alluvium and future fills generated from the onsite alluvium and bedrock) could make excavations particularly unsafe, even if all safety precautions are taken. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavations and construction equipment should be kept away from the sides of the trenches.

4.3 Slope Stability

4.3.1 Cut Slopes

As indicated previously in this report, the excavation of cut slopes in granodiorite may require localized heavy ripping or local blasting. Slopes cut into granodiorite may daylight natural joints, fractures or partings whose orientations with respect to the slope face could possibly adversely affect the stability of the slope in the form of seismically induced rock falls, wedge failures, slides or slumps.

Susceptibility to the above geometric failure modes will be greatly affected by the degree of weathering along joint or fracture surfaces. Our observations of onsite exposures indicate that weathering and clay development along joint surfaces is minor to locally moderate. Each cut slope should be evaluated during grading. Adverse conditions could possibly require the construction of a stabilization fill, buttress or possibly rock bolting. Based on our previous analysis, the proposed cut slopes are anticipated to be grossly stable for both static and pseudostatic loading conditions.

4.3.2 Fill Slopes

Based on our review of the site plan, fill slopes are designed for inclinations of 2:1 or flatter to vertical heights of up to 20 feet. Fill slopes constructed of properly compacted onsite materials are considered grossly stable to the heights proposed. Fill slopes should be keyed and benched into natural ground as depicted in Appendix A. Keyways should be at least 15 feet, or one half of the slope height in width.

Slope faces are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability.

4.4 Natural Slopes

It is our opinion that the adjacent natural slopes located along the roadway alignment are grossly stable. Our preliminary review indicates that surficial stability will be minimally impacted by the proposed grading.

However, it is possible that natural slopes containing thick colluvial soils could present a potential for erosion, localized surficial slumping and possible debris flows. Mitigation measures may include the construction of catchment ditches or debris fences

4.5 Site Drainage and Erosion Control

All drainage should be directed away from slopes, pavements and structures by means of approved permanent or temporary drainage devices. Adequate storm drainage should be provided to avoid siltation of any temporary catch basins. In general, ponding of water should be avoided adjacent to pavements. Protective measures to mitigate excessive site erosion and runoff during construction should also be implemented in accordance with the local grading ordinances.

4.6 Preliminary Pavement Design Parameters

In order to provide the following preliminary recommendations, we have assumed an R-value of 35 for preliminary design purposes. These recommendations are intended for planning purposes only and should not supersede minimum City or County requirements. For the final pavement design, appropriate traffic indices should be selected by the project civil engineer or traffic engineering consultant and representative samples of actual subgrade materials should be tested for R-value.

Table 2. Preliminary Pavement Design

Traffic Index	***AC Pavement Section Thickness***	
	Asphaltic-Concrete (AC) Thickness (inches)	Aggregate Base (AB) Thickness (inches)
5.5 to 6	3.5	6
6.5 to 7	4.0	7

The subgrade soils in the upper 6 inches and aggregate base should be properly compacted to at least 95 percent relative compaction (ASTM D1557). Base rock should conform to the "Standard Specifications for Public Works Construction" (green book) current edition or Caltrans Class 2 aggregate base having a minimum R-value of 78. Asphaltic concrete should be placed on compacted aggregate base and compacted to a minimum 95 percent relative compaction based on the laboratory standards ASTM D1561 and D2726.

The preliminary pavement sections provided in this section are meant as minimum, if thinner or highly variable pavement sections are constructed, increased maintenance and repair may be needed.

5.0 GEOTECHNICAL REVIEW

Geotechnical review is of paramount importance in engineering practice. Poor performances of many foundation and earthwork projects have been attributed to inadequate construction review. We recommend that Leighton be provided the opportunity to review the grading plan(s). Geotechnical exploration and analysis may be required based on final rough grade/development plans.

Reasonably-continuous construction observation and review during site grading and foundation installation allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction. Geotechnical conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction, and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site demolition and clearing,
- During preparation and overexcavation of surface soils as described herein,
- During compaction of all fill materials,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

Additional geotechnical exploration and analysis may be required based on final rough grade/development plans.

6.0 LIMITATIONS

This report was necessarily based in part upon data obtained from a limited number of observances, site visits, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is necessarily incomplete. The nature of many sites is such that differing characteristics can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time. This investigation was performed with the understanding that the subject site is proposed for residential development only.

This report was prepared for Pulte/BP Murrieta Hills, LLC based on Pulte/BP Murrieta Hills, LLC's needs, directions, and requirements. This report is not authorized for use by, and is not to be relied upon by any party except Pulte/BP Murrieta Hills, LLC and its successors and assigns as owner of the property, with whom Leighton and Associates, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton and Associates, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton and Associates, Inc.

The client is referred to Appendix B regarding important information provided by the Associated Soil and Foundation Engineers (ASFE) on geotechnical engineering studies and reports and their applicability.

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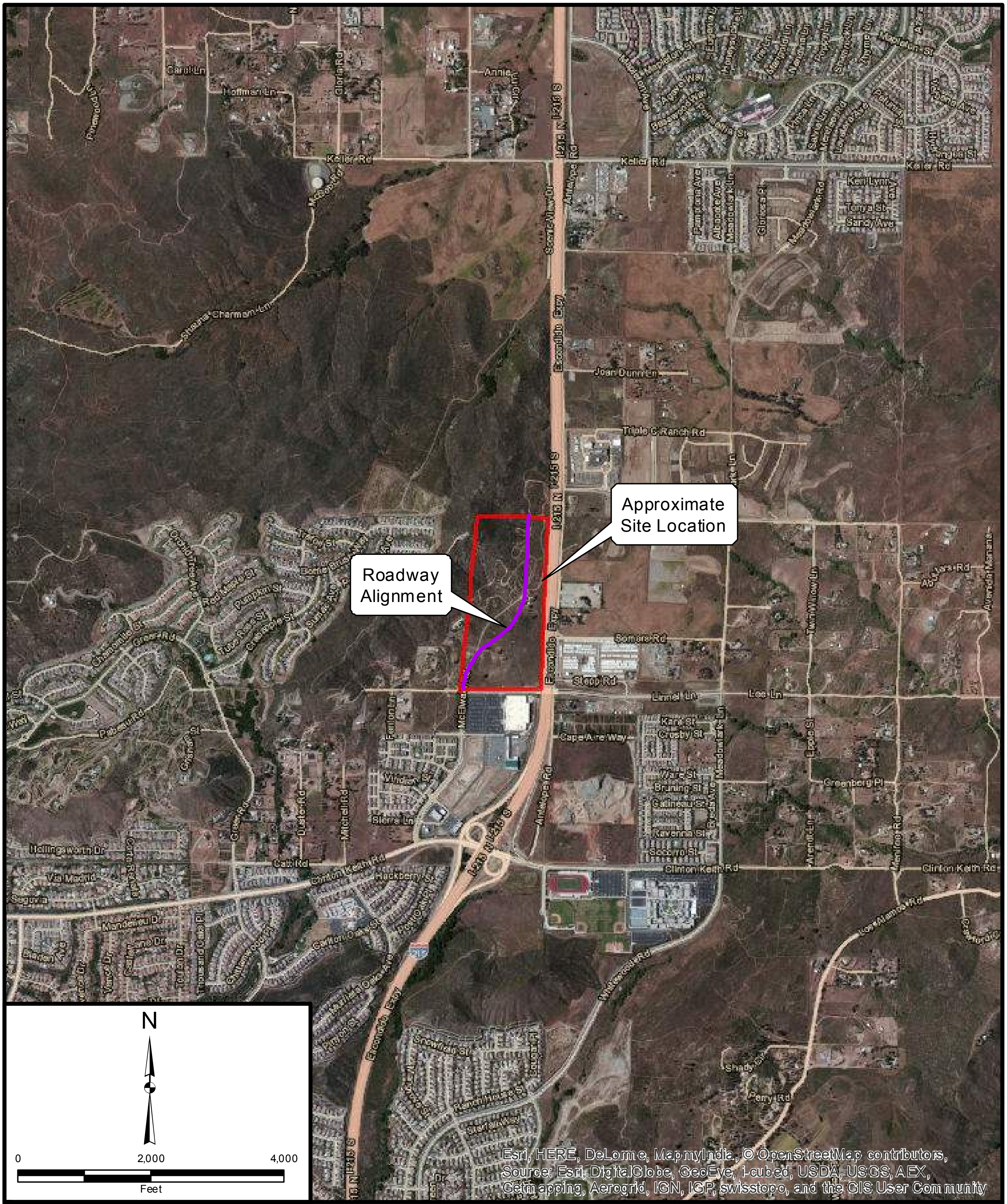

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Project: 10642.003	Eng/Geol: SIS/RFR
Scale: 1 " = 2,000 '	Date: October 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton
Author: Leighton Geomatics (cgiovando)

SITE LOCATION MAP

Murrieta Hills
McElwain Road Alignment
Murrieta, California

Figure 1

Leighton

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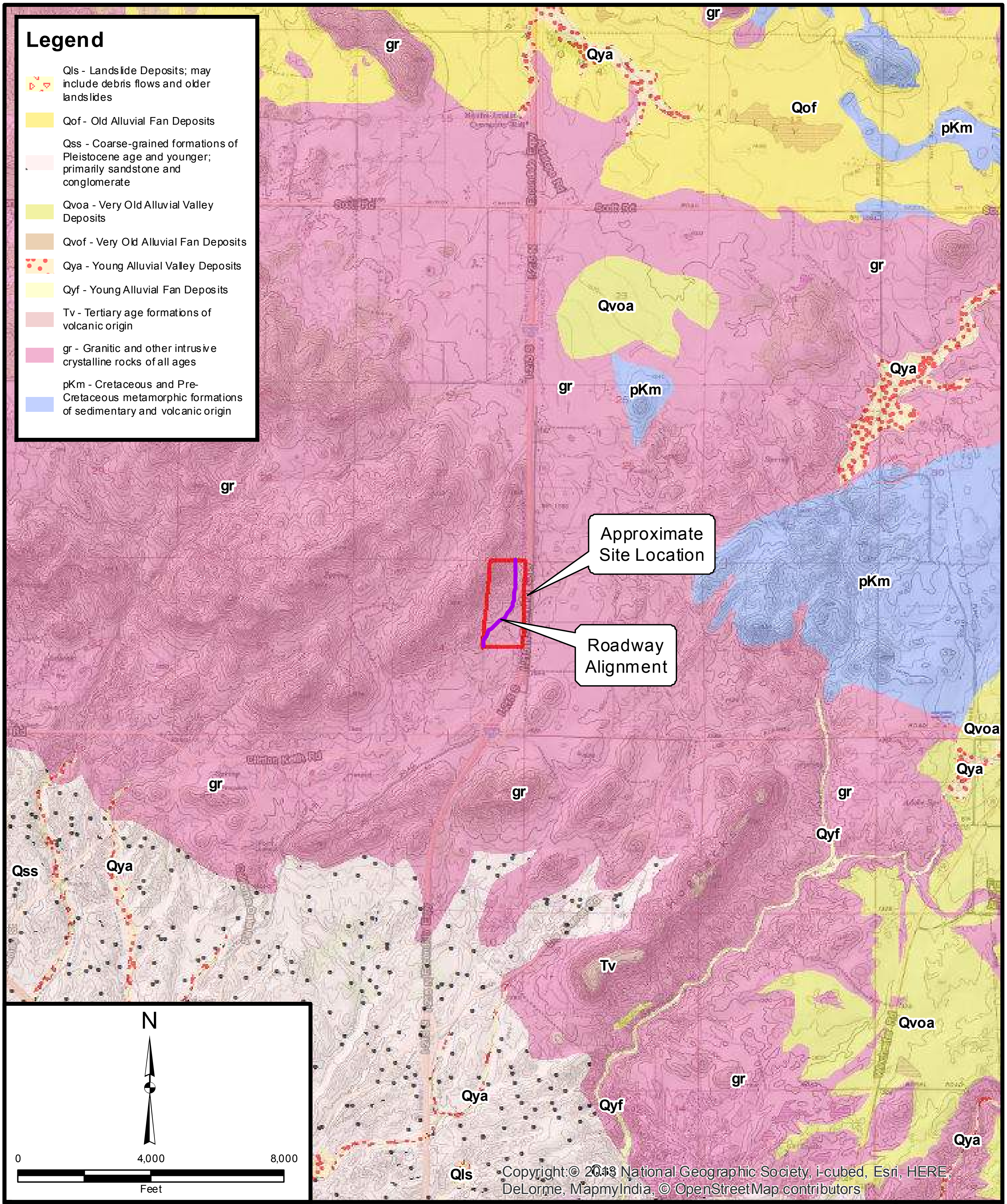

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Project: 10642.003

Eng/Geol: SIS/RFR

Scale: 1 " = 4,000 '

Date: October 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton
Author: Leighton Geomatics (cgiovando)

REGIONAL GEOLOGIC MAP

Murrieta Hills
McElwain Road Alignment
Murrieta, California

Figure 2

Leighton

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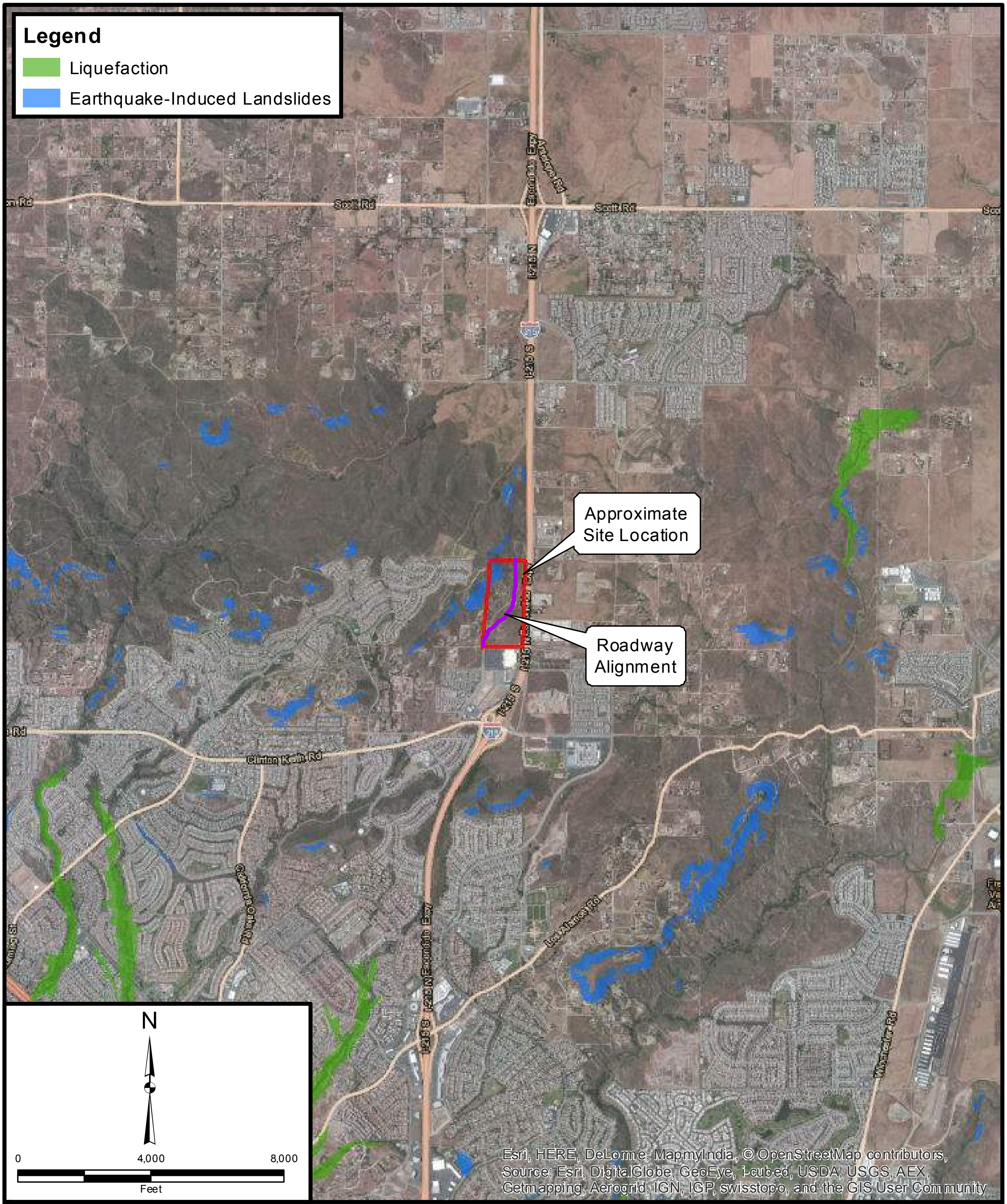

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Scale: 1 " = 4,000 '	Date: October 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton, CGS 2007
Author: Leighton Geomatics (cgiovando)

SEISMIC HAZARD ZONES

Murrieta Hills
McElwain Road Alignment
Murrieta, California

Figure 3

Leighton

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Scale: 1 " = 100 feet	Date: October 2014

Base Map: ESRI ArcGIS Online 2014
Thematic Information: Leighton
Author: Leighton Geomatics (cgiovando)

SITE GEOLOGIC MAP

Murrieta Hills
McElwain Road Alignment
Murrieta, California

Plate 1

Leighton

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APPENDIX A

General Earthwork and Grading Specifications

LEIGHTON AND ASSOCIATES, INC.
GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

TABLE OF CONTENTS

Standard Details

1.0 General

1.1 Intent

These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record

Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor

The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing

Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing

Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation

In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The Contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General

Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

3.2 Oversize

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import

If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers

Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557).

4.3 Compaction of Fill

After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes

In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557.

4.5 Compaction Testing

Field-tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing

Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations

The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety

The Contractor shall follow all OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of relative compaction from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

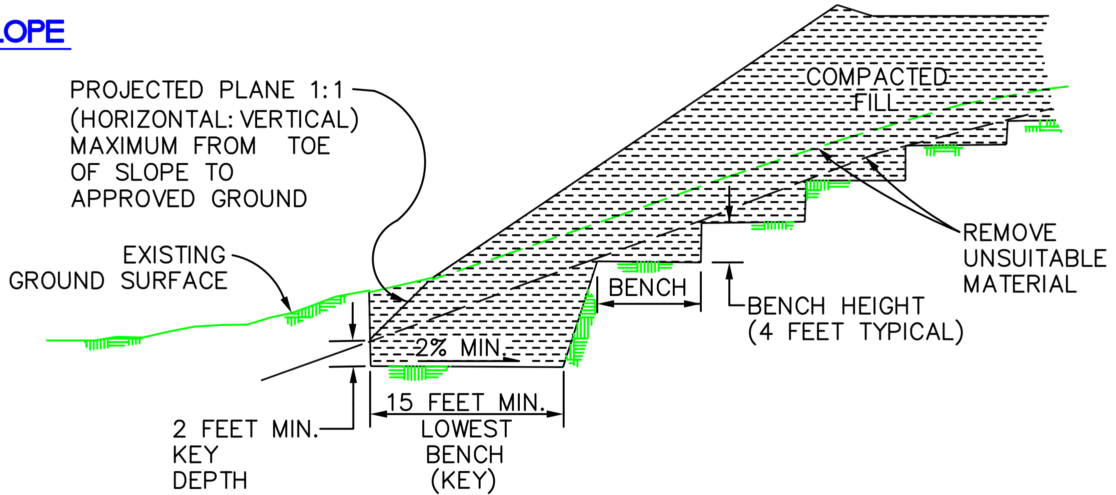
7.3 Lift Thickness

Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

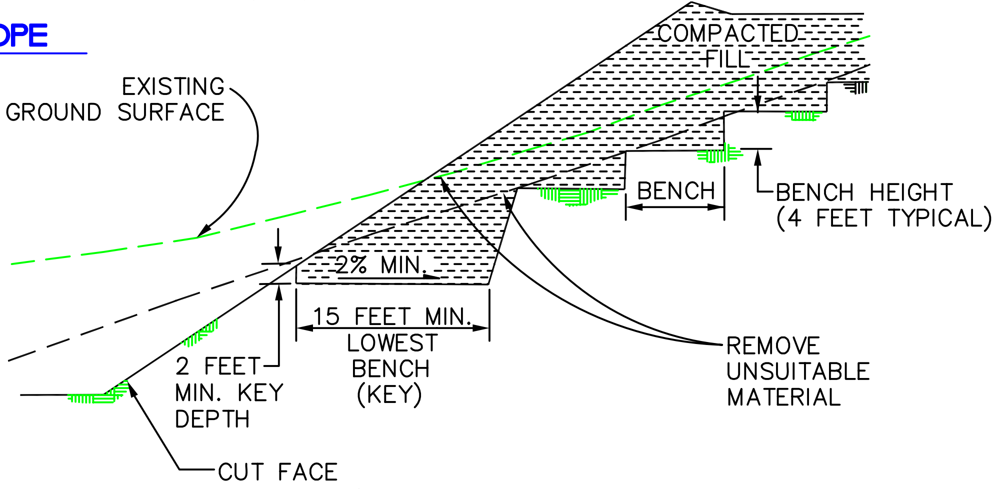
7.4 Observation and Testing

The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

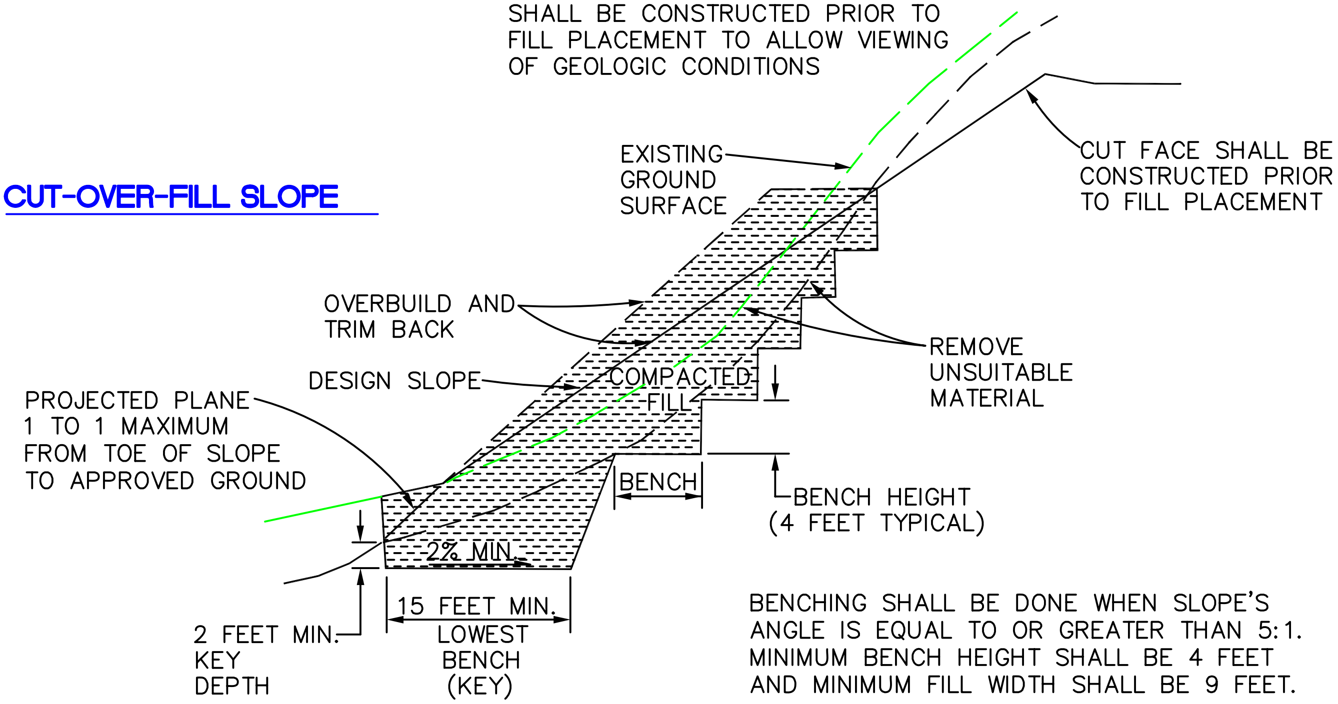
FILL SLOPE



FILL-OVER-CUT SLOPE



CUT-OVER-FILL SLOPE

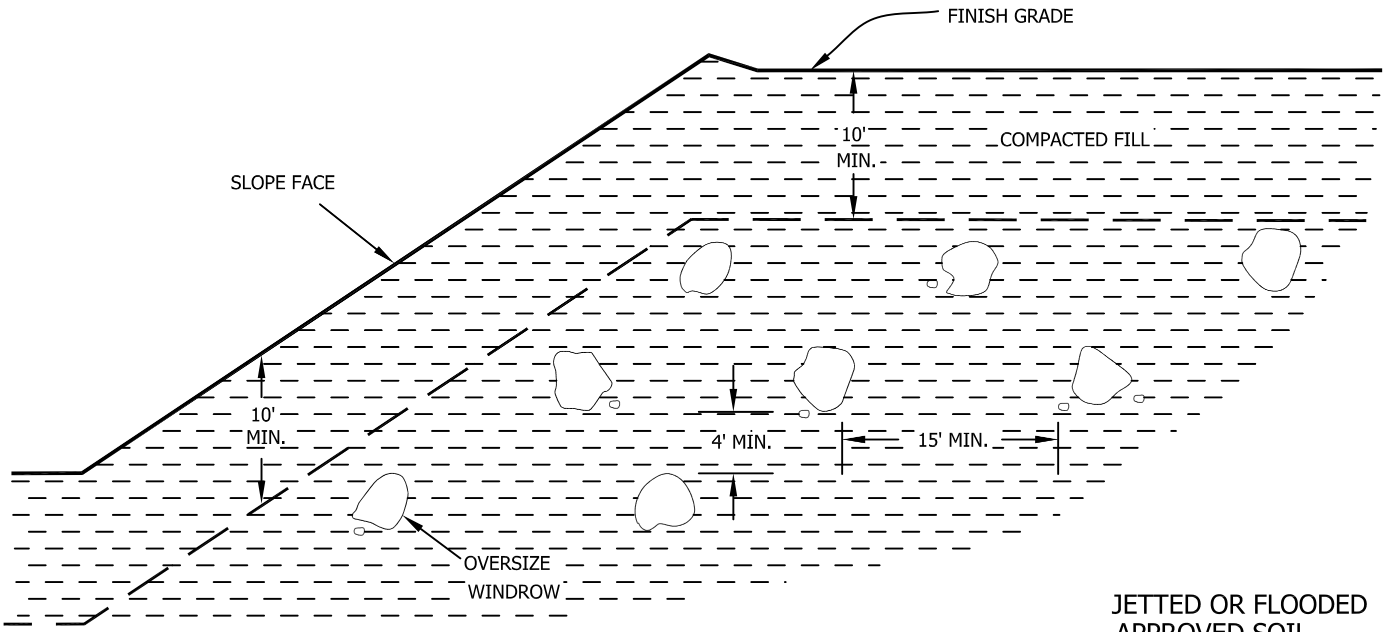


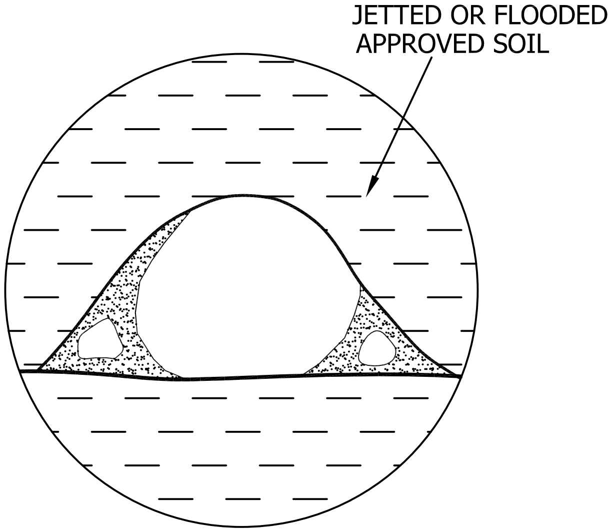
BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS A

Leighton

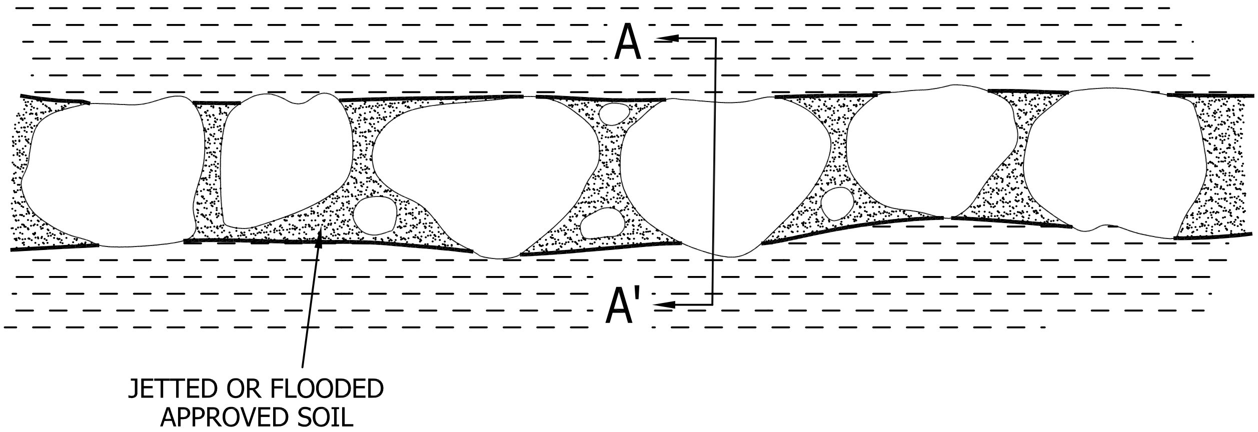




SECTION A-A'

- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.

PROFILE ALONG WINDROW



OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS B

Leighton

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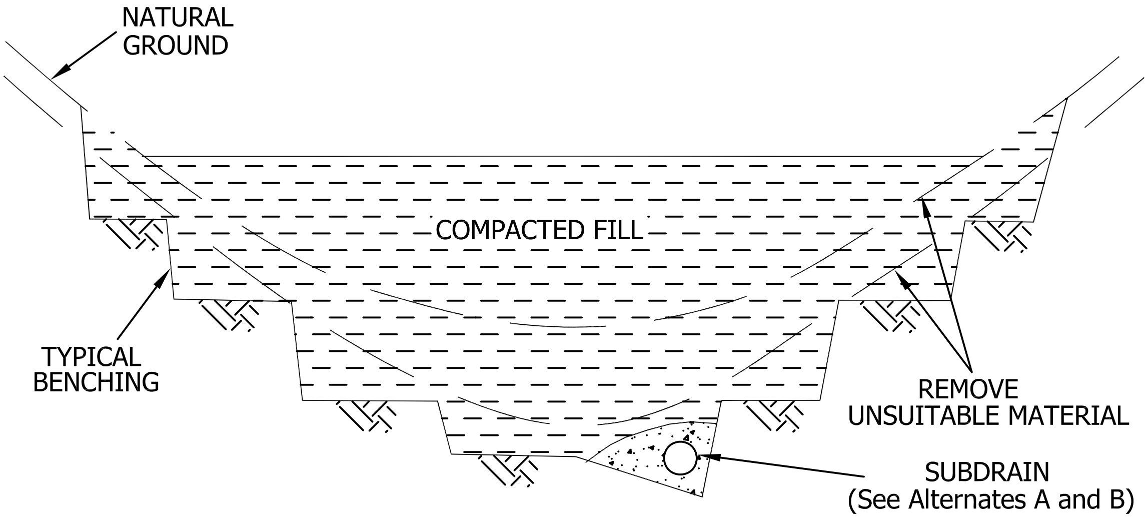
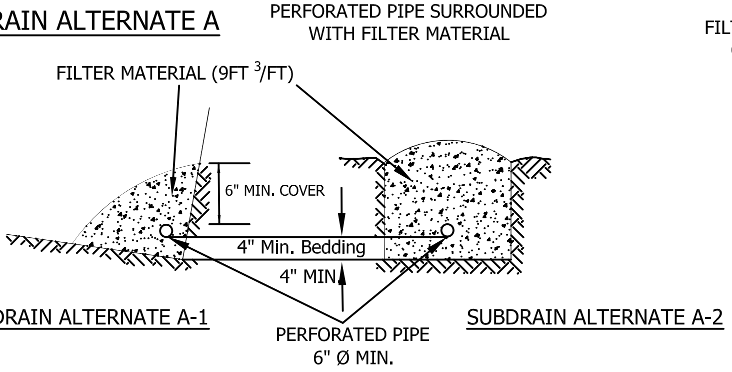


SUBDRAIN ALTERNATE A

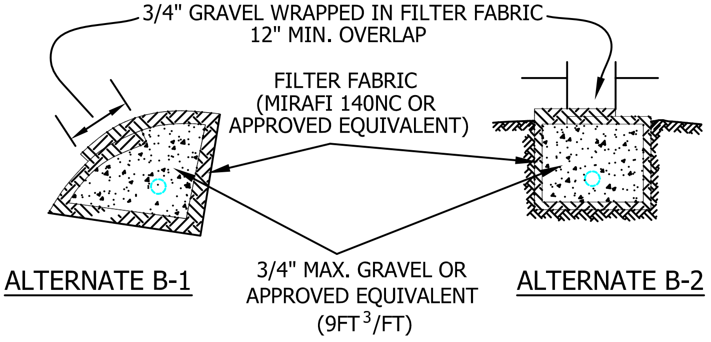


FILTER MATERIAL

FILTER MATERIAL SHALL BE CLASS 2 PERMEABLE MATERIAL PER STATE OF CALIFORNIA STANDARD SPECIFICATION, OR APPROVED ALTERNATE. CLASS 2 GRADING AS FOLLOWS:

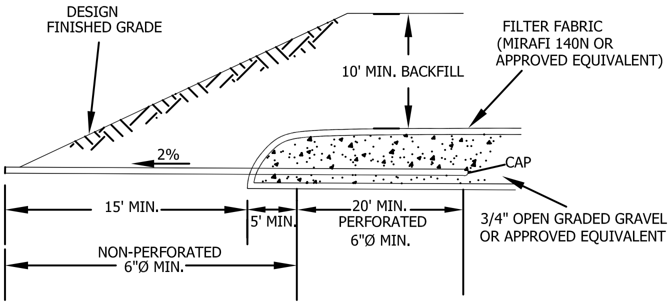
Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

SUBDRAIN ALTERNATE B



○ PERFORATED PIPE IS OPTIONAL PER GOVERNING AGENCY'S REQUIREMENTS

DETAIL OF CANYON SUBDRAIN TERMINAL



CANYON
SUBDRAIN

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS C

Leighton

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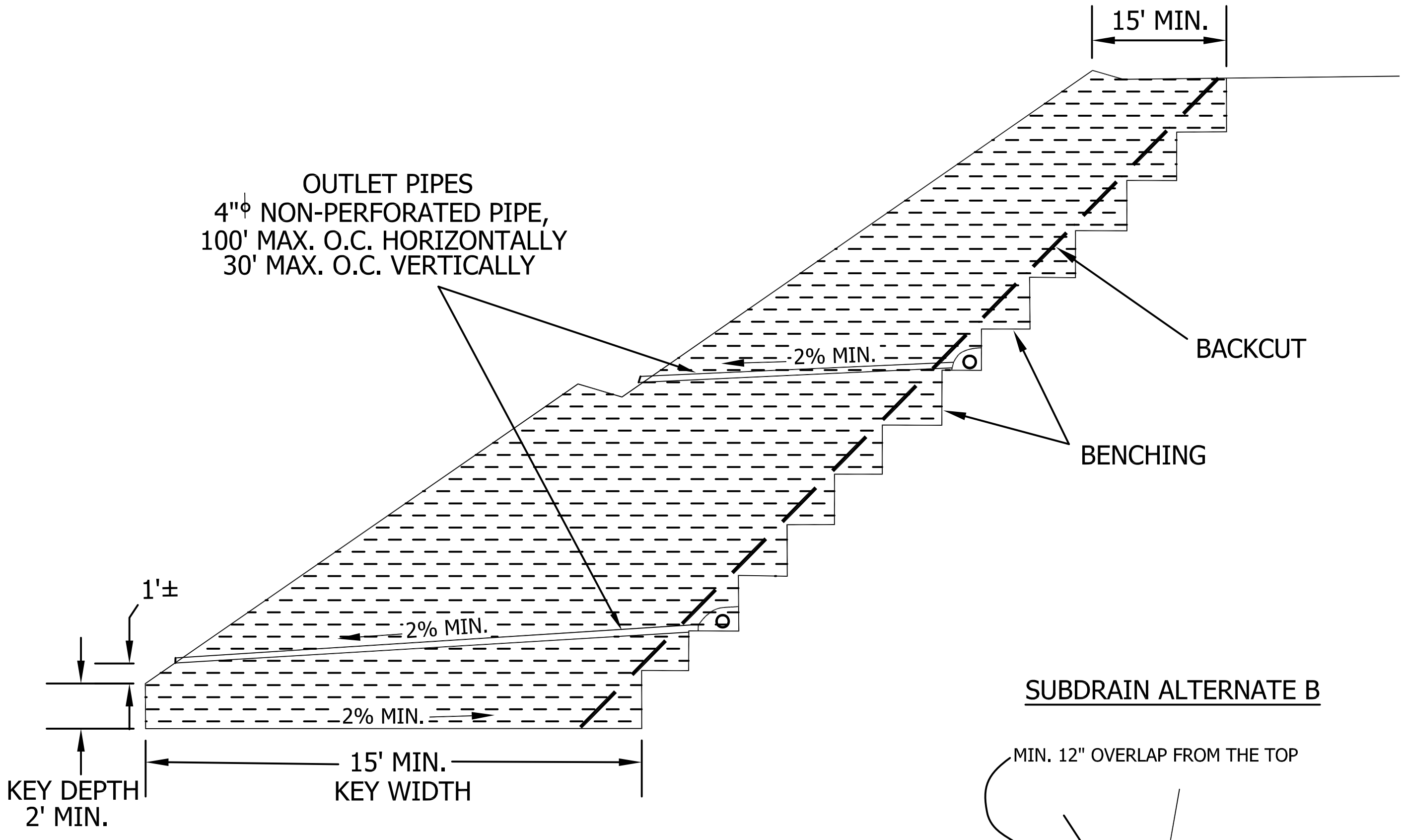
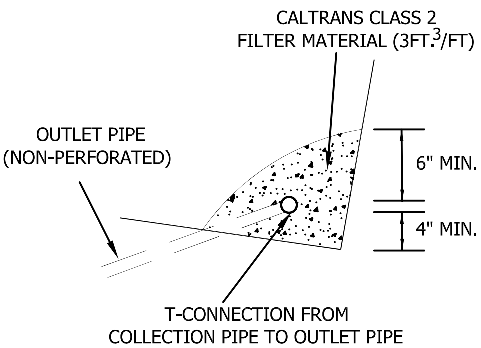
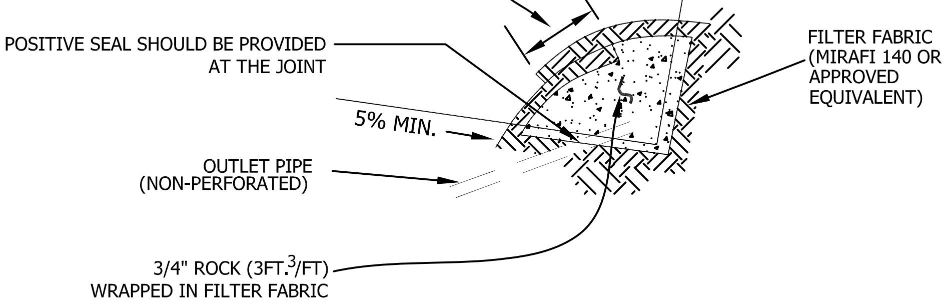


SUBDRAIN ALTERNATE A



SUBDRAIN ALTERNATE B



- SUBDRAIN INSTALLATION - Subdrain collector pipe shall be installed with perforations down or, unless otherwise designated by the geotechnical consultant. Outlet pipes shall be non-perforated pipe. The subdrain pipe shall have at least 8 perforations uniformly spaced per foot. Perforation shall be 1/4" to 1/2" if drilled holes are used. All subdrain pipes shall have a gradient at least 2% towards the outlet.
- SUBDRAIN PIPE - Subdrain pipe shall be ASTM D2751, ASTM D1527 (Schedule 40) or SDR 23.5 ABS pipe or ASTM D3034 (Schedule 40) or SDR 23.5 PVC pipe.
- All outlet pipe shall be placed in a trench and, after fill is placed above it, rodded to verify integrity.

BUTTRESS OR
REPLACEMENT FILL
SUBDRAINS

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS D

Leighton

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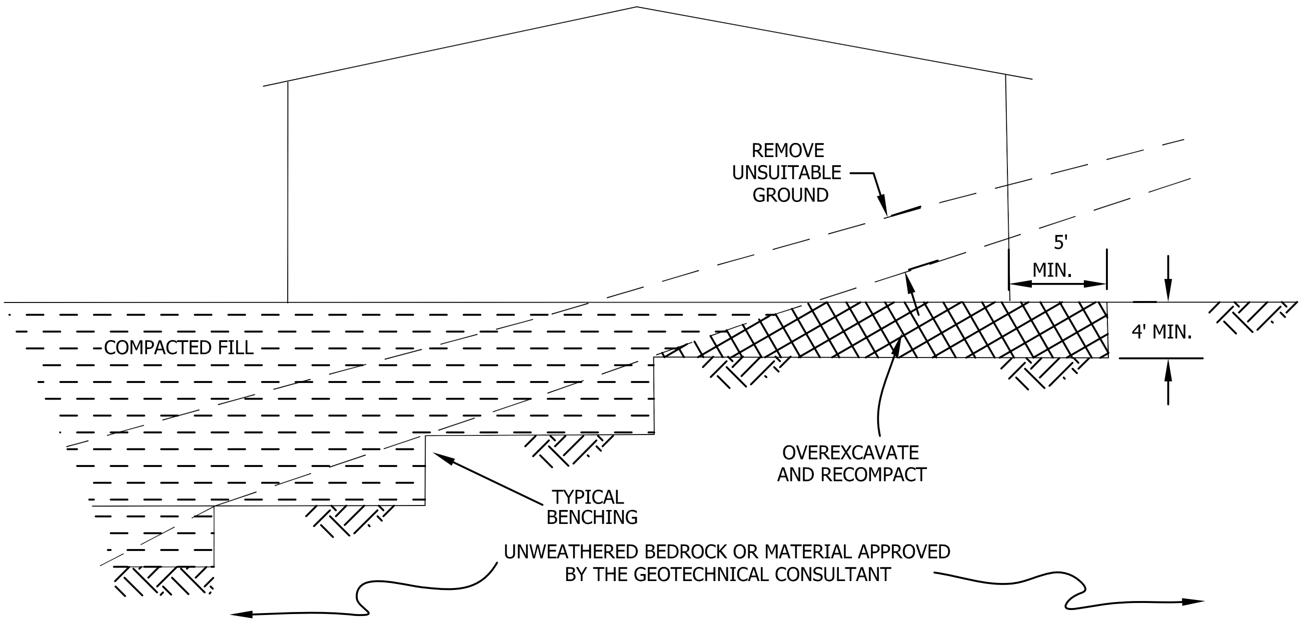
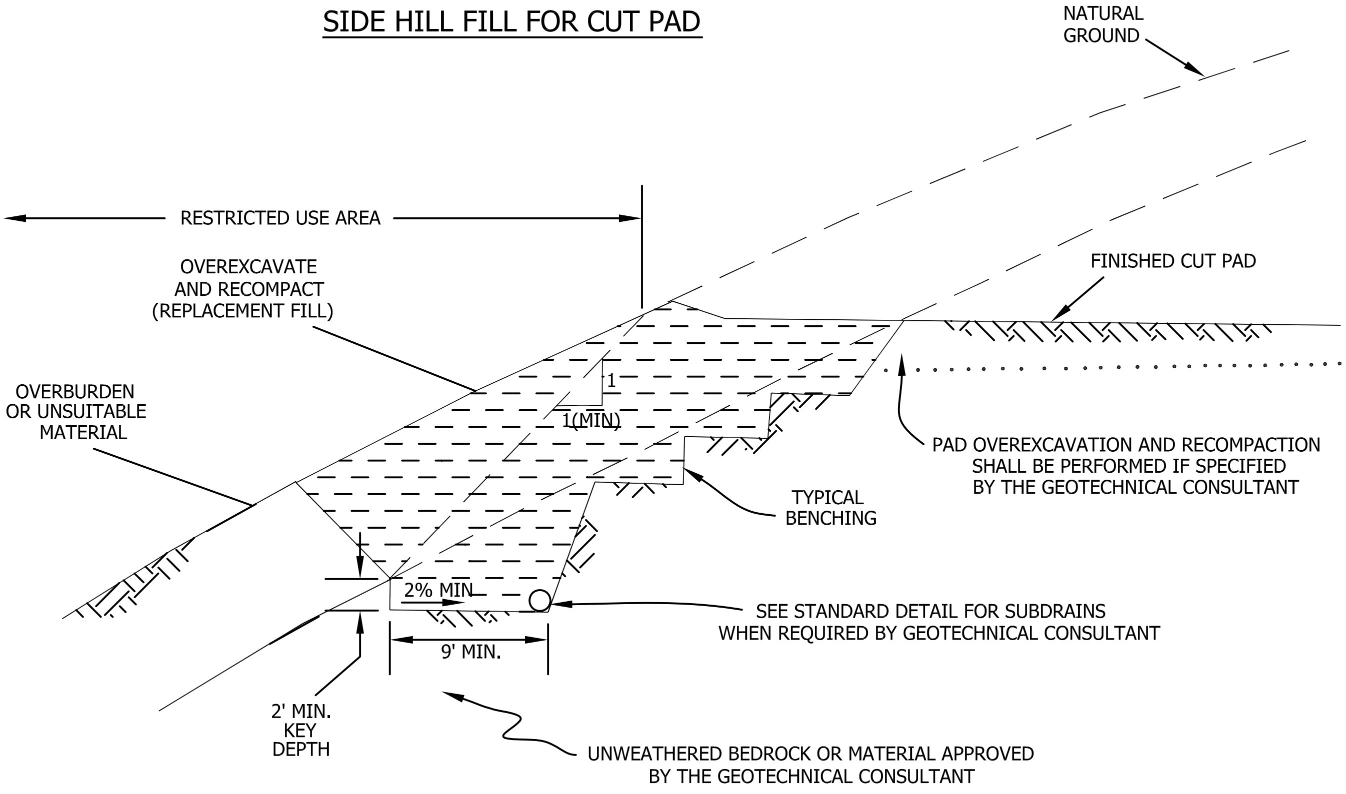
CUT-FILL TRANSITION LOT OVEREXCAVATION



SIDE HILL FILL FOR CUT PAD



TRANSITION LOT FILLS
AND SIDE HILL FILLS

GENERAL EARTHWORK AND GRADING
SPECIFICATIONS
STANDARD DETAILS E

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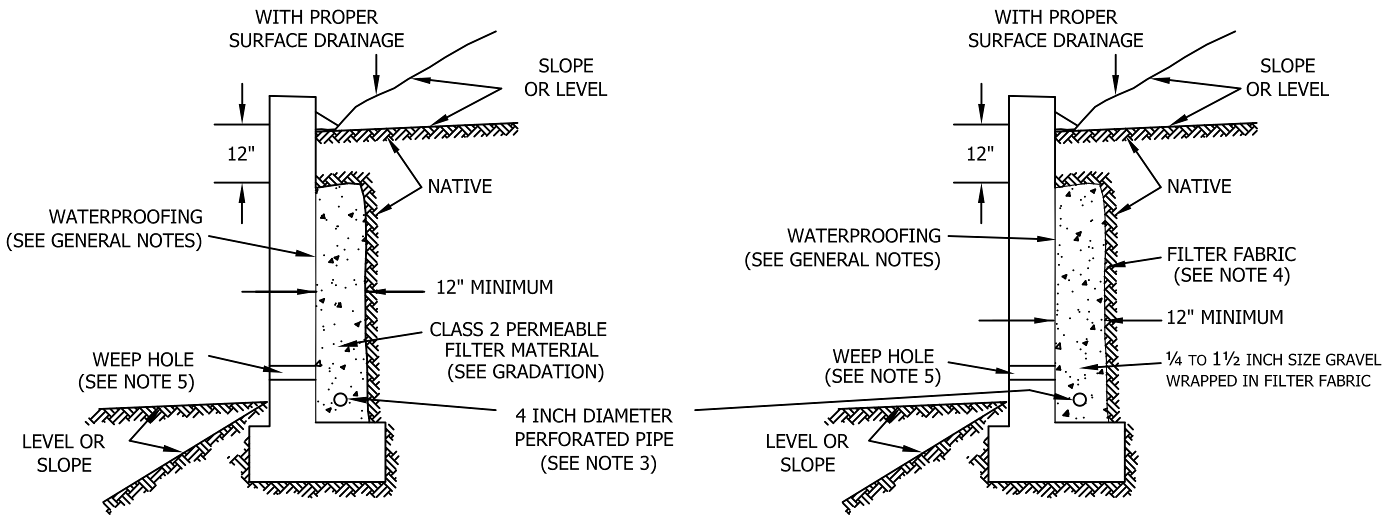
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL

OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:

1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

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Figure

APPENDIX B

ASFE, Information Regarding Geotechnical Engineering

Important Information About Your

Geotechnical Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

The following information is provided to help you manage your risks.

Geotechnical Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared *solely* for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. *And no one — not even you* — should apply the report for any purpose or project except the one originally contemplated.

Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

A Geotechnical Engineering Report Is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes—even minor ones—and request an assessment of their impact. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. *Do not rely on a geotechnical engineering report* whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. *Always* contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ—sometimes significantly—from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are *Not* Final

Do not overrely on the construction recommendations included in your report. *Those recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.*

A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure contractors have sufficient time* to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their reports. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely.* Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a *geoenvironmental* study differ significantly from those used to perform a *geotechnical* study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated environmental problems have led to numerous project failures.* If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, a number of mold prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; ***none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.***

Rely, on Your ASFE-Member Geotechncial Engineer for Additional Assistance

Membership in ASFE/The Best People on Earth exposes geotechnical engineers to a wide array of risk management techniques that can be of genuine benefit for everyone involved with a construction project. Confer with you ASFE-member geotechnical engineer for more information.

ASFE
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