
GSI Water Solutions, Inc., "Middle Canyon Spring Hydrogeologic Assessment and Impact Evaluation Report" (September 2007)

Middle Canyon Spring Hydrogeologic Assessment and Impact Evaluation Report

Prepared for:
Newhall Land and Farming Company

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Middle Canyon Spring Hydrogeologic Assessment and Impact Evaluation Report

A report prepared for:

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1 Introduction

This report presents the results of a hydrogeological assessment of Middle Canyon Spring performed for Newhall Land and Farming Company (Newhall). The objectives of the study were to: (1) characterize the source of water contributing to the spring in Middle Canyon, (2) evaluate the potential impact of planned development in the area on the spring flow (including the bridge, road, and development within Middle Canyon), and (3) provide recommendations for mitigating impacts to the spring, if there is potential for the spring flow to be adversely affected by the development. The spring area supports special-status plant and animal communities that include a previously undescribed sunflower species and an undescribed spring snail species. Conservation of these special-status plant and animal communities within the spring area is a high priority for Newhall.

The locations of the spring and Middle Canyon watershed are shown in Figure 1. Newhall intends to develop Middle Canyon and the surrounding area into residential and commercial uses. The development is commonly referred to as Mission Village, which is located within the boundary of the approved Newhall Ranch Specific Plan in unincorporated Los Angeles County.

This report presents the following:

- The methodology and approach for the study (Section 1.1)
- Historical land uses in Middle Canyon (Section 1.2)
- The geologic and hydrogeologic setting (Section 2)
- A summary (conceptual model) of the source of water to the spring (Section 3)
- An evaluation of the short-term (construction) and longer-term potential impacts of the project on the spring flow and habitat (Section 4)
- Proposed mitigation measures (Section 5)
- Conclusions (Section 6)
- References cited in this report (Section 7)

1.1 Study Methodology and Approach

The first step in this evaluation was to characterize the geology in the area to understand how the natural plumbing system to the spring works. Available published and unpublished information were used in the study. Boring logs and groundwater level data from previous geotechnical investigations performed in the canyon by Allan E. Seward Engineering Geology, Inc., were used. In addition, a drilling program was conducted during the spring of 2007 to better understand the hydrogeology in the spring area. The drilling program consisted of continuous coring of two rotosonic borings near the spring (borings CH-1 & CH-2); drilling 10 hollow-stem-auger borings down the axis of the canyon (HS-1MC through HS-10MC), and installing four new piezometers (P-1MS [at CH-1], P-2MS, P-3MC [at HS-3MC], and P-8MC [at HS-8MC]). A water level monitoring program began in the new monitoring wells, and in older wells. The data provided by the new core holes and monitoring wells allowed us to characterize stratigraphic controls on groundwater movement near the spring, understand the relationship between groundwater levels and spring flow, and monitor groundwater levels before development, during construction, and after development occurs. Subsurface information was interpreted, and geologic cross sections were constructed, to illustrate stratigraphic and structural controls on the direction and movement of shallow groundwater near the spring. Regional hydrogeologic data from other Saugus Formation wells in the area were used to assess whether the spring is being fed by a deeper bedrock flow system outside the limits of the watershed or from a more localized shallow perched zone.

Historical aerial photographs and maps were reviewed to assess how long the spring has been at its present location and whether there is any evidence that the size of the spring area has increased as a result of Newhall irrigation practices in the canyon. The Newhall farm operations staff was interviewed for information about how much irrigation and fertilizer application have occurred in the past within the watershed.

Water samples were collected from the spring, shallow alluvial groundwater (piezometer P-8B), and a nearby deep Saugus Formation irrigation well (Well #156) and tested for general cations and anions to assist in differentiating the source(s) of water contributing to the spring. Water quality and hydrogeologic information were used to develop a hydrogeologic conceptual model of the spring and the source of water to the spring.

To assess how the spring might be affected by development in and around the canyon, a pre- and post-development water budget was developed to assess how construction of impervious surfaces, construction of stormwater management systems, and importation of potable and non-potable water supplies for irrigation of landscaped areas might affect the amount of groundwater recharge that will occur post-development. The pre-development and post-development water budgets then were compared to estimate the post-development change in groundwater recharge and, potentially, spring flow. An increase or decrease of more than 1 percent in the watershed groundwater recharge is assumed to constitute a potentially significant impact to the spring flow and, subsequently, to the sensitive plant and animal communities present in the spring area.

1.2 Historical Land Uses

The earliest historical aerial photographs and maps covering the Middle Canyon area show vegetation that is indicative of a spring at this location as early as 1928, before agricultural activities and irrigation began in this area. The clearest of the early photos, taken in 1930 and displayed in Figure 2, shows evidence of a spring at this location.[1] Beginning in the early 1900s, oil exploration and development occurred in the higher elevations within the watershed. The canyon area is undeveloped and historically has been used for livestock grazing and for growing alfalfa. Irrigated areas in the canyon are shown in Figure 3 and receive their water from a deep Saugus Formation well (Well #156) located in Middle Canyon, about ¼ mile east-southeast of the spring (at the

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[1] The boundaries of the spring were not specifically called out on the original topographic map that was prepared by the USGS at that time. The spring outline shown in Figure 2 is based on field surveys conducted in 2007 by DUDEK to support the present analysis.

northwest end of the 2.4-acre irrigated area shown in Figure 3). Irrigation of this land began in 1995.

2 *Geologic and Hydrogeologic Setting*

This section presents a discussion of the geologic units and structures, the geologic evolution of the canyon, and the general geologic conditions in the canyon that affect how groundwater migrates to the spring. Also presented is a discussion of groundwater level and water quality data as they relate to the source of water to the spring. Accompanying these discussions are the following figures and appendix materials:

- Figure 4 presents a geologic map of the area near the spring.

- Figure 5 and Figure 6 are geologic cross sections in this same localized area.

- Appendix A contains geologic logs for the boreholes that were installed during the 2007 drilling program and pertinent logs from previous geotechnical investigations.

- Appendix B contains an expanded geologic map for the lower half of Middle Canyon, showing the locations of borehole logs and cross sections.

- Appendix B also contains cross sections that lie along, and perpendicular to, the central axis of Middle Canyon in the lower half of the canyon – showing the geology, the existing ground profile, and the proposed final grades after development. The cross sections are shown together on a large plate (to facilitate the comparison of these features from one section to another) and also on separate pages (for easier viewing of individual sections).

- Appendix C contains water level data for piezometers in Middle Canyon, plus hydrographs from automatic-recording pressure transducers that were installed in mid-June 2007 at three shallow piezometers located near the spring (P-1MS, P-2MS, and P-8B).

2.1 Geologic Units and Structure

The two principal geologic units in Middle Canyon are the surficial alluvial deposits of Quaternary age, including terrace deposits and landslide and slopewash (colluvium) materials; and the underlying Plio-Pleistocene Saugus Formation, which forms the bedrock material underlying the Middle Canyon area. The surficial outcrops of these units are shown in Figure 4, which is a geologic map of the lower portion of Middle Canyon. Following are summaries of the composition of these units, plus the geologic structure in the area.

2.1.1 Saugus Formation

The Saugus Formation is of continental (nonmarine) origin and consists of interbedded sandstone, conglomerate, siltstone, and mudstone that were deposited in a fluvial (river) environment. Geologic mapping in and around Middle Canyon shows that the Saugus Formation has distinctive upper (younger) and lower (older) members as follows:

- **Saugus upper member.** The upper member of the Saugus Formation is relatively permeable, consisting predominantly of coarse-grained, permeable sandstone and conglomerate that is poorly cemented and slightly friable, with only localized interbeds of silty sandstone, siltstone, and mudstone. This unit is exposed at the ground surface along the south and southwest side of Middle Canyon, including at the spring, and it also underlies the alluvium south of the “Saddle Lineament” fault zone (see Figure 4).
- **Saugus lower member.** The lower member bedrock underlying Airport Mesa on the northeast side of Middle Canyon (and north of the “Saddle Lineament” fault zone) is older and more consolidated than the younger upper Saugus Formation. The lower member is composed of interbedded sandstone, pebbly sandstone, mudstone, and siltstone.

2.1.2 Alluvium and Other Surficial Deposits

In Middle Canyon, the Saugus Formation is covered by incised, older alluvium to depths of as much as 50 feet. This alluvium generally consists of interbedded sand, silty sand, silt, and clay with gravelly units more common below 30 feet. Additionally, soil and colluvial deposits (soils and eroded Saugus Formation material originating from upslope) mantle the slopes adjacent to Middle Canyon. These deposits typically consist of silty to slightly clayey sand and gravelly sand. Three borings near the spring (B-72E, CH-1, and CH-2) and an exploratory trench located south of the spring provide evidence for a 10- to 15-foot-thick mantle of colluvium or debris flow deposits on the slope adjacent to the spring. Borings in the lower portion of the canyon (HS-1MC, HS-2MC, HS-3MC, and HS-4MC) also show, from south to north, a progressively thickening layer of fine-grained materials in the alluvium, with little sand or other coarse-grained material in the borings closest to the mouth of the canyon.

2.1.3 Geologic Structure

The bedding on the south side of the canyon strikes roughly N65W to N70W and dips 25° to 30° to the northeast. The exact orientation is difficult to determine because of the observed presence of cross bedding and channeling within the coarse-grained beds. Bedding on the north side of the canyon strikes roughly east to west and dips steeply (typically 50° to 70°) to the south. The observed change in structure underlying the lower end of Middle Canyon is interpreted to be a faulted syncline, referred to informally as the “Saddle Lineament,” based on geologic logging of trenches and borings to the east. This fault zone dips steeply to the north and is interpreted to have a reverse sense of movement, placing older Saugus Formation over younger Saugus Formation. Evidence for significant late Quaternary activity along the fault (more than 40 feet of vertical displacement) was observed in Terrace Deposits tentatively considered to be 100,000 years old. No evidence of fault movement in the Saugus Formation or the alluvium during the last 11,000 years was found, but this possibility was not precluded. Air photos do not show any lineaments in the alluvial deposits in this area, which indicates that the Saddle Lineament fault zone probably does not offset the alluvium in Middle Canyon.

2.2 Middle Canyon Geologic History

The data collected during this study have been used, along with the regional-scale geologic understanding of the Santa Clarita Valley, to develop a conceptual model of the geologic history and development of Middle Canyon. The resulting conceptual model identifies the following stages in the canyon's development: deposition and uplift of the Saugus Formation; erosion that subsequently formed Middle Canyon; further deposition, including landslides; secondary erosion and down-cutting that continued the development of the features that are observed today, including the spring. This conceptual model of the canyon's development has been prepared to provide context for interpretations (presented later in this report) of groundwater occurrence and groundwater flow patterns in the lower portion of the canyon, which in turn relate to the understanding of the hydrology of the spring.

- **Deposition and Tectonic Uplift of Saugus Formation.** The sediments forming the Saugus Formation were deposited in a fluvial environment during late-Pliocene to Pleistocene times (approximately 700,000 to 2 million years ago). During and after deposition, these sediments then were subjected to significant compression, tilting, and folding. This process uplifted the Saugus Formation sediments as a whole while also producing a synclinal structure that traverses the present-day mouth of Middle Canyon. Faults developed as part of this process, including along the Saddle Lineament where older Saugus Formation on the north side of the lineament was up-lifted against younger Saugus Formation on the south side of the lineament.

- **Erosion.** The uplifted Saugus Formation then was eroded by the ancestral Santa Clara River, and fluvial sediments were deposited at various stages of down cutting. This erosion was accompanied by continued uplifting, which further developed the topography of Middle Canyon and other nearby canyons. The upper portion of Middle Canyon was eroded into a narrow channel, while the canyon bottom gradually widened in the lower portion of the canyon. Coarse-grained pervious beds of the upper Saugus Formation were exposed on the southwest side of Middle Canyon. The orientation of the lower end of the canyon was largely controlled by the northwest-trending strike of the Saugus Formation bedding up canyon of the Saddle Lineament. The upper portion of the canyon generally cuts obliquely across the bedding strike.

- **Deposition and Landslides.** Coarse-grained alluvium was deposited in much of the canyon, indicating that high-energy water flow was occurring – probably as a result of greater rainfall than occurs today. Some of the coarse-grained alluvium was deposited above and/or adjacent to the Saugus Formation, juxtaposing coarse-grained alluvium with coarse-grained upper Saugus beds along the southern and southwestern flanks of the canyon (south of the Saddle Lineament). Additionally, because erosion locally undercut weak bedding planes that dip toward the canyon, slope failures have occurred in the past in some areas. Fine-grained (lean clay) alluvium also was deposited near the mouth of Middle Canyon during this time.

- **Secondary Down-Cutting.** The presence today of a 20-foot-high bench at the mouth of Middle Canyon indicates that the Santa Clara River truncated the oldest alluvial materials at the lower end of the canyon. Down-cutting by the river likely occurred because of continued tectonic uplift and also because the river's base level continued fluctuating in response to changes in sea level. A channel has incised the older alluvium in Middle Canyon in response to the decrease in the elevation of the Santa Clara River.

Historic aerial photographs indicate the presence of dense vegetation in essentially the same position as the current limit of phreatophytes, indicating that the spring is not a new feature. The spring likely developed as a result of the latter two stages of the canyon's evolution (deposition and landslides, followed by secondary down-cutting). The hydrogeology of the spring is discussed further in Sections 2.3, 2.4, and 3 of this report.

2.3 Local Geologic Conditions at the Spring Site

Based on groundwater elevation data in the lower portion of Middle Canyon (at piezometers P-1MS, P-2MS, P-6B, P-7B, and P-8B), groundwater levels are sufficiently high that springs would be expected to be present in the lower canyon, along the incised channel and bank of the existing creek and also along the slope face at the lower (northern) end of the canyon. However, no seeps or springs are observed in this area. Instead, the only such feature (the spring area that is the subject of this report) is located at the northwest corner of the canyon, in a direction that is cross-gradient from the main axis of the center of the canyon. The geologic explanations of these observed conditions at and near the spring are discussed below for the Saugus Formation and the alluvium.

2.3.1 Saugus Formation

Mapping of rock exposures along the existing access road and an examination of available geologic data from nearby trenches and borings have provided information on the subsurface stratigraphy near the spring and in the lower portion of Middle Canyon. This work has indicated that the Saugus Formation contains a coarse-grained section of poorly cemented and permeable sandstone and pebbly to cobbly sandstone that daylights at the spring area. To the south of the spring, this unit extends along the southwestern side of Middle Canyon and from there extends under the alluvium up-canyon to the southeast (see Figure 5 and Figure 6). As discussed later in this report (Section 2.4 and Section 3), data collection and geologic analyses indicate this upper permeable Saugus Formation bed is the likely conduit for groundwater seepage at the spring area.

In a road cut exposure of the Saugus Formation on the south side of the spring, a relatively fine-grained interbed is present below the upper permeable Saugus Formation bed. This bed can be correlated with a silt bed in the Saugus Formation that was observed at a depth of 41 feet in rotosonic boring CH-1, located immediately adjacent to the spring. Additionally, Saugus Formation mudstone beds were identified in this same boring at depths of 67 feet and 70 feet. The mudstone beds likely form perching layers that prevent shallow Saugus groundwater from infiltrating deeper down-section into the formation. Additionally, the mudstone beds likely are folded and/or cut by faulting down-dip to the north, along the Saddle Lineament fault zone, which traverses the northern portion of the spring area at depth. At the fault zone, three characteristics create a “barrier” that likely prevents Saugus Formation groundwater from migrating down-section into the deeper portions of the Saugus Formation: (1) the upward folding of the mudstone beds; (2) the presence of other fine-grained beds associated with the older Saugus Formation that is up-thrown on the opposite (north) side of the fault; and (3) the likely presence of clayey fault gouge materials created by the historical folding and faulting along the lineament.

The fine-grained interbed and the Saddle Lineament are not the only geologic features in the Saugus Formation that contribute to the presence of the spring. A slump or debris-flow deposit is also present at and near the spring, and the finer-grained nature of this deposit (compared with surrounding native soils) restricts the amount of groundwater in the permeable Saugus Formation bed that can directly enter the Santa Clara River alluvium in the lower portion of Middle Canyon. This is indicated in part by geologic logging of borings east and northeast of the spring (as well as a boring [B-72E] south of the spring), which have indicated that low-permeability materials are present in the Saugus Formation in this area. Additionally, compared with the relatively smooth slope of the ground surface farther up the canyon, the ground surface in the lower canyon area is hummocky in nature, which is consistent with the possible slump or debris-flow origin of the lower-permeability sediments in this area. Taken together, these observations regarding the geology, groundwater elevations, and the absence and presence of springs indicate that groundwater in the permeable Saugus beds is directed toward the spring area west of piezometer P-8B, rather than along the central axis of the canyon (where seeps and springs initially would be expected to occur). The mantle of reduced permeability soils associated with the slump/debris flow is saturated and provides substantial, but slower, subsurface discharge of groundwater into the spring. The fact that the flow at the two spring outlets is greater than at the visible inlets is attributable to this subsurface groundwater discharge.

2.3.2 Alluvium

Subsurface data from boring logs HS-1MC through HS-4MC indicate that the alluvium becomes progressively finer-grained near the mouth of Middle Canyon, such that lean clay appears to sit directly on the Saugus Formation bedrock. This low-permeability alluvium appears to restrict the movement of alluvial groundwater from upper Middle Canyon to the Santa Clara River alluvium. This low-permeability alluvium also produces confined conditions in the lower portion of the canyon. Because the groundwater does not readily migrate down-canyon through the alluvium, it infiltrates the coarse-grained, permeable beds of the underlying/adjacent beds of the upper Saugus Formation. Owing to the down-canyon strike of the bedding and the hydrostatic pressure that occurs up-canyon of the fine-grained plug, groundwater migrates along coarse-grained bed(s) of the Saugus Formation to where the bed(s) daylights at the spring.

2.4 Groundwater Occurrence and Groundwater Levels

Groundwater occurs within the alluvial deposits within the main canyon and side canyons, within the upper Saugus Formation as perched groundwater, and within the deeper Saugus Formation regional groundwater system. Groundwater level data from several piezometers completed in the alluvium near the mouth of the canyon, from borings drilled into the upper Saugus Formation, and from Saugus Formation Well #156 were compared to each other and to the elevation of the spring discharge point. These data are presented in Table 1. Appendix C contains a compilation of water level data in the canyon, along with groundwater elevation hydrographs at three wells in the lower Middle Canyon area that were outfitted with continuous recorders in June 2007 (wells P-1MS, P-2MS, and P-8B). Appendix C includes plots that compare these water level data with the barometric pressure data and the irrigation watering schedule.[2]

Groundwater levels measured in piezometer P-8B and boring RW-2T completed in the alluvium are similar to water levels measured at the time boring B-72E was completed in the Saugus Formation on the south side of the canyon. Additionally, a more recent temporary test hole that was drilled in the Saugus Formation next to core hole CH-2 showed a static water level similar to that in the alluvium. These data indicate that there may not be a significant difference between alluvial and Saugus Formation groundwater levels on either side of the inferred fault, in which case the fault zone may not be a significant barrier to alluvial groundwater flow (although it appears to restrict Saugus groundwater movement, as discussed in Section 2.3.1).

The coring data provide stratigraphic evidence that the shallow groundwater in the upper Saugus Formation is perched on low permeability layers within the Saugus Formation. In the lower portion of the canyon, the coring data and the water level data indicate that alluvial groundwater has greater hydraulic connection with the upper Saugus Formation than with the alluvium that is present along the Santa Clara River. Specifically, water levels in the alluvium are under confining pressure in this area, as the static water levels in the alluvial piezometers are above the top of the water-bearing zone that lies in the alluvium. The coring data indicate that the top of the alluvial water-bearing zone is overlain by relatively low-permeability sediments, which exert confining pressure on the alluvial groundwater. Additionally, the coring data indicate that the alluvium at the mouth of the canyon consists predominantly of these low-permeability sediments, which restrict the amount of alluvial groundwater that can move from lower Middle Canyon toward the Santa Clara River alluvial valley.

The spring elevation and the groundwater levels within the alluvium near the mouth of the canyon are 40 to 50 feet higher than water levels in the deep Saugus Formation well in Middle Canyon (Well #156) and other deep Saugus Formation wells located to the north, outside of the watershed. Therefore, it is unlikely that groundwater in the deeper Saugus Formation is discharging to the Middle Canyon alluvium or to the spring. Pump-

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[2] In Appendix C, the plot of the irrigation watering schedule identifies the irrigation in four distinct areas. Area A is the 6.3-acre and 2.4-acre parcels shown on Figure 3. Area B consists of the 2.1-acre and 4.6-acre parcels shown on Figure 3. The parcels identified as “Airport Mesa” and “Water Quality Basin” on the irrigation watering schedule are outside of the area shown in Figure 3.

testing and long-term water level monitoring activities along other Saugus Formation faults in the Santa Clarita Valley have indicated that those faults do not limit the flow of deep Saugus Formation groundwater across the fault zones and therefore do no act as barriers to groundwater flow in the deeper portions of the Saugus Formation. Consequently, it is unlikely that the Saddle Lineament that cuts through Middle Canyon is providing a conduit for deeper Saugus Formation groundwater to reach the surface (personal communication, Richard Slade, 2007).

2.5 Groundwater Quality

Water samples were collected from the spring, piezometer P-8B completed in the alluvium, and Well #156 completed in the deep Saugus Formation in Middle Canyon. Samples were analyzed for general water quality parameters, including cations and anions, to determine the origin of the groundwater discharging at the spring on the basis of geochemical character. The sampling work was conducted in part to obtain data about the geochemical signatures of the spring and the deep Saugus Formation to evaluate whether the deep Saugus Formation is a source of water to the spring. Table 2 presents sample analysis results for this investigation as well as historical water quality data for Well #156.

Figure 7 is a Stiff diagram and Figure 8 is a Trilinear (Piper) diagram. These water quality diagrams compare water quality signatures of each sample. Each water sample plotted on the Stiff diagram (Figure 7) has a unique geometric shape; polygons that are similar in size and shape are inferred to have a similar origin. A similar water origin also is inferred if water samples plot in similar positions on the Trilinear (Piper) diagram. The plotted position on the Trilinear (Piper) diagram also may indicate if one source of water is a mixture of two other water sources.

The shapes of the polygons plotted on the Stiff diagram (Figure 7) suggest that the spring water quality is similar to the alluvium groundwater quality. The shape of the Well #156 polygon suggests that the signature of deep Saugus Formation groundwater is different from either the alluvial groundwater sample or the spring sample. Specifically, the deep Saugus Formation groundwater is more dilute (the polygon is smaller), indicating a lower overall ionic strength than the alluvial groundwater and the spring water. Additionally, alluvial groundwater and spring water have a strong sulfate signature. In contrast, the deep Saugus Formation groundwater has much lower sulfate levels. The fact that the spring sample has a different ionic strength than the water from Well #156 indicates that groundwater in the deep Saugus Formation is not a significant contributor of water to the spring. This conclusion is consistent with the water level relationships, which indicate that the spring is not receiving groundwater from the deep Saugus Formation.

The Trilinear (Piper) diagram (Figure 8) provides a higher-resolution means of comparing the geochemical signatures of the spring water and the alluvial groundwater. The upper diamond of the Trilinear (Piper) diagram suggests that the spring sample appears to be a mixture of the alluvial groundwater and deep Saugus Formation groundwater. Considering the relative shapes of the polygons presented in the Stiff diagram (Figure 7) and the plotted positions in the Trilinear (Piper) diagram, the source of the spring water appears to be predominantly alluvial groundwater mixed with a lesser percentage of water originating from the Saugus Formation. This observation is further supported by other water quality testing results. Specifically, as shown in Table 2, concentrations of nitrate and chloride measured in the spring sample are similar to the deep Saugus Formation groundwater samples from Well #156, while calcium, magnesium, pH, and total dissolved solids (TDS) are intermediate between the deep Saugus Formation groundwater and the alluvial groundwater. Other constituents (particularly sodium, potassium, and sulfate) are present at similar concentration in spring water and alluvial groundwater. Because the groundwater elevations in the nearest deep Saugus Formation wells (including Well #156 located in Middle Canyon) are significantly lower than the alluvial groundwater or spring outlet elevation, the most likely source of Saugus Formation groundwater at the spring is the perched shallow Saugus Formation groundwater or excess irrigation water from Well #156 that infiltrates into the permeable sandstone beds that contain the uppermost shallow Saugus Formation water-bearing zone.

3 Conceptual Spring Flow Model

This section presents a conceptual model for the source of water to the spring. Figure 9 is a diagram illustrating the elements of the conceptual model. Rainfall, averaging 15 inches per year, either infiltrates into the Saugus Formation in the upland areas, infiltrates into the alluvium along the axis of the canyon, or evaporates and transpires. Some rainfall runoff exits the canyon along the Middle Canyon ephemeral stream and discharges to the Santa Clara River to the west. Infiltrating water in the upland areas migrates downslope within permeable beds of the Saugus Formation toward the axis of the canyon and discharges to the alluvium. Some infiltrating water becomes perched on lower permeability beds in the Saugus Formation. A year-round water table is present in the alluvium, and groundwater flows within the alluvium toward the mouth of the canyon.

Portions of the canyon are irrigated from the deep Saugus Formation Well #156 located within the canyon. Irrigation water that is not transpired percolates into the alluvium and mixes with alluvial groundwater. Some irrigation water also may fall directly on the Saugus Formation.

Permeable beds within the Saugus Formation appear to be in juxtaposition with saturated alluvial deposits farther up the canyon. These beds may become conduits for groundwater movement into the flanks of the canyon within the Saugus Formation. At least one of these permeable beds on the south flank is underlain by lower permeability beds that inhibit continued downward movement of groundwater and instead promote groundwater movement horizontally and downgradient toward the mouth of the canyon. On the south side of the canyon, this stratigraphic sequence was observed in boreholes near the spring (B-72E, CH-1, and P-2MS) and is also visible in a road cut near the spring. The borehole data and the observed strike and dip of the beds in the road cut together indicate that these permeable beds are the primary conduit by which groundwater moves toward, and discharges to the ground surface at, the spring. Additionally, the finer-grained Saugus beds that underlie these permeable Saugus beds limit the amount of downward groundwater migration, thereby allowing these permeable Saugus beds to be the primary source of water to the spring.

As discussed in Section 2.4, consideration also was given to the possibility of whether the fault zone that crosses the western end of the canyon could be a partial barrier to groundwater movement within the Saugus Formation and alluvium and, therefore, act to direct alluvial groundwater flow toward the spring. As discussed in Section 2.3.1, the Saddle Lineament fault zone does act as a barrier to the migration of groundwater down dip along bedding planes into the deeper Saugus Formation aquifer. Faulting does not appear to be a factor affecting groundwater movement within the alluvium, as indicated by three observations. First, borehole geologic data indicate that there is no significant discrepancy in the elevation of the bedrock-alluvium contact across the fault. Second, there is no indication of localized high groundwater conditions along the fault zone. Third, lineaments (which would be indicative of faulting) could not be found in the alluvium.

In summary, the primary factors contributing to the presence of the spring and to its source of water are:

1. **The presence of fine-grained alluvium at the mouth of Middle Canyon.** This material restricts groundwater movement from Middle Canyon to the Santa Clara River alluvium.

2. **The presence of permeable beds at the top of the Saugus Formation in the lower end of Middle Canyon.** These localized permeable beds connect the shallow alluvial groundwater system in lower Middle Canyon to the spring, and thereby act as the primary conduit directing groundwater flow to the spring.

3. **The presence of fine-grained beds in the Saugus Formation, directly beneath the uppermost permeable Saugus beds.** These fine-grained beds limit the amount of downward groundwater migration, thereby allowing the permeable Saugus beds to be the primary source of water to the spring.

4. **The presence of a faulted synclinal structure.** The Saddle Lineament, which traverses the lower end of Middle Canyon, blocks downward migration of groundwater along Saugus Formation bedding planes. The Saddle Lineament converges with the upper permeable Saugus source bed at the spring area.

5. **The presence of the buried landslide/debris flow at the lower end of Middle Canyon.** This feature contains soils that are of lower permeability than upgradient areas. This reduced permeability limits the amount of subsurface groundwater discharge that otherwise would occur to the Santa Clara River alluvium.

The groundwater chemistry data provide additional indications regarding the source(s) of water discharging at the spring. On the basis of the water chemistry, the water discharging at the spring appears to be a mixture of alluvial groundwater and other groundwater—likely from the shallow Saugus Formation. The most likely sources of shallow Saugus Formation groundwater at the spring are the perched groundwater observed in several shallow Saugus Formation borings and/or irrigation water from Well #156 that comes in direct contact with exposed shallow Saugus Formation beds. There is no indication from water level or geological data that water discharging at the spring is originating from the deeper Saugus Formation or from outside of the Middle Canyon watershed.

Some uncertainties exist in the current understanding of the spring system, including the following:

- The quantity of water discharging from the spring, and seasonal and long-term variations in spring flow
- The relationship between shallow groundwater levels and the magnitude of spring discharge, both on a short-term (seasonal) basis and a long-term (multi-year/decadal) basis
- The precise locations where the uppermost permeable Saugus Formation beds intersect saturated alluvial deposits up-canyon from the spring
- The amount of seasonal variability in the spring's water quality

Nonetheless, the field work (drilling, geologic mapping, and water level and water quality measurements) and subsequent data analysis activities conducted to date have provided a significant advancement in the understanding of the spring system. This information has allowed for the development of a conceptual model of the spring hydrogeology and an evaluation of potential impacts to the spring that may arise from development of Mission Village. The impact evaluation is presented in Section 4.

4 Impact Evaluation

This section of the report evaluates the potential impact of Mission Village on the spring area and habitat. Section 4.1 discusses the future land use that will occur under post-development conditions. Section 4.2 then presents the methodology and calculations for the evaluation of potential impacts on groundwater recharge and subsequent spring flow. Section 4.3 evaluates the potential for construction-related impacts on the spring area.

4.1 Future Land Uses

Middle Canyon is planned to become a portion of a mixed-use development within Newhall Ranch Specific Plan, referred to as Mission Village. Figure 10 is a map showing the distribution of the various land uses inside and outside of the existing watershed boundary. With the exception of the spring area and some open space areas, the majority of the existing watershed will be developed. Development plans include areas for residential, commercial, roads, and open space. Commerce Center Drive will be constructed across the northern end of the canyon and will lie to the north and northeast of the spring area, as shown in Figure 10 and discussed in detail in Section 4.3 of this report.

As discussed below in Section 4.2.2 of this report, recharge to groundwater occurs primarily from rainfall, with a small contribution (about 2 percent) occurring from agricultural irrigation. Under the planned development, the groundwater system will be recharged by direct infiltration of urban irrigation, direct infiltration of rainfall, and infiltration from water quality basins that will receive rainfall runoff. Figure 11 shows how rainfall runoff that occurs inside and outside the existing watershed footprint will be managed. The amount of impervious area within the watershed will be increased as a result of building structures, parking lots, and roads. Stormwater control structures and comprehensive water quality improvements (water quality basins, biofiltration, drainage swales, etc.) will be constructed to manage stormwater and urban runoff. Some runoff within the existing watershed boundary will be conveyed to water quality basins outside of the watershed footprint and some of the runoff that occurs outside of the existing watershed will be conveyed to water quality basins within the watershed. This is discussed in further detail in the impact evaluation below.

4.2 Evaluation of Potential Impacts to Groundwater Recharge and Spring Flow

Section 4.2.1 presents the methodology for the evaluation. Sections 4.2.2 and 4.2.3 present the estimates of groundwater recharge rates under existing and post-development conditions, respectively. Using the estimated groundwater recharge rates derived from the analysis, Section 4.2.4 summarizes the potential changes in groundwater recharge that could arise from the development and the potential significance of these changes on the spring flow.

4.2.1 Methodology

GSI Water Solutions, Inc. (GSI), with assistance from Geosyntec Consultants, has developed a hydrologic water budget for the Middle Canyon area to evaluate potential impacts to spring flow resulting from development. This approach was taken because changes in the amount of impervious surfaces, surface soil infiltration rates, irrigation amount and location, and stream condition will change the amount of water infiltrating to the groundwater system that lies in the Middle Canyon watershed and supplies the spring. The elements of the water budget (e.g., rainfall, shallow infiltration, deep percolation [recharge] to groundwater, evapotranspiration, and runoff) are derived from the conceptual model of the groundwater and spring system discussed in the previous section. The U.S. Environmental Protection Agency (EPA) Stormwater Management Model (SWMM) (Version 4.4H, July 1, 2003) was used in the preparation of the water budget because, like other water budget tools, it contains various elements of the hydrologic system including impervious surface percentage, surface soil infiltration rates, slope, evaporation, and rainfall to estimate runoff characteristics. The SWMM model also computes a shallow infiltration term that quantifies the amount of water that is able to migrate below approximately the upper 1 inch of soil during a given rainfall event. Using the findings from a previously calibrated basin-scale groundwater numerical modeling study in the Santa Clarita Valley (CH2M HILL, 2004 and 2005), we estimated the proportion of the SWMM-computed shallow infiltration volumes that likely migrate further downward in the form of deep percolation that recharges the groundwater system.[3] This approach allowed us to evaluate how various land use changes may affect groundwater recharge and potential impacts to spring flow. The SWMM model has been used in Middle Canyon (Mission Village) and elsewhere on Newhall projects to analyze runoff characteristics for stormwater management. This approach allows us to be consistent in our use of assumptions related to the hydrologic system applied to the Mission Village development.

The primary purpose of the SWMM water budget analysis work was to determine how groundwater recharge would change under post-development conditions. The change in groundwater recharge was calculated by developing two SWMM models: one model representing pre-development conditions and one model representing post-development conditions. The primary variables that differed between the pre-development and post-development models were:

- **Land use effects on watershed configuration.** Changes to land use resulted in changes to the configuration of the watershed: specifically, the sizes and locations of the areas contributing water to the spring.

- **Land use effects on impervious cover.** The types of land use changes that occur will cause changes to the amount of impervious cover within the contributing watershed for the spring.

- **Water use.** The water budget within the contributing watershed will change because water will be imported for irrigating landscaping within the development footprint that falls inside the watershed. Also, the existing agricultural irrigation that occurs in the canyon will be discontinued.

The SWMM model was run by first specifying values for various hydrologic elements, including impervious area, soil type, slope, precipitation (using a 35-year record from 1969 through 2003), evapotranspiration, irrigation, and infiltration rates that were assigned to each subarea and land use category. For a given SWMM model run, the model then calculated runoff volumes and groundwater infiltration values. The impacts of the change in land and water use then were calculated as the difference between the pre-development and post-development models.

The existing pre-development watershed boundary is shown in Figure 1. Currently, the area is undeveloped, apart from a few existing dirt roads and some areas irrigated by Newhall. For the purpose of the model, the watershed was divided into four major sub-basins (see Figure 1). Within each subbasin, several sub-areas pertaining to different

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[3] The remaining shallow infiltration water that does not recharge the groundwater system is retained moisture in the shallow soils and eventually can be returned to the atmosphere via evapotranspiration processes between rainfall events.

land use types were defined. Figure 10 shows the various land use designations for the post-development condition.

4.2.2 Evaluation of Baseline Pre-Development Groundwater Recharge

Because the watershed is primarily undeveloped, the impervious area was estimated to range from 5 to 10 percent in the four sub-catchments that were identified within the watershed. For the entire watershed, the pervious area (325 acres) occupies about 91 percent of the 356-acre watershed area, and this pervious area is where precipitation currently infiltrates below the upper 1 inch of soil. Stormwater runoff and evaporation from soils in the watershed were calculated by the pre-development SWMM model. Shallow infiltration over the entire watershed then was estimated by subtracting the SWMM-calculated runoff and evapotranspiration terms from the total amount of precipitation.

The water purveyors in the Santa Clarita Valley have developed a detailed numerical model of the groundwater system that is regional in scale, covering the entire valley. This basin-wide model was calibrated to a 25-year history of monthly groundwater elevation trends and Santa Clara River flows (for the time period 1980 through 2004). We used information from this model to help us estimate the amount of deep percolation (recharge to groundwater) from the SWMM model results. The regional groundwater model's design and calibration is described by CH2M HILL (2004 and 2005). The calibration process included a detailed process for quantifying the time-varying groundwater recharge that occurs as: (1) infiltration of stormwater in riverbeds and (2) direct deep recharge of precipitation. The direct recharge term equals the rainfall amount minus the amount of stormwater runoff and evapotranspiration. During the 25-year simulation period, the calibrated model generated a direct deep recharge term equal to an average of 25 percent of rainfall during this period. The magnitude of this term during any given year was highly dependent on the amount of rainfall during that year, as well as during the preceding year(s) (which affects antecedent soil moisture conditions). The variability in year-to-year deep percolation ranged from 0 percent of rainfall in the driest years to more than 50 percent in the wettest years. The regional model calibration work identified that during the course of many years (a decade or longer), the average deep recharge that occurs outside of streams averaged 25 percent. Additionally, the rolling average of the model-derived deep recharge rates for 10-year-long periods ranged from about 18 percent to 33 percent.[4] These values were used to convert the shallow infiltration terms computed by SWMM to deep groundwater recharge rates under current conditions.

For the 35-year historical rainfall record, the SWMM model estimated that shallow infiltration (below approximately the upper 1 inch of soil) accounts for, on average, 98 percent of the rainfall water that does not become stormwater. This infiltration occurs across the entire watershed area. Applying the 25 percent factor to convert from shallow

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[4] For the period 1980 through 2004, the 10-year rolling average is a calculation of the average infiltration that occurs during the 10-year period 1980 through 1989, then the 10-year period 1981 through 1990, etc., continuing through the 10-year period 1995 through 2004. The lowest 10-year average (18.5 percent) occurred for the 10-year period 1981 through 1990.The highest 10-year average (33 percent) occurred for the 10-year period 1992 through 2001.

infiltration to deep percolation on a long-term basis resulted in an average annual deep percolation rate of 37.6 million gallons per year (MG/yr) over the 365-acre pervious area within the existing watershed. For the range of infiltration rates estimated from the 10-year rolling average, the annual deep percolation rates ranges between about 27.1 and 49.6 MG/yr within this same area.

The analysis of groundwater recharge under current (baseline pre-development) conditions also accounted for agricultural irrigation. A detailed analysis of crop types, crop water demands, and actual pumping was performed for the Newhall Ranch Specific Plan (CH2M HILL, 2002 and 2004). This analysis indicated that approximately 37 percent of the applied irrigation water becomes groundwater recharge. Based on the irrigated area (15.5 acres), the average application of irrigation water (6.5 acre-ft/yr), and deep percolation of 37 percent of the applied water, the average annual deep percolation rate under current conditions is about 2.4 ft/yr, or 0.8 MG/yr.

4.2.3 Evaluation of Post-Development Groundwater Recharge

Estimating long-term groundwater infiltration volumes under the post-development scenario requires much more information and several assumptions. The first step is to determine the amount of groundwater recharge to the watershed directly from precipitation, and the second step is to add a component that represents water for urban irrigation. A third step is to incorporate infiltration from the large water quality basin (WQ Basin C) that treats stormwater flows. These are handled as follows:

- **Step 1 (Recharge from Direct Precipitation).** The impervious area under developed conditions is assigned on the basis of land use type (see Figure 10), and the remaining pervious area is available for precipitation infiltration and urban irrigation. Because the Mission Village development extends well beyond the boundaries of the existing watershed, those portions of the village located outside the existing watershed are not included in the calculations of deep percolation arising from direct precipitation and urban irrigation under post-development conditions.

- **Step 2 (Recharge from Urban Irrigation).** The approach for determining groundwater recharge arising from irrigation water is based on land use types. We assumed that all pervious areas would be landscaped and irrigated, except for natural open areas. The type of land use dictated the irrigation rates that were applied to the pervious areas. For instance, it was assumed that residential areas have lawns to be watered, whereas businesses typically have shrubs and bushes requiring less water. The percentage of irrigation water percolating below the root zone in irrigated areas (also referred to as deep percolation) was derived from the groundwater flow model developed for the basin (CH2M HILL, 2004). The following table presents assumptions used for computing pervious areas and deep percolation of irrigation water for each land use type.

Assumptions Used to Calculate Recharge from Imported Irrigation				
Land Use[1]	**% Impervious[2]**	**% Pervious**	**Deep Percolation (in/yr)[3]**	**Deep Percolation (Acre-ft/yr per acre)**
Commercial	91	9	1	0.0833
Education	80	20	1	0.0833
Multi-Family Residential	68	32	2.2	0.1833
Single Family Dwelling	42	58	2.2	0.1833
Parks (landscaped)	10	90	2.2	0.1833
Open Space (landscaped)	1	99	2.2	0.1833
Open Space (not landscaped)	1	99	0	0
Transportation (roads)	100	0	0	0

[1] Land Use categories based on 12/06 NLF development plan for Mission Village.

[2] % Impervious area computed by Geosyntec Consultants for proposed conditions based on November 2006 development plan for Mission Village.

[3] Deep percolation rates are from CH2M HILL (2004).

- **Step 3 (Recharge from Water Quality [WQ] Basin C).** Besides these two sources of infiltration (direct rainfall and irrigation), the post-development analysis also accounts for infiltration that will occur from the large WQ basin located within the existing watershed boundaries (see Figure 11). This WQ basin, referred to as Mission Village Basin C, collects drainage from approximately 382 acres of tributary area within the Mission Village and off-site project areas. As shown in Figure 11, our analysis included three types of proposed condition drainage subareas. First, some of the proposed drainage subareas (shown in red in Figure 11) are located entirely within the existing Middle Canyon watershed. These subareas will contribute precipitation-related infiltration and irrigation-related infiltration from within the existing Middle Canyon watershed and also will contribute runoff to Basin C. A portion of the runoff volume routed to Basin C also will contribute to groundwater recharge as described below. A second case (shown in green in Figure 11) occurs in areas near the watershed boundary that receive infiltration from precipitation and irrigation, but have their surface water runoff routed in drainage piping to WQ basins located outside of the watershed or directly to the Santa Clara River. In this case, the infiltration component from the WQ basins is not included in the groundwater recharge volume for the existing watershed. A third case consists of subareas lying outside of the existing watershed boundary that have their runoff routed into the watershed (shown in blue in Figure 11) and directed into Basin C. In this case, the infiltration term from the WQ basin is included in the groundwater recharge volume for the existing watershed, but the precipitation- and irrigation-related recharge quantities are not included because they occur outside the Middle Canyon watershed.

For the first and third cases, which involve deep percolation from Basin C, the runoff volume captured (i.e., routed into) Basin C is assumed to be 80 percent of the runoff generated within the tributary area to Basin C. This assumption is consistent with stormwater quality performance standards established in the Newhall Ranch Specific Plan Sub-Regional Stormwater Mitigation Plan. The remaining 20 percent of runoff volume is assumed to bypass the basin during large storm events when the basin is at capacity. Of the runoff routed to the Basin C storm drains, approximately 12 percent is assumed to contribute to groundwater recharge. The remainder either bypasses the WQ basin directly to the Santa Clara River (20 percent), is treated in the basin and then discharged to the Santa Clara River (64 percent), or is lost in Basin C to evapotranspiration (4 percent).

- The sum of infiltration over pervious areas and from WQ basins within the watershed yields the total amount of groundwater recharge that occurs under post-development conditions.

Compared with the pre-development model, the post-development model is run using the same climatic conditions, but differing runoff, irrigation, and infiltration characteristics. In particular, the different infiltration characteristics in the post-development model are lower ground surface slopes (2 to 3 percent, versus up to 15 percent in the pre-development baseline model) and lower saturated hydraulic conductivity (75 percent of the pre-development value, to reflect the compaction that will arise from the filling and grading activities that will occur during construction). The net difference between the pre-development and post-development model runs indicates how much the amount of groundwater recharge to the Middle Canyon watershed may change as a result of the development of Mission Village.

4.2.4 Post-Development Impacts on Groundwater Recharge and Spring Flow

As discussed previously, a reduction in average annual groundwater recharge resulting from development potentially could have an adverse impact on spring flow, which in turn potentially could adversely affect the flora and fauna communities present in the spring area. The results of the groundwater recharge calculations for pre-development and post-development are presented below, using the 25 percent factor for direct rainfall (to convert from shallow infiltration to deep percolation in areas outside WQ Basin C):

Water Budget Calculations (Deep Recharge of Rainfall Outside Basin C = 25 Percent of Shallow Infiltration)		
Existing Conditions		
Estimated groundwater recharge – rainfall	37.6	MG/yr
Estimated groundwater recharge – irrigation	0.8	MG/yr
Total estimated groundwater recharge - existing conditions	**38.4**	**MG/yr**
Post-Development Conditions		
Estimated groundwater recharge – rainfall	21.2	MG/yr
Estimated groundwater recharge – Water Quality Basin C	13.6	MG/yr
Total estimated groundwater recharge – imported irrigation	7.0	MG/yr
Total estimated groundwater recharge – post-development conditions	**41.8**	**MG/yr**
Net Change in Groundwater Recharge		
Change in volume of recharge	3.4	MG/yr
Percentage change = (developed – existing)/existing	8.8	%

MG/yr = million gallons per year.

These water budget calculations indicate that the effect of the development potentially will be to increase groundwater recharge by about 9 percent. As shown in the table, a 16.4 MG/yr reduction in direct recharge of rainfall occurs due to development (21.2 MG/yr post-development versus 37.6 MG/yr under pre-development conditions). However, this reduction is more than offset by a 19.8 MG/yr increase in other recharge sources (13.6 MG/yr from the WQ basins, plus 7.0 MG/yr from imported irrigation, minus 0.8 MG/yr of existing agricultural irrigation recharge that is eliminated by the development). In summary, the analysis indicates that stormwater routing and increased water imports for irrigation will more than offset the reduction in recharge over pervious areas, and a decrease in groundwater recharge therefore is unlikely to occur at a watershed scale because of the development.

Currently, recharge from rainfall occurs over a large area— the entire watershed. Under developed conditions, recharge from rainfall and from irrigation will continue over a large area—at a watershed scale. In these water budget calculations, the total watershed-scale recharge is estimated to be 28.2 MG/yr under developed conditions, which is 9.4 MG/yr less than under present conditions (37.6 MG/yr). While this 9.4 MG/yr difference is more than offset by the significant recharge that will occur at WQ Basin C (13.6 MG/yr), the re-distribution of recharge under developed conditions is expected to change, which potentially could change the spring flow.

The water balance calculation results were examined in more detail by selecting the low (18 percent) and high (33 percent) values that describe the proportion of non-runoff water that becomes deep groundwater recharge (in areas outside of WQ Basin C). As with the 25 percent factor, these percentages are applied to the SWMM model results for both existing conditions and post-development conditions. Using the 18 percent factor for direct rainfall (to convert from shallow infiltration to deep percolation in areas outside WQ Basin C), the groundwater recharge calculations for pre-development and post-development conditions are shown in the following table.

Water Budget Calculations **(Deep Recharge of Rainfall Outside Basin C = 18 Percent of Shallow Infiltration)**		
Existing Conditions		
Estimated groundwater recharge – rainfall	27.1	MG/yr
Estimated groundwater recharge – irrigation	0.8	MG/yr
Total estimated groundwater recharge–existing conditions	**27.9**	**MG/yr**
Post-Development Conditions		
Estimated groundwater recharge – rainfall	15.3	MG/yr
Estimated groundwater recharge – Water Quality Basin C	13.6	MG/yr
Total estimated groundwater recharge – imported irrigation	7.0	MG/yr
Total estimated groundwater recharge–post-development conditions	**35.9**	**MG/yr**
Net Change in Groundwater Recharge		
Change in volume of recharge	8.0	MG/yr
Percentage change = (developed – existing) / existing	28.5	%

MG/yr = million gallons per year.

Compared with the original analysis, the influence of lowering the percentage of shallow infiltration that becomes deep groundwater recharge is to further increase the amount of groundwater recharge under post-development conditions. This occurs because the development-induced decrease in direct-rainfall recharge (27.1 minus 15.3 = 11.8 MG/yr) is less than the 20.6 MG/yr of combined recharge occurring from basin C (13.6 MG/yr) and imported irrigation (7.0 MG/yr) under post-development conditions. Additionally, much (about three-quarters) of the total existing-condition recharge (27.9 MG/yr) is met by two of the three recharge terms under post-development conditions (Basin C recharge and imported irrigation recharge [13.6 + 7.0 = 20.6 MG/yr]).

Using the 33 percent factor for direct rainfall (to convert from shallow infiltration to deep percolation in areas outside WQ Basin C), the groundwater recharge calculations for pre-development and post-development conditions are as follows:

Water Budget Calculations **(Deep Recharge of Rainfall Outside Basin C = 33 Percent of Shallow Infiltration)**		
Existing Conditions		
Estimated groundwater recharge – rainfall	49.6	MG/yr
Estimated groundwater recharge – irrigation	0.8	MG/yr
Total estimated groundwater recharge - existing conditions	**50.4**	**MG/yr**
Post-Development Conditions		
Estimated groundwater recharge – rainfall	28.0	MG/yr
Estimated groundwater recharge – water quality basin C	13.6	MG/yr
Total estimated groundwater recharge – imported irrigation	7.0	MG/yr
Total estimated groundwater recharge - post-development conditions	**48.6**	**MG/yr**
Net Change in Groundwater Recharge		
Change in volume of recharge	-1.8	MG/yr
Percentage change = (developed – existing) / existing	-3.6	%

In this case, the influence of post-development conditions is to slightly reduce the amount of groundwater recharge. This occurs because the development-induced decrease in direct-rainfall recharge (49.6 minus 28.0 = 21.6 MG/yr) is slightly greater than the 20.6 MG/yr of combined recharge occurring from Basin C (13.6 MG/yr) and imported irrigation (7.0 MG/yr) under post-development conditions.

4.2.5 Conclusions from the Water Balance Analysis

In summary, the water budget analysis indicates that an increase in groundwater recharge of about 9 percent will occur within the Middle Canyon watershed during the course of many years (time periods on the order of a decade or longer). This indicates that a potentially significant long-term increase (more than 1 percent) in groundwater recharge could occur, which therefore could result in a potentially significant impact on spring flow. A potentially significant impact is also possible because of the areal re-distribution of recharge that will occur under developed conditions.

Additionally, the development’s effect on recharge to the groundwater system in the Middle Canyon watershed could fluctuate over long time periods in response to the historic variability in rainfall that occurs over periods of 10 or more years. Applying the same water budget calculation techniques to the historical range of the 10-year average rainfall recharge rates (as derived from a detailed numerical model of groundwater recharge in the Santa Clarita Valley from 1980 through 2004), the influence of the development during shorter time periods could range from an approximate 4 percent decrease in groundwater recharge to an approximate 29 percent increase in groundwater recharge. Therefore, a potentially significant reduction in groundwater recharge could occur during wet periods (when the effect of the development is to reduce the wet-weather recharge), and a potentially significant increase in recharge could occur during drier periods (when the effect of the development is to direct the limited dry-weather recharge to the water quality basin rather than maintaining it as the diffuse recharge that currently occurs across the entire watershed). Additionally, these sensitivity analyses and the longer-term analysis together indicate that while the development could cause spring flows to vary by more than 1 percent, the development is more likely to increase the spring flow than to decrease the spring flow.

On the basis of the water budget analysis, the Mission Village development poses a potentially significant impact to the spring flow. Because the spring lies at the discharge (lower) end of the canyon, the year-to-year variations in spring flow may be more muted than the annual variations in rainfall and recharge that are predicted by the water budget analysis. This muted response of the spring flow could occur because of the relatively slow rate of groundwater movement in the alluvium and Saugus Formation aquifer systems. Nonetheless, the analysis indicates that the development could create notable short-term and long-term changes in groundwater recharge. Because the water balance analysis indicates that changes in long-term and short-term groundwater recharge could be more than 1 percent, without mitigation the planned development of Mission Village could have a potentially significant impact on groundwater recharge and, subsequently, spring flow and sensitive plant and animal communities that are present in the spring area.

4.3 Potential Construction-Related Impacts on the Spring Area

Besides the potential water budget impacts, Newhall has considered other factors associated with Mission Village construction and full build-out that potentially could impact the spring area. In particular, Newhall has considered the potential influences of road construction and lot development activities on the spring flow and habitat. The proposed development feature closest to the spring is Commerce Center Drive, a significant roadway that passes near the east side of (to the east and northeast of) the spring. During this evaluation, Newhall identified that a significant impact would arise if the road alignment were to pass through the spring area or if the temporary limits of construction were to cause construction activities, equipment, and related materials to extend into the spring area.

Figure 12 is an aerial photo of the spring area that includes an overlay of the original alignment planned for Commerce Center Drive. This alignment is shown on the Mission Village Tentative Tract Map dated December 21, 2006. As shown in Figure 12, under this plan the road alignment crosses the eastern margin of the spring area, and the limits of temporary construction impacts extend as much as 50 feet into the spring area. Consequently, the road alignment presented in the Tentative Tract Map dated December 21, 2006, will have a potentially significant impact on the spring during road construction and also may have a significant impact on the spring afterward.

5 Proposed Mitigation Measures

Mitigation measures will be necessary to address potentially significant impacts to the spring that have been identified. Section 5.1 discusses mitigation measures that are proposed to address potentially significant changes in spring flow that could occur as a result of development of Mission Village. Section 5.2 discusses mitigation measures to address the potentially significant impacts to the spring that could occur because of the Commerce Center Drive alignment contained on the Mission Village Tentative Tract Map, dated December 21, 2006.

5.1 Mitigation to Address Potential Impacts on Groundwater Recharge and Spring Flow

To minimize the potential short-term impacts on spring flow that have been identified from our water budget analysis (to levels that are less than significant), this report recommends that a monitoring and response program be implemented for the spring area. The purpose of the program will be to (1) address the potentially significant impact that the Mission Village development could pose to future spring flows, and (2) provide information that will indicate in the future whether adaptive management measures should be considered for implementation to address future spring flows. The monitoring and response program will consist of the following activities:

1. Install surface water gauging stations at the two primary channels conveying spring water from the spring area. Monitor flow at least monthly for at least 1 year. Monitor during and after construction to identify changes.
2. Continue monitoring groundwater levels (using continuous-recording transducers and data loggers) in the two shallow Saugus Formation piezometers (P-1MS and P-2MS) that were installed recently near the spring area. Monitor groundwater levels for at least 1 year before construction, and continue monitoring during construction.
3. Obtain rainfall data from the nearest precipitation gauging station.
4. Correlate groundwater levels, spring flow, and rainfall data. Estimate target monthly spring flow rates based on pre-development monitoring data.
5. Collect water samples on a quarterly basis quarterly for at least 1 year at the spring and at piezometers P-1MS and P-2MS, and test for common cations and anions (including nitrate). Correlate water quality with spring flow and establish baseline water quality conditions at the spring.
6. Conduct a vegetative and biota survey of the spring area to determine habitat composition and health. Establish success criteria for the spring area based on groundwater levels, habitat composition and health, and water quality. Continue to periodically monitor spring area diversity and health.
7. Prepare a spring mitigation plan that includes measures to provide water to the spring area if monitoring data indicate that construction activities or full build-out of the development are reducing spring flow to below pre-development target flow rates or degrading water quality. Additionally, the spring mitigation plan will include measures to increase water flow out of the spring if monitoring data indicate that construction activities or full build-out of the development are increasing flow into the spring (at rates above pre-development target flows) at unacceptable levels.
8. If there is a substantial change in spring flow or water quality that can be attributed to construction activities or full build-out of the development, or if the spring area success criteria are being affected by construction activities or the full build-out of the development, develop and implement adaptive management measures to address the changes.

5.2 Mitigation to Address Potential Construction-Related Impacts on the Spring Area

As discussed in Section 4.3 of the report, the original alignment of Commerce Center Drive (as shown on the December 21, 2006, Mission Village Tentative Tract map) is expected to have a potentially significant impact on the spring flow and habitat because the roadway grading and construction activities would extend into the spring area. Consequently, Newhall has revised the road alignment as a mitigation measure to address the potentially significant impact posed by the original design. The revised alignment is shown in Figures 13 and 14 and will be incorporated into the development plan for Mission Village.

As shown in Figure 13, the northern edge of the spring lies 75 feet from the permanent roadway and 55 feet from the southern limit of the area where temporary construction activities will occur. The distances between the spring and the roadway are shown in cross-sectional view in Figure 14. The revised alignment that is shown in Figures 13 and 14 has been identified and selected by Newhall as the preferred design to address the potential significant impact to the spring area that was posed by the original design. The revised design has been selected to prevent encroachment on the spring area during and after construction of Commerce Center Drive. Thus, the mitigation provided by the revised design will eliminate direct encroachment on the spring area that otherwise would have occurred under the original design–including temporary construction impacts that may include excavating unsuitable soils, meeting fill requirements, and possibly conducting temporary dewatering activities.

Figure 14 also shows a cross-section (C-C’) extending south from the spring toward the nearest developed land parcels. As shown in the cross section C-C’ and the Figure 14 map, the spring lies between 275 and 350 feet from the closest areas where the existing ground surface will be altered to create building pads. Additionally, the elevations of the ground surfaces for building pads within the development (1,150 feet and higher) will be 130 feet (and more) higher than the elevation of the spring area (which lies between 980 feet and 1,020 feet in elevation). Consequently, the closest lot development activities will not have a significant adverse impact on the spring area.

6 Conclusions

A hydrogeologic assessment of the Middle Canyon Spring has been conducted that has resulted in the development of a hydrogeologic conceptual model of the spring. This information has been used to conduct an analysis of potential impacts to the discharge of groundwater into the spring area. The impact evaluation has identified the following potentially significant impacts of the development on the spring area:

- A long-term increase in groundwater discharge to the spring of about 9 percent
- Potential shorter-term changes in groundwater discharge to the spring arising from multi-year cycles of below-normal and above-normal rainfall
- Alterations to the spring arising from the alignment of a significant roadway (Commerce Center Drive) that will be present in the lower portion of Middle Canyon

These potential impacts will be addressed by (1) implementing a monitoring and response program to monitor the spring, and (2) revising the alignment of Commerce Center Drive to place the road alignment and temporary road construction areas outside of the spring. These mitigation measures are designed to provide continued monitoring of the spring before and during development of Mission Village and to reduce the potential impacts of the development to levels that are below significance thresholds.

7 References

CH2M HILL. 2002. Newhall Ranch Updated Water Resources Impact Evaluation. Prepared for the Newhall Ranch Company. November 2002.

CH2M HILL. 2004. Regional Groundwater Flow Model for the Santa Clarita Valley: Model Development and Calibration. Prepared for the Upper Basin Water Purveyors, Santa Clarita, California. April 2004.

CH2M HILL. 2005. Technical Memorandum: Calibration Update of the Regional Groundwater Flow Model for the Santa Clarita Valley, Santa Clarita, California. Prepared for the Santa Clarita Valley Water Purveyors. August 2005.

Tables

Sample ID	Month Drilled	Description	Top Elevation	Depth Drilled	Groundwater Level		Geology			Comments
			ft MSL	ft bgs	ft bgs	Elev.	Type	Depth (ft bgs)		
MS-1	---	spring	1,005	0	0	1,005	Qal-TQs	At boundary		
P-6B	April 2004	2" piezometer	1,000	37	8.5	991.5	Qal	0	37	Water level ranges from 7.0 to 11.0 ft bgs.
P-7B	April 2004	2" piezometer	1,007	26	6	1,001	Qal	0	26	Water level ranges from 4.0 to 8.0 ft bgs.
P-8B	March 2004	2" piezometer	1,027	40	9	1,018	Qal	0	40	Water level ranges from 8.0 to 10.5 ft bgs.
Middle Canyon Deep Saugus Well (#156)	September 1961	irrigation well (deep)	1,053	1,805.55	83.4	970	TQs	0	1,805.55	Geologic information based on communication only (no log).
Magic Mt. Canyon Well (VWC #206)	September 2003	municipal well (deep)	1,055	2,150	73.5	982	TQs	0	2,150	Data from RCS report (2004)
RW-1T	October 2003	boring - rotary wash	999	38	15	984	Qal	0	38	
RW-2T	October 2003	boring - rotary wash	1,037	35	14.5	1,022.5	Qal	0	35	
RW-3T	July 2004	boring - rotary wash	1,051	40	21	1,030	Qal	0	40	
RW-3M	July 2004	boring - rotary wash	1,068	50	32	1,036	Qal	0	30	
							TQs	30	50	
B-1E	November 1999	boring - bucket auger	1,109	74	NP	NP	Qsw	0	7	
							Qal	NP	NP	
							TQs	7	74	
B-2E	July 2004	boring - bucket auger	1,072	18	NP	NP	Casing	0	2.5	
							TQs	2.5	18	
B-72E	March 2004	boring - bucket auger	1,067	50	49	1,018	S	0	14	
							TQs	14	50	
B-73E	March 2004	boring - bucket auger	1,060	55	40	1,020	TQs	0	55	
CH-1 / P-1MS	March 2007	boring - sonic continuous core / piezometer - hollow stem auger	1,028	75	12.5	1,015.5	S	0	1	Water level ranges from 11.6 to 13.0 ft bgs.
							Qcol	1	13	
							TQs	13	75	
P-2MS	April 2007	hollow stem auger	1,039	60	19	1,020	TQs	0	60	Water level ranges from 18.1 to 19.7 ft bgs.
CH-2	April 2007	boring - sonic continuous core	1,029	107	See P-2MS for water level data		Qsw	0	6.5	
							Qal	6.5	17	
							TQs	17	107	

KEY

Symbol	Name	Description
S	Soil/Debris Flow	
Qsw	Slopewash	
Qcol	Colluvium	
Qal	Quaternary alluvium	Loose sediments
TQs	Bedrock (Saugus Fm.)	Consolidated sediments
NP	Not present	
NA	Not applicable	
MSL	Mean sea level	
bgs	below ground surface	

Water Solutions, Inc.

Table 1
Summary of Stratigraphic and Water Level Data
Newhall Ranch

(results are in mg/L unless otherwise indicated)

					Field Parameters																
Sample ID	**Description**	**Aquifer**	**Sample Date**	**pH**	**EC (uS/cm)**	**Temp. (deg-F)**	**pH**	**Total Dissolved Solids (TDS)**	**Si**	**Ca**	**Mg**	**Na**	**K**	**Bicarbonate (as $CaCO_3$)**	**Sulfate (SO_4)**	**Chloride**	**Nitrate (as N)**	**F**	**B**	**Fe**	**Hardness (Grains Per Gallon)**
MS-1	spring		Aug-09-2006	7.09	1674	69.7	7.66	1480		203	78.9	160	5.03	276	1400	**25.5**	6.31				
P-8B	piezometer	Qal (alluvial)	Aug-09-2006	6.58	2407	69.0	7.49	2200		349	122	164	5.65	265	1540	68.2	14.8				
Middle Canyon Well (Well #156)	deep well	TQs (Saugus Fm. - older consolidated alluvium)	Oct-12-1961					959		122	42	100		260	399	30	6		0.35		28.0
			Feb-02-1962	8.06	1462			1204		154	56	118		264	571	30	11	0.5	0.30	<0.1	30.0
			Feb-13-1962	7.48	1392			1213		154	56	119		270	576	31	7	0.5	0.42	0.1	36.1
			Feb-16-1962	7.5					22.4	148.4	62.0	106.8		289.9	557.2	28.4			0.15		36.7 (629.2 ppm CaCO3)
			Apr-18-1963					1217													36.3
			Sep-30-1963	7.99	1442			1165		141	60.0	110		278	535	30	11	0.5	0.56	<0.1	35.0
			Aug-09-2006	7.67	1290	68.4	7.84	970		150	52.3	137	4.16	206	540	20.9	6.11				

Groundwater from Middle Canyon Spring
Groundwater from shallow alluvial aquifer (Qal)
Groundwater from deep, Saugus Formation

Table 2
Summary of Middle Canyon Water Quality
Newhall Ranch

Figures

Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

Legend

Middle Canyon Watershed

102 Existing Subwatersheds

Major Roads

Santa Clara River

Spring

Data Source: Geosyntec SWMM Model

0 625 1,250 2,500
Feet

Figure 1
Middle Canyon Watershed Boundaries

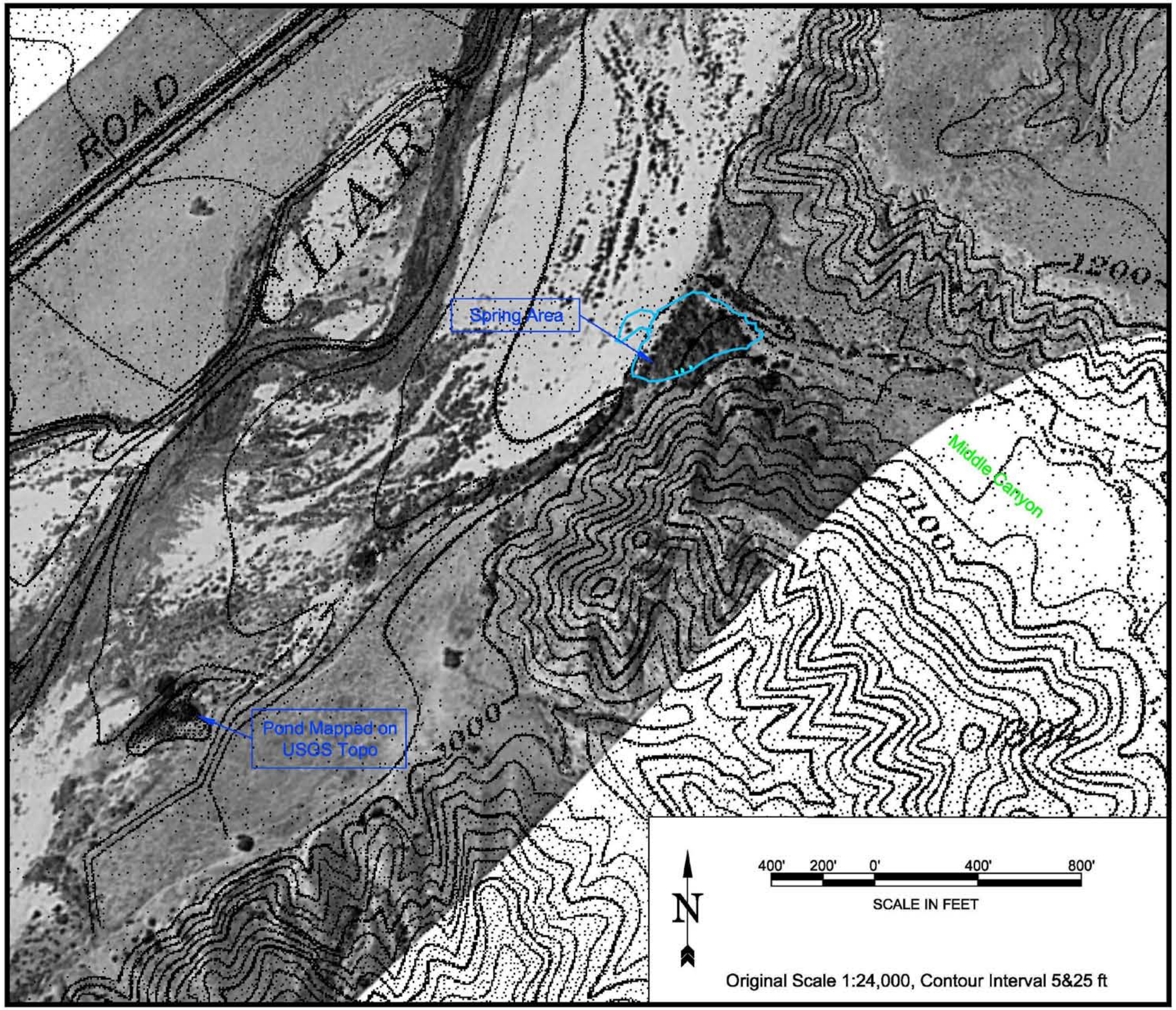
Newhall Land and Farming Company

GSI Water Solutions, Inc.

Geosyntec consultants

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Project_mxds\Fig1_Exist_Analysis_GSI.mxd



NOTE: Spring Area mapped in 2007 by DUDEK

Project Vicinity

Santa Clarita

Ventura County

Los Angeles County

Figure 2

Topo - 1929-1930 USGS Surveys (1940 LC)
with Aerial Photo by Fairchild

Newall Land and Farming Company

GSI Water Solutions, Inc.

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Fig2_1930_Aerial_GSI.pdf

Figure 3
Irrigated Land Area in Middle Canyon

Newhall Land and Farming Company

GSI Water Solutions, Inc.

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Fig3_Irrigated_Land_GSI.pdf

Project
Vicinity

Santa Clarita

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Los Angeles County

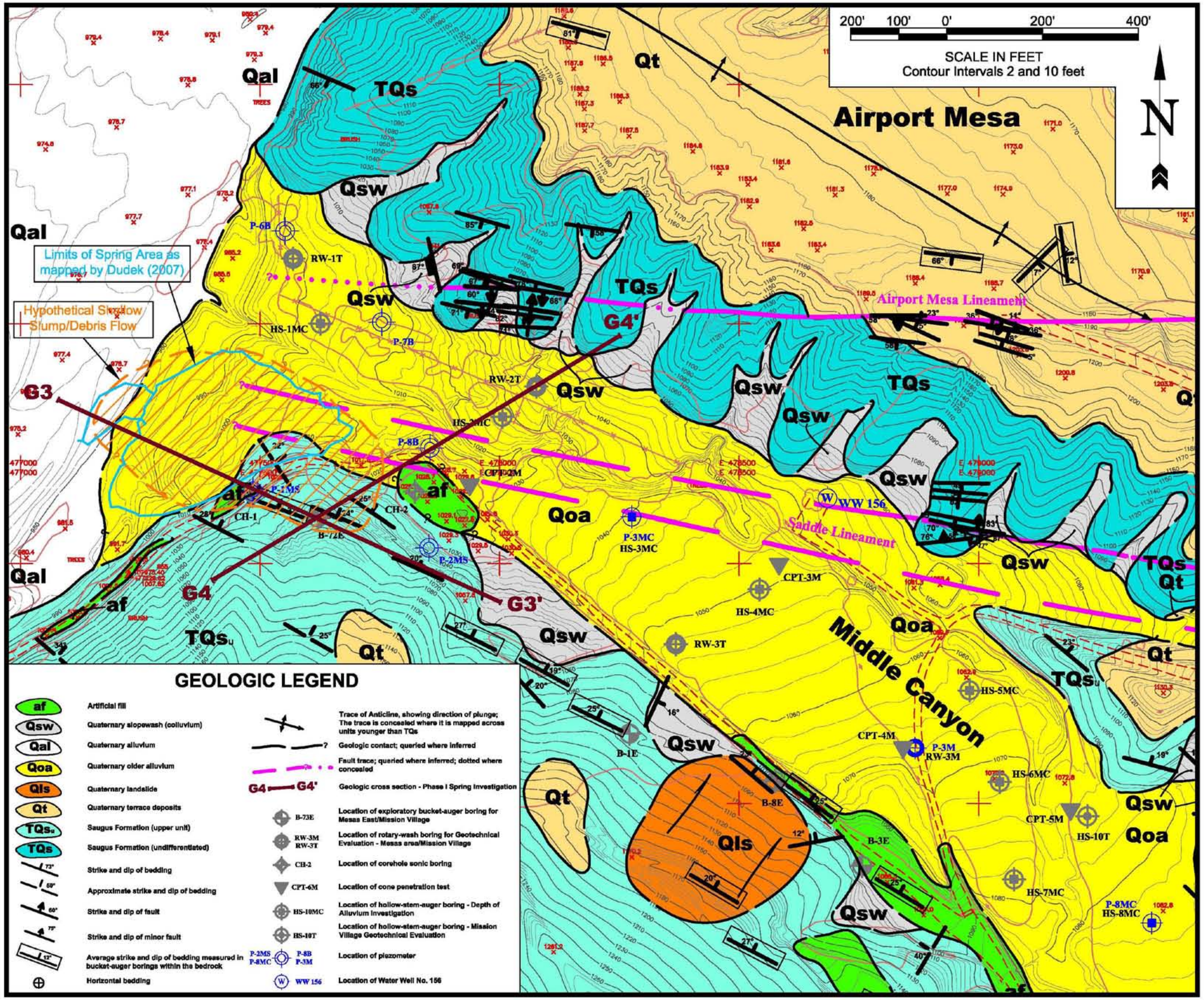

Figure 4
Geologic Map of Spring Area

Newhall Land and Farming Company

GSI Water Solutions, Inc.

September 2007

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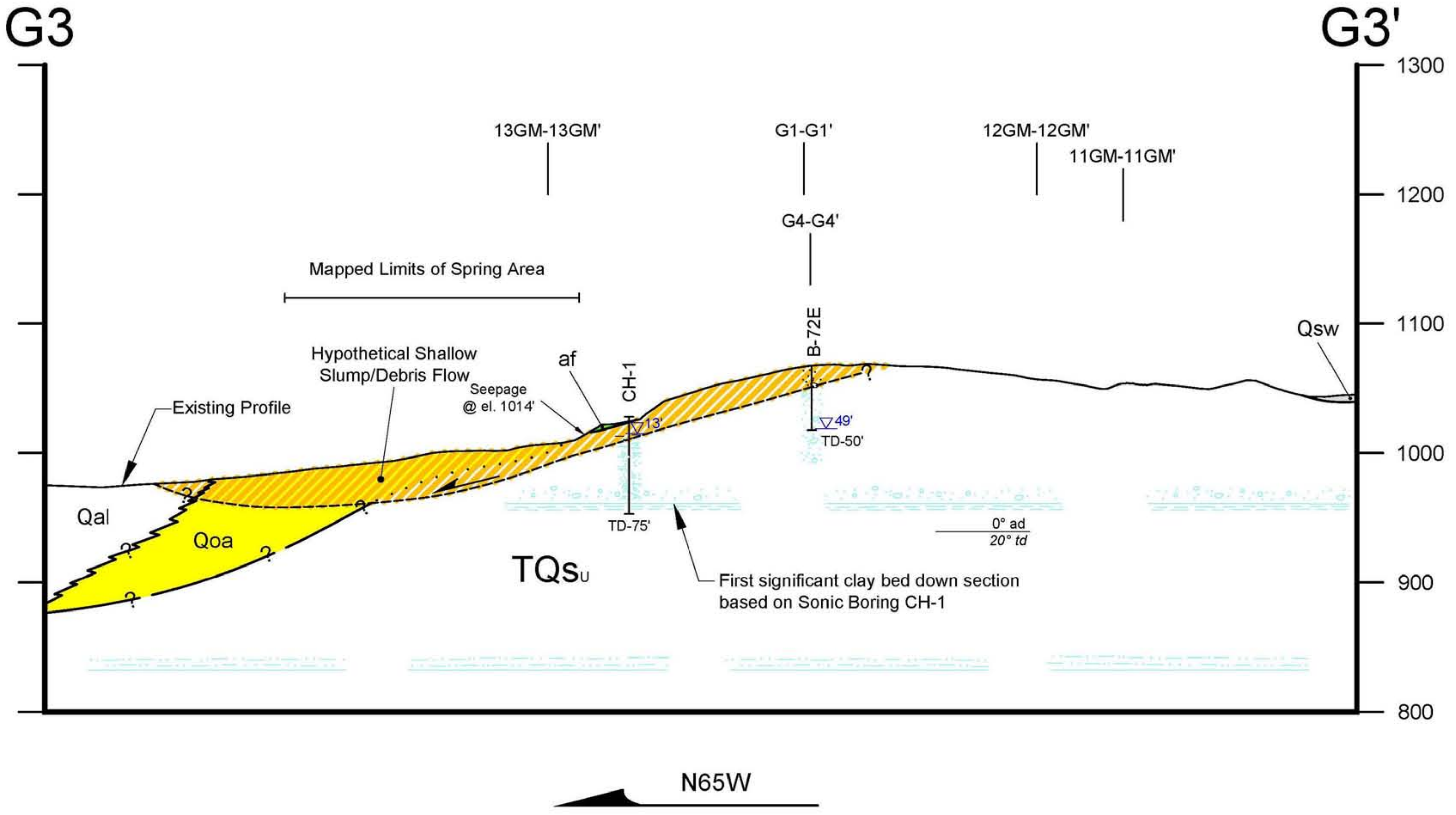
Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County



Legend

af	Artificial fill
Qsw	Quaternary slopewash
Qal	Quaternary Alluvium
TQs_u	Saugus Formation (upper unit)

Figure 5
Geologic Cross-Section
G3-G3'

Newhall Land and Farming Company

GSI Water Solutions, Inc.

September 2007

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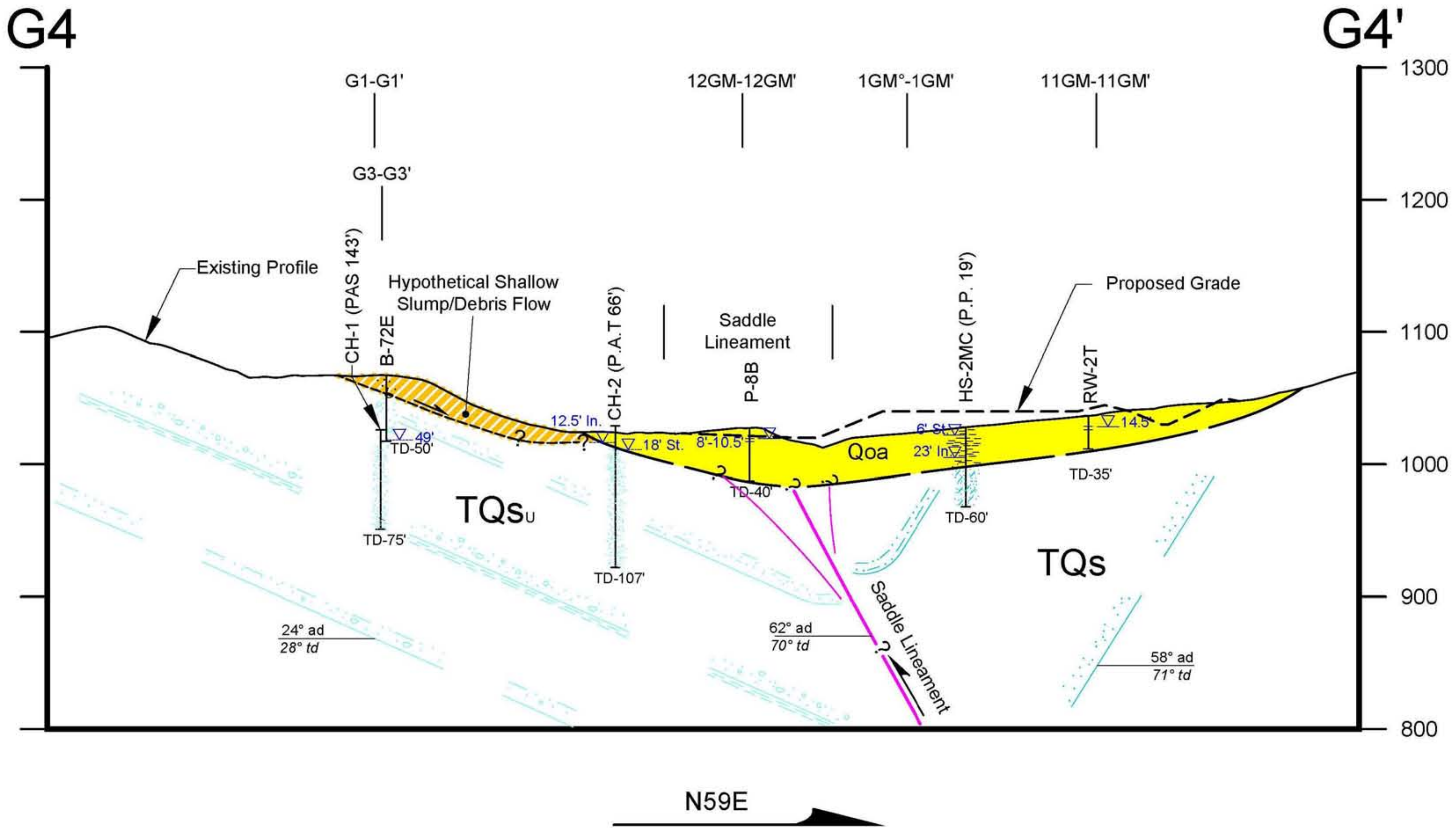
Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County



Legend

Qal	Quaternary Alluvium
TQs$_u$	Saugus Formation (upper unit)

Figure 6
Geologic Cross-Section
G4-G4'

Newall Land and Farming Company

GSI Water Solutions, Inc.

September 2007

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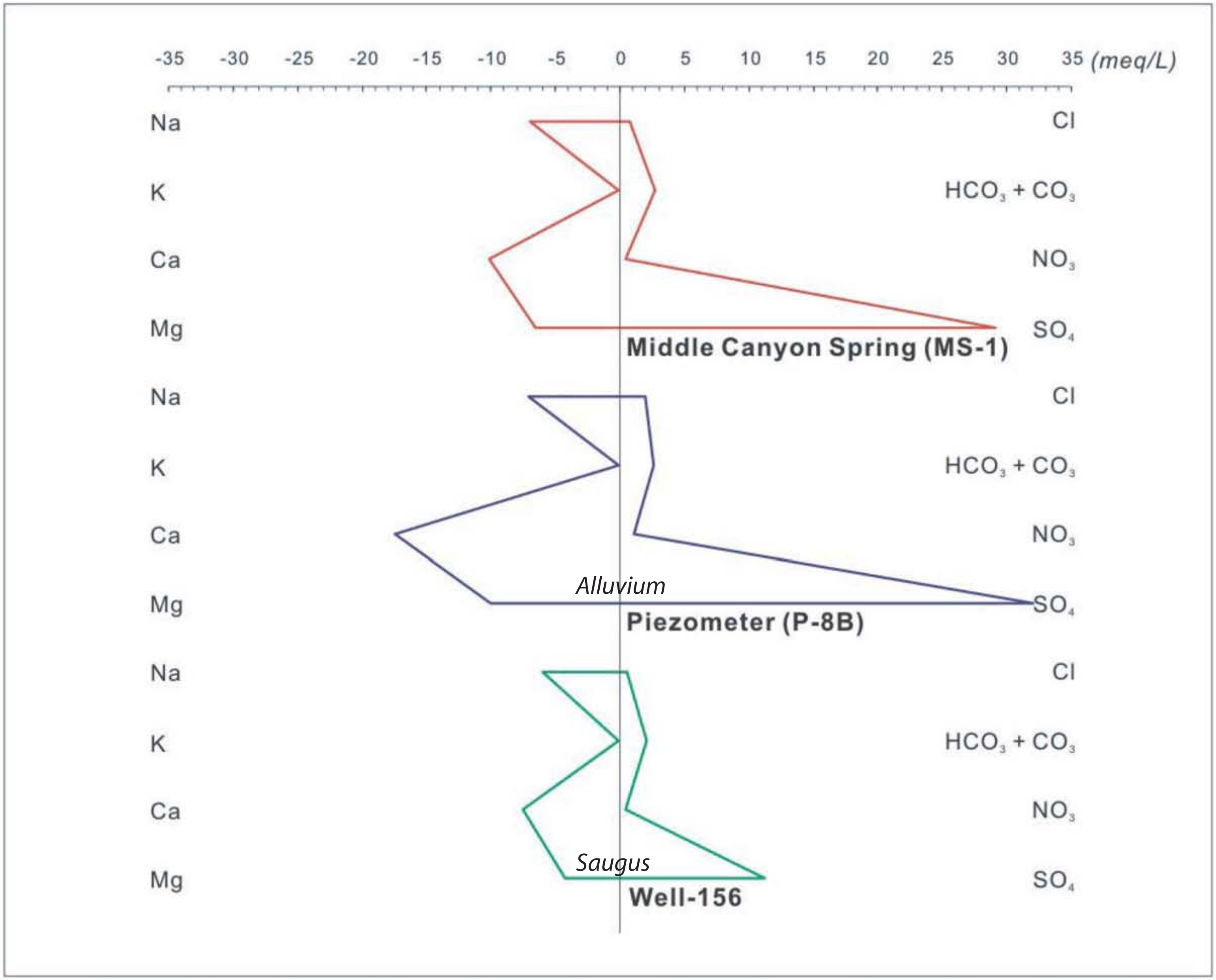
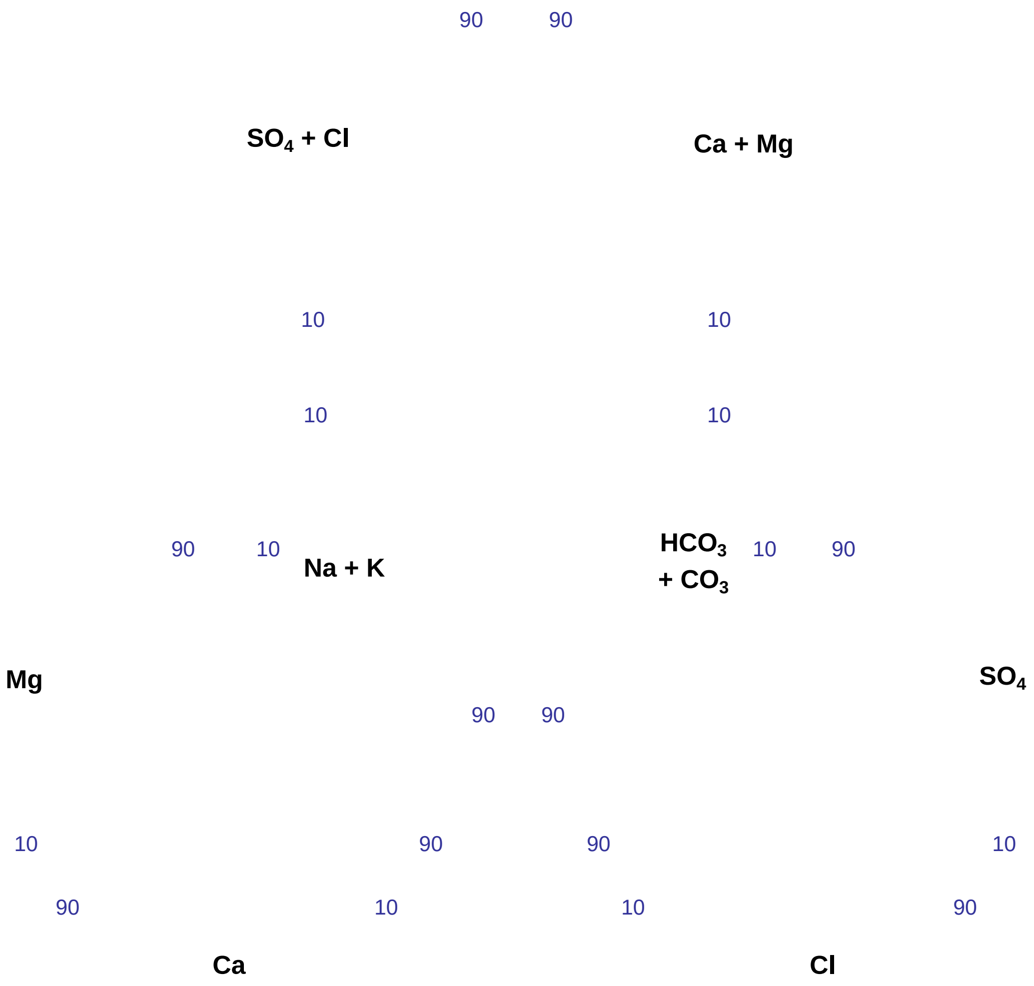


Note: For analytes reported as non-detect, a concentration of one-half the detection limit was used for plotting.

GSI Water Solutions, Inc.

Figure 7
Stiff Diagram
Newhall Ranch



Middle Canyon Spring (MS-1)

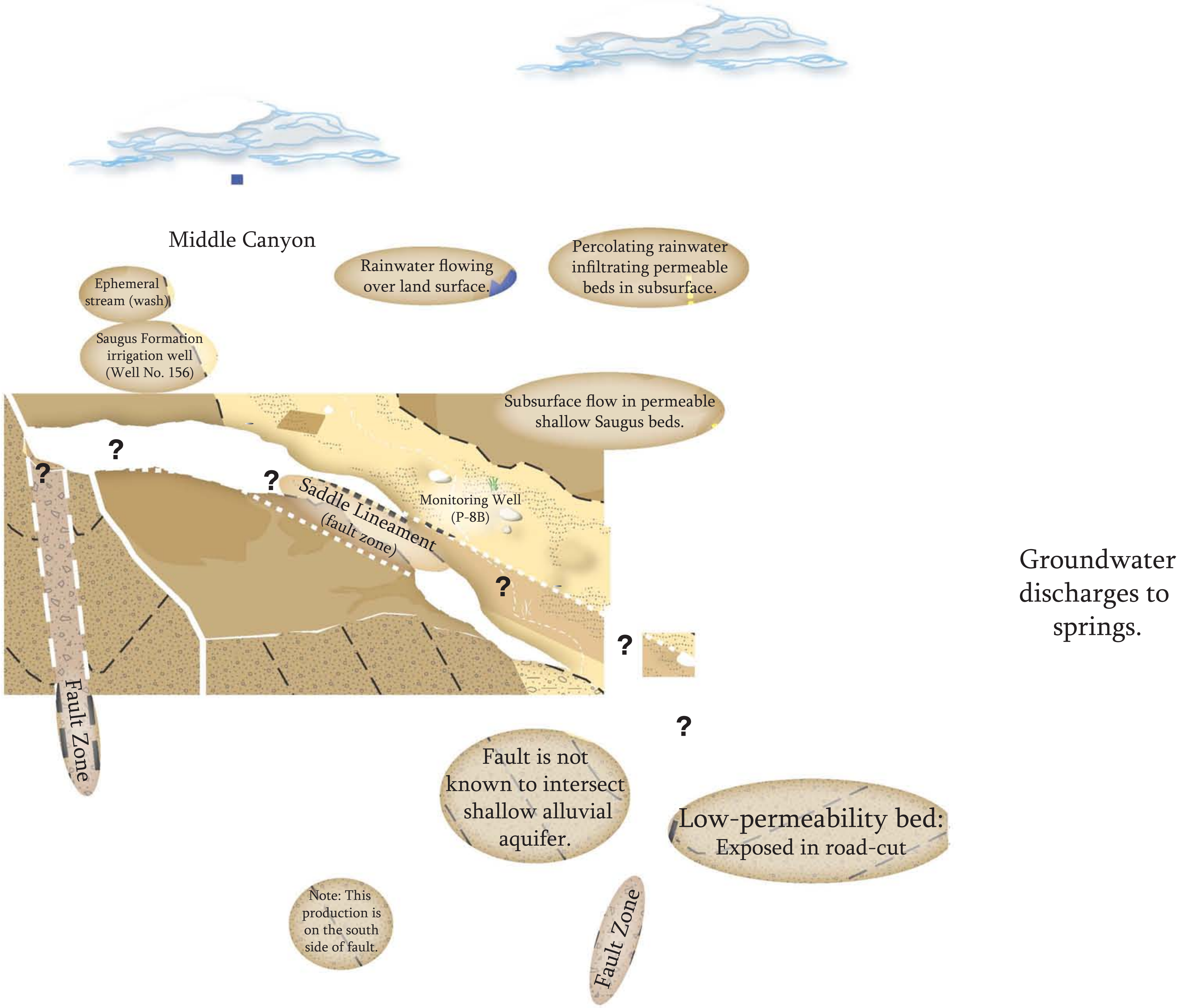
Piezometer (P-8B)
(Alluvium)

Well-156
(Saugus)

Note: For analytes reported as non-detect, a concentration of one-half the detection limit was used for plotting.

Figure 8
Piper Diagram
Newhall Ranch

P:\102 - Newhall\007 - Middle Canyon Spring\Figures\MC_Piper.xls



Legend

Shallow alluvium:
Loose & permeable.

Saugus Formation (Saugus):
Permeable with isolated beds of low permeability.

Geologic unit boundary.

Mapped, concealed fault zone boundary.

Unknown extent of fault zone boundary.

Relative direction of fault zone motion.

Static water level.

Water table surface.

Conceptual Model:

Rainwater that falls within the drainage basin flows overland to channels within the drainage system.

Surface water percolates into the permeable shallow alluvium.

Surface water percolates into the upper portion of the Saugus.

Irrigation water from a well completed in the deep Saugus (Well No.156) percolates into the shallow alluvium.

Alluvial groundwater mixes with percolated deep Saugus irrigation water. This groundwater is detected in Monitoring Well P-8B downgradient of irrigated land.

Some of the mixed groundwater builds up either behind the fault zone or an unmapped low permeability block and permeates adjacent dipping beds of the upper Saugus on the south side of the canyon. It then becomes perched on a layer in the Saugus Formation.

The perched groundwater in the upper Saugus flows westward along permeable beds.

The springs occur where a very permeable shallow Saugus bed intersects the ground surface.

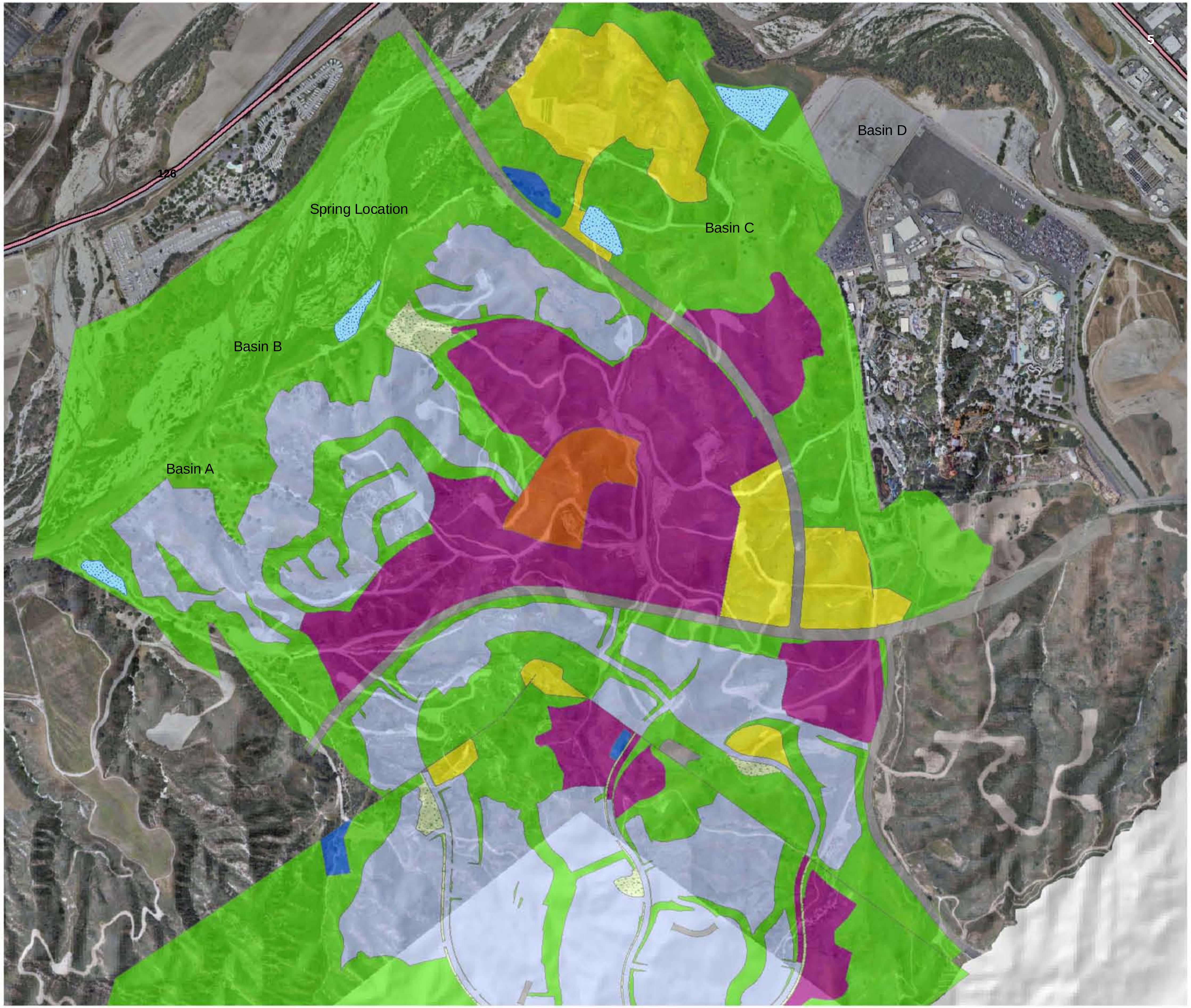
Figure 9

Middle Canyon Spring:
Hydrogeologic Conceptual Model

Newhall Land and Farming Company
September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Fig9_Conceptual Model_final draft_v3.pdf
Last modified: June 1, 2007

GSI Water Solutions, Inc.



Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

Legend

Land Use

Commercial

Education

Single Family

Multi Family

Park

Open Space

Water Quality Basins

Major Roads

Middle Canyon Watershed

Santa Clara River

Storm Drains

Major Roads

WQ Basins

Spring

Data Source: Geosyntec SWMM Model

0 625 1,250 2,500
Feet

Figure 10
Mission Village
Proposed Land Use

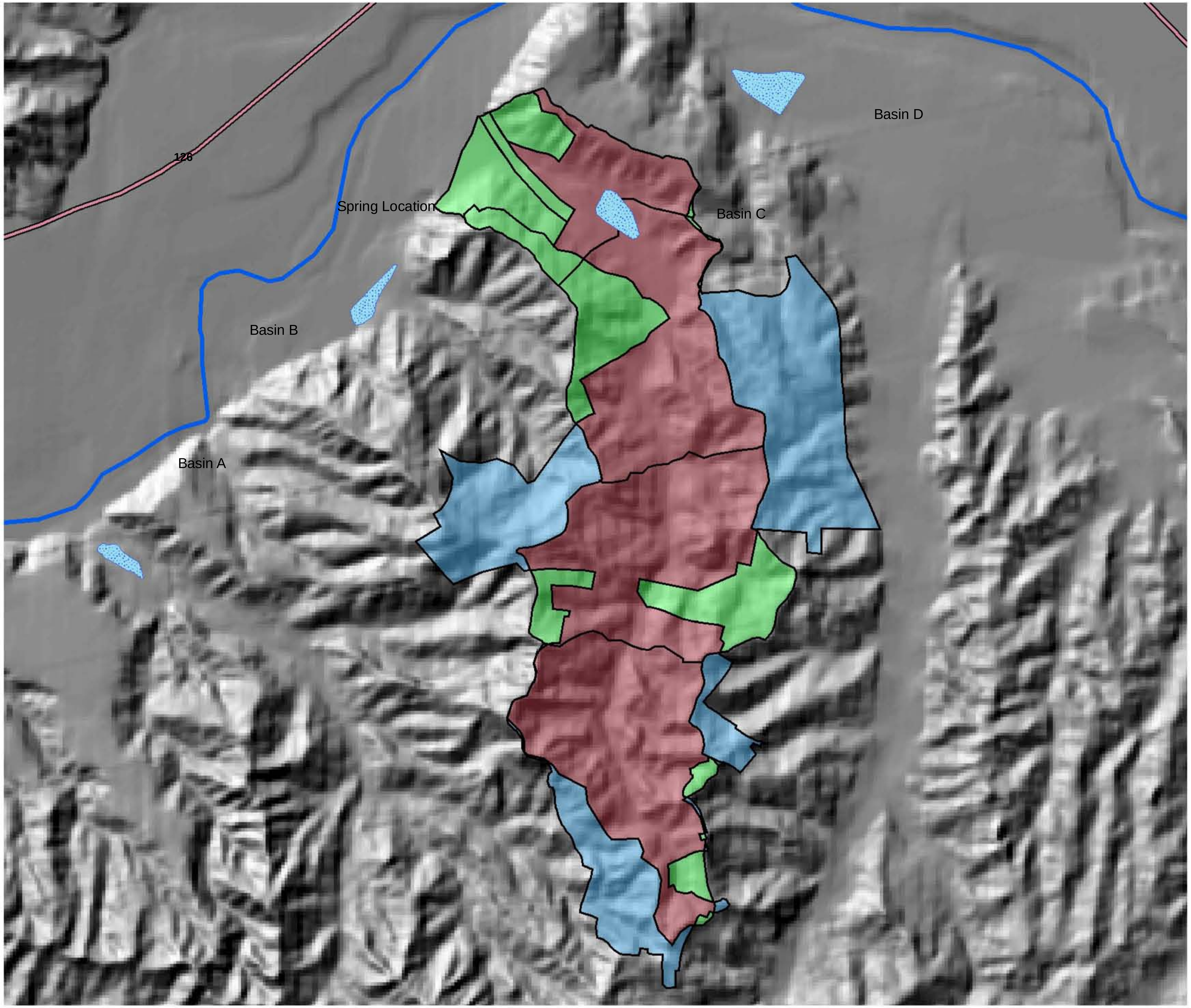
Newhall Land and Farming Company

GSI Water Solutions, Inc.

Geosyntec consultants

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Project_mxds\Fig10_Land_Use_GSI.mxd



Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

Legend

Santa Clara River

Major Roads

Spring

Middle Canyon Watershed

Storm Drains

WQ Basins

Proposed Catchment Type

Runoff Remains in Middle Canyon

Runoff Exported Out of Middle Canyon

Runoff Imported to Middle Canyon

Data Source: Geosyntec SWMM Model

0 625 1,250 2,500
Feet

Figure 11
Mission Village
Proposed Drainage

Newhall Land and Farming Company

GSI Water Solutions, Inc.

Geosyntec consultants

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Project_mxds\Fig11_Drainage_GSI.mxd

Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

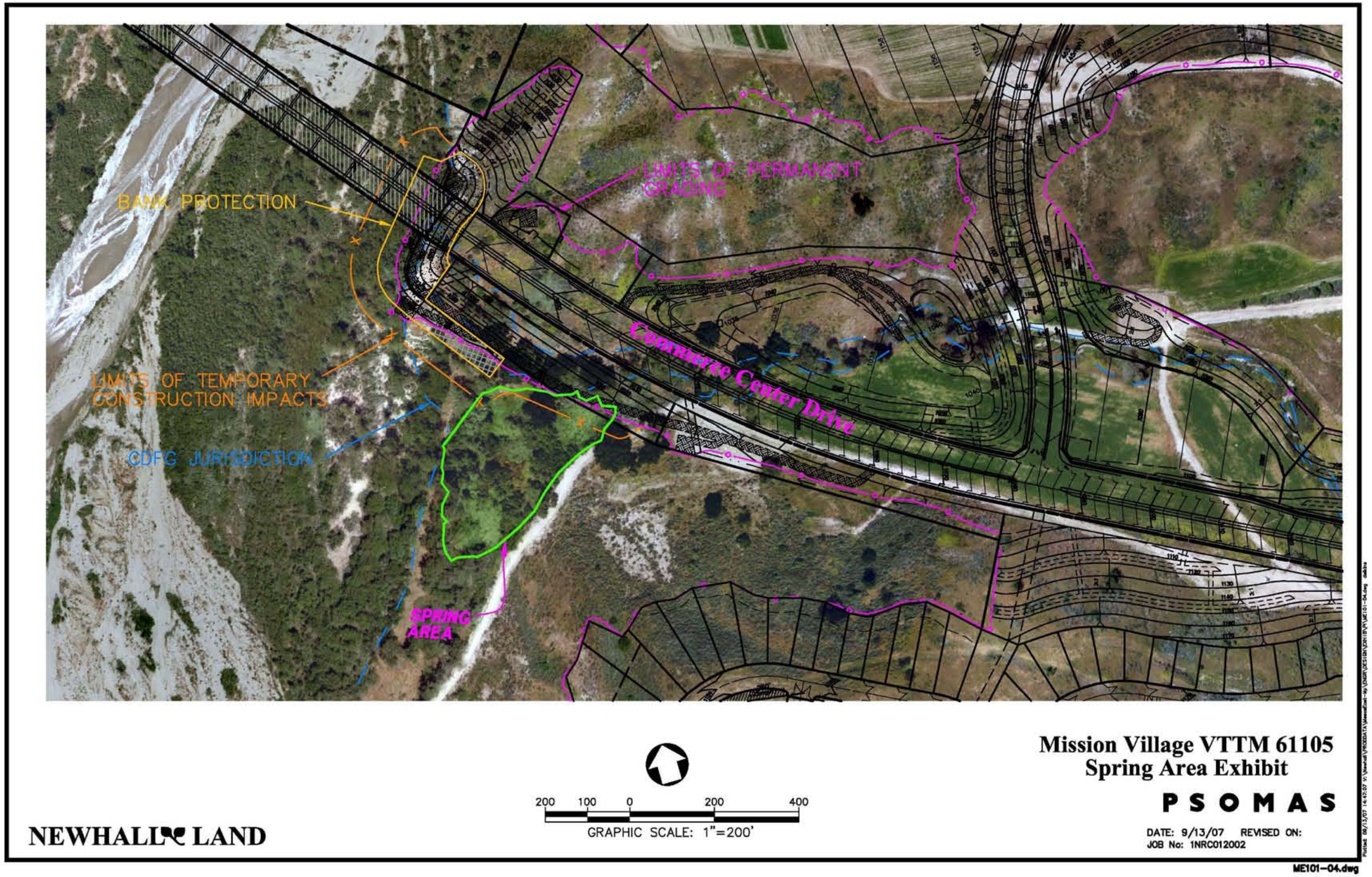


Figure 12
Original Alignment for
Commerce Center Drive
(12-21-2006 Tentative Tract Map)

Newhall Land and Farming Company

GSI Water Solutions, Inc.

PSOMAS

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Fig12_Spring_Aerial_GSI_rev.pdf

Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

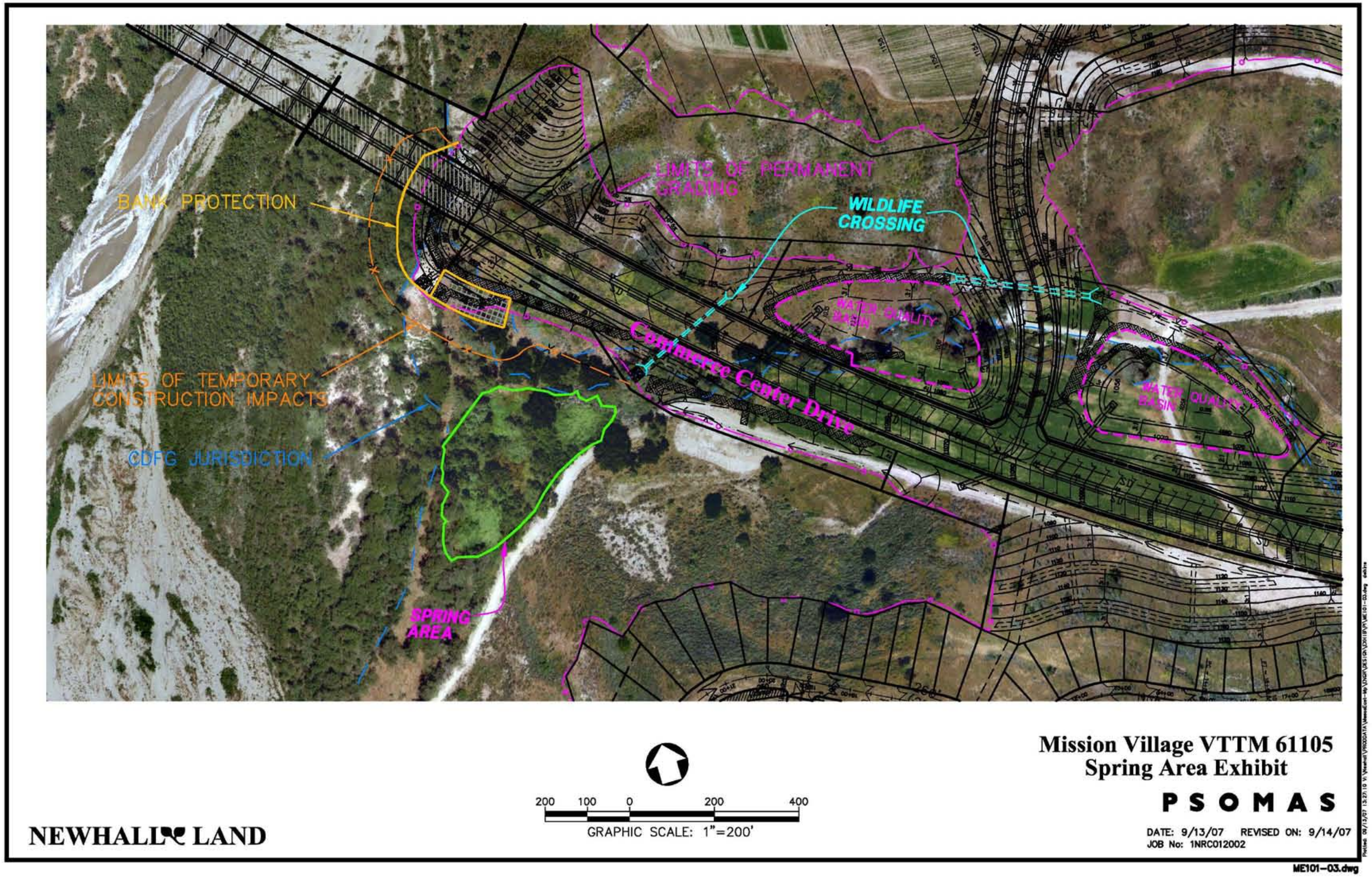


Figure 13

Revised Alignment for
Commerce Center Drive

Newhall Land and Farming Company

GSI Water Solutions, Inc.

PSOMAS

June 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Commerce_Center_Dr_RevAlign.pdf

Project
Vicinity

Santa Clarita

Ventura County

Los Angeles County

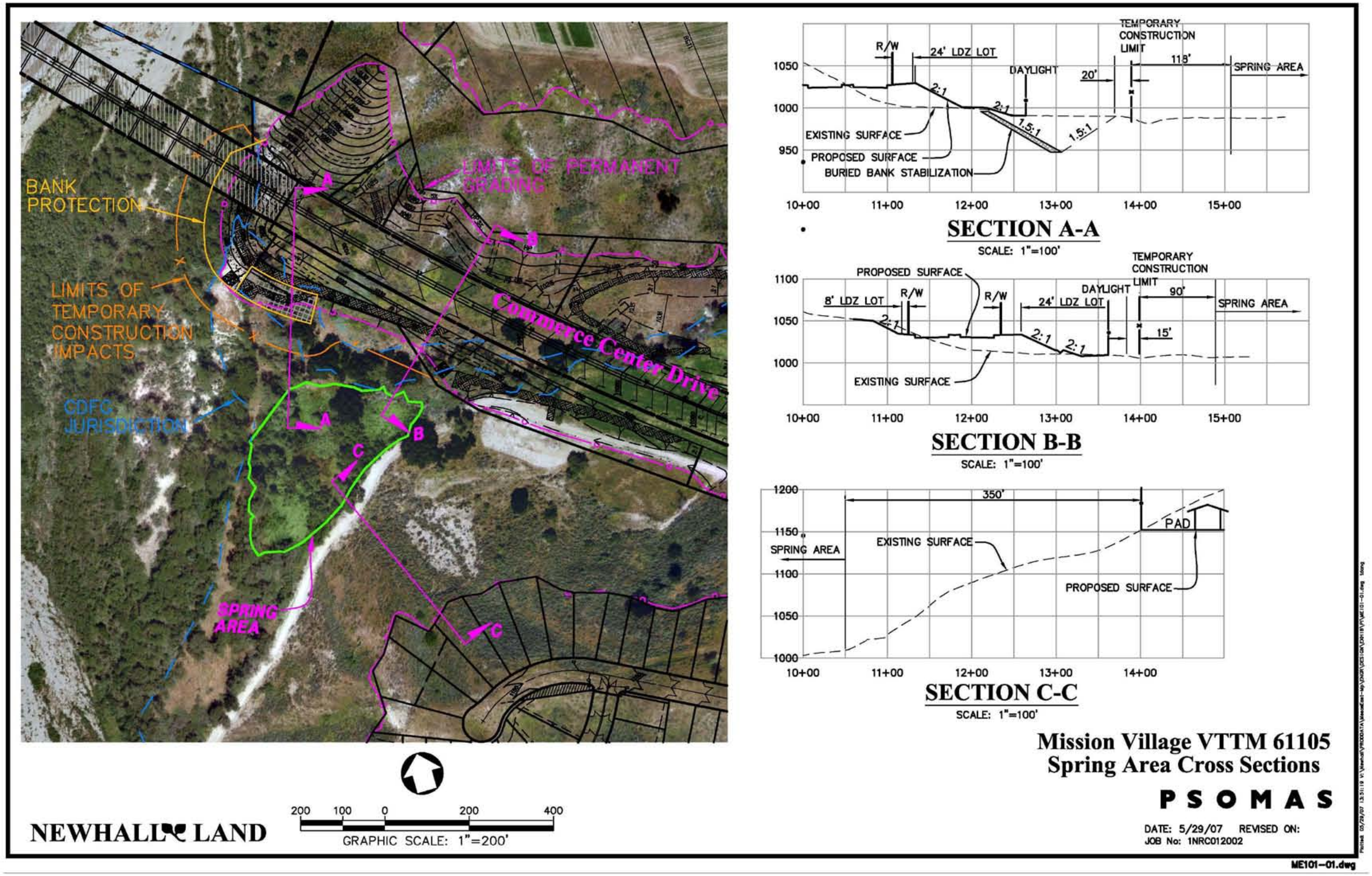


Figure 14

Cross Sections Through Revised Alignment for Commerce Center Drive

Newhall Land and Farming Company

GSI Water Solutions, Inc.

PSOMAS

September 2007

P:\102 - Newhall\007 - Middle Canyon Spring\Project_GIS\Draft_GIS_Figures\Fig14_XSections_Through_RevAlign.pdf

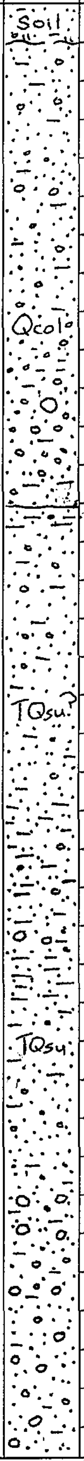
Appendix A

CLIENT: The Newhall Land & Farming Company
PROJECT: Evaluation of Middle Canyon Spring
Newhall Ranch
DRILLING COMPANY: ProSonic
DRILLING METHOD: Sonic Continuous Core
HAMMER TYPE: NA
DRIVING WEIGHTS: NA

JOB NO.: 07-1155PG (1)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 3/2/07 & 3/6/07
HOLE DIA: 7" Casing
AVERAGE DROP: NA
ELEVATION: 1028'±

DRILL HOLE LOG

BORING NO. CH-1

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
5 10 15 20 25 30 35						**SOIL; (0 - 1')** @ 0' Dark-brown (10YR 3/3) silty clayey sand with pebbles; cohesive; slightly damp **COLLUVIUM; Qcol (1 - 13')** @ 1' Pale-brown (10YR 6/3), silty, pebbly sand; loose; dry to slightly damp; poorly sorted @ 10' With cobbles and coarser sand; damp **BEDROCK ?; TQsu? (13 - 24')** @ 13' Light yellowish-brown (10YR 6/4) silty, clayey sandstone with pebbles; less friable; damp @ 13.5' Light-brown (7.5YR 6/3) silty, pebbly sandstone; damp to dry; poorly sorted @ 16.5' Sample material grades to moist @ 21' Light olive-brown (2.5YR 5/3) clayey, sandy siltstone with pebbles; moist **BEDROCK; TQsu (24 - 75')** @ 24' Light reddish-brown (5YR 6/3) pebbly, sandy siltstone with cobbles; moist @ 25' Light-gray (5Y 7/1) sandy siltstone/mudstone; moderately hard; dry @ 26' Light yellowish-brown (2.5Y 6/3), silty sandstone with pebbles; moist; moderately sorted @ 31' Coarse, silty, pebbly sandstone with cobbles; wet	@ 13 - 24' Weaterhed TQsu or colluvium @ 17 - 21' Sample completely saturated and disturbed; appears to be dominantly sand @ 27 -31' Sample completely saturated and disturbed; appears to be dominantly sand

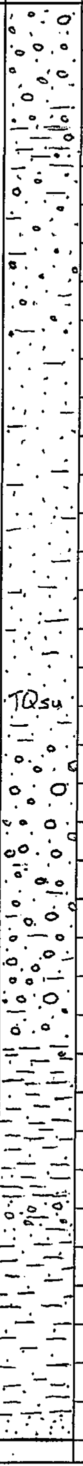
ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Evaluation of Middle Canyon Spring
Newhall Ranch
DRILLING COMPANY: ProSonic
DRILLING METHOD: Sonic Continuous Core
HAMMER TYPE: NA
DRIVING WEIGHTS: NA

JOB NO.: 07-1155PG (1)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 3/2/07 & 3/6/07
HOLE DIA: 7" Casing
AVERAGE DROP: NA
ELEVATION: 1028'±

BORING NO. CH-1

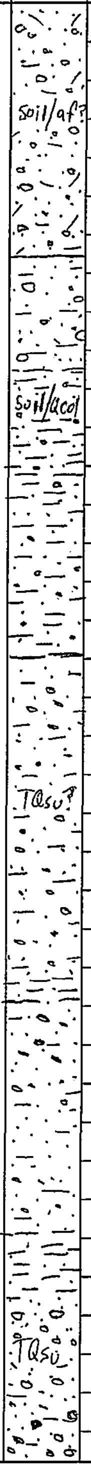
DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
							
40							
						@ 41' Interbed of light olive-brown (2.5Y 5/4) silty, clayey sandstone with pebbles; damp to moist	
						@ 42' Light yellowish-brown (10YR 6/4), fine- to medium-grained, silty sandstone with pebbles; damp to moist	
45							
						@ 47' Light yellowish-brown silty sandstone	Began drilling 47 - 57' on 3/2/07. Drill rig broke down; resumed on 3/6/07; Sample material from 47 - 57' completely saturated and disturbed
50							
55							
						@ 57' Grayish-brown (2.5YR 5/2) silty, very coarse-grained pebbly sandstone with cobbles; moist to wet	@ 57 - 66' Sample looks disturbed Driller said he hasn't hit anything hard up to 66'
60							
65						@ 65' Dark grayish-brown (2.5Y 4/2) clayey, silty sandstone with pebbles; damp to moist	@ 65' Bulk Sample
						@ 67' Light yellowish-brown (10YR 6/4) mudstone; damp	@ 67' Bulk Sample
						@ 69' Grayish-brown silty, coarse-grained pebbly sandstone; damp	
70						@ 70' Light yellowish-brown mudstone; damp	
							@ 72' Bulk Sample LL= 41 PI= 20
75						@ 74.5' More silt/sand content	

CLIENT: The Newhall Land & Farming Company	JOB NO.: 07-1155PG (1)	**DRILL HOLE LOG**
PROJECT: Evaluation of Middle Canyon Spring Newhall Ranch	DATE: 9/12/07	
	LOGGED BY: RHV	
DRILLING COMPANY: ProSonic	DRILLED: 3/2/07 & 3/6/07	
DRILLING METHOD: Sonic Continuous Core	HOLE DIA: 7" Casing	
HAMMER TYPE: NA	AVERAGE DROP: NA	**BORING NO.** CH-1
DRIVING WEIGHTS: NA	ELEVATION: 1028'±	

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
						TOTAL DEPTH 75' (Elev. 953') Ground Water @ 13' (Elev. 1015') No Caving (Hole Cased) Piezometer (P-1MS) installed to 60' on 4/27/07, 5' east of CH-1 in dirt road; 55' of screen and 5' of solid casing with bentonite/ grout seal and flushmount box at top; transducer installed on 6/18/07 at depth of approximately 30'	Boring backfilled with Enviroplug medium bentonite chips form 75' to 63' (6 bags); Backfilled with cuttings to surface; Hole backfilled again on 4/27/07 following settlement
80							
85							
90							
95							
100							
105							
110							

ALLAN E. SEWARD ENGINEERING GEOLOGY. INC.

CLIENT: The Newhall Land & Farming Company	JOB NO.: 07-1155PG (1)	**DRILL HOLE LOG**
PROJECT: Evaluation of Middle Canyon Spring Newhall Ranch	DATE: 9/12/07	
	LOGGED BY: RHV	
DRILLING COMPANY: ProSonic	DRILLED: 3/6/07 & 3/7/07	
DRILLING METHOD: Sonic Continuous Core	HOLE DIA: 7" Casing	
HAMMER TYPE: NA	AVERAGE DROP: NA	**BORING NO.** CH-2
DRIVING WEIGHTS: NA	ELEVATION: 1029'±	

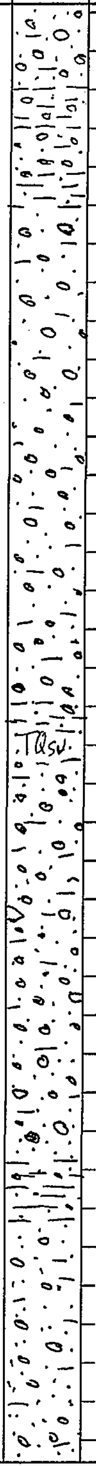


DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
						SOIL/ARTIFICIAL FILL?; soil/af? (0 - 6.5') @ 0 - 6.5' Pale-yellow (2.5Y 7/4) silty, pebbly sand with cobbles; dry to damp	
5							
						SOIL/QUATERNARY COLLUVIUM; soil/Qcol (6. 5 - 17') @ 6.5' Light yellowish-brown (2.5Y 6/3) silty, pebbly sand with cobbles; black silty organic content; loose; dry to damp	
10						@ 9.5' Black (5Y 2.5/1) organic-rich sandy, clayey silt with pebbles; loose; damp	
						@ 12' Very dark-gray (2.5Y 3/1) sandy, clayey silt with pebbles; less organics; loose; damp	
						@ 13' Dark-brown (10YR 3/3) sandy, clayey silt with pebbles; cohesive; damp to moist; orange staining	
15							@ 15' Bulk Sample
						BEDROCK ?; TQsu? (17 - 32') @ 17' Light yellowish-brown (2.5Y 6/3) clayey, silty sandstone with pebbles; cohesive; soft; damp to moist	Material from 17 - 32' is not as tight as typical TQsu; May represent colluvium or possibly landslide affected TQsu
20						@ 20' Light yellowish-brown pebbly, silty sandstone; friable; moist; moderate orange oxidation; grades coarser with depth	
25						@ 25.5' 6"-thick interbed of light olive-brown (2.5Y 5/4) clayey, sandy siltstone; moist; moderate orange oxidation	
30							
						BEDROCK; TQsu (32 - 107') @ 32' Light olive-brown mudstone; cohesive; damp; moderate orange oxidation	@ 32' Bulk Sample
35						@ 33.5' Olive-brown (2.5Y 4/4) pebbly, silty sandstone with cobbles; damp; blocky	
						@ 36' Grayish-brown (2.5Y 5/2) silty, pebbly sandstone with cobbles; damp to moist	

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG (1)
PROJECT: Evaluation of Middle Canyon Spring Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: ProSonic
DRILLED: 3/6/07 & 3/7/07
DRILLING METHOD: Sonic Continuous Core
HOLE DIA: 7" Casing
HAMMER TYPE: NA
AVERAGE DROP: NA
DRIVING WEIGHTS: NA
ELEVATION: 1029'±

DRILL HOLE LOG

BORING NO. CH-2

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
40						@ 40' Olive-brown pebbly, sandy siltstone/mudstone; cohesive; damp; moderate orange oxidation	
						@ 41' Grayish-brown silty, pebbly sandstone with cobbles; friable; moist	
						@ 42.5' Olive-gray (5Y 5/2) clayey, sandy siltstone; cohesive; damp; slight orange coloration	@ 42.5' Bulk Sample
						@ 43' Grayish-brown silty, pebbly sandstone with cobbles; friable; moist	
45							
50							
55							
			TQsv			@ 56' Clayey, silty sandstone with pebbles/cobbles; moist; moderate orange oxidation	
						@ 58' Grayish-brown (2.5Y 5/2) silty, pebbly sandstone with cobbles; friable; moist to wet	
60							@ 60' Bulk Sample
65							
						@ 68' 1 1/2'-thick interbed of pebbly, sandy mudstone	At 8:30 a.m. on 3/7/07, Ground Water is at 20' inside casing. Drilling soft to 67' but getting harder to 77'
70							
75							

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG (1)
PROJECT: Evaluation of Middle Canyon Spring Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: ProSonic
DRILLED: 3/6/07 & 3/7/07
DRILLING METHOD: Sonic Continuous Core
HOLE DIA: 7" Casing
HAMMER TYPE: NA
AVERAGE DROP: NA
DRIVING WEIGHTS: NA
ELEVATION: 1029'±

BORING NO. CH-2

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	DESCRIPTION	Remarks
							@ 78 - 84' Wet zone
80							
						@ 84' Interbed of olive-gray (5Y 5/2) silty, clayey sandstone with pebbles and cobbles; very compact/hard; damp	
85						@ 85' Interbedded mudstone and coarse-grained, grayish-brown silty, pebbly sandstone; fine-grained layers appear more competent	
							@ 88' Bulk Sample
90							
95							
						@ 99' Light olive-brown (2.5Y 5/3) silty, pebbly mudstone with cobbles; moist	
100							
105							
						TOTAL DEPTH 107' (Elev. 922') Ground Water approximately @ 20' on morning of 3/7/07 Ground Water @ 18' initially in confirmatory boring (4/26/07) Ground Water @ 12.5' the following morning (4/27/07) No Caving (Hole Cased)	Boring Backfilled with cuttings from 107 - 47.5'; backfilled with bentonite chips from 47.5 to 5' (13 bags) and the last 5' backfilled with cuttings
110							

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: BMW
DRILLING COMPANY: Valley Well Drilling
DRILLED: 6/8/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 6"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1002'

BORING NO. HS-1MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0 - 28')**				
5	■	18		SP-SM	@ 5' Poorly graded SAND with silt and gravel; loose; damp; dark yellowish brown (10YR 4/4)	9.0	121		
10	⧄	12		CL	@ 10' No recovery; sampler came up wet with clayey residue; lean clay?				
15	■	9			@ 15' Sandy lean CLAY with gravel; firm; wet; dark brown (10YR 3/3)	15.5	115		
20	■	8		CH	@ 20' Sandy fat CLAY with gravel; firm; wet; olive gray (5Y 4/2) to black (10YR 2/1)	17.4	103		LL= 52 PI= 33
25	■	23			@ 25' Fat CLAY with sand; stiff; very dark gray (5Y 3/1)	27.8	100	81	
				SP	**WEATHERED BEDROCK; TQs (28 - 43')**				
30	■	79			@ 30' Poorly graded SANDSTONE with silt; dense; wet; brownish yellow (10YR 6/8)	10.0	129		
35	■	80		SP-SM	@ 35' Silty SANDSTONE/poorly graded SANDSTONE with silt; dense; wet; yellowish brown (10YR 5/4)	12.6	126		

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: BMW
DRILLED: 6/8/07
HOLE DIA: 6"
AVERAGE DROP: 30"
ELEVATION: 1002'

DRILL HOLE LOG

BORING NO. HS-1MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	68		SM	@ 40' Silty clayey SANDSTONE with gravel; dense; wet; brown (10YR 5/3)	18.0	114		
				SP-SM	**BEDROCK; TQs (43 - 60')**				
45	■	50/5"			@ 45' Silty SANDSTONE; very dense; wet; yellowish brown (10YR 5/6); layers of poorly graded gravel	9.5	126		
50	■	50/6"		SC	@ 50' Clayey SANDSTONE with gravel; very dense; moist; yellowish brown (10YR 5/6)	15.3	121		
55									
60					TOTAL DEPTH 60' (Elev. 942') Ground Water initially encountered @ 13' Ground Water @ surface at end of drilling Ground Water @ surface on 6/11/07 with evidence of possible minor surficial flow				
65									
70									
75									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: BMW
DRILLED: 6/7/07
HOLE DIA: 6"
AVERAGE DROP: 30"
ELEVATION: 1028'

BORING NO. HS-2MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0 - 25')**				
5		28		ML	@ 5' Sandy SILT; very stiff; dry; dark brown (10YR 3/3); $CaCo_3$	6.3	121		
10		8		CL	@ 10' Lean CLAY; firm; moist; olive brown (2.5Y 4/3)	23.1	103		
15		14		CL	@ 15' Lean CLAY; firm; moist; olive brown (2.5YR 4/3)	19.0	109		LL= 32 PI= 13
20		25			@ 20' Sandy lean CLAY; stiff; moist; brown (10YR 4/3)	17.1	116	6	
25		50/6"		SP-SC	**WEATHERED BEDROCK; TQs (25 - 42')** @ 25' Clayey SAND with gravel to poorly graded SAND with gravel in tip; sandy SILT in rings; very dense; wet; dark yellowish brown (10YR 3/6)	14.1	123		
30		60		SM	@ 30' Silty SAND with gravel; dense; wet; brownish yellow (10YR 6/6)	10.4	128		
35		50/6"		SP	@ 35' Poorly graded SAND with silt; very dense; wet; yellowish brown (10YR 5/6)	10.2	130		

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: BMW
DRILLED: 6/7/07
HOLE DIA: 6"
AVERAGE DROP: 30"
ELEVATION: 1028'

DRILL HOLE LOG

BORING NO. HS-2MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	54		SC-SM	@ 40' Silty clayey SAND; medium dense to dense; wet; dark yellowish brown (10YR 4/6)	14.3	120		
				SM	**BEDROCK; TQs (42 - 60')**				
45	■	50/5"			@ 45' Silty SANDSTONE; very dense; damp to wet; dark yellowish brown (10YR 4/6)	8.8	130		
50	■	91/ 11"		SC	@ 50' Clayey SANDSTONE to sandy lean CLAYSTONE; very dense; moist to wet; yellowish brown (10YR 5/4)	15.5	120		
55									
60	■	50/5"		SM	@ 60' Silty SANDSTONE with gravel; very dense; moist to wet; olive brown (2.5YR 4/4)	8.7	135		
					TOTAL DEPTH 60' (Elev. 968') Ground Water initially encountered @ 23' Ground Water @ 6' after completion of hole and on 6/11/07				
65									
70									
75									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/18/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1042'

BORING NO. HS-3MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0 - 32')**				
5	■	1		CL-ML	@ 5' Silty CLAY; very soft; wet; very dark grayish brown (10YR 3/2)	19.9	104		
					@ 9' - ground water				
10	■	11			@ 10' Sandy silty CLAY with gravel; firm; wet; dark brown (10YR 3/3)	17.2	115		
15	■	13		ML	@ 15' Sandy SILT; firm; moist to wet; mottled olive brown (2.5Y 4/4) to grayish brown (2.5Y 5/2)	14.5	119		
20	■	17			@ 20' Sandy SILT with gravel; stiff; moist to wet; mottled olive brown (2.5Y 4/4) to grayish brown (2.5Y 5/2)	17.9	115		
25	■	33		SM	@ 25' Silty SAND with gravel; medium dense; moist; light olive brown (2.5Y 5/4)	15.4	119		
30				GP	@ 30' Rock in hole - no sample; possible basal alluvium gravel; drilling became harder below the rock				
				SP	**BEDROCK; TQsu (32 - 55')**				
35	■	82			@ 35' Poorly graded SANDSTONE with silt and gravel; dense; wet; light olive brown (2.5Y 5/4)	9.9	131		

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/18/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1042'

BORING NO. HS-3MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	91			@ 40' Poorly graded SANDSTONE with silt and gravel; very dense; wet; light olive brown (2.5Y 5/4)	9.8	126		
45	■	50/3"		SM	@ 45' Silty coarse SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/4); gravely layer in upper portion of sampler barrel	7.9	135		
50									
55	■	50/4"			@ 55' Silty SANDSTONE; very dense; moist to wet; olive brown (2.5Y 4/4) to light olive brown (2.5Y 5/4)	13.6	121		
					TOTAL DEPTH 55' (Elev. 987') Ground Water @ 9' (Boring located in actively irrigated field) Piezometer subsequently installed on 6/8/07 (screen from 30 to 5', blank above) Ground water @ 5.8' on 6/11/07				
60									
65									
70									
75									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/18/07
HOLE DIA: 8"
AVERAGE DROP: 24"
ELEVATION: 1049'

BORING NO. HS-4MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0 - 27')**				
5		6		CL-ML	@ 5' Sandy silty CLAY with gravel; soft; moist; dark brown (10YR 3/3); no recovery (description from cuttings)	13.1	122		
10	■	10			@ 10' Sandy silty CLAY with gravel; firm; wet; dark brown (10YR 3/3)	20.3	101		
15	■	17		ML	@ 15' Sandy SILT with gravel; stiff; wet; light olive brown (2.5Y 5/5)	14.9	121		
20	■	29		CL-ML	@ 20' Silty CLAY with gravel; very stiff; damp to moist; olive brown (2.5Y 4/4)	17.2	119		
25	■	33		SM	@ 25' Silty SAND with gravel; medium dense; moist; olive brown (2.5Y 4/4)	17.5	117		
					BEDROCK; TQsu (27 - 60') @ 27' Drilling harder				
30	■	50/4"			@ 30' Silty SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/4)	13.6	128		
35	■	50/5"			@ 35' Silty coarse-grained SANDSTONE with gravel; very dense; moist to wet; light olive brown (2.5Y 5/6)	38.8	103		

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/18/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 24"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1049'

DRILL HOLE LOG

BORING NO. HS-4MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	50/4"		SP	@ 40' Poorly graded SANDSTONE with silt and gravel; very dense; damp; light olive brown (2.5Y 5/6)	5.4	89		
45	■	50/4"		SM	@ 45' Silty, coarse-grained SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/3)	7.8	132		
50	■	50/6"			@ 50' Silty coarse-grained SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/4)	10.5	128		
55									
60	■	50/3"		SP	@ 60' Poorly graded SANDSTONE with silt and gravel; very dense; wet; olive brown (2.5Y 4/4)				
					TOTAL DEPTH 60' (Elev. 989') Ground Water @ 9' (Boring located in actively irrigated field)				
65									
70									
75									

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/17/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1063'

DRILL HOLE LOG

BORING NO. HS-5MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0 - 43')**				
5	⧄	13			@ 5' No sample; rock in tip; blow count suspect				
10	■	9	▥	ML	@ 10' Sandy SILT with gravel; firm; damp; yellowish brown (10YR 5/4)	7.8	109		
15	■	13	▥		@ 15' Sandy SILT with gravel; firm; damp to moist; dark yellowish brown (10YR 4/4)	15.6	115		
20	■	60	▒	SM	@ 20' Silty SAND with gravel; dense; moist; light olive brown (2.5Y 5/4)	10.6	119		
25	■	61	▒		@ 25' Silty coarse SAND with gravel; dense; damp to moist; light olive brown (2.5Y 5/4)	4.3	118		
30	■	35	▽ ▒		@ 30' Silty SAND; medium dense; moist to wet; dark yellowish brown (10YR 3/6)	12.2	120		
35	■	89/ 10"	▒		@ 35' Silty SAND with gravel; very dense; moist to wet; olive brown (2.5Y 4/4)	9.7	130		

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/17/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1063'

BORING NO. HS-5MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	48		SP	@ 40' Poorly graded coarse SAND with gravel; medium dense; wet; small cobbles	6.1	132		
				SM	**<u>BEDROCK</u>; TQsu (43 - 65')**				
45	■	79/8"			@ 45' Silty coarse SANDSTONE with gravel; very dense; dry to damp; olive brown (2.5Y 4/4)	7.3	132		
50	■	74		ML	@ 50' Sandy SILTSTONE; hard; dry to damp; light olive brown (2.5Y 5/6); CaCo$_3$	15.2	120		
55									
60	■	72/ 10"		SM	@ 60' Silty SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/4)	8.4	134		
65	■	50/5"			@ 65' Silty SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/4)				
					TOTAL DEPTH 65' (Elev. 998') Ground Water @ 30' (Boring located in actively irrigated field)				
70									
75									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/15-5/16/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1071'

BORING NO. HS-6MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0			▥		**QUATERNARY ALLUVIUM; Qal (0 - 42')**				
5	■	8	▥	SM	@ 5' Silty SAND; loose; damp; dark yellowish brown (10YR 4/4)	9.9	118		
10	■	16	⁘	SP	@ 10' Poorly graded SAND with silt and gravel; loose; damp to moist; light olive brown (2.5Y 5/3)	2.5	115		
15	■	15	▨	SC-SM	@ 15' Silty clayey SAND with gravel; loose; damp; olive brown (2.5Y 4/3)	12.4	119		
20	■	17	⁘	SP	@ 20' Poorly graded SAND with silt and gravel; loose; dry to damp; light olive brown (2.5Y 5/4)	3.2	114		
25	■	23	▥	SM	@ 25' Silty SAND with gravel; medium dense; moist; olive brown (2.5Y 4/4)	6.2	121		
30	■	41	▥		@ 30' Silty SAND with gravel; medium dense; moist; light olive brown (2.5Y 5/4).	9.4	119		
35	■	76	⁘	SP	@ 35' Poorly graded SAND with gravel; dense; moist; olive brown (2.5Y 4/4)	3.1	121		

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/15-5/16/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1071'

DRILL HOLE LOG

BORING NO. HS-6MC

						LABORATORY TESTS			
DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	24	▽	SM	@ 40' Silty SAND with gravel; medium dense; wet; olive brown (2.5Y 4/3)	18.1	112		
				SP	**<u>BEDROCK</u>; TQsu (42 - 90')**				
45	■	50/6"			@ 45' Small sample recovery in tip; very coarse sand with no apparent matrix; very dense; wet				
50	■	50/3"		SM	@ 50' Silty SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/3)	8.0	137		
55									
60	■	50/2"		SP	@ 60' Poorly graded SANDSTONE with silt and gravel; very dense; wet; light olive brown (2.5Y 5/3)	10.6	127		
65									
70	■	50/4"		SM	@ 70' Silty SANDSTONE; very dense; wet; light olive brown (2.5Y 5/3)				
75									

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/15-5/16/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1071'

DRILL HOLE LOG

BORING NO. HS-6MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
80	■	50/4"	░	SP	@ 80' Poorly graded SANDSTONE with silt and gravel; very dense; wet; light olive brown (2.5Y 5/4)				
85			░						
90	■	50/2"	▨	CL-ML	@ 90' Silty CLAYSTONE; hard; damp to dry; olive brown (2.5Y 4/4)				
					TOTAL DEPTH 90' (Elev. 981') Ground Water @ 39.5'(Boring located in actively irrigated field)				
95									
100									
105									
110									
115									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/15/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1079'

BORING NO. HS-7MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**<u>QUATERNARY ALLUVIUM</u>; Qal (0 - 33')**				
5	■	7		SM	@ 5' Silty SAND with gravel; loose; damp to moist; light yellowish brown (2.5Y 6/3)	10.5	107		
10	■	27		SP	@ 10' Poorly graded coarse SAND with gravel; medium dense; damp; light olive brown (2.5Y 5/3)	2.4	124		
15	■	9		CL	@ 15' Lean CLAY with sand; firm; damp to moist; olive brown (2.5Y 4/3); $CaCo_3$?	15.0	110		
20	■	32			@ 20' Lean CLAY with sand; very stiff; damp; light olive brown (2.5Y 5/6); $CaCo_3$?	19.3	107		
25	■	46			@ 25' Sandy lean CLAY; medium dense; damp; light olive brown (2.5Y 5/4)	18.6	115		
30	■	52		SP	@ 30' Poorly graded coarse SAND with gravel; medium dense; damp to moist; light olive brown (2.5Y 5/4); moderate oxidation	4.0	119		
					<u>BEDROCK</u>; TQsu (33 - 80')				
35	■	50/5"			@ 35' Poorly graded SANDSTONE with gravel; dense to very dense; damp to moist; light olive brown (2.5Y 5/4); slight oxidation	5.5	122		

CLIENT: The Newhall Land & Farming Company	JOB NO.: 07-1155PG-1 (4)	**DRILL HOLE LOG**	
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch	DATE: 9/12/07 LOGGED BY: RHV		
DRILLING COMPANY: Valley Well Drilling	DRILLED: 5/15/07		
DRILLING METHOD: Hollow Stem	HOLE DIA: 8"	**BORING NO.**	HS-7MC
HAMMER TYPE: Autohammer	AVERAGE DROP: 30"		
DRIVING WEIGHTS: 140 lbs	ELEVATION: 1079'		

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	50	▨	CL	@ 40' Lean CLAYSTONE with sand; hard; damp; light olive brown (2.5Y 5/6)	18.9	109		
45	■	50	▨		@ 45' Lean CLAYSTONE with sand; very stiff; damp to moist; olive brown (2.5Y 4/4); moderate oxidation	21.0	103		
50	■	50/5"	▨		@ 50' Sandy lean CLAYSTONE; hard; dry to damp; light olive brown (2.5Y 5/6)	17.5	113		
55	■	50/5"	▥	ML	@ 55' Sandy SILTSTONE with gravel; hard; dry to damp; light olive brown (2.5Y 5/4)				
60			▥						
65	■	50/5"	▨	CL-ML	@ 65' Silty CLAYSTONE with gravel; hard; dry to damp; light olive brown (2.5Y 5/4); $CaCo_3$				
70			▨						
75	■	78	▨		@ 75' Silty CLAYSTONE; hard; dry to damp; olive brown (2.5Y 4/4); below silty sand; light olive brown (2.5Y 5/4); very hard drilling below 75'				

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/15/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1079'

DRILL HOLE LOG

BORING NO. HS-7MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
			▨						
80	■	50/3"	▨	CL	@ 80' Lean CLAYSTONE; hard; dry to damp; dark yellowish brown (10YR 4/6)				
					TOTAL DEPTH 80' (Elev. 998') Ground Water @ 73' (Boring located in actively irrigated field)				
85									
90									
95									
100									
105									
110									
115									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/16/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1083'

BORING NO. HS-8MC

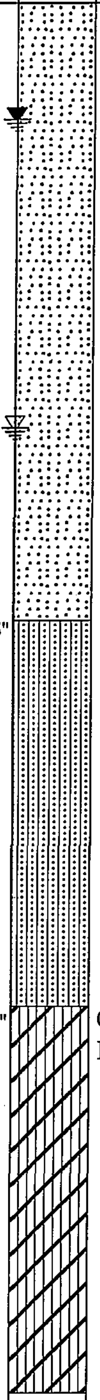
DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0			▨		**QUATERNARY ALLUVIUM; Qal (0 - 35')**				
5	■	11	▨	CL	@ 5' Sandy lean CLAY with gravel; firm; damp; dark yellowish brown (10YR 4/4)	14.2	115		
10	■	7	▨		@ 10' Sandy lean CLAY with gravel; soft; damp; light yellowish brown (2.5Y 5/4)	10.4	108		
15	■	15	░	SP	@ 15' Poorly graded SAND with silt and gravel; loose; damp; light yellowish brown (2.5Y 6/4)	2.8	113		
20	■	5	▥	SM	@ 20' Silty clayey SAND with gravel; very loose; damp; light yellowish brown (2.5Y 6/4)	14.4	111		
25	■	19	░	SP	@ 25' Poorly graded SAND with silt and gravel to silty clayey SAND; medium dense; damp; light yellowish brown (2.5Y 6/4)	3.2	116		
30	■	16	▥	SM	@ 30' Silty clayey SAND with gravel; loose; damp; olive brown (2.5Y 4/4)	9.5	120		
35	■	74	░	SP	**BEDROCK; TQsu (35 - 75')** @ 35' Poorly graded coarse SANDSTONE with silt and gravel; dense; damp to moist; light olive brown (2.5Y 5/4)	3.7	121		

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)

DRILL HOLE LOG

PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/16/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1083'

BORING NO. HS-8MC



DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS: Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	50		@ 40' Poorly graded coarse SANDSTONE with silt, gravel and cobbles; very dense; damp; light olive brown (2.5Y 5/4)	5.2	116		
45	■	50			3.7	129		
50								
55	■	50/5"	SM	@ 55' Silty SANDSTONE with gravel; very dense; wet; light olive brown (2.5Y 5/3)	13.8	122		
60								
65	■	50/3"	CL-ML	@ 65' Silty CLAYSTONE; hard; damp; olive brown (2.5Y 4/4)				
70								
75				TOTAL DEPTH 75' (Elev. 1008') Ground Water @ 50' initially; @ 42' on 5/17/07 Piezometer installed (screen from 73 to 8'; blank above) (Boring located in				

ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/16/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1083'

DRILL HOLE LOG

BORING NO. HS-8MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
					actively irrigated field)				
80									
85									
90									
95									
100									
105									
110									
115									

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/17/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1098'

BORING NO. HS-9MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0			▥		**<u>QUATERNARY ALLUVIUM</u>; Qal (0 - 38')**				
5	■	9	▥	ML	@ 5' Sandy SILT; firm; damp; yellowish brown (10YR 5/4)	11.3	112		
10	■	16	▨	CL-ML	@ 10' Silty CLAY with gravel; stiff; damp to moist; dark yellowish brown (10YR 4/4)	13.3	117		
15	■	11	▒	SM	@ 15' Silty SAND with gravel; loose; damp to moist; light olive brown (2.5Y 5/4)	8.8	109		
20	■	20	▒		@ 20' Silty SAND; medium dense; damp to moist; light olive brown (2.5Y 5/4)	7.9	113		
25	■	20	▒		@ 25' Silty SAND with gravel; medium dense; damp to moist; light olive brown (2.5Y 5/4)	4.5	122		
30	■	34	▒			3.0	128		
35	■	37	░	SP	@ 35' Poorly graded coarse SAND with silt and gravel; medium dense; damp to moist; light olive brown (2.5Y 5/4)	2.3	120		
			░		**<u>BEDROCK</u>; TQsu (38 - 50')**				

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/17/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1098'

BORING NO. HS-9MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	83/ 11"	░		@ 40' Poorly graded SAND with silt and gravel; very dense; damp; light olive brown (2.5Y. 5/4)	7.6	127		
45	■	50/4"	▥	SM	@ 45' Silty SAND with gravel; very dense; damp; light olive brown (2.5Y 5/3)	5.8	107		
50	■	50/4"	▨	SC	@ 50' Clayey SAND with gravel; very dense; damp; olive brown (2.5Y 4/4)	5.2	109		
					TOTAL DEPTH 50' (Elev. 1048') No Ground Water (Boring located in actively irrigated field)				
55									
60									
65									
70									
75									

KEY TO SYMBOLS

Symbol	Description
UNITED SOIL CLASSIFICATION SYMBOLS	
▥	Silt
▥	Silty sand
▒	Poorly graded sand
▩	Silty clayey sand
▧	Silty lean clay
▨	Lean clay
▨	Clayey sand
GROUND WATER DATA	
▽	GROUND WATER WHILE DRILLING
▼	GROUND WATER AFTER DRILLING
SAMPLE TYPE	
⧅	No Recovery
■	CALIFORNIA DRIVE SAMPLE Split-barrel sampler in accordance with ASTM D-3550 Standard Test Method

Notes:

1. These logs are subject to the limitations, conclusions, and recommendations in this report.

2. Results of tests conducted on samples recovered are reported on the logs.

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow Stem
HAMMER TYPE: Autohammer
DRIVING WEIGHTS: 140 lbs

JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 5/18/07
HOLE DIA: 8"
AVERAGE DROP: 30"
ELEVATION: 1111'

DRILL HOLE LOG

BORING NO. HS-10MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0			▨		**QUATERNARY ALLUVIUM**; **Qal (0 - 43')**				
5	■	26	▨	SC-SM	@ 5' Silty clayey SAND with gravel; medium dense; damp; brown (10YR 4/3)	9.0	129	48	
10	■	5	▨		@ 10' Silty SAND with gravel; very loose; dry to damp; dark yellowish brown (10YR 4/6)	6.1	113		
15	■	12	░	SM	@ 15' Silty SAND with gravel and cobbles; loose; damp; yellowish brown (10YR 5/6)	8.6	113		
20	■	31	░		@ 20' Silty SAND with gravel; medium dense; damp; yellowish brown (10YR 5/6)	3.6	119		
25	■	39	░		@ 25' Silty SAND with gravel; medium dense; damp; light olive brown (2.5Y 5/4)	3.3	114		
30	■	25	░		@ 30' Silty SAND with gravel; medium dense; damp; light olive brown (2.5Y 5/4)	4.1	123		
35	■	40	░		@ 35' Silty SAND with gravel; medium dense; damp; light olive brown (2.5Y 5/4)	3.1	117		

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
JOB NO.: 07-1155PG-1 (4)
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DATE: 9/12/07
LOGGED BY: RHV
DRILLING COMPANY: Valley Well Drilling
DRILLED: 5/18/07
DRILLING METHOD: Hollow Stem
HOLE DIA: 8"
HAMMER TYPE: Autohammer
AVERAGE DROP: 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION: 1111'

BORING NO. HS-10MC

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	■	21			@ 40' Silty, fine SAND; medium dense; damp to moist; light olive brown (2.5Y 5/6)	6.6	105		
				SP-SM	**BEDROCK; TQsu (43 - 55')**				
45	■	82			@ 45' Poorly graded SANDSTONE with silt and gravel; dense; dry to damp; light olive brown (2.5Y 5/4) to olive brown (2.5Y 4/4)	3.0	122		
50	■	50/4"		CL-ML	@ 50' Silty CLAYSTONE to sandy, silty CLAYSTONE with gravel; hard; damp; light olive brown (2.5Y 5/4) to olive brown (2.5Y 4/4); CaCo$_3$	19.5	108		
55	■	50/6"		CL	@ 55' Lean CLAYSTONE; hard; dry; olive brown (2.5Y 4/3)				
					TOTAL DEPTH 55' (Elev. 1056') No Ground Water				
60									
65									
70									
75									

KEY TO SYMBOLS

UNITED SOIL CLASSIFICATION SYMBOLS

Symbol	Description
░	Poorly graded sand with silt
▨	Lean clay
▨	Fat clay
░	Poorly graded sand
▥	Silty sand
▨	Clayey sand
▥	Silt
░	Poorly graded sand with clay
▩	Silty clayey sand
▨	Silty lean clay
⁘	Poorly graded gravel

GROUND WATER DATA

Symbol	Description
▽	GROUND WATER WHILE DRILLING
▼	GROUND WATER AFTER DRILLING

SAMPLE TYPE

Symbol	Description
■	CALIFORNIA DRIVE SAMPLE Split-barrel sampler in accordance with ASTM D-3550 Standard Test Method
⧄	No Recovery

Notes:

1. These logs are subject to the limitations, conclusions, and recommendations in this report.

2. Results of tests conducted on samples recovered are reported on the logs.

DRILL HOLE LOG

CLIENT: Newhall Ranch Co.
PROJECT: Mesas East
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Rotary Wash
HAMMER TYPE: Safety Drive
DRIVING WEIGHTS: 140 lbs.
JOB NO.: 1703E-1
DATE: 07/22/04
LOGGED BY: KPC
DRILLED: 10/21/03
HOLE DIA: 5 1/2" O.D.
AVERAGE DROP (in.): 30"
ELEVATION 999'

BORING NO. RW-1T

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	LABORATORY TESTS Dry Density (pcf)	LABORATORY TESTS % fines	LABORATORY TESTS Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0-38')**				
		7 8 15		CL-ML	@ 3' Silty CLAY; stiff; damp; grayish brown; caliche and voids	7.7	107		
5		20 35 50/3"		CL	@ 6' Lean CLAY with sand and gravel; hard; damp; orangish to grayish brown; some small cobbles and voids	6.6	121		
10		27 24 50/5"		SP-SM	@ 9' Poorly graded SAND with silt and gravel; very dense; damp; yellowish brown	5.7	123		
		23 35 25		SP	@ 12' Poorly graded SAND with gravel; very dense; moist; yellowish brown	9.4			
15		10 10 14		SP-SC	@ 15' Poorly graded SAND with clay; medium dense; slightly moist; grayish brown	14.1			
20		6 7 11		CL	@ 20' Lean CLAY with gravel; stiff; slightly moist; gray	23.3	105		Consol
25		10 24 48		GC CL	@ 25' Clayey GRAVEL; medium dense; slightly moist; gray @ 25.5' Sandy lean CLAY; hard; slightly moist; gray	13.9	117		
30		6 6 10			@ 30' -very stiff	27.6			LL= 35 PI= 16
35		30 27 29		SP-SM	@ 35' Poorly graded SAND with silt and gravel; dense; moist; orangish brown	15.3	112		
		32 50		GM	@ 38' Silty GRAVEL; very dense; moist; grayish brown	11.2			

DRILL HOLE LOG

CLIENT: Newhall Ranch Co.
JOB NO.: 1703E-1
PROJECT: Mesas East
DATE: 07/22/04
LOGGED BY: KPC
DRILLING COMPANY: Valley Well Drilling
DRILLED: 10/21/03
DRILLING METHOD: Rotary Wash
HOLE DIA: 5 1/2" O.D.
HAMMER TYPE: Safety Drive
AVERAGE DROP (in.): 30"
DRIVING WEIGHTS: 140 lbs.
ELEVATION 999'

BORING NO. RW-1T

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40					Total depth 38' Ground Water @ 15'				
45									
50									
55									
60									
65									
70									
75									

CLIENT: Newhall Ranch Co.
PROJECT: Mesas East
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Rotary Wash
HAMMER TYPE: Safety Drive
DRIVING WEIGHTS: 140 lbs.

JOB NO.: 1703E-1
DATE: 07/22/04
LOGGED BY: KPC
DRILLED: 10/21/03
HOLE DIA: 5 1/2" O.D.
AVERAGE DROP (in.): 30"
ELEVATION 1037'

DRILL HOLE LOG

BORING NO. RW-2T

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0-35')**				
	■	18 16 24		SM	@ 3' Silty SAND with gravel; medium dense; damp; yellowish to grayish brown	3.3	122		
5									
	■	30 50/5"			@ 6' -dense	4.2	129		
10	◣	35 50		SP-SM	@ 9' Poorly graded SAND with silt; very dense; damp; yellowish to grayish brown	10.0			
					@ 12' -no recovery				
15	■	30 50			@ 15' -with gravel; damp to moist; grayish brown	7.2	124		
20	◣	30 50				7.1			
25	◣	10 20 30		SP	@ 25' Poorly graded SAND; dense to very dense; damp to moist; grayish to yellowish brown	3.1			
30	◣	26 29/2" 29/2"			@ 30' -very dense	5.1			
35	◣	17 24 36			Total depth 35' Ground Water @ 14.5'	5.0			

CLIENT: Newhall Ranch Co.
PROJECT: Mesas East
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Rotary Wash
HAMMER TYPE: Safety Drive
DRIVING WEIGHTS: 140 lbs.

JOB NO.: 1703E-1
DATE: 07/22/04
LOGGED BY: KPC
DRILLED: 10/22/03
HOLE DIA: 5 1/2" O.D.
AVERAGE DROP (in.): 30"
ELEVATION 1051'

DRILL HOLE LOG

BORING NO. RW-3T

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0-40')** @ 0-5' Bulk Sample				
	◪	5 4 3		SM	@ 3' Silty SAND; loose; damp; yellowish brown	8.8			
5									
	◪	7 4 2		SP-SM	@ 6' Poorly graded SAND with silt and gravel; loose; damp; yellowish brown; partial recovery	9.0			
	◪	7 4 9		SC	@ 9' Clayey SAND; medium dense; damp to moist; yellowish brown	10.8			
10									
	■	11 12 12		SP-SM	@ 12' Poorly graded SAND with silt; medium dense; damp; yellowish to grayish brown; sandy clay lenses at 13.5 ft	17.9	112		
15	◪	15 14 21		SC	@ 15' Clayey SAND with cobbles; dense; slightly moist; yellowish brown	10.0			
20	◪	12 13 25	▽	CL	@ 20' Sandy lean CLAY with gravel; hard; moist; yellowish brown	18.9			
25	■	8 16 22		SC	@ 25' Clayey SAND; dense; moist; yellowish brown	12.7	124		
30	☒	50/5"			@ 30' -no recovery				
	◪	22 50/5"		GP-SP	@ 33' Poorly graded SAND interbedded with poorly graded GRAVEL; very dense; moist; light gray	6.0			
35									
	◪	30 50/4"				7.8			

CLIENT: Newhall Ranch Co.	JOB NO.: 1703E-1	**DRILL HOLE LOG**	
PROJECT: Mesas East	DATE: 07/22/04		
	LOGGED BY: KPC		
DRILLING COMPANY: Valley Well Drilling	DRILLED: 10/22/03		
DRILLING METHOD: Rotary Wash	HOLE DIA: 5 1/2" O.D.	**BORING NO.**	RW-3T
HAMMER TYPE: Safety Drive	AVERAGE DROP (in.): 30"		
DRIVING WEIGHTS: 140 lbs.	ELEVATION 1051'		

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	◣	8 16 46	▨	SP	@ 40' Poorly graded SAND; very dense; moist; grayish brown	6.7			
					Total Depth 40' Ground Water @ 21'				
45									
50									
55									
60									
65									
70									
75									

KEY TO SYMBOLS

Symbol	Description
UNITED SOIL CLASSIFICATION SYMBOLS	
░	Poorly graded sand
▥	Silty sand
▨	Silty lean clay
□	Blank
▧	Clayey sand
▩	Silty clayey sand
▨	Lean clay
░	Poorly graded sand with silt
░	Poorly graded sand with clay
▥	Silt
⁙	Poorly graded gravel
▓	Silty gravel
▓	Clayey gravel
▓	Silty clayey gravel
▨	Fat clay

Symbol	Description
⁙	Poorly graded gravel and sand
GROUND WATER DATA	
▽	GROUND WATER WHILE DRILLING
SAMPLE TYPE	
■	CALIFORNIA DRIVE SAMPLE 2.42" I.D. sampler
⧄	No Recovery
◩	STANDARD PENETRATION TEST Split barrel sampler in accordance with ASTM D-1558 Standard Test Method

Notes:

1. These logs are subject to the limitations, conclusions, and recommendations in this report.
2. Results of tests conducted on samples recovered are reported on the logs.

DRILL HOLE LOG

CLIENT: Newhall Ranch Co.

PROJECT: Newhall Ranch Mesas Area

DRILLING COMPANY: Valley Well Drilling

DRILLING METHOD: Rotary Wash

HAMMER TYPE: Automatic Safety

DRIVING WEIGHTS: 140 lbs

JOB NO.: 99-1703L-1

DATE: 7/22/04

LOGGED BY: MAS

DRILLED: 10/7/99

HOLE DIA: 5 1/2" O.D.

AVERAGE DROP (in.): 30"

ELEVATION 1068

BORING NO. RW-3M

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**QUATERNARY ALLUVIUM; Qal (0-30')**			7	
		17 13 10		SW-SM	@ 3' Well graded SAND with silt and gravel; medium dense; moist; grayish-brown				
5		7 10 15		SW	@ 5' Well graded SAND with gravel; medium dense; moist; grayish-brown	8.5	117	4	Consol
		12 20 18		SM	@ 8' Silty SAND with gravel; medium dense; moist; grayish-brown	11.1	119	31	Consol
10									
		10 15 25		SP-SM	@ 11' Poorly graded SAND with silt and gravel; medium dense; moist; grayish-brown	5.5	122		
15		12 21 22		SM	@ 15' Silty SAND with gravel; medium dense; moist; grayish-brown			33	
20		17 37 34			@ 20' -very dense			21	
25		10 17 20		CL-ML	@ 25' Sandy, silty CLAY with gravel; hard; moist; brown			51	LL= 27 PI= 7 % -5 micron= 10
30		17 50			**BEDROCK; TQs (30-50')** @ 30' SANDSTONE; dense; moist to wet; grayish-brown				
					@ 32' -wet				
35		12 50			@ 35' -very dense				

CLIENT: Newhall Ranch Co.
JOB NO.: 99-1703L-1
PROJECT: Newhall Ranch Mesas Area
DATE: 7/22/04
LOGGED BY: MAS
DRILLING COMPANY: Valley Well Drilling
DRILLED: 10/7/99
DRILLING METHOD: Rotary Wash
HOLE DIA: 5 1/2" O.D.
HAMMER TYPE: Automatic Safety
AVERAGE DROP (in.): 30"
DRIVING WEIGHTS: 140 lbs
ELEVATION 1068

DRILL HOLE LOG

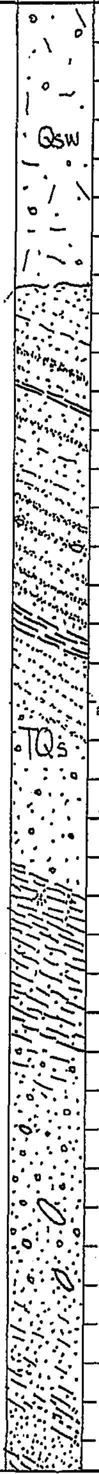
BORING NO. RW-3M

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40	◪	50							
45	◪	50			@ 45' SILTSTONE; very dense; wet; brown				
50	■	27 34 50/5"			@ 50' CLAYSTONE; hard; wet; yellowish-brown				
					TOTAL DEPTH 50' (Elev. 1018) No Caving Ground Water @ 32'				
55									
60									
65									
70									
75									

DRILL HOLE LOG

CLIENT: Newhall Ranch Company
PROJECT: Newhall Ranch - Mesas-East Phase II Landslide Investigation
DRILLING COMPANY: Tri-Valley Drilling/Dave
DRILLING METHOD: Bucket-Auger (86' Rig)
HAMMER TYPE: Telescoping Kelly Bar
DRIVING WEIGHTS: 0-28'=3450 lbs; 28-57'=2050 lbs; 57-85'=1140 lbs.
JOB NO.: 99-1703QlsII-1
DATE: 7/22/04
LOGGED BY: VCG
DRILLED: 11/3-4/99
HOLE DIA: 24"
AVERAGE DROP (in.): 12"
ELEVATION: 1109'

BORING NO. B-1E

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
						<u>SLOPEWASH</u>; Qsw (0 - 7 Ft.) @ 0' Light yellowish-brown to tan, fine- to coarse-grained silty pebbly sand; dry; loose; abundant root hairs and pinholes to 6 ft.	Downhole logged on 11/3 and 11/4/99
5	■	1 2 2		114/5.5			@ 5' Bulk Sample
						<u>BEDROCK</u>; TQs (7 - 74 Ft.) @ 7' Mottled rusty brown and gray, fine- to medium-grained sandstone with thin interbeds of gray to dark-brown clayey siltstone; minor CaCo3-lined fractures; friable; loose to moderately dense; dry; krotovina to 8 ft.	
10	■	3 5 4		B:N68W,32NE			@ 10' Bulk Sample @ 10' % fines = 20.2
						@ 13' Tan to gray, fine- to coarse-grained pebbly sandstone with scattered pebbles; friable; well stratified	
15	■	4 6 8		123/12.2		@ 15' Medium-brown silty sandstone interbed, damp	
						@ 17' Medium- to coarse-grained pebbly sandstone	@ 17-22' minor ravelling and belling of hole
				apx B:N33W,24NE			
20	■	2 5 6		107/18.7			
				B:N63W,21NE B:N66W,25NE		@ 22' Medium- to rusty-brown clayey siltstone with minor sand; well stratified; soft to slightly firm @ 22.5' Minor parting surface	
25							
						@ 27' Grades to medium to very coarse pebbly sandstone and fine- to coarse-grained sandstone with scattered cobbles; moderately dense; friable	
30							
						@ 32' Yellowish-tan fine-grained silty sandstone with minor CaCo3 pods	
				B:N68W,22NE			
35						@ 35' Medium-brown siltstone with mionr sand and clay	
						@ 37' Yellowish-tan fine-grained sandstone	

CLIENT: Newhall Ranch Company
PROJECT: Newhall Ranch - Mesas-East Phase II Landslide Investigation
DRILLING COMPANY: Tri-Valley Drilling/Dave
DRILLING METHOD: Bucket-Auger (86' Rig)
HAMMER TYPE: Telescoping Kelly Bar
DRIVING WEIGHTS: 0-28'=3450 lbs; 28-57'=2050 lbs; 57-85'=1140 lbs.

JOB NO.: 99-1703QlsII-1
DATE: 7/22/04
LOGGED BY: VCG
DRILLED: 11/3-4/99
HOLE DIA: 24"
AVERAGE DROP (in.): 12"
ELEVATION: 1109'

DRILL HOLE LOG

BORING NO. B-1E

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
						@ 38' Medium-brown plastic clay with minor silt, 1" thick; no striations on parting surface; CaCo3 on parting surface	
40						@ 38.5' Yellowish-tan fine-grained silty sandstone	
						@ 43.5' Grades to fine- to coarse-grained pebbly sandstone and conglomerate; very friable	@ 45' belling of hole up to 7 ft. wide
45							@ 47' Downhole logging ceased due to unsafe conditions
50							
55							
60							
65							
70							
75						TOTAL DEPTH 74 Ft. (Elev. 1035') No Ground Water Minor Caving @ 17-22 Ft. Caving @ 45-74 Ft.	Backfill tamped every 5 ft.

DRILL HOLE LOG

CLIENT:	Newhall Ranch Company	JOB NO.:	99-1703QlsII-1
PROJECT:	Newhall Ranch - Mesas-East Phase II Landslide Investigation	DATE:	7/22/04
		LOGGED BY:	SKM
DRILLING COMPANY:	Tri-Valley Drilling/Dave	DRILLED:	11/9/99
DRILLING METHOD:	Bucket-Auger (86'Rig)	HOLE DIA:	24"
HAMMER TYPE:	Telescoping Kelly Bar	AVERAGE DROP (in.):	12"
DRIVING WEIGHTS:	0-28'=3450 lbs; 28-57'=2050 lbs; 57-85'=1145 lbs	ELEVATION:	1087'

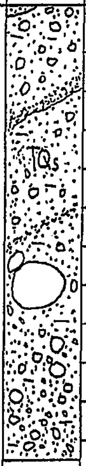
BORING NO. B-3E

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
						SLOPEWASH; Qsw (0 - 6 inches) @ 0' Medium grayish-brown sandy silt with pebbles; moderately dense	Downhole logged on 11/9/99 All contacts continuous and with consistent thickness around hole. Weathered down to 2 ft.
						BEDROCK; TQs (6 inches - 49.5 Ft.) @ 6" Weathered bedrock medium brown clayey siltstone with CaCO3 nodules	
						@ 2' Mottled olive-brown with FeOx (and CaCo3) siltstone to clayey siltstone; moderately hard; damp	
5	■	2 4 6		B:N61W,22NE			@ 5' % fines = 84. 5
						@ 8' Dark grayish-brown massive sandy clayey siltstone with pebbles and concretions	
10							
						@ 11.4' Light grayish-brown sandy gravel lense @ 11.7' Silty claystone to clayey siltstone	
15	■	3 8 9		123/14.2		@ 15.5' Grades to a mottled light reddish-brown to light greenish-tan silty sandstone	
						@ 18' Grades to an olive brown clayey siltstone interbedded with clay lenses	
20							
				B:N63W,24NW		@ 23' 1" medium brown silty clay lense	Clay lenses @ 23', 27.1' and 33' do not exhibit sharp contacts
25							
				B:N64W,27NE		@ 27.1' 3/4" medium brown clay lense	
30	■	4 10 14		108/19.1			
				B:N65W,26NE		@ 33' 1.5" medium brown clay lense	
35						@ 35' Grades to a mottled light brown to grayish-brown silty sandstone with siltstone lenses	

DRILL HOLE LOG

CLIENT:	Newhall Ranch Company	JOB NO.:	99-1703QlsII-1
PROJECT:	Newhall Ranch - Mesas-East Phase II Landslide Investigation	DATE:	7/22/04
		LOGGED BY:	SKM
DRILLING COMPANY:	Tri-Valley Drilling/Dave	DRILLED:	11/9/99
DRILLING METHOD:	Bucket-Auger (86'Rig)	HOLE DIA:	24"
HAMMER TYPE:	Telescoping Kelly Bar	AVERAGE DROP (in.):	12"
DRIVING WEIGHTS:	0-28'=3450 lbs; 28-57'=2050 lbs; 57-85'=1145 lbs	ELEVATION:	1087'

BORING NO. B-3E

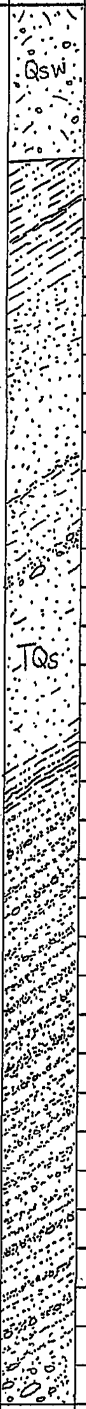


DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
40				B:N48W,25NE		@ 38' Light grayish-tan to brown cobble conglomerate with minor silt, moderately friable, damp	@ 38'-49.5' Minor caving (1 ft. back) Conglomerate unit is laminated in places and has continuous interbeds (1-2" thick) of fine-grained sandstone
45				B:N53W,23NE			
50						TOTAL DEPTH 49.5 Ft. (Elev. 1037.5') No Ground Water Minor Caving 38 to 49.5 Ft.	Stopped drilling at 49.5' due to bucket spinning on top of large igneous clasts Backfill tamped every 5 ft.
55							
60							
65							
70							
75							

DRILL HOLE LOG

CLIENT: Newhall Ranch Company
JOB NO.: 99-1703QlsII-1
PROJECT: Newhall Ranch - Mesas-East Phase II Landslide Investigation
DATE: 7/22/04
LOGGED BY: VCG/BJS
DRILLING COMPANY: Tri-Valley Drilling/Dave
DRILLED: 11/18/99
DRILLING METHOD: Bucket-Auger (86' Rig)
HOLE DIA: 24"
HAMMER TYPE: Telescoping Kelly Bar
AVERAGE DROP (in.): 12"
DRIVING WEIGHTS: 0-28'=3450 lbs; 28-57'=2050 lbs; 57-85'=1140 lbs.
ELEVATION: 1080'

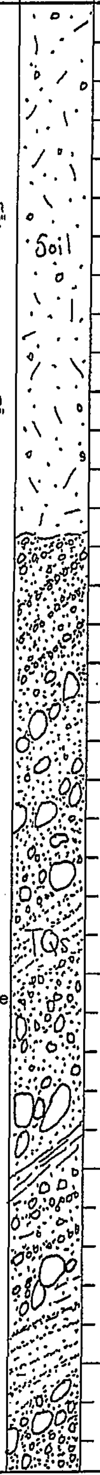
BORING NO. B-8E

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
						**SLOPEWASH; Qsw (0 - 4 Ft.)** @ 0' Medium- to light yellowish-brown fine-grained sandy silt with carbonate pods; minor roots; loose to moderately dense; dry to damp	Downhole logged on 11/18/99
				B:N62W,20NE		**BEDROCK; TQs (4 - 36 Ft.)** @ 4' Light yellowish-brown to tannish-brown to tan fine-grained sandy siltstone with lenses of medium-brown clayey siltstone, moderately dense; well bedded	
5							
				B:N59W,25NE		@ 8' Tan to rusty gray fine- to coarse-grained sandstone	
10						@ 10' Fine-grained sandstone	
						@ 12.2' Medium- to grayish-brown, fine- to coarse-grained silty sandstone; damp	
15				B:N52W,24NE			
				B:N54W,21NE		@ 19' Light yellowish-green to yellowish-brown fine-grained sandy siltstone with rusty brown mottling and minor clay	
20						@ 21' Grades to yellowish-tan, fine- to coarse-grained sandstone with scattered pebbles; well bedded	
25				B:N41W,24NE			
30							
							@ 33' Minor belling of hole
35						@ 35' Scattered cobbles	
						TOTAL DEPTH 36 Ft. (Elev. 1044') No Ground Water, Minor Belling from 33 to 36 Ft.	Backfill tamped every 5 ft.

DRILL HOLE LOG

CLIENT: Newhall Ranch Company®
JOB NO.: 04-2023-4
PROJECT: Mesas East - Tentative Map
DATE: 07/22/04
LOGGED BY: MAS
DRILLING COMPANY: Tri-Valley Drilling (David)
DRILLED: 3/4 -5/04
DRILLING METHOD: Bucket Auger
HOLE DIA: 24"
HAMMER TYPE: Telescoping Kelly Bar
AVERAGE DROP (in.): 12"
DRIVING WEIGHTS: 0-27'=3450 lbs, 27-57'=2050 lbs, 57-87'=1140 lbs
ELEVATION: 1067'

BORING NO. B-72E

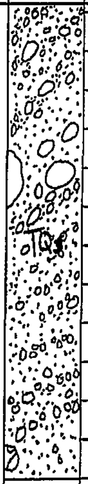


DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
0						**<u>SOIL/DEBRIS FLOW</u>; S (0-14')** @ 0' Light brown silty sand with gravel; loose; damp; roots; no voids	
5	■	Push 1/12"		117/5.0			
10	■	Push 1/12"		113/2.7			
14						**<u>BEDROCK</u>; TQs (14-50')** @ 14' Pale yellowish-brown to pale whitish-gray pebbly sandstone; moderately hard to hard; dry to damp	
15	■	1 1 1		3.9			
17				B:N78W,37NE			
18							@ 18-45' Continual use of core and grab buckets
20	◺	2/4"					20' No Recovery, Rock In Tip
23				B:N65W,34NE		@ 23' Pale yellowish-brown thinly laminated silty sandstone interbeds; moderately hard; damp	
25	◺	2/6" Bounce					25' No Recovery, Rock In Tip
30				16.7		@ 30' Light brown to pale reddish-brown silty sandy mudstone interbed; moderately hard to hard; damp; continuous planes	@ 30' Small bulk sample
33				B:N68W,24NE		@ 33' Pale yellowish-brown thinly laminated silty sandstone interbeds; moderately hard; damp	
35							@ 35' Did not sample due to cobbles

DRILL HOLE LOG

CLIENT: Newhall Ranch Company®
JOB NO.: 04-2023-4
PROJECT: Mesas East - Tentative Map
DATE: 07/22/04
LOGGED BY: MAS
DRILLING COMPANY: Tri-Valley Drilling (David)
DRILLED: 3/4 -5/04
DRILLING METHOD: Bucket Auger
HOLE DIA: 24"
HAMMER TYPE: Telescoping Kelly Bar
AVERAGE DROP (in.): 12"
DRIVING WEIGHTS: 0-27'=3450 lbs, 27-57'=2050 lbs, 57-87'=1140 lbs
ELEVATION: 1067'

BORING NO. B-72E

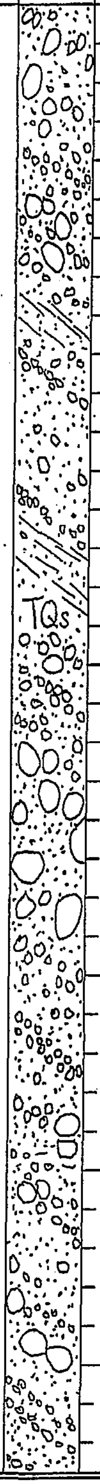
DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
40							
45							@ 45' Did not sample due to excessive cobble @ 49' Ground Water
50						TOTAL DEPTH 50' Ravelling 15-45' Ground Water @ 49' Caving 0-14'	
55							
60							
65							
70							
75							

ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.

DRILL HOLE LOG

CLIENT: Newhall Ranch Company®
JOB NO.: 04-2023-4
PROJECT: Mesas East - Tentative Map
DATE: 07/22/04
LOGGED BY: MAS
DRILLING COMPANY: Tri-Valley Drilling (David)
DRILLED: 3/5 - 9/04
DRILLING METHOD: Bucket Auger
HOLE DIA: 24"
HAMMER TYPE: Telescoping Kelly Bar
AVERAGE DROP (in.): 12"
DRIVING WEIGHTS: 0-27'=3450 lbs, 27-57'=2050 lbs, 57-87'=1140 lbs
ELEVATION: 1060'

BORING NO. B-73E



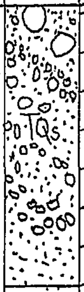
DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
					BEDROCK; TQs (0-55') @ 0' Pale yellowish-brown silty pebbly sandstone conglomerate; moderately hard; dry to damp; roots; no voids; pebbly channels	
						@ 3-40' continual use of core and grab bucket
			B:N65W,20NE			
5		1 4 4				@ 5' No Recovery, rock in tip
					@ 7' Light brown to pale reddish-brown silty claystone pods; moderately hard; damp	
10	■	1 4 6	186/3.7			
			17.7			@ 14' Small bulk sample
15	■	5 5/5"	129/2.0			@ 15' Rock in Tip
			B:N68W,22NE			
20		2				@ 20' No recovery, rock in tip; 1 Drop & 1 Bounce; Tip was destroyed
25						@ 25' Did not attempt to sample; abundent cobbles
			B:N58W,30NE			
30						
			B:N64W,22NE			
35						

CLIENT: Newhall Ranch Company®
PROJECT: Mesas East - Tentative Map
DRILLING COMPANY: Tri-Valley Drilling (David)
DRILLING METHOD: Bucket Auger
HAMMER TYPE: Telescoping Kelly Bar
DRIVING WEIGHTS: 0-27'=3450 lbs, 27-57'=2050 lbs, 57-87'=1140 lbs

JOB NO.: 04-2023-4
DATE: 07/22/04
LOGGED BY: MAS
DRILLED: 3/5 - 9/04
HOLE DIA: 24"
AVERAGE DROP (In.): 12"
ELEVATION: 1060'

DRILL HOLE LOG

BORING NO. B-73E

DEPTH (feet)	SAMPLE TYPE	BLOWS / 6"	GRAPHIC LOG	ATTITUDES, DRY DENSITY (pcf)/ MOISTURE CONTENT (%)	USCS SYMBOL	Description Soils: description; consistency/density; moisture; color; other Bedrock: color, lithology; hardness; moisture; other	Remarks
							
40							
45						TOTAL DEPTH 55' Ravelling @ 0-55' Ground Water @ 40' Caving @ 40-45'	
50							
55							
60							
65							
70							
75							

DRILL HOLE LOG

CLIENT: The Newhall Land & Farming Company
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch
DRILLING COMPANY: Valley Well Drilling
DRILLING METHOD: Hollow-Stem Auger
HAMMER TYPE: Auto Hammer
DRIVING WEIGHTS: 140 lbs
JOB NO.: 07-1155PG-1 (4)
DATE: 9/12/07
LOGGED BY: RHV
DRILLED: 4/26/07
HOLE DIA: 6"
AVERAGE DROP: 30"
ELEVATION: 1039'

BORING NO. P-2MS

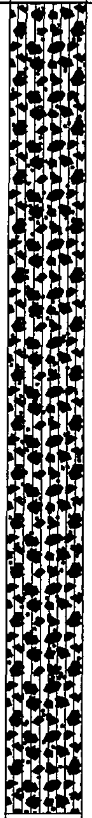
DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
0					**BEDROCK; TQsu (0 - 60')**				Unit is uppermost section of TQsu; poorly cemented to moderately friable
5	■	48		SM	@ 5' - Silty SANDSTONE with gravel and cobbles; medium dense; dry to damp; light yellowish brown (2.5Y 6/4)				
10	■	46		ML	@ 10' - Sandy SILTSTONE with gravel; very stiff; damp; light olive brown (2.5Y 5/4)				
15	■	48			@ 15' - Sandy SILTSTONE with gravel; very stiff; damp to moist; moderate oxidation; olive brown (2.5Y 4/3)				
			▽						@ 19' Groundwater
20				GW-GM	@ 20' - cobble				@ 20' No sample Driller said he hit a cobble
25	■	64			@ 25' Well-graded GRAVEL with silt and sand; dense; wet; light yellowish brown (2.5Y 5/3)			6	
30		57			@ 30' - no recovery- some pea-size gravel in sample taken but most fell out				Drilling difficult due to very coarse pebbly sand with cobbles and gravel layers. Driller flushed out approximately 6' of hole, normally approximately 1'; poorly consolidated No caving, but very loose
35		50/2"			@ 35' - no recovery; very dense				@ 35' Driller said drilling changed;

ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.

CLIENT: The Newhall Land & Farming Company	JOB NO.: 07-1155PG-1 (4)		
PROJECT: Assessment of Middle Canyon Alluvium Depths Newhall Ranch	DATE: 9/12/07		
	LOGGED BY: RHV		
DRILLING COMPANY: Valley Well Drilling	DRILLED: 4/26/07		
DRILLING METHOD: Hollow-Stem Auger	HOLE DIA: 6"		
HAMMER TYPE: Auto Hammer	AVERAGE DROP: 30"		
DRIVING WEIGHTS: 140 lbs	ELEVATION: 1039'		

DRILL HOLE LOG

BORING NO. P-2MS

DEPTH (feet)	SAMPLE TYPE	BLOWS / 12"	GRAPHIC LOG	USCS SYMBOL	DESCRIPTION	LABORATORY TESTS			
						Moisture Content (%)	Dry Density (pcf)	% fines	Other Tests
40									still hard but not cobbly No sampling due to cobbles
45									
50									
55									
60					TOTAL DEPTH 60' (Elev. 979') Ground Water @ 19' on 4/26/07 Ground Water @ 19.7' on 4/27/07 @ 7:00 AM No Caving Piezometer installed to 60'; 55' of screen and 5' of solid casing with bentonite/grout seal and monument at top; transducer installed on 6/18/07 @ depth of approximately 40'				
65									
70									
75									

KEY TO SYMBOLS

Symbol	Description
UNITED SOIL CLASSIFICATION SYMBOLS	
▦	Silty sand
▥	Silt
▩	Well graded gravel with silt
GROUND WATER DATA	
▽	GROUND WATER WHILE DRILLING
SAMPLE TYPE	
■	CALIFORNIA DRIVE SAMPLE Split-barrel sampler in accordance with ASTM D-3550 Standard Test Method
⧅	No Recovery

Notes:

1. These logs are subject to the limitations, conclusions, and recommendations in this report.

2. Results of tests conducted on samples recovered are reported on the logs.

CPT INTERPRETATIONS

SOUNDING : CPT-1M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 13:33

PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	308.41	2.19	SAND to SILTY SAND	77	100	100		
.300	.98	165.39	2.95	SILTY SAND to SANDY SILT	55	88	91		
.450	1.48	119.86	2.50	SILTY SAND to SANDY SILT	40	64	82		
.600	1.97	144.21	1.88	SILTY SAND to SANDY SILT	48	77	87		
.750	2.46	184.13	1.11	SAND to SILTY SAND	46	74	94		
.900	2.95	139.26	1.61	SAND to SILTY SAND	35	56	86		49.0
1.050	3.44	113.83	2.00	SILTY SAND to SANDY SILT	38	61	80		48.0
1.200	3.94	79.22	3.33	SANDY SILT to CLAYEY SILT	32	51		4.6	
1.350	4.43	98.55	2.09	SILTY SAND to SANDY SILT	33	53	76		46.0
1.500	4.92	109.56	1.47	SAND to SILTY SAND	27	44	79		46.0
1.650	5.41	99.70	2.68	SANDY SILT to CLAYEY SILT	40	64		5.8	
1.800	5.91	124.22	1.50	SAND to SILTY SAND	31	50	83		46.0
1.950	6.40	61.89	3.31	SANDY SILT to CLAYEY SILT	25	40		3.6	
2.100	6.89	41.07	2.59	SANDY SILT to CLAYEY SILT	16	26		2.7	
2.250	7.38	47.35	2.29	SANDY SILT to CLAYEY SILT	19	28		3.1	
2.400	7.87	47.61	2.23	SANDY SILT to CLAYEY SILT	19	28		3.1	
2.550	8.37	79.86	2.61	SANDY SILT to CLAYEY SILT	32	45		5.3	
2.700	8.86	127.55	1.66	SILTY SAND to SANDY SILT	43	58	83		44.5
2.850	9.35	120.65	.91	SAND to SILTY SAND	30	40	81		44.0
3.000	9.84	111.71	1.90	SILTY SAND to SANDY SILT	37	48	78		43.5
3.150	10.33	105.23	2.12	SILTY SAND to SANDY SILT	35	45	75		43.0
3.300	10.83	76.84	3.69	CLAYEY SILT to SILTY CLAY	38	48		4.5	
3.450	11.32	74.25	4.24	CLAYEY SILT to SILTY CLAY	37	45		4.3	
3.600	11.81	64.41	4.68	CLAY to SILTY CLAY	43	51		3.7	
3.750	12.30	46.57	5.16	CLAY	47	54		2.7	
3.900	12.80	61.06	4.95	CLAY to SILTY CLAY	41	46		3.5	
4.050	13.29	69.22	6.03	*VERY STIFF FINE GRAINED	69	78			
4.200	13.78	81.60	4.06	CLAYEY SILT to SILTY CLAY	41	45		4.8	
4.350	14.27	219.35	1.53	SAND to SILTY SAND	55	59	92		44.5
4.500	14.76	267.94	1.81	SAND to SILTY SAND	67	71	97		45.5
4.650	15.26	401.17	1.62	SAND to SILTY SAND	100	100	100		47.0
4.800	15.75	293.48	1.76	SAND to SILTY SAND	73	75	99		45.5
4.950	16.24	190.91	2.52	SILTY SAND to SANDY SILT	64	64	86		43.5
5.100	16.73	214.49	2.38	SILTY SAND to SANDY SILT	71	71	89		44.0
5.250	17.22	165.94	2.88	SILTY SAND to SANDY SILT	55	54	81		42.5
5.400	17.72	173.95	2.38	SILTY SAND to SANDY SILT	58	56	82		43.0
5.550	18.21	416.95	1.79	SAND to SILTY SAND	100	100	100		46.5
5.700	18.70	430.70	1.38	SAND	86	81	100		46.5
5.850	19.19	129.61	2.64	SILTY SAND to SANDY SILT	43	40	72		41.0
6.000	19.69	113.91	3.28	SANDY SILT to CLAYEY SILT	46	42		6.6	
6.150	20.18	111.34	3.43	SANDY SILT to CLAYEY SILT	45	40		6.5	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 25.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-1 M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	99.72	3.62	SANDY SILT to CLAYEY SILT	40	36		5.8	
6.450	21.16	91.29	3.94	CLAYEY SILT to SILTY CLAY	46	41		5.3	
6.600	21.65	200.89	2.56	SILTY SAND to SANDY SILT	67	59	83		42.5
6.750	22.15	235.01	3.09	SILTY SAND to SANDY SILT	78	68	87		43.0
6.900	22.64	160.25	3.65	SANDY SILT to CLAYEY SILT	64	55		9.3	
7.050	23.13	90.18	4.97	*VERY STIFF FINE GRAINED	90	77			
7.200	23.62	53.37	5.50	CLAY	53	45		3.1	
7.350	24.11	96.41	3.41	SANDY SILT to CLAYEY SILT	39	32		5.6	
7.500	24.61	97.28	3.72	CLAYEY SILT to SILTY CLAY	49	40		5.6	
7.650	25.10	180.22	2.50	SILTY SAND to SANDY SILT	60	49	78		41.5
7.800	25.59	376.50	1.73	SAND to SILTY SAND	94	76	99		44.5
7.950	26.08	322.45	2.04	SAND to SILTY SAND	81	65	94		44.0
8.100	26.57	292.73	2.43	SILTY SAND to SANDY SILT	98	78	92		43.5
8.250	27.07	252.60	2.41	SILTY SAND to SANDY SILT	84	67	87		42.5
8.400	27.56	181.96	2.91	SILTY SAND to SANDY SILT	61	48	78		41.0
8.550	28.05	170.94	2.78	SILTY SAND to SANDY SILT	57	45	76		40.5
8.700	28.54	169.49	2.57	SILTY SAND to SANDY SILT	56	45	75		40.5
8.850	29.04	124.20	3.50	SANDY SILT to CLAYEY SILT	50	39		7.2	
9.000	29.53	168.34	2.47	SILTY SAND to SANDY SILT	56	44	75		40.0
9.150	30.02	115.42	3.09	SANDY SILT to CLAYEY SILT	46	36		6.7	
9.300	30.51	63.29	5.18	CLAY to SILTY CLAY	42	33		3.6	
9.450	31.00	73.27	4.51	CLAYEY SILT to SILTY CLAY	37	28		4.2	
9.600	31.50	70.17	5.02	*VERY STIFF FINE GRAINED	70	54			
9.750	31.99	151.09	2.60	SILTY SAND to SANDY SILT	50	39	71		39.5
9.900	32.48	99.30	4.89	*VERY STIFF FINE GRAINED	99	76			
10.050	32.97	158.30	4.41	*VERY STIFF FINE GRAINED	100	100			
10.200	33.46	549.24	1.98	SAND to SILTY SAND	100	100	100		

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 25.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

CPT INTERPRETATIONS

SOUNDING : CPT-2M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 08:52

PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	302.84	.79	SAND	61	97	100		
.300	.98	181.66	1.32	SAND to SILTY SAND	45	73	93		
.450	1.48	143.51	1.44	SAND to SILTY SAND	36	57	87		
.600	1.97	100.89	.85	SAND to SILTY SAND	25	40	77		49.5
.750	2.46	76.82	1.47	SILTY SAND to SANDY SILT	26	41	69		47.5
.900	2.95	71.57	1.42	SILTY SAND to SANDY SILT	24	38	67		46.5
1.050	3.44	65.86	1.06	SILTY SAND to SANDY SILT	22	35	64		45.5
1.200	3.94	60.25	1.39	SILTY SAND to SANDY SILT	20	32	62		44.5
1.350	4.43	69.00	1.11	SILTY SAND to SANDY SILT	23	37	66		44.5
1.500	4.92	56.17	2.14	SANDY SILT to CLAYEY SILT	22	36		3.7	
1.650	5.41	38.64	2.52	SANDY SILT to CLAYEY SILT	15	25		2.6	
1.800	5.91	39.90	2.46	SANDY SILT to CLAYEY SILT	16	26		2.6	
1.950	6.40	43.30	2.62	SANDY SILT to CLAYEY SILT	17	28		2.9	
2.100	6.89	50,84	2.86	SANDY SILT to CLAYEY SILT	20	32		3.4	
2.250	7.38	52.01	5.29	CLAY	52	78		3.0	
2.400	7.87	52.47	5.62	CLAY	52	76		3.1	
2.550	8.37	51.52	5.81	CLAY	52	73		3.0	
2.700	8.86	47.57	5.92	CLAY	48	65		2.8	
2.850	9.35	41.66	5.42	CLAY	42	56		2.4	
3.000	9.84	38.11	5.41	CLAY	38	50		2.2	
3.150	10.33	35.67	5.03	CLAY	36	45		2.1	
3.300	10.83	34.59	5.05	CLAY	35	43		2.0	
3.450	11.32	34.74	5.17	CLAY	35	42		2.0	
3.600	11.81	30.80	4.63	CLAY to SILTY CLAY	21	25		1.8	
3.750	12.30	27.21	4.95	CLAY	27	33		1.6	
3.900	12.80	25.09	4.74	CLAY	25	30		1.4	
4.050	13.29	23.92	4.40	CLAY to SILTY CLAY	16	19		1.5	
4.200	13.78	22.24	4.57	CLAY	22	26		1.4	
4.350	14.27	20.88	4.33	CLAY	21	24		1.3	
4.500	14.76	18.10	3.71	CLAY to SILTY CLAY	12	14		1.1	
4.650	15.26	18.27	4.41	CLAY	18	21		1.2	
4.800	15.75	16.72	3.72	CLAY to SILTY CLAY	11	12		1.1	
4.950	16.24	14.98	3.75	CLAY to SILTY CLAY	10	11		.9	
5.100	16.73	12.53	3.70	CLAY	13	14		.8	
5.250	17.22	11.92	3.36	CLAY to SILTY CLAY	8	9		.7	
5.400	17.72	12.28	3.35	CLAY to SILTY CLAY	8	9		.7	
5.550	18.21	30.91	3.55	CLAYEY SILT to SILTY CLAY	15	17		2.0	
5.700	18.70	16.66	2.51	CLAYEY SILT to SILTY CLAY	8	9		1.0	
5.850	19.19	14.26	3.07	CLAY to SILTY CLAY	10	10		.9	
6.000	19.69	13.64	3.15	CLAY to SILTY CLAY	9	10		.8	
6.150	20.18	16.44	2.85	CLAYEY SILT to SILTY CLAY	8	9		1.0	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 11.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-2 M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	23.54	2.97	CLAYEY SILT to SILTY CLAY	12	12		1.5	
6.450	21.16	23.67	2.95	CLAYEY SILT to SILTY CLAY	12	12		1.5	
6.600	21.65	22.43	3.93	CLAY to SILTY CLAY	15	15		1.4	
6.750	22.15	41.75	4.16	CLAY to SILTY CLAY	28	28		2.4	
6.900	22.64	44.85	4.27	CLAY to SILTY CLAY	30	30		2.6	
7.050	23.13	91.99	3.47	SANDY SILT to CLAYEY SILT	37	37		5.3	
7.200	23.62	101.49	3.24	SANDY SILT to CLAYEY SILT	41	40		5.9	
7.350	24.11	88.42	3.10	SANDY SILT to CLAYEY SILT	35	35		5.1	
7.500	24.61	46.14	4.02	CLAYEY SILT to SILTY CLAY	23	22		2.6	
7.650	25.10	41.49	3.81	CLAYEY SILT to SILTY CLAY	21	20		2.4	
7.800	25.59	91.14	2.78	SANDY SILT to CLAYEY SILT	36	35		5.3	
7.950	26.08	183.68	1.98	SILTY SAND to SANDY SILT	61	59	83		43.0
8.100	26.57	95.09	3.60	SANDY SILT to CLAYEY SILT	38	36		5.5	
8.250	27.07	92.41	3.43	SANDY SILT to CLAYEY SILT	37	35		5.3	
8.400	27.56	135.31	3.21	SANDY SILT to CLAYEY SILT	54	51		7.9	
8.550	28.05	278.73	1.29	SAND	56	52	94		44.5
8.700	28.54	195.41	1.87	SAND to SILTY SAND	49	45	84		43.0
8.850	29.04	394.56	1.10	SAND	79	73	100		46.0
9.000	29.53	408.39	1.82	SAND to SILTY SAND	100	93	100		46.0
9.150	30.02	427.17	1.32	SAND	85	78	100		46.0
9.300	30.51	395.47	.90	SAND	79	72	100		46.0
9.450	31.00	130.38	3.37	SANDY SILT to CLAYEY SILT	52	47		7.6	
9.600	31.50	54.73	3.68	CLAYEY SILT to SILTY CLAY	27	24		3.1	
9.750	31.99	117.06	3.98	CLAYEY SILT to SILTY CLAY	59	52		6.8	
9.900	32.48	143.30	2.86	SILTY SAND to SANDY SILT	48	42	74		41.0
10.050	32.97	314.78	1.57	SAND to SILTY SAND	79	69	96		44.5
10.200	33.46	259.08	1.16	SAND	52	45	90		43.5
10.350	33.96	116.63	2.84	SANDY SILT to CLAYEY SILT	47	41		6.7	
10.500	34.45	66.56	3.81	CLAYEY SILT to SILTY CLAY	33	29		3.8	
10.650	34.94	67.98	6.23	*VERY STIFF FINE GRAINED	68	59			
10.800	35.43	176.31	3.87	*SAND to CLAYEY SAND	88	75			
10.950	35.93	268.70	2.34	SILTY SAND to SANDY SILT	90	76	91		43.5
11.100	36.42	421.20	1.56	SAND to SILTY SAND	100	89	100		45.5
11.250	36.91	485.40	1.36	SAND	97	82	100		46.0
11.400	37.40	412.62	1.28	SAND	83	69	100		45.5
11.550	37.89	178.92	4.58	*VERY STIFF FINE GRAINED	100	100			
11.700	38.39	357.15	1.87	SAND to SILTY SAND	89	74	98		44.5
11.850	38.88	441.85	.65	GRAVELLY SAND to SAND	74	61	100		45.5
12.000	39.37	397.43	.67	GRAVELLY SAND to SAND	66	55	100		45.0
12.150	39.86	142.55	3.68	SANDY SILT to CLAYEY SILT	57	47		8.2	
12.300	40.35	141.47	1.99	SILTY SAND to SANDY SILT	47	38	71		39.5
12.450	40.85	392.60	.59	GRAVELLY SAND to SAND	65	53	100		44.5
12.600	41.34	270.00	2.13	SAND to SILTY SAND	68	55	89		43.0
12.750	41.83	316.02	1.02	SAND	63	51	94		44.0
12.900	42.32	261.04	1.53	SAND to SILTY SAND	65	52	88		43.0
13.050	42.81	520.18	.81	GRAVELLY SAND to SAND	87	69	100		46.0
13.200	43.31	461.16	1.60	SAND to SILTY SAND	100	91	100		45.0
13.350	43.80	454.24	1.92	SAND to SILTY SAND	100	90	100		45.0

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 11.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

CPT INTERPRETATIONS

SOUNDING : CPT-3 M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 07:47

PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	173.12	1.31	SAND to SILTY SAND	43	69	92		
.300	.98	242.42	.86	SAND	48	78	100		
.450	1.48	225.28	1.64	SAND to SILTY SAND	56	90	100		
.600	1.97	83.98	1.84	SILTY SAND to SANDY SILT	28	45	71		48.5
.750	2.46	34.03	1.33	SILTY SAND to SANDY SILT	11	18	45		44.5
.900	2.95	22.97	1.44	SANDY SILT to CLAYEY SILT	9	15		1.8	
1.050	3.44	21.50	.57	SILTY SAND to SANDY SILT	7	11	32		40.0
1.200	3.94	20.80	.73	SANDY SILT to CLAYEY SILT	8	13		1.6	
1.350	4.43	19.69	1.67	SANDY SILT to CLAYEY SILT	8	13		1.6	
1.500	4.92	18.55	.87	SANDY SILT to CLAYEY SILT	7	12		1.5	
1.650	5.41	18.23	1.01	SANDY SILT to CLAYEY SILT	7	12		1.4	
1.800	5.91	19.42	.78	SANDY SILT to CLAYEY SILT	8	12		1.5	
1.950	6.40	16.63	2.71	CLAYEY SILT to SILTY CLAY	8	13		1.1	
2.100	6.89	82.90	2.14	SILTY SAND to SANDY SILT	28	43	71		44.0
2.250	7.38	40.28	2.19	SANDY SILT to CLAYEY SILT	16	24		2.7	
2.400	7.87	53.92	2.19	SANDY SILT to CLAYEY SILT	22	31		3.6	
2.550	8.37	18.40	4.35	CLAY	18	26		1.2	
2.700	8.86	17.76	3.21	CLAYEY SILT to SILTY CLAY	9	12		1.1	
2.850	9.35	18.25	4.18	CLAY	18	24		1.2	
3.000	9.84	19.65	4.05	CLAY to SILTY CLAY	13	17		1.3	
3.150	10.33	32.87	3.52	CLAYEY SILT to SILTY CLAY	16	21		2.1	
3.300	10.83	66.26	2.42	SANDY SILT to CLAYEY SILT	27	33		4.4	
3.450	11.32	98.41	1.86	SILTY SAND to SANDY SILT	33	40	72		42.5
3.600	11.81	122.16	2.04	SILTY SAND to SANDY SILT	41	48	78		43.0
3.750	12.30	136.77	2.89	SANDY SILT to CLAYEY SILT	55	64		8.0	
3.900	12.80	50.86	3.84	CLAYEY SILT to SILTY CLAY	25	29		2.9	
4.050	13.29	43.11	3.11	CLAYEY SILT to SILTY CLAY	22	24		2.8	
4.200	13.78	41.02	3.21	CLAYEY SILT to SILTY CLAY	21	23		2.7	
4.350	14.27	30.87	4.87	CLAY	31	33		1.8	
4.500	14.76	35.86	4.65	CLAY to SILTY CLAY	24	25		2.1	
4.650	15.26	81.94	2.44	SANDY SILT to CLAYEY SILT	33	34		5.4	
4.800	15.75	66.24	3.26	SANDY SILT to CLAYEY SILT	26	27		3.8	
4.950	16.24	17.38	4.90	CLAY	17	18		1.1	
5.100	16.73	10.64	1.99	CLAYEY SILT to SILTY CLAY	5	5		.8	
5.250	17.22	13.83	3.93	CLAY	14	14		.9	
5.400	17.72	17.04	4.34	CLAY	17	17		1.1	
5.550	18.21	26.51	3.80	CLAY to SILTY CLAY	18	17		1.7	
5.700	18.70	28.55	4.20	CLAY to SILTY CLAY	19	19		1.6	
5.850	19.19	55.36	4.36	CLAYEY SILT to SILTY CLAY	28	27		3.2	
6.000	19.69	45.44	3.97	CLAYEY SILT to SILTY CLAY	23	22		2.6	
6.150	20.18	12.39	6.70	CLAY	12	12		.7	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 16.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-3M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	19.33	3.61	CLAY to SILTY CLAY	13	12		1.2	
6.450	21.16	12.07	2.87	CLAY to SILTY CLAY	8	8		.7	
6.600	21.65	21.92	2.90	CLAYEY SILT to SILTY CLAY	11	10		1.4	
6.750	22.15	56.30	3.52	CLAYEY SILT to SILTY CLAY	28	26		3.2	
6.900	22.64	99.06	4.80	*VERY STIFF FINE GRAINED	99	92			
7.050	23.13	41.79	3.01	CLAYEY SILT to SILTY CLAY	21	19		2.7	
7.200	23.62	52.75	3.45	CLAYEY SILT to SILTY CLAY	26	24		3.0	
7.350	24.11	156.87	2.46	SILTY SAND to SANDY SILT	52	48	77		42.0
7.500	24.61	63.63	5.90	CLAY	64	58		3.7	
7.650	25.10	220.50	2.15	SILTY SAND to SANDY SILT	74	66	87		43.0
7.800	25.59	140.07	3.29	SANDY SILT to CLAYEY SILT	56	50		8.1	
7.950	26.08	33.44	5.75	CLAY	33	30		1.9	
8.100	26.57	124.43	2.94	SANDY SILT to CLAYEY SILT	50	44		7.2	
8.250	27.07	323.52	1.16	SAND	65	57	97		44.5
8.400	27.56	193.03	3.92	*SAND to CLAYEY SAND	97	85			
8.550	28.05	427.13	1.34	SAND	85	75	100		46.0
8.700	28.54	472.40	.75	GRAVELLY SAND to SAND	79	68	100		46.0
8.850	29.04	431.59	.76	GRAVELLY SAND to SAND	72	62	100		46.0
9.000	29.53	129.21	2.52	SILTY SAND to SANDY SILT	43	37	70		39.5
9.150	30.02	68.26	3.05	SANDY SILT to CLAYEY SILT	27	23		3.9	
9.300	30.51	88.40	2.84	SANDY SILT to CLAYEY SILT	35	30		5.1	
9.450	31.00	92.18	4.06	CLAYEY SILT to SILTY CLAY	46	39		5.3	
9.600	31.50	158.44	2.92	SILTY SAND to SANDY SILT	53	45	75		41.0
9.750	31.99	170.11	2.32	SILTY SAND to SANDY SILT	57	48	77		41.5
9.900	32.48	166.07	2.96	SILTY SAND to SANDY SILT	55	46	76		41.0
10.050	32.97	150.84	3.37	SANDY SILT to CLAYEY SILT	60	50		8.8	
10.200	33.46	297.09	2.22	SILTY SAND to SANDY SILT	99	82	93		44.0
10.350	33.96	419.12	1.89	SAND to SILTY SAND	100	86	100		45.0
10.500	34.45	231.84	3.87	*SAND to CLAYEY SAND	100	95			
10.650	34.94	345.48	2.40	SILTY SAND to SANDY SILT	100	94	97		44.0
10.800	35.43	420.82	1.66	SAND to SILTY SAND	100	85	100		45.0
10.950	35.93	229.59	2.23	SILTY SAND to SANDY SILT	77	62	85		42.5
11.100	36.42	153.37	4.57	*VERY STIFF FINE GRAINED	100	100			

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*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 16.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

CPT INTERPRETATIONS

SOUNDING : CPT-4 M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 14:20

PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	181.01	2.05	SILTY SAND to SANDY SILT	60	96	93		
.300	.98	199.09	2.87	SILTY SAND to SANDY SILT	66	100	96		
.450	1.48	262.69	.69	SAND	53	84	100		
.600	1.97	84.34	3.97	CLAYEY SILT to SILTY CLAY	42	67		5.0	
.750	2.46	70.83	2.46	SANDY SILT to CLAYEY SILT	28	45		4.7	
.900	2.95	56.43	2.18	SANDY SILT to CLAYEY SILT	23	36		3.8	
1.050	3.44	44.47	1.89	SANDY SILT to CLAYEY SILT	18	28		3.0	
1.200	3.94	62.46	2.75	SANDY SILT to CLAYEY SILT	25	40		4.1	
1.350	4.43	83.47	2.41	SILTY SAND to SANDY SILT	28	44	71		45.5
1.500	4.92	90.14	1.49	SILTY SAND to SANDY SILT	30	48	73		45.5
1.650	5.41	90.46	5.31	*VERY STIFF FINE GRAINED	90	100			
1.800	5.91	63.22	3.02	SANDY SILT to CLAYEY SILT	25	40		4.2	
1.950	6.40	49.93	3.02	SANDY SILT to CLAYEY SILT	20	32		3.3	
2.100	6.89	87.40	2.52	SANDY SILT to CLAYEY SILT	35	54		5.8	
2.250	7.38	87.59	4.19	CLAYEY SILT to SILTY CLAY	44	66		5.1	
2.400	7.87	88.70	3.99	CLAYEY SILT to SILTY CLAY	44	65		5.2	
2.550	8.37	116.34	2.92	SANDY SILT to CLAYEY SILT	47	66		6.8	
2.700	8.86	123.58	3.47	SANDY SILT to CLAYEY SILT	49	68		7.2	
2.850	9.35	121.20	2.77	SANDY SILT to CLAYEY SILT	48	65		7.1	
3.000	9.84	139.85	2.38	SILTY SAND to SANDY SILT	47	61	84		44.5
3.150	10.33	144.36	2.80	SILTY SAND to SANDY SILT	48	61	84		44.5
3.300	10.83	135.78	3.65	SANDY SILT to CLAYEY SILT	54	67		7.9	
3.450	11.32	144.97	2.57	SILTY SAND to SANDY SILT	48	59	83		44.0
3.600	11.81	148.73	2.55	SILTY SAND to SANDY SILT	50	59	83		44.0
3.750	12.30	134.86	3.06	SANDY SILT to CLAYEY SILT	54	63		7.9	
3.900	12.80	119.03	3.49	SANDY SILT to CLAYEY SILT	48	54		7.0	
4.050	13.29	124.20	3.39	SANDY SILT to CLAYEY SILT	50	56		7.3	
4.200	13.78	192.33	1.66	SAND to SILTY SAND	48	53	88		44.5
4.350	14.27	143.23	2.46	SILTY SAND to SANDY SILT	48	52	79		43.0
4.500	14.76	112.02	2.53	SILTY SAND to SANDY SILT	37	40	72		42.0
4.650	15.26	80.77	2.98	SANDY SILT to CLAYEY SILT	32	34		4.7	
4.800	15.75	68.58	4.23	CLAYEY SILT to SILTY CLAY	34	35		4.0	
4.950	16.24	128.23	2.48	SILTY SAND to SANDY SILT	43	43	74		42.0
5.100	16.73	134.46	2.27	SILTY SAND to SANDY SILT	45	45	75		42.0
5.250	17.22	138.66	2.94	SANDY SILT to CLAYEY SILT	55	55		8.1	
5.400	17.72	109.79	2.81	SANDY SILT to CLAYEY SILT	44	43		6.4	
5.550	18.21	82.05	3.66	CLAYEY SILT to SILTY CLAY	41	39		4.8	
5.700	18.70	90.40	3.83	CLAYEY SILT to SILTY CLAY	45	43		5.3	
5.850	19.19	134.82	2.33	SILTY SAND to SANDY SILT	45	42	74		41.0
6.000	19.69	166.01	1.99	SILTY SAND to SANDY SILT	55	51	79		42.0
6.150	20.18	121.80	3.19	SANDY SILT to CLAYEY SILT	49	44		7.1	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-4 M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	100.83	3.54	SANDY SILT to CLAYEY SILT	40	36		5.9	
6.450	21.16	56.72	5.77	CLAY	57	50		3.3	
6.600	21.65	180.45	1.95	SILTY SAND to SANDY SILT	60	53	80		42.0
6.750	22.15	142.40	3.13	SANDY SILT to CLAYEY SILT	57	49		8.3	
6.900	22.64	112.41	4.30	*VERY STIFF FINE GRAINED	100	96			
7.050	23.13	69.56	5.35	*VERY STIFF FINE GRAINED	70	59			
7.200	23.62	179.07	4.10	*VERY STIFF FINE GRAINED	100	100			
7.350	24.11	341.91	2.31	SILTY SAND to SANDY SILT	100	95	97		44.5
7.500	24.61	208.26	2.50	SILTY SAND to SANDY SILT	69	57	82		42.0
7.650	25.10	95.28	4.80	*VERY STIFF FINE GRAINED	95	78			
7.800	25.59	202.00	2.65	SILTY SAND to SANDY SILT	67	54	81		42.0
7.950	26.08	148.59	4.21	*VERY STIFF FINE GRAINED	100	100			
8.100	26.57	195.62	2.38	SILTY SAND to SANDY SILT	65	52	80		41.5
8.250	27.07	370.32	2.21	SAND to SILTY SAND	93	73	98		44.0
8.400	27.56	480.35	1.35	SAND	96	75	100		45.5
8.550	28.05	338.05	2.51	SILTY SAND to SANDY SILT	100	87	94		44.0
8.700	28.54	359.44	2.80	*SAND to CLAYEY SAND	100	100			
8.850	29.04	530.50	2.22	*SAND to CLAYEY SAND	100	100			

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

CPT INTERPRETATIONS

SOUNDING : CPT-5 M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 14:51

PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

PAGE 1 of 2

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	121.73	1.31	SAND to SILTY SAND	30	49	82		
.300	.98	95.84	2.56	SANDY SILT to CLAYEY SILT	38	61		6.4	
.450	1.48	83.02	1.68	SILTY SAND to SANDY SILT	28	44	71		
.600	1.97	25.37	7.45	CLAY	25	41		1.5	
.750	2.46	34.52	3.93	CLAYEY SILT to SILTY CLAY	17	28		2.0	
.900	2.95	38.98	3.32	CLAYEY SILT to SILTY CLAY	19	31		2.6	
1.050	3.44	40.81	3.55	CLAYEY SILT to SILTY CLAY	20	33		2.4	
1.200	3.94	4.82	5.03	CLAY	5	8		.3	
1.350	4.43	.81	31.44	ORGANIC MATERIAL	1	1		.1	
1.500	4.92	38.81	2.98	CLAYEY SILT to SILTY CLAY	19	31		2.6	
1.650	5.41	49.33	2.67	SANDY SILT to CLAYEY SILT	20	32		3.3	
1.800	5.91	60.97	2.60	SANDY SILT to CLAYEY SILT	24	39		4.0	
1.950	6.40	72.34	1.52	SILTY SAND to SANDY SILT	24	39	67		43.5
2.100	6.89	161.97	2.08	SILTY SAND to SANDY SILT	54	84	90		46.5
2.250	7.38	137.65	1.49	SAND to SILTY SAND	34	52	85		45.5
2.400	7.87	183.94	1.43	SAND to SILTY SAND	46	67	94		46.5
2.550	8.37	150.99	1.59	SAND to SILTY SAND	38	53	88		45.5
2.700	8.86	62.42	1.73	SILTY SAND to SANDY SILT	21	29	63		41.0
2.850	9.35	41.49	3.29	CLAYEY SILT to SILTY CLAY	21	28		2.7	
3.000	9.84	38.86	3.36	CLAYEY SILT to SILTY CLAY	19	25		2.6	
3.150	10.33	46.29	2.72	SANDY SILT to CLAYEY SILT	19	24		3.0	
3.300	10.83	175.35	1.51	SAND to SILTY SAND	44	54	89		45.0
3.450	11.32	68.88	1.46	SILTY SAND to SANDY SILT	23	28	62		40.0
3.600	11.81	36.69	3.81	CLAYEY SILT to SILTY CLAY	18	22		2.1	
3.750	12.30	46.19	3.32	CLAYEY SILT to SILTY CLAY	23	27		3.0	
3.900	12.80	57.72	2.88	SANDY SILT to CLAYEY SILT	23	26		3.8	
4.050	13.29	67.20	2.26	SANDY SILT to CLAYEY SILT	27	30		4.4	
4.200	13.78	72.85	2.19	SILTY SAND to SANDY SILT	24	27	61		39.5
4.350	14.27	42.96	3.63	CLAYEY SILT to SILTY CLAY	21	23		2.5	
4.500	14.76	32.04	5.09	CLAY	32	34		1.8	
4.650	15.26	33.18	4.75	CLAY	33	35		1.9	
4.800	15.75	34.27	4.89	CLAY	34	35		2.0	
4.950	16.24	32.74	5.02	CLAY	33	33		1.9	
5.100	16.73	32.57	4.82	CLAY	33	33		1.9	
5.250	17.22	57.57	2.49	SANDY SILT to CLAYEY SILT	23	23		3.8	
5.400	17.72	79.31	2.51	SANDY SILT to CLAYEY SILT	32	31		5.2	
5.550	18.21	81.60	3.82	CLAYEY SILT to SILTY CLAY	41	39		4.7	
5.700	18.70	50.63	3.50	CLAYEY SILT to SILTY CLAY	25	24		2.9	
5.850	19.19	36.84	4.60	CLAY to SILTY CLAY	25	23		2.1	
6.000	19.69	36.39	4.65	CLAY to SILTY CLAY	24	22		2.1	
6.150	20.18	30.53	5.85	CLAY	31	28		1.7	

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-5 M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	60.08	3.51	CLAYEY SILT to SILTY CLAY	30	27		3.5	
6.450	21.16	96.81	3.38	SANDY SILT to CLAYEY SILT	39	34		5.6	
6.600	21.65	94.16	2.45	SILTY SAND to SANDY SILT	31	28	61		38.5
6.750	22.15	49.08	4.71	CLAY to SILTY CLAY	33	28		2.8	
6.900	22.64	71.91	3.71	CLAYEY SILT to SILTY CLAY	36	31		4.2	
7.050	23.13	53.73	4.14	CLAYEY SILT to SILTY CLAY	27	23		3.1	
7.200	23.62	94.94	3.61	SANDY SILT to CLAYEY SILT	38	32		5.5	
7.350	24.11	57.51	3.60	CLAYEY SILT to SILTY CLAY	29	24		3.3	
7.500	24.61	311.05	1.94	SAND to SILTY SAND	78	64	94		44.0
7.650	25.10	331.06	1.32	SAND	66	54	95		44.0
7.800	25.59	370.11	1.24	SAND	74	60	98		44.5
7.950	26.08	380.35	1.70	SAND to SILTY SAND	95	76	99		44.5
8.100	26.57	418.06	2.18	SAND to SILTY SAND	100	83	100		45.0
8.250	27.07	522.37	2.31	*SAND to CLAYEY SAND	100	100			
8.400	27.56	710.02	1.67	SAND	100	100	100		
8.550	28.05	477.24	1.50	SAND	95	74	100		45.0
8.700	28.54	394.03	1.93	SAND to SILTY SAND	99	75	99		44.5
8.850	29.04	437.24	1.62	SAND to SILTY SAND	100	83	100		44.5
9.000	29.53	407.07	1.75	SAND to SILTY SAND	100	76	99		44.0
9.150	30.02	294.13	2.16	SAND to SILTY SAND	74	55	89		43.0
9.300	30.51	229.83	3.00	SILTY SAND to SANDY SILT	77	57	82		42.0
9.450	31.00	284.89	1.98	SAND to SILTY SAND	71	53	88		42.5
9.600	31.50	269.04	2.35	SILTY SAND to SANDY SILT	90	66	87		42.5
9.750	31.99	319.10	2.31	SILTY SAND to SANDY SILT	100	78	91		43.0
9.900	32.48	359.46	2.33	SAND to SILTY SAND	90	66	95		43.5
10.050	32.97	384.66	2.42	SILTY SAND to SANDY SILT	100	93	96		44.0
10.200	33.46	307.35	2.93	*SAND to CLAYEY SAND	100	100			

---

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

CPT INTERPRETATIONS

SOUNDING : CPT-6 M
PROJECT : AES-NEWHALL RNCH
DATE/TIME: 09-07-99 09:50
PROJECT No.: 99-A893
CONE/RIG : 408\#1 JH,GO

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
.150	.49	78.99	2.25	SILTY SAND to SANDY SILT	26	42	70		
.300	.98	66.71	3.80	CLAYEY SILT to SILTY CLAY	33	53		3.9	
.450	1.48	55.05	3.52	CLAYEY SILT to SILTY CLAY	28	44		3.2	
.600	1.97	157.83	1.99	SILTY SAND to SANDY SILT	53	84	89		
.750	2.46	135.84	1.80	SILTY SAND to SANDY SILT	45	72	85		
.900	2.95	99.77	2.05	SILTY SAND to SANDY SILT	33	53	76		48.0
1.050	3.44	64.78	2.74	SANDY SILT to CLAYEY SILT	26	41		4.3	
1.200	3.94	74.23	1.71	SILTY SAND to SANDY SILT	25	40	68		45.5
1.350	4.43	126.77	1.60	SAND to SILTY SAND	32	51	83		47.0
1.500	4.92	130.57	1.32	SAND to SILTY SAND	33	52	84		47.0
1.650	5.41	186.21	1.20	SAND to SILTY SAND	47	74	94		48.0
1.800	5.91	246.59	3.55	*SAND to CLAYEY SAND	100	100			
1.950	6.40	191.10	1.51	SAND to SILTY SAND	48	76	95		47.5
2.100	6.89	150.39	1.62	SAND to SILTY SAND	38	58	88		46.0
2.250	7.38	92.10	1.25	SAND to SILTY SAND	23	35	74		44.0
2.400	7.87	76.16	1.12	SAND to SILTY SAND	19	28	69		42.5
2.550	8.37	90.69	1.19	SAND to SILTY SAND	23	32	74		43.0
2.700	8.86	367.56	.79	SAND	74	100	100		48.5
2.850	9.35	426.32	.96	SAND	85	100	100		49.0
3.000	9.84	367.71	.78	SAND	74	96	100		48.0
3.150	10.33	220.39	1.22	SAND	44	56	96		46.0
3.300	10.83	75.46	2.34	SANDY SILT to CLAYEY SILT	30	37		5.0	
3.450	11.32	50.46	2.58	SANDY SILT to CLAYEY SILT	20	24		3.3	
3.600	11.81	76.52	1.85	SILTY SAND to SANDY SILT	26	30	64		40.5
3.750	12.30	133.08	1.74	SILTY SAND to SANDY SILT	44	52	80		43.0
3.900	12.80	287.46	1.26	SAND	57	66	100		46.0
4.050	13.29	134.69	2.33	SILTY SAND to SANDY SILT	45	50	79		43.0
4.200	13.78	432.44	1.42	SAND	86	95	100		47.5
4.350	14.27	311.90	1.25	SAND	62	67	100		46.0
4.500	14.76	419.46	1.13	SAND	84	89	100		47.0
4.650	15.26	164.54	2.84	SILTY SAND to SANDY SILT	55	57	83		43.0
4.800	15.75	234.93	1.20	SAND	47	48	92		44.5
4.950	16.24	206.84	.99	SAND	41	42	88		44.0
5.100	16.73	131.61	1.16	SAND to SILTY SAND	33	33	75		42.0
5.250	17.22	135.44	1.47	SAND to SILTY SAND	34	33	75		42.0
5.400	17.72	120.67	.60	SAND	24	23	71		41.0
5.550	18.21	87.38	.99	SAND to SILTY SAND	22	21	62		39.0
5.700	18.70	42.30	2.08	SANDY SILT to CLAYEY SILT	17	16		2.7	
5.850	19.19	100.70	.73	SAND to SILTY SAND	25	23	65		39.5
6.000	19.69	116.40	.80	SAND to SILTY SAND	29	27	69		40.0
6.150	20.18	127.00	1.68	SILTY SAND to SANDY SILT	42	38	71		40.0

*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

HOLGUIN, FAHAN & ASSOCIATES, INC.

Interpretations based on: Robertson and Campanella, 1989.

SOUNDING : CPT-6 M

DEPTH (m)	DEPTH (ft)	TIP RESISTANCE (tsf)	FRICTION RATIO (%)	SOIL BEHAVIOR TYPE	N(60)	N1(60)	Dr (%)	Su (tsf)	PHI (Degrees)
6.300	20.67	192.10	1.16	SAND to SILTY SAND	48	43	83		42.5
6.450	21.16	137.77	1.84	SILTY SAND to SANDY SILT	46	41	73		40.5
6.600	21.65	97.30	1.66	SILTY SAND to SANDY SILT	32	28	62		38.5
6.750	22.15	102.78	2.23	SILTY SAND to SANDY SILT	34	30	64		39.0
6.900	22.64	110.64	2.47	SILTY SAND to SANDY SILT	37	32	65		39.0
7.050	23.13	101.36	3.02	SANDY SILT to CLAYEY SILT	41	34		5.9	
7.200	23.62	119.20	2.13	SILTY SAND to SANDY SILT	40	33	67		39.0
7.350	24.11	318.18	1.08	SAND	64	53	95		44.0
7.500	24.61	453.53	.97	SAND	91	75	100		45.5
7.650	25.10	121.39	1.55	SAND to SILTY SAND	30	25	67		39.0
7.800	25.59	84.04	2.26	SILTY SAND to SANDY SILT	28	23	56		38.0
7.950	26.08	91.80	1.36	SAND to SILTY SAND	23	18	58		38.0
8.100	26.57	74.59	1.91	SILTY SAND to SANDY SILT	25	20	52		37.0
8.250	27.07	45.17	4.19	CLAYEY SILT to SILTY CLAY	23	18		2.6	
8.400	27.56	85.26	2.02	SILTY SAND to SANDY SILT	28	22	55		37.5
8.550	28.05	173.10	*****		0	0			45.0

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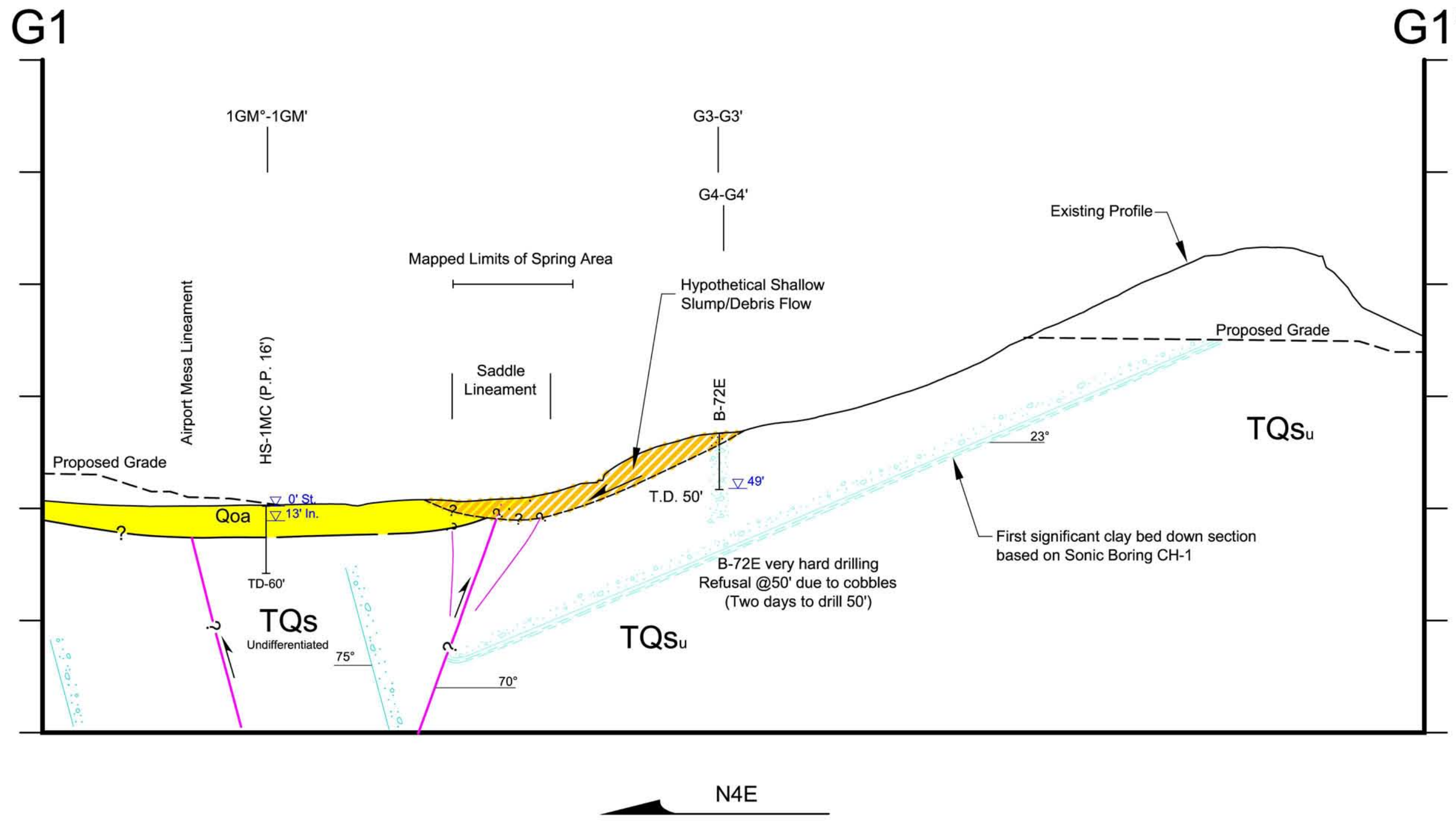
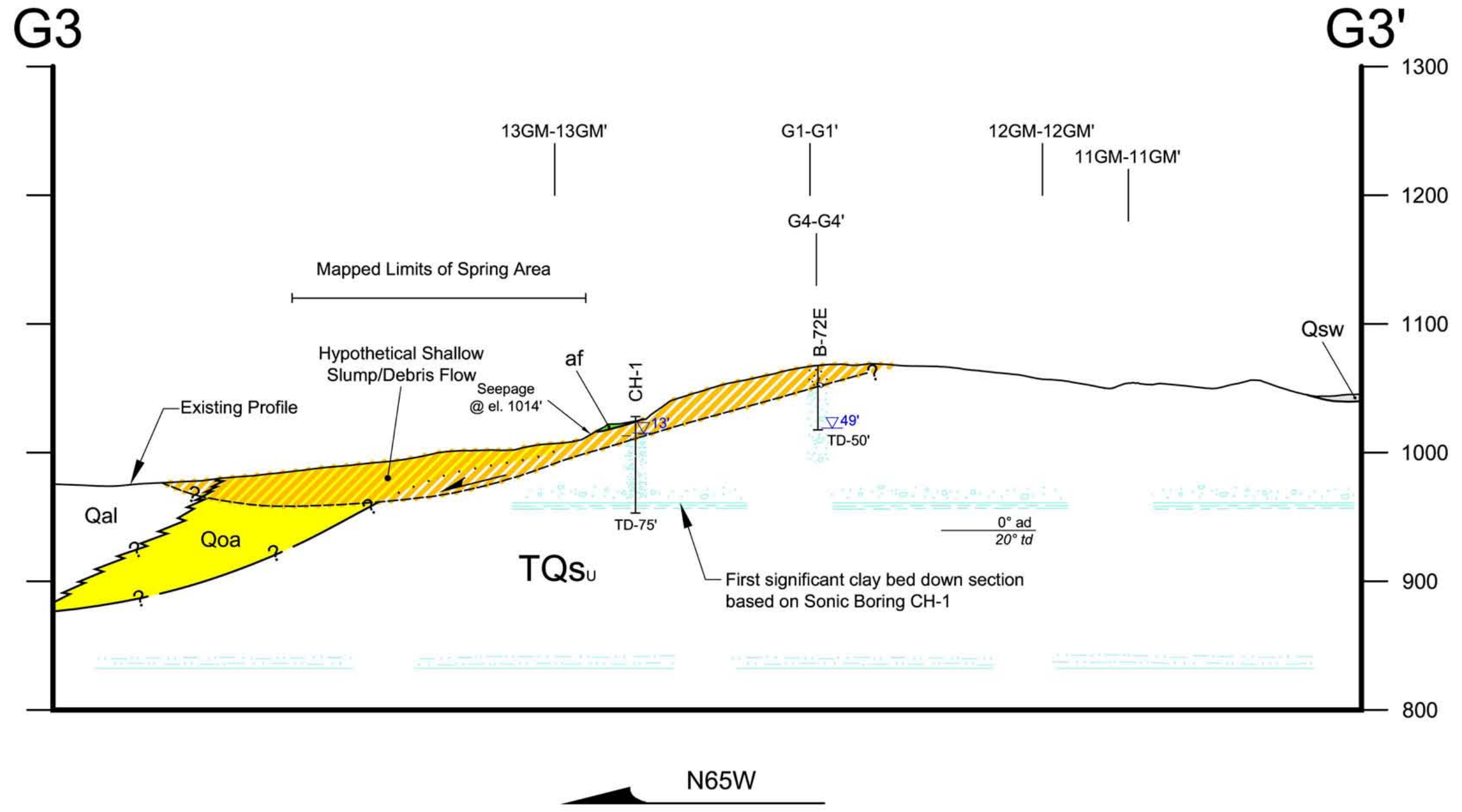
*INDICATES OVERCONSOLIDATED OR CEMENTED MATERIAL
ASSUMED TOTAL UNIT WT = 120 pcf
ASSUMED DEPTH OF WATER TABLE = 30.0 ft
N(60) = EQUIVALENT SPT VALUE (60% Energy)
N1(60) = OVERBURDEN NORMALIZED EQUIVALENT SPT VALUE (60% Energy)
Dr = OVERBURDEN NORMALIZED EQUIVALENT RELATIVE DENSITY
Su = OVERBURDEN NORMALIZED UNDRAINED SHEAR STRENGTH
PHI = OVERBURDEN NORMALIZED EQUIVALENT FRICTION ANGLE

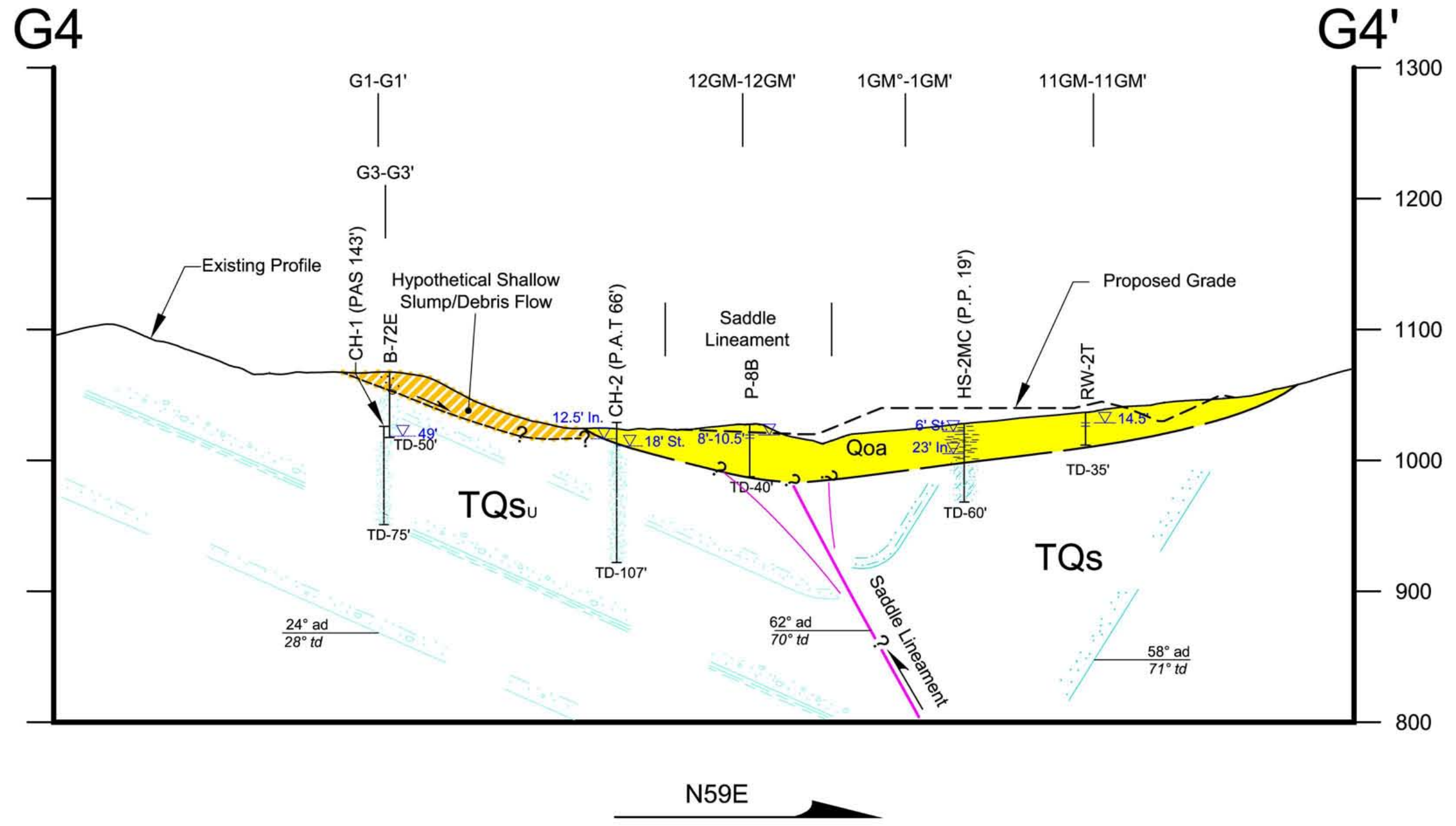
HOLGUIN, FAHAN & ASSOCIATES, INC.

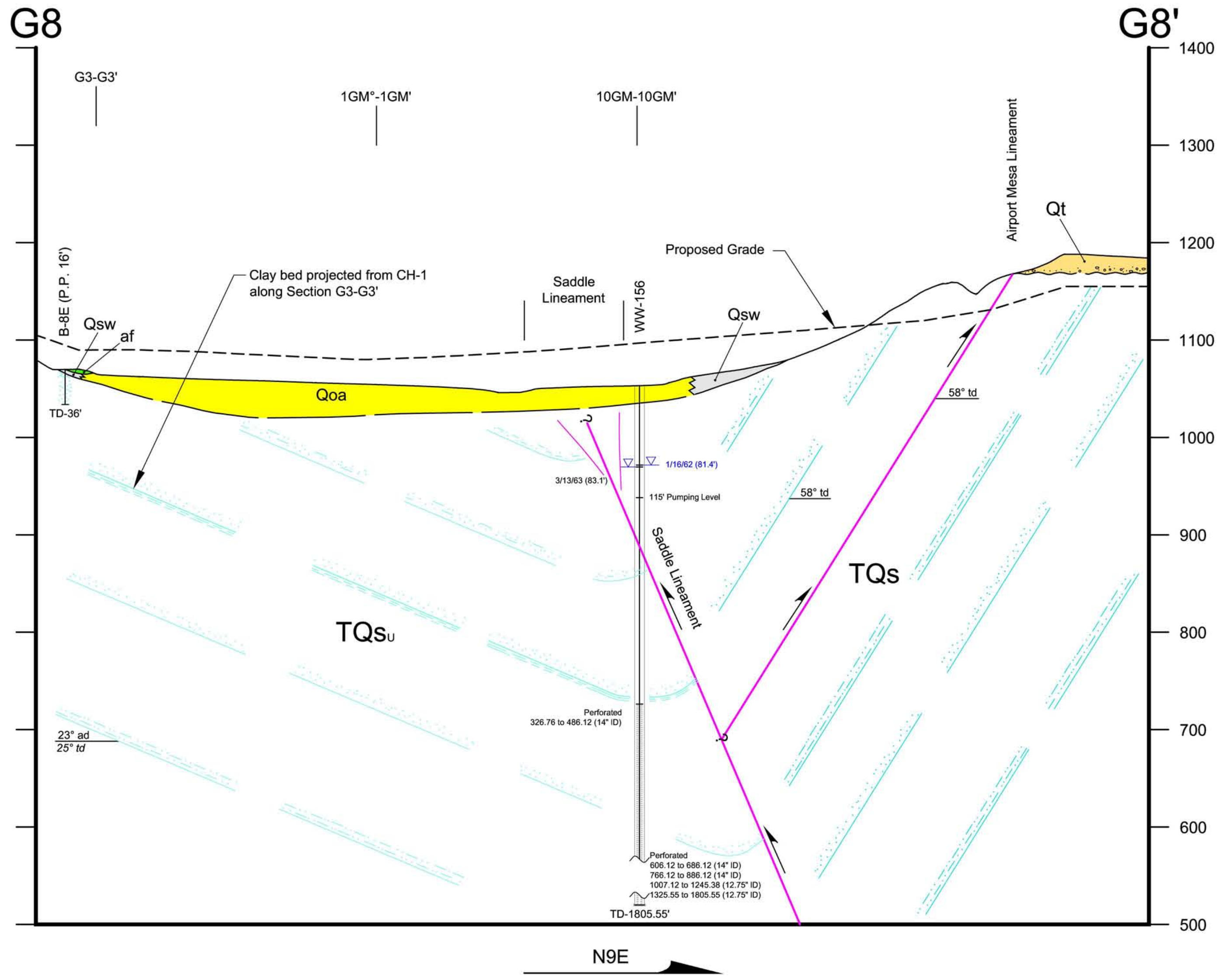
Interpretations based on: Robertson and Campanella, 1989.

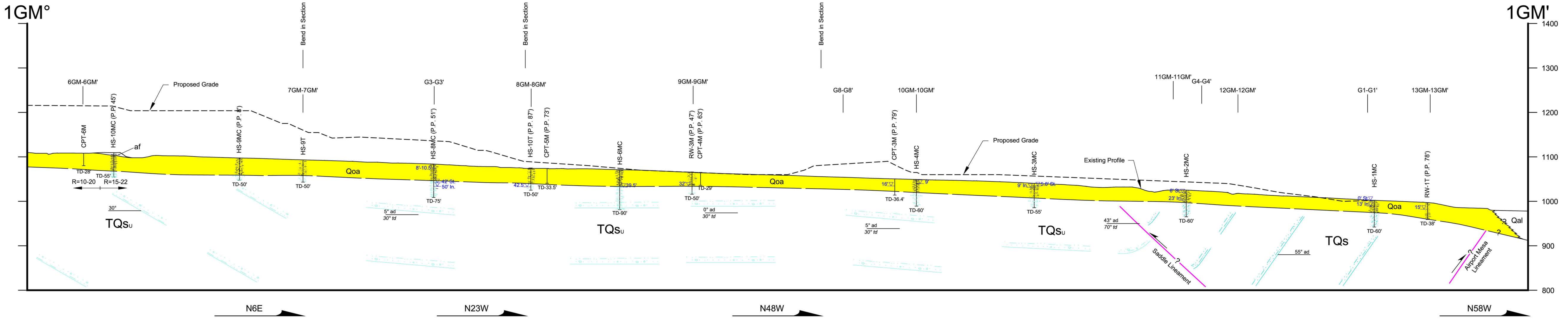
Appendix B

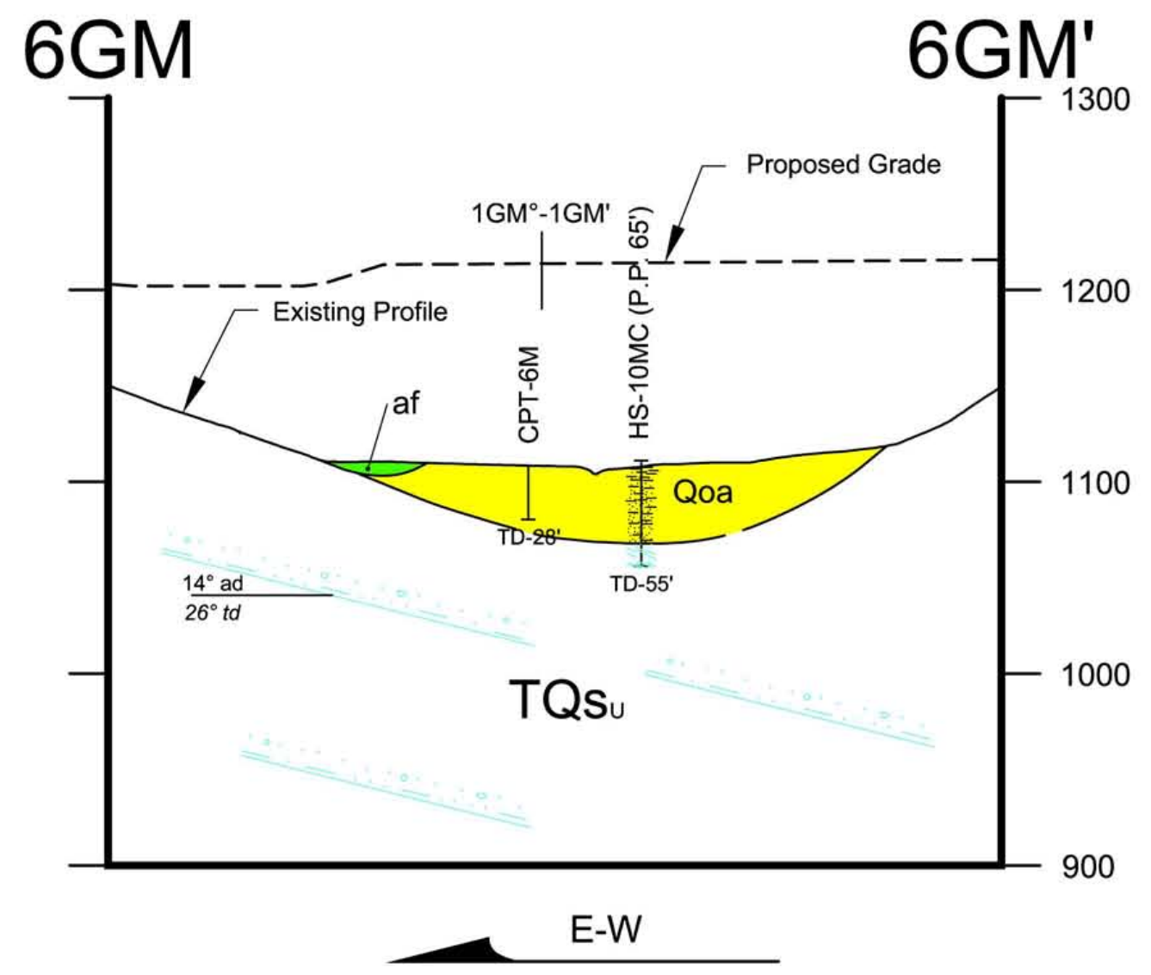


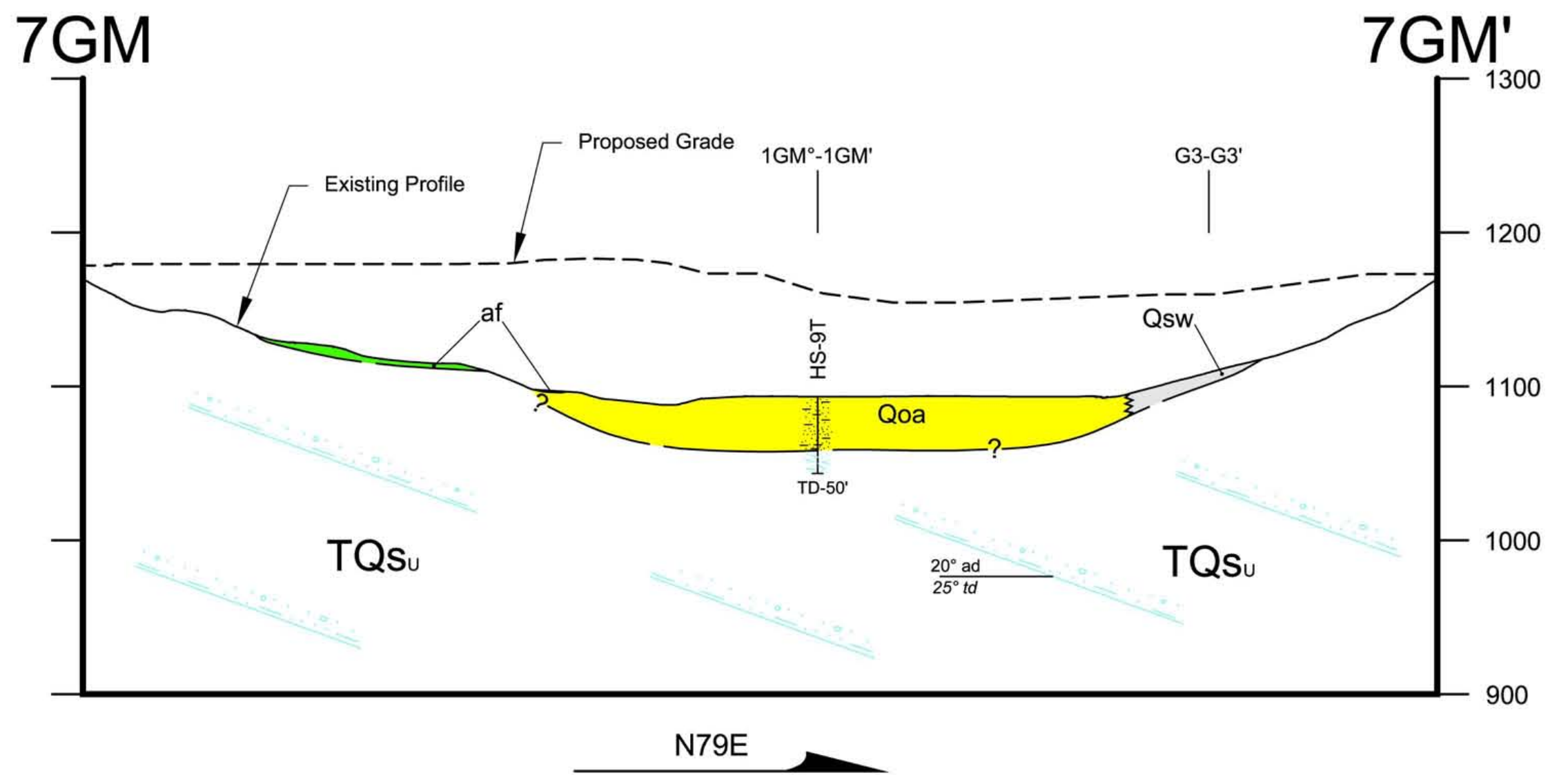


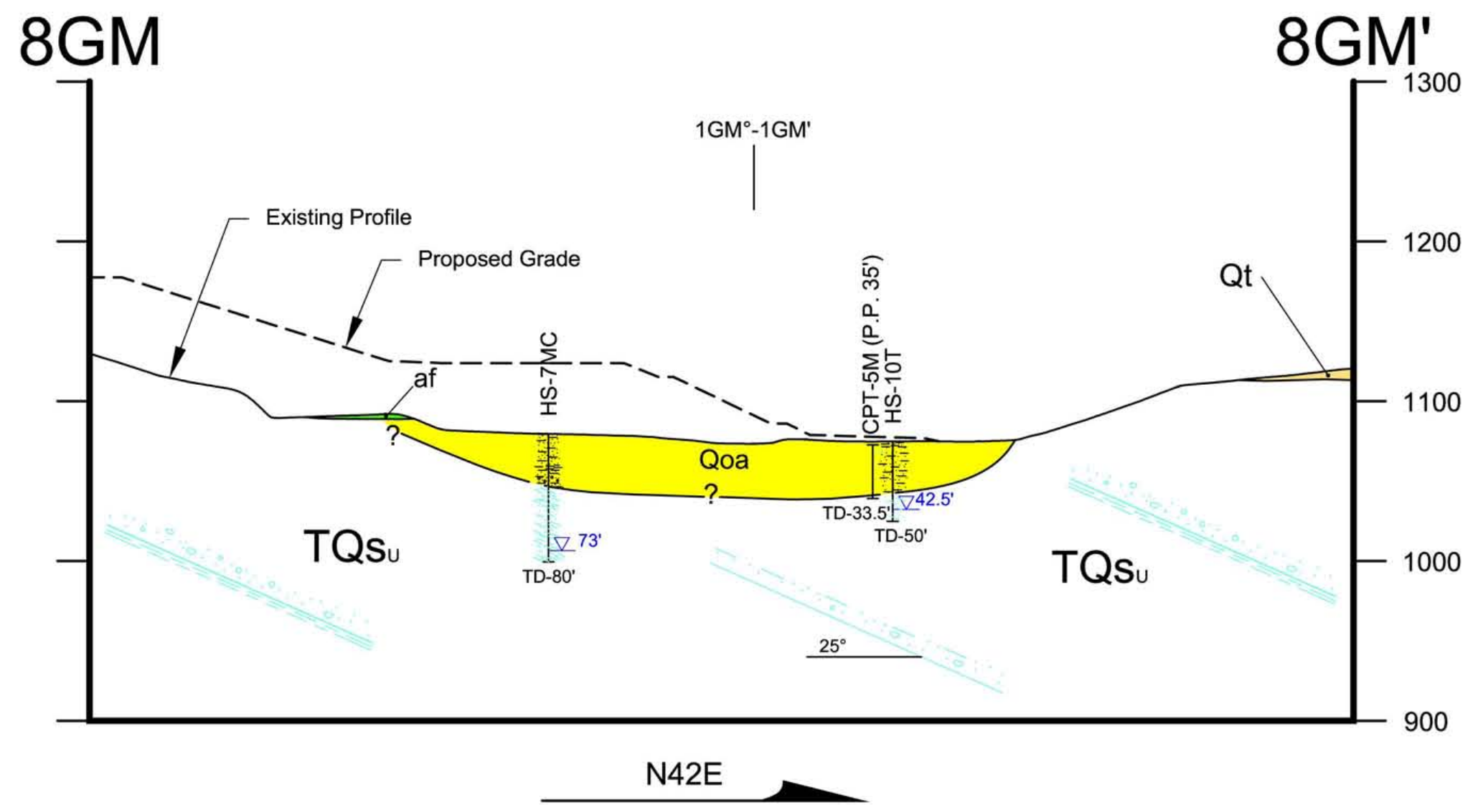


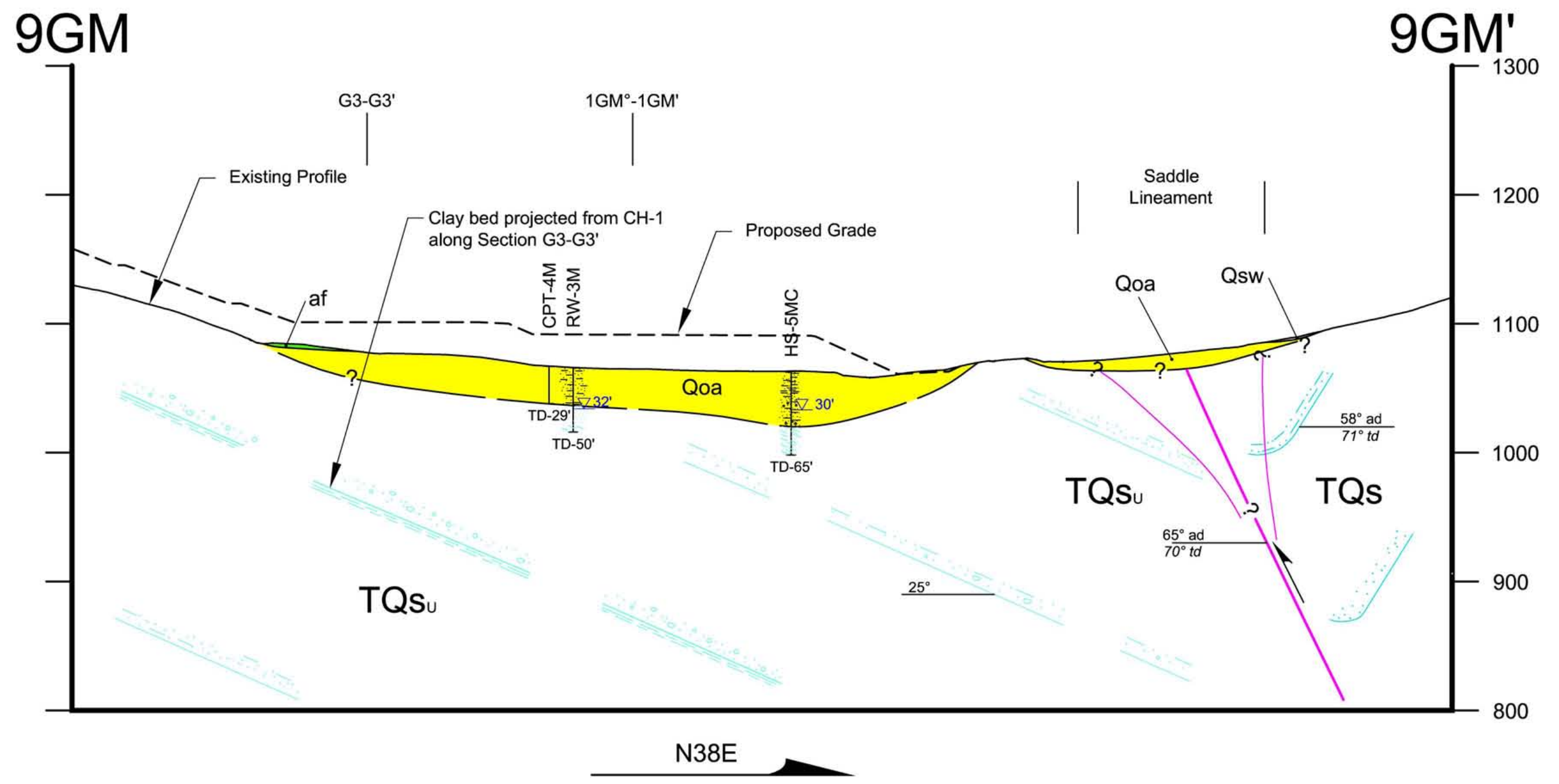


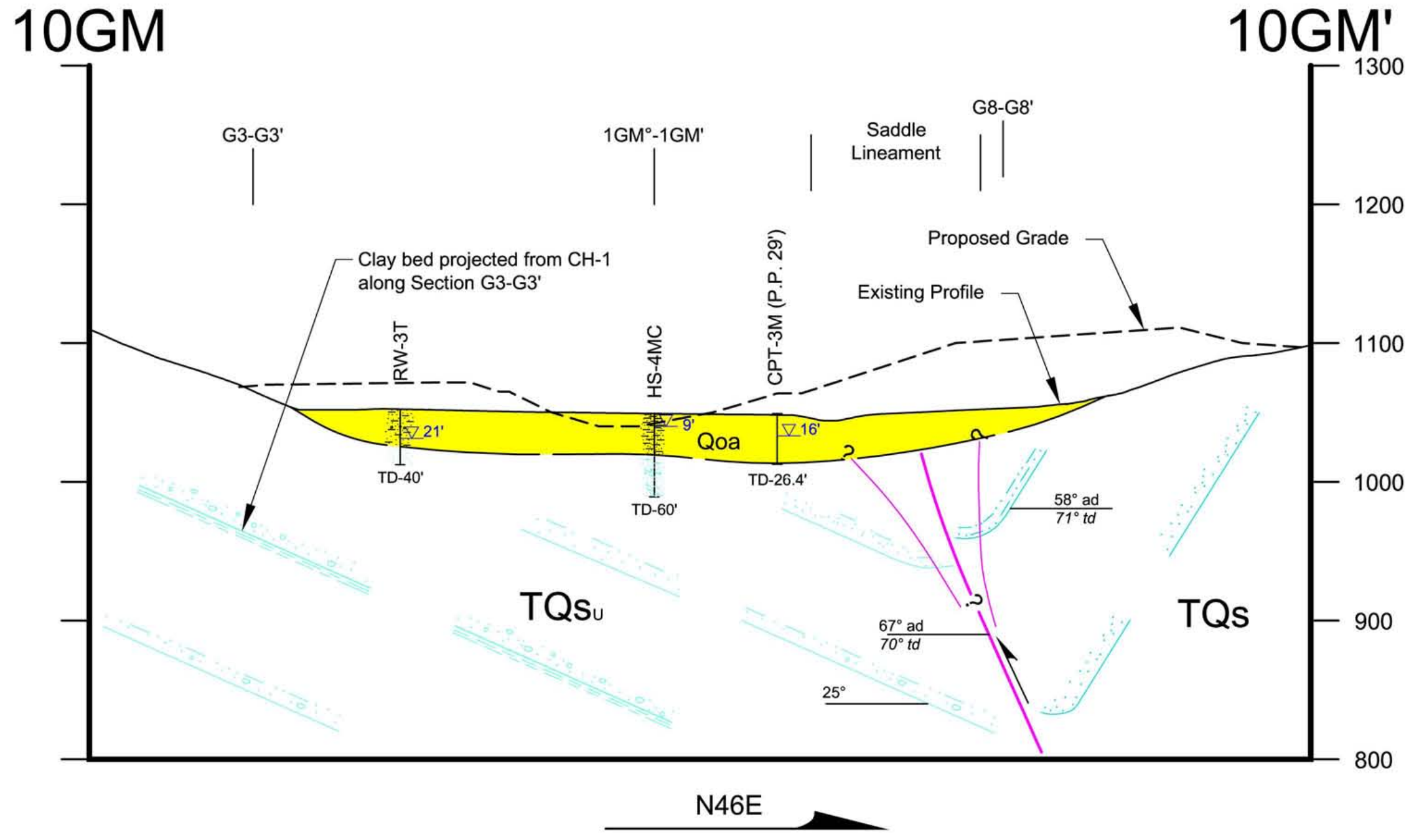


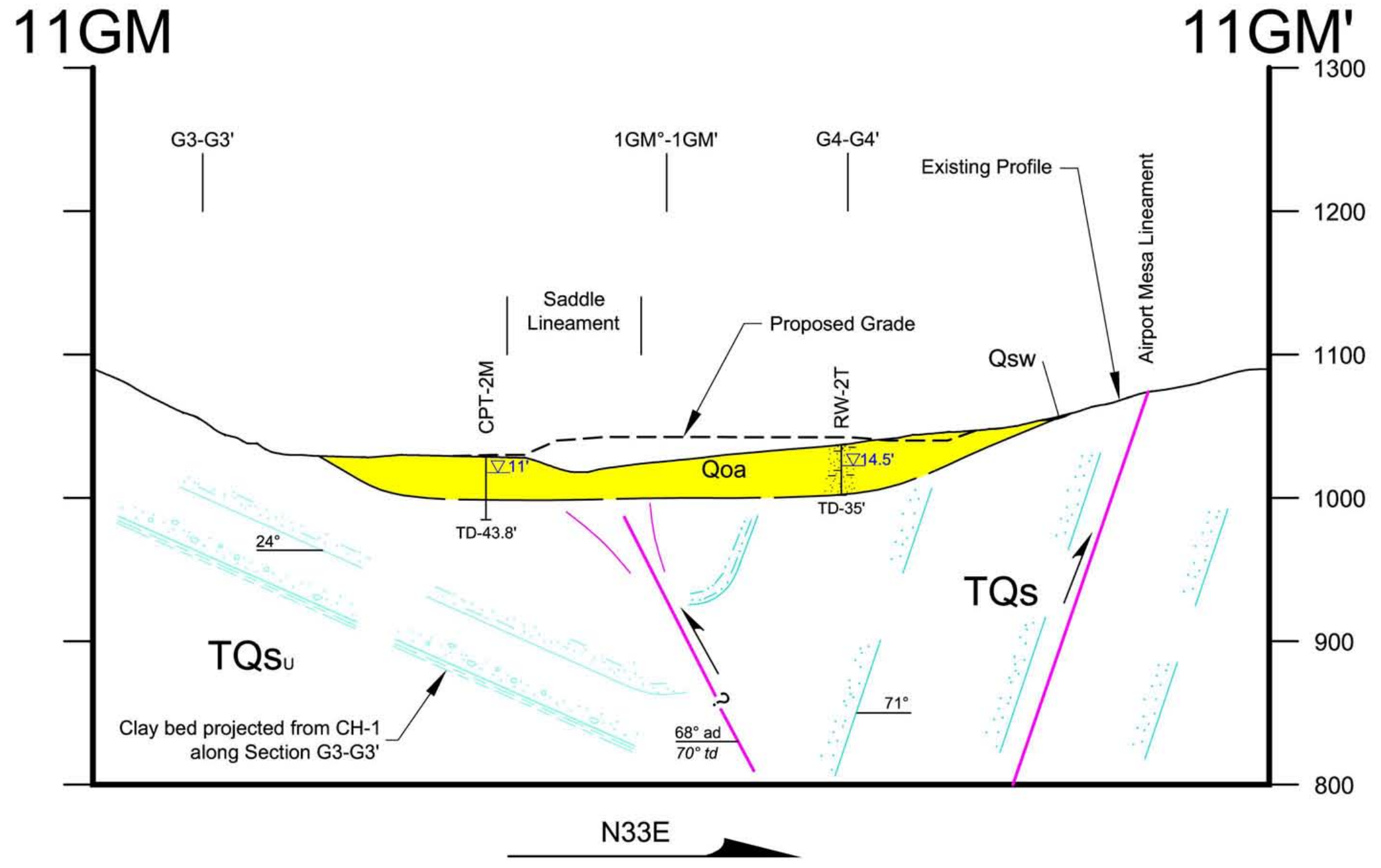


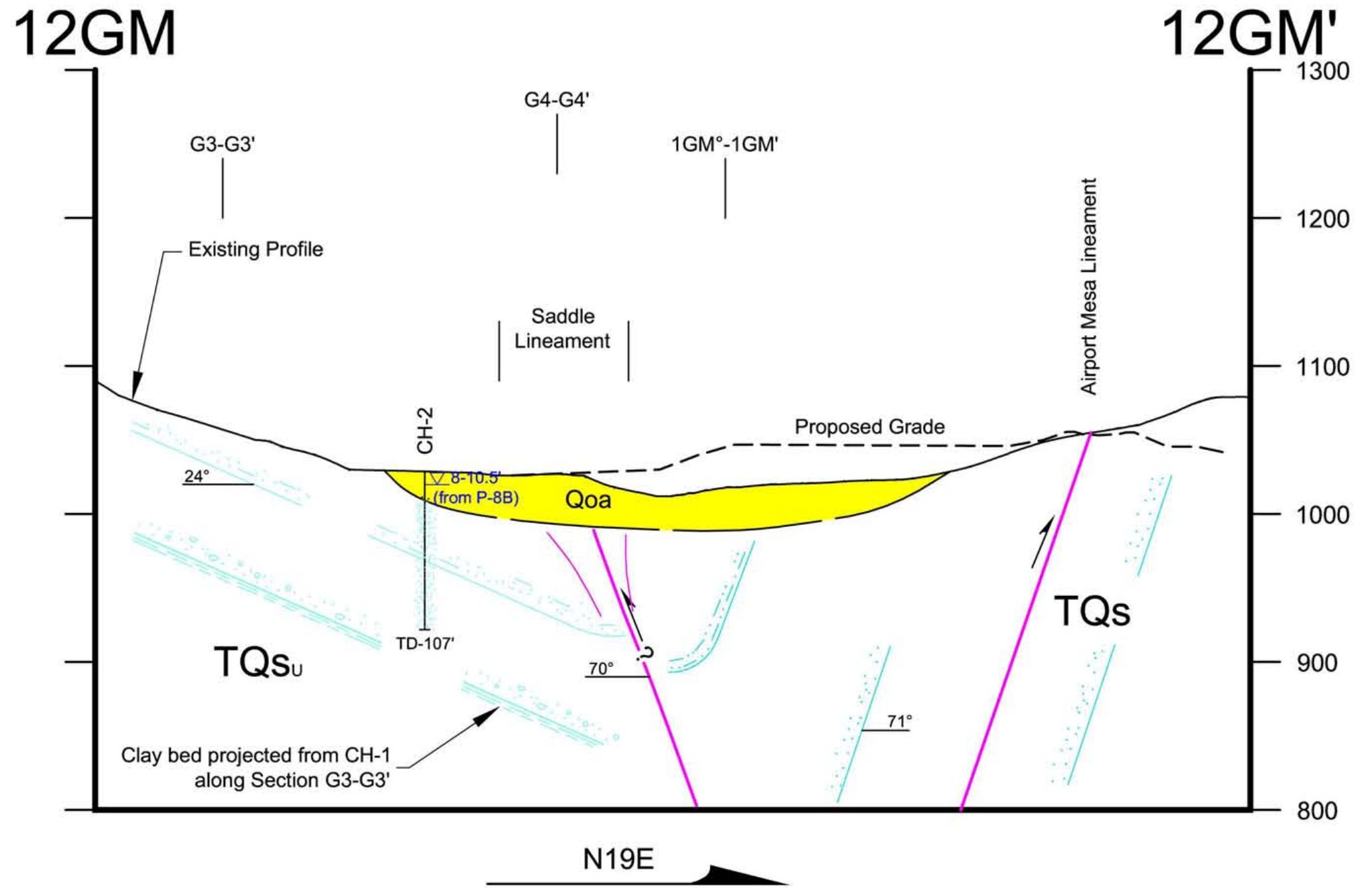


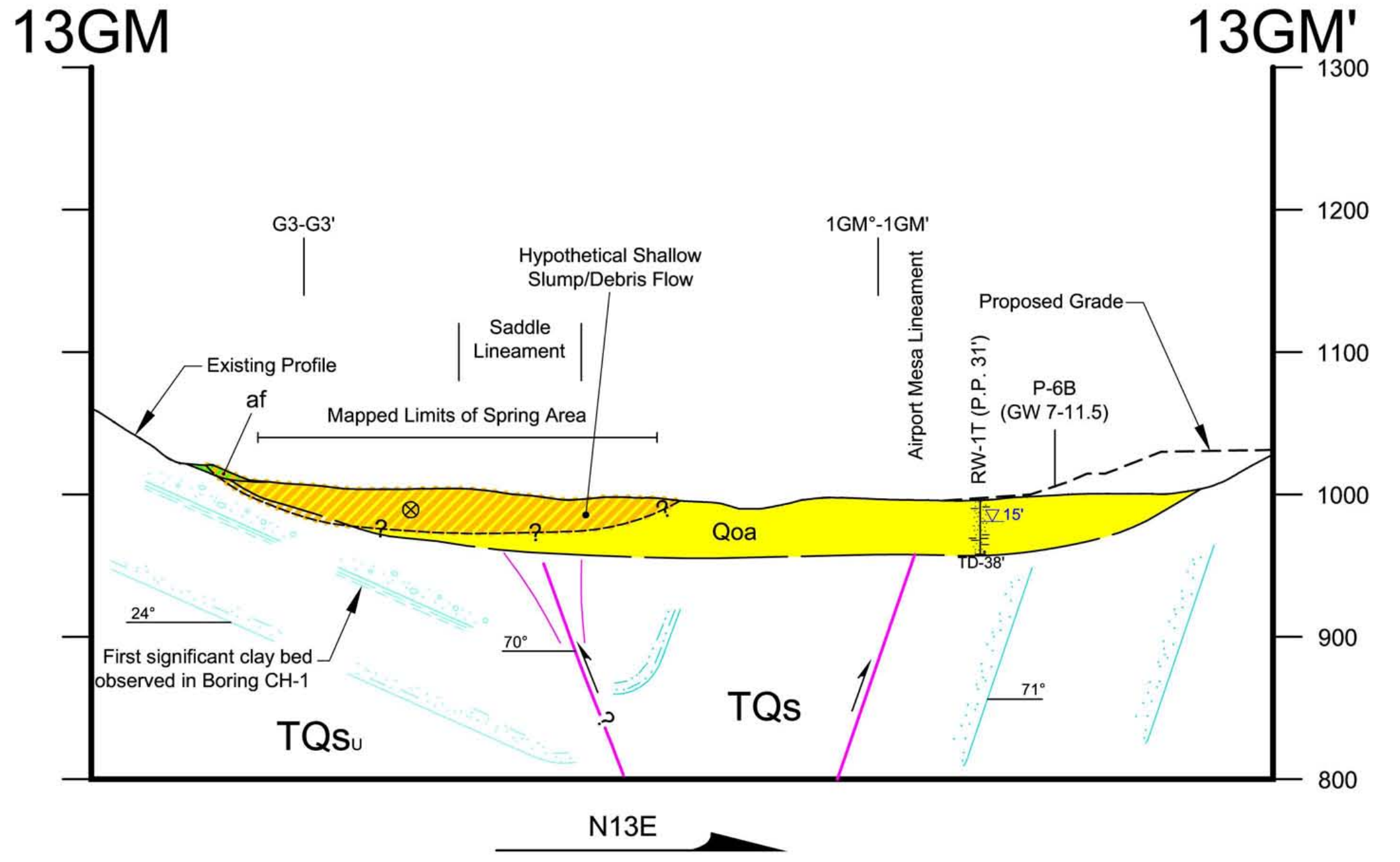












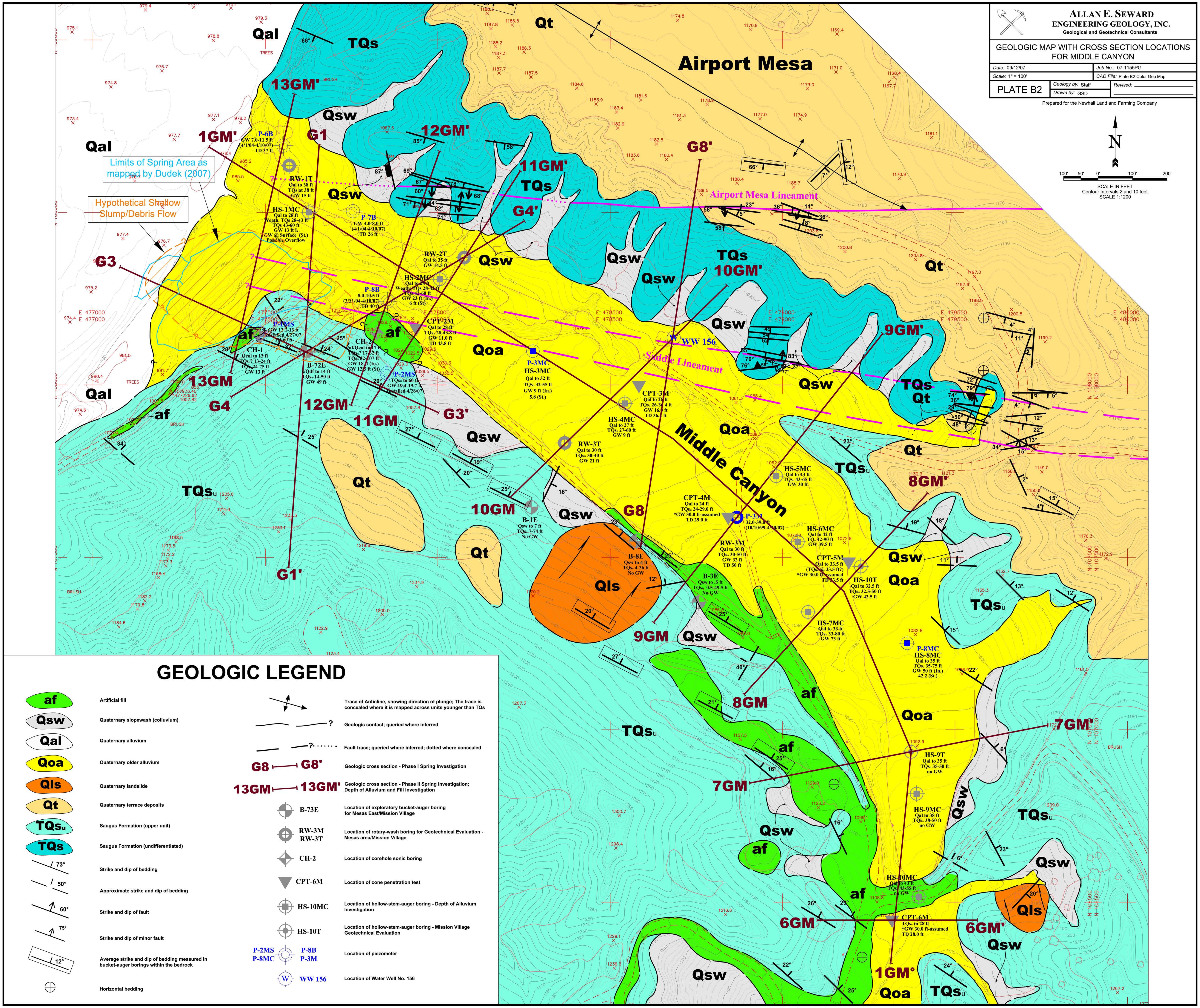
ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

Geologic Cross Sections For Middle Canyon

Date: 09/12/07	*Job No.:* 07-1155PG
Scale: 1" = 100'	*CAD File:* Plate B1 Sections Color Geo Map

PLATE B1

Geology by: Staff
Drawn by: GSD
Revised: ____________



ALLAN E. SEWARD
ENGINEERING GEOLOGY, INC.
Geological and Geotechnical Consultants

GEOLOGIC MAP WITH CROSS SECTION LOCATIONS FOR MIDDLE CANYON

Date: 09/12/07
Job No.: 07-1155PG
Scale: 1" = 100'
CAD File: Plate B2 Color Geo Map
PLATE B2
Geology by: Staff
Drawn by: GSD
Revised: ____________

Prepared for the Newhall Land and Farming Company

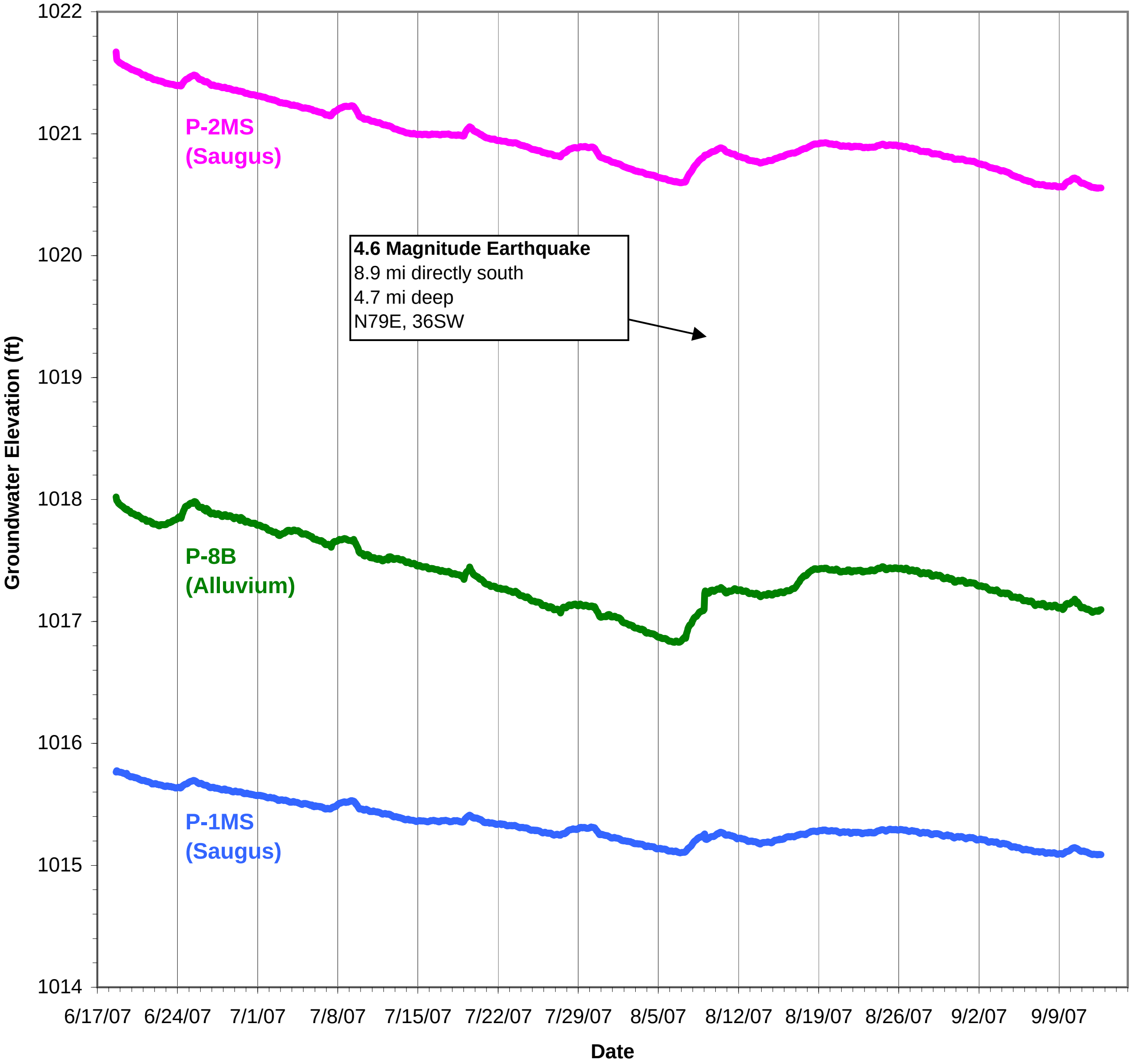
GEOLOGIC LEGEND

af	Artificial fill
Qsw	Quaternary slopewash (colluvium)
Qal	Quaternary alluvium
Qoa	Quaternary older alluvium
Qls	Quaternary landslide
Qt	Quaternary terrace deposits
TQsu	Saugus Formation (upper unit)
TQs	Saugus Formation (undifferentiated)
73°	Strike and dip of bedding
50°	Approximate strike and dip of bedding
60°	Strike and dip of fault
75°	Strike and dip of minor fault
12°	Average strike and dip of bedding measured in bucket-auger borings within the bedrock
⊕	Horizontal bedding

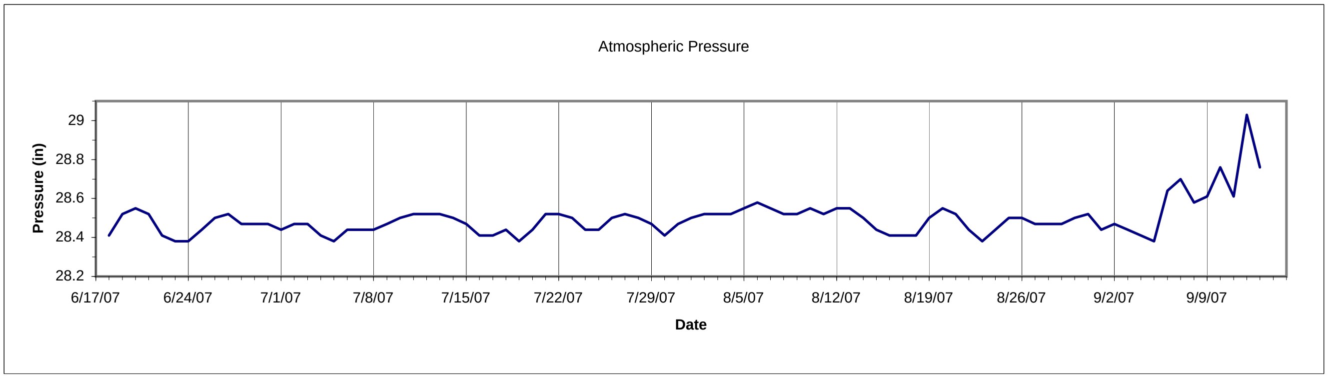
	Trace of Anticline, showing direction of plunge; The trace is concealed where it is mapped across units younger than TQs
?	Geologic contact; queried where inferred
?- · · · · · ·	Fault trace; queried where inferred; dotted where concealed
G8 ⊢—⊣ G8'	Geologic cross section - Phase I Spring Investigation
13GM ⊢—⊣ 13GM'	Geologic cross section - Phase II Spring Investigation; Depth of Alluvium and Fill Investigation
B-73E	Location of exploratory bucket-auger boring for Mesas East/Mission Village
RW-3M RW-3T	Location of rotary-wash boring for Geotechnical Evaluation - Mesas area/Mission Village
CH-2	Location of corehole sonic boring
▼ CPT-6M	Location of cone penetration test
HS-10MC	Location of hollow-stem-auger boring - Depth of Alluvium Investigation
HS-10T	Location of hollow-stem-auger boring - Mission Village Geotechnical Evaluation
P-2MS P-8MC P-8B P-3M	Location of piezometer
Ⓦ WW 156	Location of Water Well No. 156

Appendix C

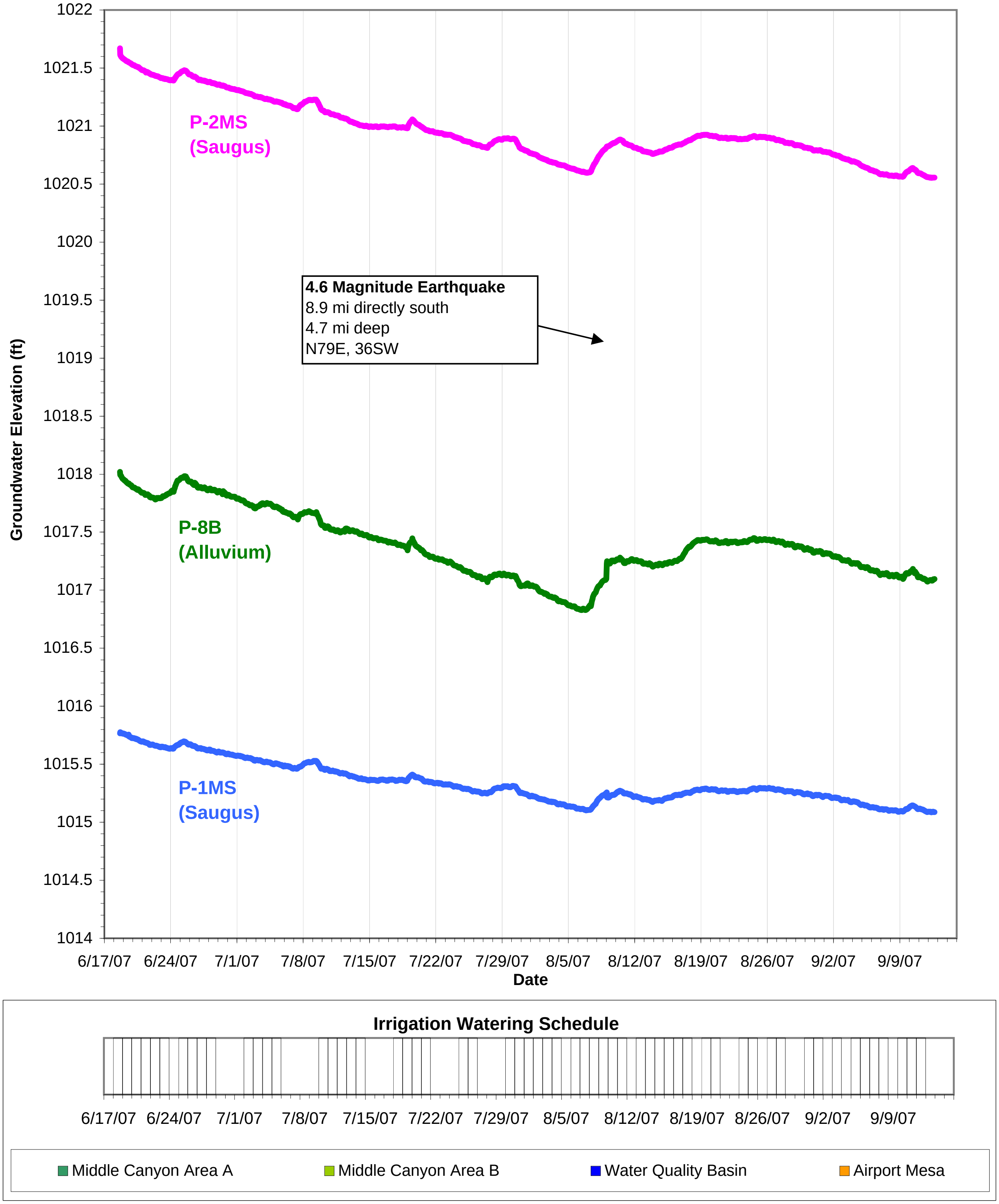
Groundwater Elevations Near Middle Canyon Spring
June 18 - September 12, 2007
(Plotted Against Barometric Pressure)



4.6 Magnitude Earthquake
8.9 mi directly south
4.7 mi deep
N79E, 36SW



Groundwater Elevations Near Middle Canyon Spring
June 18 - September 12, 2007
(Plotted Against Irrigation Watering Schedule)



4.6 Magnitude Earthquake
8.9 mi directly south
4.7 mi deep
N79E, 36SW

PIEZOMETER DATA SUMMARY
Middle Canyon Area (1155PG-1 (4))

MISSION VILLAGE

PIEZOMETER	DATE RECORDED	GROUND WATER DEPTH BELOW SURFACE (FT.)	GROUND WATER ELEVATION (FT.)	COMMENTS
P-3M Elev. 1068± Total Depth: 48’ N: 107618 E: 478860 Area: Central Middle Canyon, Adjacent to Dirt Road	10/10/99	**32.0**	1036.0	Initial Depth 48’
	11/10/99	35.0	1033.0	
	12/10/99	35.0	1033.0	
	1/19/00	35.0	1033.0	
	4/7/00	34.0	1034.0	
	7/10/00	35.5	1032.5	
	10/10/00	36.0	1032.0	
	1/10/01	35.0	1033.0	
	4/10/01	33.0	1035.0	
	7/10/01	34.5	1033.5	
	10/10/01	39.0	1029.0	
	1/10/02	35.0	1033.0	
	4/10/02	35.0	1033.0	
	7/10/02	35.5	1032.5	
	10/10/02	35.5	1032.5	
	1/10/03	35.0	1033.0	
	4/9/03	35.5	1032.5	
	7/18/03	36.0	1032.0	
	10/9/03	36.0	1032.0	
	1/9/04	36.5	1031.5	
	4/12/04	34.0	1034.0	
	7/21/04	36.5	1031.5	
	10/11/04	37.5	1030.5	
	1/19/05	36.0	1032.0	
	4/11/05	35.0	1033.0	
	7/15/05	34.0	1034.0	
	10/20/05	35.5	1032.5	
	1/18/06	36.0	1032.0	
	4/14/06	35.0	1033.0	
	7/12/06	32.3	1035.8	
	10/11/06	33.0	1035.0	
	1/10/07	34.25	1033.8	
	4/10/07	34.2	1033.8	
	6/18/07	33.5	1034.5	
	7/24/07	34.8	1033.2	
	8/10/07	35.1	1032.9	
	8/24/07	34.3	1033.7	
	9/12/07	35.0	1033.0	

PIEZOMETER DATA SUMMARY
Middle Canyon Area (1155PG-1 (4))

COMMERCE CENTER

PIEZOMETER	DATE RECORDED	GROUND WATER DEPTH BELOW SURFACE (FT.)	GROUND WATER ELEVATION (FT.)	COMMENTS
P-6B	4/1/04	11.0	989.0	Initial Depth 37’
Elev. 1000±	4/12/04	10.5	989.5	
Total Depth: 37’	5/11/04	10.0	990.0	
N: 108694	7/21/04	10.5	989.5	
E: 477552	10/11/04	10.0	990.0	
Portion: Lower Middle Canyon; just down canyon of Airport Mesa Lineament Fault	1/19/05	**7.0**	993.0	
	4/11/05	8.0	992.0	
	7/14/05	8.0	992.0	
	10/20/05	8.5	991.5	
	1/18/06	11.50	988.5	
	4/14/06	9.00	991.0	
	7/12/06	9.50	990.5	
	10/11/06	10.00	990.0	
	1/10/07	9.75	990.3	
	4/10/07	9.4	990.6	
	6/18/07	10.3	989.7	
	7/24/07	10.3	989.7	
	8/10/07	10.3	989.7	
	8/24/07	10.7	989.3	
	9/12/07	10.8	989.2	
P-7B	4/1/04	**4.0**	1003.0	Initial Depth 26’
Elev. 1007±	4/12/04	4.5	1002.5	
Total Depth: 26’	5/11/04	6.0	1001.0	
N: 108504	7/21/04	7.5	999.5	
E: 477754	10/11/04	8.0	999.0	
Portion: Lower Middle Canyon; just up canyon of Airport Mesa lineament fault zone	1/19/05	7.5	999.5	
	4/11/05	7.0	1000.0	
	7/14/05	6.5	1000.5	
	10/20/05	7.5	999.5	
	1/18/06	7.00	1000.0	
	4/14/06	7.00	1000.0	
	7/12/06	7.00	1000.0	
	10/11/06	7.50	999.5	
	1/10/07	7.75	999.3	
	4/10/07	7.1	999.9	
	6/18/07	7.1	999.9	
	7/24/07	7.6	999.4	
	8/10/07	7.4	999.6	
	8/24/07	7.2	999.8	
	9/12/07	7.2	999.8	

PIEZOMETER DATA SUMMARY
Middle Canyon Area (1155PG-1 (4))

COMMERCE CENTER				
PIEZOMETER	**DATE RECORDED**	**GROUND WATER DEPTH BELOW SURFACE (FT.)**	**GROUND WATER ELEVATION (FT.)**	**COMMENTS**
P-8B Elev. 1027± Total Depth: 40’ N: 108241 E: 477754 Portion: West Side of Middle Canyon, in saddle lineament fault zone	3/31/04	**8.0**	1019.0	Initial Depth 40’
	4/12/04	**8.0**	1019.0	
	5/11/04	9.0	1018.0	
	7/21/04	10.5	1016.5	
	10/11/04	10.5	1016.5	
	1/19/05	9.0	1018.0	
	4/11/05	9.0	1018.0	
	7/14/05	**8.0**	1019.0	
	10/20/05	9.0	1018.0	
	1/18/06	10.00	1017.0	
	4/14/06	9.00	1018.0	
	7/12/06	8.75	1018.3	
	8/4/06	8.50	1018.5	
	10/11/06	8.50	1018.5	
	1/10/07	9.00	1018.0	
	4/10/07	9.60	1017.4	
	4/27/07	10.0	1017.0	
	6/18/07	8.0	1019.0	Transducer installed
	7/25/07	13.2	1013.8	*measured from top of transducer See transducer data for detailed readings beginning 6/18/07

PIEZOMETER DATA SUMMARY
Middle Canyon Area (1155PG-1 (4))

MIDDLE CANYON

PIEZOMETER	DATE RECORDED	GROUND WATER DEPTH BELOW SURFACE (FT.)	GROUND WATER ELEVATION (FT.)	COMMENTS
P-1MS (CH-1)	3/6/07	13.0	1015.0	Initial Depth 60'
Elev. 1028' ±	6/6/17	12.1	1015.9	
Total Depth: 60'	6/18/07	11.9	1016.1	Transducer installed
N: 108151	6/21/07	11.6	1016.4	(11'11")
E: 477485	7/18/07	N/A		Extra Desiccant pkts added to help control condensation
Portion: In road above spring (TQsu)	7/25/07	12.5	1015.5	*measured from top of transducer; Desiccant in tube replaced
	8/24/07	N/A		Desiccant in tube replaced
				See Transducer data for detailed readings beginning 6/18/07
P-2MS	4/26/07	19.0	1020.0	Initial Depth 60'
Elev. 1039' ±	4/27/07	19.7	1019.3	@ 7:00am
Total Depth: 60'	6/6/07	19.4	1019.6	
N: 108034	6/18/07	19.2	1019.8	Transducer installed
E: 477852	6/21/07	18.1	1020.9	
Portion: On slope 385' southeast of spring (TQsu)	7/25/07	20.2	1018.8	*measured from top of transducer
				See Transducer data for detailed readings beginning 6/18/07
P-3MC	5/18/07	9.0	1033.0	Initial Depth of Boring 55'
Elev. 1042' ±	6/8/07	6.0	1036.0	Piezometer Installed: 30' deep
Total Depth: 30'	6/11/07	5.8	1036.2	
N: 108098	6/18/07	3.9	1038.1	
E: 478276	7/24/07	4.9	1037.1	
Portion: Lower Middle Canyon, just up canyon of saddle lineament fault zone	8/10/07	8.8	1033.2	
	8/24/07	3.7	1038.3	Sprinklers on but trickling near piezometer
	9/12/07	5.5	1036.5	
P-8MC	5/16/07	50.0	1033.0	Initial Depth 73'
Elev. 1083' ±	5/17/07	42.0	1041.0	
Total Depth: 73'	6/29/07	48.7	1034.3	
N: 107251	7/24/07	49.4	1033.6	
E: 479361	8/10/07	49.7	1033.3	
Portion: Upper Middle Canyon	8/24/07	48.9	1034.1	
	9/12/07	49.4	1033.6	

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- Northings and eastings are based on GPS survey and are in a local coordinate system defined by Psomas and Hunsaker.
- Note 2" diameter screened pvc installed from bottom of hole to within ~ 5' of surface; blank pipe with bentonite/grout seal and monument or flushmount above.