Allan E. Seward Engineering Geology, Inc., "Preliminary Geologic and Geotechnical Report" (October 2007)

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PRELIMINARY GEOLOGIC AND GEOTECHNICAL REPORT

Updated EIR Review for Subject Portions of Newhall Ranch

Mission Village, Landmark Village, Homestead and WRP Site
Newhall Ranch
Los Angeles County, California

Draft

Prepared For:

The Newhall Land and Farming Company
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Dated October 31, 2007
Job No: 07-1155UE (1)

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TABLE OF CONTENTS

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October 31, 2007 Job No: 07-1155UE (1)

The Newhall Land and Farming Company
23823 West Valencia Boulevard
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Attention: Mr. Matt Carpenter

Subject: **GEOLOGIC AND GEOTECHNICAL REPORT**
Updated EIR Review for Subject Portions of Newhall Ranch

Project: Mission Village, Landmark Village, Homestead and WRP Site
Newhall Ranch
Los Angeles County, California

References: See end of text

Dear Mr. Carpenter:

The following report presents an updated review of Geologic and Geotechnical conditions relative to proposed development at the Mission Village, Landmark Village, Homestead, and WRP Site portions of the Newhall Ranch Master Planned Community relative to the updated EIR for the Specific Plan in preparation by Impact Sciences.

1.0 INTRODUCTION

This firm (AESEGI) prepared a geologic report in support of the original EIR for the Newhall Ranch Specific Plan, dated September 19, 1994. A companion Geotechnical Report, also dated September 19, 1994, was prepared by R.T. Frankian and Associates (RTF&A). Additional geologic and geotechnical reports were prepared to address offsite road alignments, comments from L.A. County Reviewers and comments submitted during the public review process (see list of Referenced reports by AESEGI and RTF&A at end of report). These reports were incorporated as technical appendices to the primary EIR document prepared by Impact Sciences. It is our understanding that an updated EIR is now being prepared by Impact Sciences for the Newhall Ranch Specific Plan.

Subsequent to the completion of our EIR work, investigations were completed to evaluate geologic and geotechnical conditions at the various development areas proposed within Newhall Ranch. Reports were prepared by AESEGI for submittal to Los Angeles County reviewing agencies for the Mission Village (VTT 61105), Landmark Village (VTT 53108), Homestead (VTT 060678), and WRP Site portions of Newhall Ranch. The following report presents an updated geologic and geotechnical review of these four development areas based on additional investigations completed by this firm in support of the new EIR being prepared by Impact Sciences. It is our understanding that the Potrero Canyon area will be addressed by another consultant.

2.0 SCOPE OF WORK

The scope of work completed during the preparation of this report included the following tasks:

1. Coordination with The Newhall Land and Farming Company and Impact Sciences.

2. Geologic and Geotechnical review of reports prepared by AESEGI and RTF&A for the first EIR document (referenced at the end of the text).

3. Review of our subsequent reports, which were prepared to address the Mission Village, Landmark Village, Homestead and WRP Site development areas (see referenced reports at the end of the text).

4. Preparation of the following report and tables, which summarize the geologic and geotechnical conditions at the subject development areas and our conclusions and recommendations relative to future development on Newhall Ranch.

3.0 SITE DESCRIPTION

Newhall Ranch consists of approximately 11,971 acres of unincorporated land in northwestern Los Angeles County. The locations of the development areas discussed in this report are shown on the attached **Location Map**, and the acreages for each are provided in **Table 1**. The primary geographic feature on Newhall Ranch is the Santa Clara River and its tributaries, including Salt, Potrero, Long, Lion, and Middle Canyons on the south side, and San Martinez Grande and Chiquito Canyons on the north. Several large mesas are present that represent old uplifted alluvial deposits associated with the ancestral Santa Clara River.

Mission Village includes the northeastern portion of Newhall Ranch, northeast of Lion Canyon and south of the Santa Clara River. Landmark Village is located north of the Santa Clara River, west of Castaic Creek, south of Highway 126 and east of Chiquito Canyon. Homestead includes the remainder of Newhall Ranch north of Potrero Canyon and north of Potrero Mesa, except for the WRP Site, which is located on the south side of Highway 126 adjacent to the Los Angeles/Ventura County line. Specific descriptions for each area are provided below.

Mission Village (formerly referred to as Mesas East) is a dominantly hillside area cut by several north-draining tributaries of the Santa Clara River, including Lion Canyon on the southwest boundary of the site, Dead End Canyon, Middle Canyon, and Magic Mountain Canyon on the eastern boundary of the site. Two large areas of flat, elevated terrain are present on the western and northeastern portions of the site, known as Exxon Mesa and Airport Mesa, respectively. Slope gradients range from gentle in the mesa and canyon floor areas to steep along the Santa Clara River bluffs and where resistant sandstone beds outcrop. The site is largely undeveloped except for roads and pads associated with past oil well drilling and operations. Portions of Middle Canyon and Airport Mesa have been used for agricultural purposes and portions of the site have been used for cattle grazing. One active water well that is used for agricultural irrigation is located in Middle Canyon. The Magic Mountain Theme Park is located east of the project. Elevations at the site range from 940 ft along the Santa Clara River to a high point of 1510 ft. Vegetation at the site typically consists of annual grasses and sparse chaparral, with thick chaparral and local oak trees more prevalent on north-facing slopes. Riparian vegetation, including cottonwood trees, willows and mule fat, is present in the larger drainages and along the Santa Clara River.

Landmark Village (formerly referred to as River Village) is located on gently inclined alluvial surfaces. Small banks exist between younger and older alluvium and ascending fill and natural slopes adjacent to Highway 126. Elevations at the site range from 900 ft adjacent to the Santa Clara River up to 1005 ft on the knob along Highway 126. Most of the site has been utilized for agricultural purposes and at least 13 water wells have been drilled on the site to provide irrigation water. The northern margin of the site has been altered by construction of Highway 126, the abandoned Southern Pacific Railroad line, and various pipelines. Debris, including concrete and asphalt concrete blocks, has been placed on several portions of the site. Five abandoned oil wells have been drilled on or immediately adjacent to the site.

The Homestead site includes eight development areas, as noted in **Table 1** and as illustrated on the attached **Location Map**. The site is largely undeveloped except for roads and pads associated with past oil well drilling operations and ranching/agricultural activities. Extensive roads, pads, and pipelines have been constructed for oil wells and associated facilities in the Long Canyon/Potrero Canyon area as part of the development of the Rancho San Francisco Oil Lease. Local roads and pads associated with oil wells and production are also present at the Homestead West, Chiquito Canyon, and Chiquito Estate Lot areas. Old alluvial surfaces at Homestead West, Homestead Central, Onion Fields, and Grapevine Mesa at Mesas West have been used for agricultural purposes in the recent past. Several residential structures (now abandoned) are present at Walnut Orchard on Homestead Central. The Chiquita Canyon Landfill is located on an adjacent parcel east of Chiquito Canyon and a training facility for the Los Angeles County Fire Department currently occupies the mesa north of Homestead Central. Existing public road access to the site includes Highway 126, Chiquito Canyon Road, and San Martinez Grande Canyon Road. The site topography is dominated by the Santa Clara River valley, which bisects the site from east to west.

North of Highway 126, the project is traversed by two major south-draining tributaries of the Santa Clara River, namely San Martinez Grande Canyon to the west and Chiquito Canyon to the east (see **Location Map**). The central portion of San Martinez Grande Canyon, which consists of gently sloping alluvial surfaces incised roughly 15 to 20 feet by the active channel, and is bounded by steep slopes and ridgelines with short tributary canyons to the east and west. West of San Martinez Grande Canyon, in the Homestead West area, three gently sloping field areas on the south transition abruptly into steep terrain to the north that is dominated by south-draining canyons and intervening ridgelines. At the Homestead Central area, located east of San Martinez Grande Canyon, two gently sloping alluvial surfaces occur to the southwest and are bounded by moderate to steep slopes and ridges to the west. Uplifted mesa surfaces occur on the western ridge and along the northern margin of the site at Fire Training Mesa. The hillside gradients adjacent to Chiquito Canyon vary from moderate to very steep where resistant sandstone beds are exposed. Elevations on the site north of the river range from approximately 860 to 1540 ft at Homestead West, 895 to 1230 ft at Homestead Central, and from 940 ft at the mouth of Chiquito Canyon up to 1768 ft at the high point in the Chiquito Estate Lot area. Aside from agricultural fields, vegetation west of the Del Valle fault consists primarily of seasonal grasses and local patches of chaparral shrubs. Chaparral vegetation is more abundant east of the fault, particularly on the north-facing slopes, and oak trees locally occur in Chiquito Canyon.

South of the river, the Onion Field consists of a gently sloping alluvial fan surface that extends northward from the mouth of Long Canyon and even flatter alluvial surfaces originally formed by the Santa Clara River. The Onion Field is bordered to the south by steep slopes and ridges on both sides of Long Canyon. Potrero Ridge is a steep, narrow, west-trending ridge that rises more than 300 ft above the Onion Field. To the east, this ridge becomes more complicated topographically and eventually forms the divide between Long Canyon and Potrero Canyon to the south. This eastern ridge has been extensively modified by the construction of pads and roads for the development of the Rancho San Francisco Oil Lease. Long Canyon is a fairly linear, northwest-draining canyon with a series of short tributary canyons. Adobe Canyon is a tributary canyon that extends east-southeast from the northwest end of Long Canyon. The steep ridgeline area on the northside of Long and Adobe Canyons is known as Sawtooth Ridge and forms a natural boundary with Mesas West to the north. The central portion of Mesas West is dominated by a large, dissected group of mesas, the largest of which is designated as Grapevine Mesa. These mesas are bounded by steep, ascending natural slopes and ridges to the southeast and along Sawtooth Ridge to the southwest. Lion Canyon bounds the site to the northeast, and steep, descending bluffs bound the proposed Mesas West development along the south margin of the Santa Clara River. Elevations on the site south of the river range from approximately 870 to 1130 ft at the Onion Field, 905 to 1410 ft at Potrero Ridge, 900 to 1440 ft in the Long Canyon area, and from 920 to 1530 ft at Mesa West. Aside from agricultural areas, vegetation at the site ranges from annual grasses with sparse chaparral shrubs on the north margin of Potrero Canyon, to dense chaparral with oak trees in the more protected slope areas, particularly on north-facing slopes and canyons, and on the slopes and ridges surrounding Grapevine Mesa and associated satellite mesas at Mesas West.

The proposed WRP site is located south of State Highway 126, north of the Santa Clara river floodplain, and east of the Ventura County line, in the western portion of Newhall Ranch. Elevations at the site range from about 830 ft (at the toe of the channel bank near the county line) up to 928 ft on the eastern hill. The western portion of the site is cut by two tributary drainage channels and the eastern end of the site is relatively elevated. Remaining portions of the site consist primarily of an elevated alluvial surface that is currently utilized for agriculture. The southern margin of the site roughly coincides with the existing bank of the Santa Clara River floodplain. During previous realignment and widening of State Highway 126, an ascending fill slope was constructed along portions of the northern margin of the site, and a descending cut slope was constructed along the eastern, elevated portion of the site, forming an isolated hill. Prior to being widened and realigned to the northern margin of the site, State Highway 126 originally traversed the eastern portion of the site, contouring around the southern margin of the hill. An abandoned railroad line was also constructed around this hill.

4.0 PROPOSED DEVELOPMENT

A grading concept was developed in 1994 for the Newhall Ranch Specific Plan (at a scale of 1"=500') that illustrated the general location of proposed arterial roads, significant proposed constructed slopes (231) and pad areas (see 9/19/94 reports by AESEGI and RTF&A). The site was initially divided into 24 planning areas ("villages"), and a possible High Country Estate Lot Area was proposed in the southern portion of the site (which was subsequently abandoned). A tentative map (TPM 24500) was also prepared (at a scale of 1"=500') that subdivided Newhall Ranch into 30 lots, each in excess of 40 acres in size. Of the 30 lots, 24 were designated for residential, commercial, and industrial development and 6 lots were proposed as open space areas. Offsite extension of both Magic Mountain Parkway and Valencia Blvd to Newhall Ranch was also planned. Geologic and Geotechnical reports addressing these plans and related review comments are listed in the references at the end of this report.

Following approval of the Newhall Ranch Specific Plan, Tentative Map Level Designs were prepared for each of the major development areas. Mass Grading Plans and Bank Protection Plans were also prepared for the WRP Site and addressed from a geologic and geotechnical standpoint by this firm. The general planning parameters for each of the proposed development areas (excluding Potrero Canyon) are provided on **Table 1**, based on the latest plans addressed by this firm and submitted to the County for Review.

The following report summarizes geologic and geotechnical conditions at each of the subject development areas and presents updated conclusions and recommendations based on the results of additional subsurface explorations, laboratory testing and analysis, and in response to code revisions implemented since the original investigations and reports were completed.

5.0 GEOLOGIC SETTING AND STRUCTURE

Newhall Ranch is located in the Traverse Ranges geomorphic province of southern California, in the eastern portion of the Ventura Basin. The Ventura Basin has been tectonically downwarped in the geologic past to produce a large-scale synclinal structure, which has developed a thick accumulation of Cenozoic sediments. Bedrock underlying the Homestead West, Homestead Central, Potrero Ridge, Onion Field, the south side of Long

Canyon, and the west side of Chiquito Canyon, as well as the WRP Site and the western end of Landmark Village, consists of the Pliocene, marine Pico Formation. The remainder of Homestead, Landmark Village and Mission Village areas are underlain by bedrock of the Plio-Pliesotcene Saugus Formation, which is subdivided into upper and lower members south of the Santa Clara River. The bedrock units have been tectonically deformed into east-west to northwest-trending folds, and have locally been cut by faulting. Younger terrace deposits, consisting of old stream channel and alluvial fan deposits, locally overlie the bedrock with moderate to steep angular discordance. The most laterally extensive terrace level forms dissected mesa surfaces at Mesas West, Homestead Central, and Mission Village. At least three levels of older alluvium have been mapped adjacent to the Santa Clara River and extending up the larger tributary drainages. Recent alluvium is present along the Santa Clara River and in the larger drainage areas, and soil and/or slopewash mantle most of the site.

The bedrock exposed north of the Santa Clara River has been folded into two anticlines and two synclines that plunge to the east and southeast. These folds are informally designated as the Homestead anticline (west of San Martinez Grande Canyon), the Grapevine Mesa syncline (East of San Martinez Grande Canyon at Homestead Central), the Del Valle Anticline (in central Chiquito Canyon and at Landmark Village), and the Chiquito/Middle Canyon syncline (in upper Chiquito Canyon). The Homestead anticline is a broad fold that is truncated by the Del Valle fault to the east. This southwest-dipping, right-lateral-oblique reverse fault is the most significant fault feature identified on the Homestead site. North of Homestead West, several large landslides have been mapped that apparently failed as a result of shallower dipping beds near the crest of the Homestead anticline. At Homestead West and at Central and at the WRP site, bedding on the south limb of this fold generally dips 40 to 60° to the south and southeast. The Grapevine Mesa syncline, a broad fold underlying Grapevine Mesa, is interpreted to extend westward below the Santa Clara River to Homestead Central. At its west end, the trace of this fold bends northward near the Del Valle fault and bedding on the southwest limb of the fold steepens up to 70° adjacent to the fault. Bedding on the northeast limb of this fold generally dips 10º to 20° to the southeast. In middle Chiquito Canyon, the beds roll back to dip 10º to 20° to the northeast across the broad, southeast-plunging Del Valle anticline. These beds are folded again to the north across the Chiquito/Middle Canyon syncline. Beds on the north limb of this fold dip 35º to 50° to the south and southeast. Bedding on the south limb of this fold in the Chiquito Estate area locally shallows to horizontal and the adjacent plunge of the fold locally reverses to the west. A previously unrecognized, northeast-trending warp appears to be responsible for these changes.

Bedrock south of the river on the Homestead project is folded into the southeast-plunging Grapevine Mesa syncline and the northwest-plunging Newhall-Potrero anticline. Bedding on the north limb of the syncline generally dips 15º to 35° to the south and bedding on the south limb generally dips 45º to 55° to the northeast at Sawtooth Ridge. South of Sawtooth Ridge, the bedding shallows to 35º to 40° to the northeast and south of Long Canyon the bedding shallows to 30º to 35° north. At Potrero Ridge, the Newhall-Potrero anticline plunges roughly 15° to the northwest and the bedding rolls around to dip 25º to 30° to the southwest on the southwest limb of the fold.

On the Mission Village project, the southeast-plunging Del Valle anticline extends southeast below the Santa Clara River and continues along the northeast side of Lion Canyon. Bedding on the north limb of this fold strikes northwest and generally dips 15º to 30º to the northeast. The older section of bedding steepens along strike to the southeast, forming a monoclinal warp east of Middle Canyon. The Holser structural zone, a zone of folding and faulting, traverses the northeastern corner of Mission Village at Airport Mesa. The southern boundary of this zone is defined by a south-vergent syncline that is cut by north-dipping reverse faulting, which is designated informally as the Saddle Lineament. A south-dipping reverse fault, designated informally as the Airport Mesa Lineament, parallels the Saddle Lineament to the north. The "Airport Mesa" anticline and the "Bluffs" syncline further deform the bedrock to the north of these faults.

No active (Holocene) faults are known to exist on Newhall Ranch per Alquist-Priolo criteria. However, the Del Valle fault and both the Saddle lineament and Airport Mesa Lineament faults show evidence of late Quaternary activity. No evidence for a fault connecting the Del Valle fault with the Salt Creek fault to the south, as was tentatively interpreted in our 9/14/94 report, was found during our investigations. The results of our investigations of these faults are summarized in **Section 10** of this report and described in detail in the referenced reports.

6.0 SUBSURFACE EXPLORATIONS

Multiple phases of subsurface explorations were completed on Newhall Ranch by AESEGI in order to obtain geologic and geotechnical data to assist the Project Civil Engineers in the design of the project, to evaluate the feasibility of preliminary design alternatives, and to address tentative maps and grading plans submitted for review to the County of Los Angeles. The subsurface investigations included the excavation and logging of 1,249 trenches to document the geologic structure, distribution of landslide material, and thickness of surficial material, including 5,441 linear feet of long trenches and dozer cuts to evaluate faulting on the four subject portions of Newhall Ranch. A total of 314 bucket-auger borings were drilled and logged to document geologic structure, define the depth and geometry of mapped landslides, describe geologic units, evaluate faulting, and to collect samples for laboratory testing. A total of 43 rotary-wash borings and 163 hollow-stem-auger borings were completed to obtain sampler blow count data, material descriptions, and ground water data, and to obtain samples for laboratory testing in order to document the engineering characteristics of the site alluvium and terrace deposits. In addition, a total of 275 cone penetration test (CPTs) soundings were completed to further document the engineering characteristics of the alluvial materials at the subject development areas and to provide data for detailed analyses of liquefaction potential and earthquake-induced ground settlement. The locations of all subsurface explorations were documented in the field with a Trimble GPS unit. All of the borings and trenches were logged and sampled by AESEGI personnel. Copies of all of our boring and trench logs are presented in the reports referenced at the end of the text. **Table 2** presents the number of each exploration type completed at the subject development areas.

7.0 GEOLOGIC UNITS

7.1 Pico Formation (Tp)

The oldest geologic unit exposed on the subject portions of Newhall Ranch is the Pliocene marine Pico Formation. The lower, western portion of this formation consists dominantly of locally fossiliferous siltstone and mudstone with uncommon interbeds and lenses of graded sandstone and pebbly sandstone that were deposited in a deep (approximately 2000 ft) marine basin. The siltstone and mudstone units are typically unoxidized and medium to bluish gray at depth, but weather to olive gray to olive brown near the surface. The sandstone is typically light yellowish gray to greenish gray. The younger, eastern portion of the formation typically contains more sandstone, silty sandstone and pebbly to cobbly sandstone with locally common fossils, interbedded with less common siltstone and mudstone units. The upper contact is gradational (at Long Canyon) and interfingering (at Chiquito Canyon) with the overlying brackish to nonmarine Saugus Formation.

To the north of the Santa Clara River, the Pico Formation underlies most of the Homestead area and the west end of Landmark Village, except in the eastern portion of Chiquito Canyon, and where it is concealed by terrace deposits and alluvium. West of the Del Valle fault, the older, fine-grained section of the Pico Formation is dominant. The upper 10 to 15 feet of this formation is commonly weathered and subject to shallow surficial failures on steep slopes. Steep, rounded slopes are common in this area because the unweathered rock at depth is generally hard and stable where bedding conditions are geologically favorable. East of the fault, at Homestead Central, Chiquito Canyon and the west end of Landmark Village, sandstone and silty sandstone beds indicative of the upper portion of the formation are common. Where geologically favorable conditions are exposed in this area, steep slopes and cliffs are common. Gentle slopes are common where the bedding conditions are daylighted or adverse. In Chiquito Canyon, the contact with the overlying Saugus Formation is interfingering, with local, nonmarine, clay-rich red beds exposed below marine units. As a general rule, the contact was designated above the last obvious marine bed with a schematic, interfingering contact. The outcrop pattern of this contact supports a marine regression to the south or southwest, with the nonmarine Saugus Formation overlapping the Pico Formation upsection.

South of the Santa Clara River, the Pico Formation underlies most of the Homestead project southwest of Long Canyon. The contact with the Saugus Formation occurs just northeast of Long Canyon, except where it crosses to the southwest side at the bend near the mouth of the canyon. A small section of possible transitional, brackish water deposits was locally observed along the contact, but no significant interfingering was observed. On the north margin of Potrero Canyon, the Pico Formation consists dominantly of siltstone and mudstone, with progressively more silty sandstone and sandstone beds present up section. Moderate to locally steep slopes and rounded hills develop on the finer-grained bedrock. A large section of hard massive sandstone occurs in the upper section at Potrero Ridge, and to a lesser extent at the same stratigraphic level on the east limb of the Newhall-Potrero anticline. Steep, high slopes and cliffs have developed above this resistant unit, even where the bedding is daylighted, such as on the south side of Potrero Ridge. Vegetation on the fine-grained units is dominated by seasonal grasses and local patches of chaparral shrubs. Chaparral vegetation becomes more dominant on the coarser grained units and on north-facing slopes. The more resistant sandstone units form relatively barren outcrops.

7.2 Saugus Formation (TQs, TQsl, TQsu)

Sediments of the Saugus Formation (TQs) were deposited stratigraphically above the Pico Formation in a transitional brackish to nonmarine environment during late Pliocene to Pleistocene times. South of the Santa Clara River, an essentially complete stratigraphic section of this formation is exposed between Long Canyon and Airport Mesa, with the youngest known deposits occurring just south of the Saddle Lineament. This section has been divided into two informal members based on observed changes in the stratigraphy and induration of the rock.

The lower member (TQsl), which is recognized on Homestead and Mission Village to the southwest of Dead End Canyon, consists dominantly of yellowish-gray sandstone and pebble to cobble conglomerate with light greenish-gray siltstone and reddish-brown, expansive, “red bed” mudstone interbeds. This unit is moderately indurated and forms steep slopes and cliffs on antidip slopes and on dip slopes where no fine-grained interbeds are present.

The upper member of the Saugus Formation (TQsu) is exposed from Dead End Canyon to the Saddle Lineament. This unit is less indurated than the lower member, and the finer grained interbeds are typically more yellowish brown and silty, and it has relatively few classic Saugus Formation “red beds”. Some published geologic maps correlate the upper member with the Pacoima Formation, but review of the type section description for this formation indicates that it is lithologically distinct from units exposed on Newhall Ranch and the section exposed on Mission Village more closely resembles the Saugus Formation both depositionally and structurally.

The Saugus Formation exposed below Airport Mesa to the north of the Saddle Lineament consists of moderately indurated sandstone, with interbedded siltstone and mudstone that is more typical of the type section. This section likely correlates with the lower member, but is mapped as undifferentiated because of uncertain correlations across the Saddle Lineament fault. The Saugus Formation exposed in Chiquito Canyon and at Landmark Village typically consists of interbedded light yellowish-gray sandstone and pebbly sandstone, greenish-gray to light-brown siltstone and sandy siltstone, and brown to reddish-brown mudstone. This unit also likely correlates with the lower member but is mapped as undifferentiated because the upper member was not documented in this area.

The transitional brackish-water Sunshine Ranch member of the Saugus Formation was not mapped on Newhall Ranch. Thin stratigraphic sections of gray to greenish-gray, fine-grained deposits typical of the Sunshine Ranch member were locally observed at the base of the Saugus Formation in upper Chiquito Canyon and at Long Canyon. However, this unit was not extensive enough to accurately define at the current, small map scale. Chaparral vegetation is moderately dense on the Saugus Formation, with seasonal grasses more abundant on south-facing slopes. Resistant sandstone units form relatively barren outcrops.

7.3 Quaternary Terrace Deposits (Qt)

Deposits of relatively flat-lying older alluvium that are significantly elevated above the active stream channel areas are designated as Quaternary terrace deposits. Terrace deposits underlying Grapevine Mesa, adjacent satellite mesas to the west, Exxon Mesa, Airport Mesa, and Fire Training Mesa, are at a similar elevation above the Santa Clara River and likely represent the eroded remnants of a formerly extensive river floodplain. At least one older (higher) terrace deposit and several remnants of lower (younger) undifferentiated terrace deposits have been mapped on the subject portions of Newhall Ranch. Most of these sediments were deposited in a fluvial environment, although deposits on the marginal portions to the south of the Airport Mesa and Grapevine Mesa are probably alluvial fan deposits.

The large mesa surfaces are typically 180 to 200 ft above the active Santa Clara River channel or adjacent tributary channels and the deposits range from 40 to over 100 ft in thickness. This unit typically consists of a basal 5- to 10-ft thick, cobble- to boulder-rich, gravelly sand, with local clast-supported beds that are friable and light gray to yellowish gray in color. Interbedded yellowish-gray to light yellowish-brown sand and silt with local clay overlies the basal unit. This material is generally dense below a depth of 10 to 20 ft. A 5- to 10-ft thick cap of sandy silt and clay soil is usually present on the terrace surfaces. Vegetation on the larger mesa surfaces has generally been disturbed by agricultural or oil production activities. Vegetation on the margins of the mesas varies from mixed chaparral and annual grasses to dense chaparral.

An older terrace deposit was encountered on Potrero Ridge and locally to the east, roughly 320 to 350 ft above the Santa Clara River. This unit ranges from 15 to 35 ft in thickness and consists of a friable, light-gray, cobbly, pebbly sand basal layer, roughly 2 to 10 ft in thickness, overlain by light yellowish-gray sand and silty sand with pebbles. Two small remnants of old terrace deposits of uncertain affinity were also encountered near the northern margin of the Homestead West portion of the project.

Several remnants of younger terrace deposits are also present on the subject portions of Newhall Ranch. A significant deposit has been mapped at Homestead West, and on the adjacent WRP Site to the south, a portion of which is exposed in cut slopes associated with Highway 126. This deposit appears to be derived primarily from the adjacent, fine-grained Pico Formation bedrock and consists of silt and clay with local sand interbeds. The basal unit is irregular in thickness, containing up to 5 ft of cobbles and boulders, but is locally absent. This deposit is generally stiff to hard below a depth of 10 to 15 ft. A second area of younger terrace deposits occurs along the margin of Lion Canyon, on the eastern boundary of Mesas West. This unit consists of up to 50 ft of interbedded sand and pebbly sand, with local cobbles. Younger terrace deposits were also mapped on the margin of Airport Mesa and in Dead End Canyon.

7.4 Older Alluvium (Qoa)

At least three (3) levels of older alluvium have been recognized on the subject portions of Newhall Ranch. However, because the different levels cannot be correlated with certainty between the various canyons on the site, separate designations have not been assigned for each level.

In Chiquito Canyon and the Chiquito Estate Lot area, the older alluvium consists primarily of silty sand and gravelly sand, with uncommon fine-grained interbeds. At Homestead Central, the older alluvium consists of interbedded silty clay, silty sand, poorly graded sand, clayey sand, and lean clay. Fine-grained sediments were more dominant in the older alluvium at San Martinez Grande Canyon. At Homestead West, the older alluvium consists dominantly of lean clay and silty clay, with uncommon sandy interbeds. These fine-grained deposits are likely derived from the fine-grained Pico Formation bedrock exposed in the tributary canyons to the north. The older alluvium at the WRP site is dominantly fine-grained at shallow depths and coarse near the base. The older alluvium mapped in the Onion Field area consists dominantly of silty sand and poorly graded sand with interbeds of gravel, silty clay and clayey sand. The adjacent younger alluvial deposits are almost entirely coarse-grained. Older alluvium in Long Canyon consists primarily of silty sand and poorly graded sand with uncommon silt and silty clay interbeds. Older alluvium underlies the eastern portion of Landmark Village and consists of sand and silty sand with local interbeds of sandy silt and lean clay. Older alluvium is also present in the tributary canyons on Mission Village, but was not differentiated from the younger alluvium. In general, the older alluvium is incised up to 40 ft in the tributary canyon areas.

7.5 Alluvium (Qal)

Active and recently active alluvium has been mapped in the larger channel areas on the subject portions of Newhall Ranch. This unit is relatively minor in the incised portions of the tributary canyons but is extensive along the Santa Clara River and associated flood plain. Much of the Santa Clara River channel area is proposed to remain as open space following development. However, extensive areas of granular, younger alluvium occur at the Onion Field and on the western portion of Landmark Village. The alluvium is derived from erosion of the adjacent older alluvium and hillsides, and from upstream areas of the drainages. Alluvium in the Homestead West area contains more silt and clay, owing to the fine-grained nature of the Pico Formation in the source area. The alluvium in San Martinez Grande Canyon consists of interbedded sand and silt, with minor pebbly sand. At Chiquito Canyon, Long Canyon, Onion Field, and Landmark Village, the alluvium consists primarily of sand, silty sand, and gravely sand with local silt and sandy silt interbeds. At Mesas West, the alluvium is present in relatively small, narrow canyons and any older alluvium has been mapped together as undifferentiated alluvium. The alluvium at Mesas West consists primarily of silty sand, gravelly sand, and sandy silt. Undifferentiated alluvium is also mapped in Potrero Canyon. This alluvium consists almost entirely of lean clay and silty clay, with uncommon silty sand interbeds on the Homestead portion of the Canyon. The undifferentiated alluvium mapped in the tributary canyons on Mission Village consists dominantly of sand, silty sand, and gravelly sand with sandy silt and lean clay interbeds at depth, with silts and clays becoming more prevalent at shallow depths. The alluvium at the mouth of Middle Canyon is dominantly lean clay and sandy lean clay.

7.6 Slopewash (Qsw)

Slopewash, or colluvium, is a heterogeneous deposit formed on slopes as a result of weathering, sheet wash, creep and shallow debris flows on sloping ground. This unit is generally thickest in swales and side canyons, and at the toe of existing natural slopes, where it commonly interfingers with the canyon alluvial deposits. This unit also forms the backfill material in landslide grabens. The slopewash generally consists of poorly sorted, grayish-brown to brown pebbly silty sand, but varies depending on the composition of the underlying source material. This unit is generally unsuitable for support of structures or certified, compacted fills.

7.7 Residual Soil

Natural surfaces on the site are mantled by surface soils formed by in-place weathering of the underlying parent material. Residual soil is most strongly developed on old, gently dipping surfaces, such as mesas and other terrace/older alluvial surfaces. The soils observed on the larger mesa surfaces generally consist of 5 to 10 ft of brown to dark-brown silty to clayey sand and sandy silt to lean clay with scattered pebbles. Soils developed on sloping surfaces are generally overprinted and modified by creep and erosion, and have generally been included in the slopewash description in our logs. Residual soil is generally unsuitable for the support of structures or certified, compacted fill.

7.8 Artificial Fill (af)

Existing, uncompacted artificial fill on the site ranges from minor spill fills generated during past grading of minor roads and oil well pads to larger accumulations placed to bridge roads across drainages. Artificial fill is generally unsuitable for the support of structures or certified, compacted fill.

7.9 Compacted Artificial Fill (Caf)

Compacted artificial fill was placed by Caltrans during construction of Highway 126. Where fills are proposed adjacent to Highway 126, the condition of the compacted fill should be confirmed at the Grading Plan stage.

7.10 Landslides (Qls, Qols)

Numerous landslides were mapped on Newhall Ranch in our September 19, 1994 report for the Specific Plan, based on review of published maps, analysis of aerial photographs and geomorphic features, and very limited subsurface investigations. Generic recommendations to mitigate potential adverse impacts of landslides relative to future development were presented in our September 19, 1994 report. Of the mapped landslides, the 18 largest (in excess of 1000 ft in largest dimension as mapped in 1994) were designated by number (Qls-I through Qls-XVIII) and preliminary recommendations for mitigation of hazards associated with these landslides were provided in our report dated December 4, 1995. **Table 3** presents updated recommendations for each of these landslides located within the subject portions of Newhall Ranch.

Extensive subsurface explorations were performed by this firm to document the extent, three-dimensional geometry, and stability of the landslides mapped on the subject portions of Newhall Ranch. The refined limits of these landslides are presented in the referenced geologic/geotechnical reports for each area. A total of 112 landslides were mapped on the Homestead project, including 20 at the proposed Chiquito Business Park, 20 at the Chiquito Estate lots, 20 at Homestead Central, 17 at Homestead West, 9 at Potrero Ridge, 15 at Long Canyon, and 11 at Mesas West. An additional 52 landslides were mapped on the Mission Village site. No landslides were found at Landmark Village, the WRP site, or the Onion Field. Recommended options to mitigate potential adverse impacts to future development from each of the mapped landslides are provided in the referenced reports. Recommended mitigation options include grading removal, partial removal and stabilization, and placement in a Restricted Use Area.

7.11 Surficial Failures (Qsf)

Numerous, shallow surficial failures and debris flow deposits are locally present on steeply inclined slopes on the subject portions of Newhall Ranch. These deposits generally consist of slopewash, soil, and weathered rock that typically failed during periods of heavy rainfall. Some of these failures occurred or were reactivated during the heavy rain season from October 2004 to April 2005, while others are older features mapped based on geomorphology and exposures observed in our subsurface explorations. Options for mitigation include grading removal, building setbacks, and retaining structures such as impact walls and debris basins.

8.0 GROUND WATER

Ground water associated with the Santa Clara River alluvial aquifer underlies much of the alluvium on the subject portions of Newhall Ranch. Ground water is generally shallowest adjacent to the active channel of the river with contours of ground water elevation typically oriented perpendicular to the axis of the channel, which is indicative of strong hydraulic connectivity between the active channel and adjacent alluvial deposits. Ground water occurs in Chiquito and San Martinez Grande Canyons, which have significant up-canyon source areas. Ground water in other, smaller tributary canyons was generally only observed near the mouth of the canyons. A total of 42 piezometers have been installed to monitor seasonal and annual fluctuations in ground water conditions at the site. Historic high ground water conditions were interpolated for the alluvial portions of the site based on review of subsurface exploration data, piezometer data, Los Angeles County Flood Control District (LACFCD) water well data, and published ground water contours. Interpolated contours of historic high ground water elevation or depth for the alluvial portions of each development area are shown on the maps provided in the referenced reports. Ground water conditions are also illustrated in hydrogeologic cross sections prepared for the larger alluvial areas at each proposed development area. The alluvial ground water conditions are summarized in **Table 4** for each development area.

A spring area has been identified near the mouth of Middle Canyon on Mission Village. This spring appears to be the result of a complex interaction between up-gradient recharge to the south and geologic conditions at and adjacent to the spring. A detailed hydrogeologic assessment of the spring and evaluation of potential impacts from future development are provided in the referenced report completed in collaboration with GSI Water Solutions, Inc. and GeoSyntec.

Ground water was locally encountered in our explorations in the elevated portions of the site. Where encountered, this ground water was generally perched above clay-rich, low permeability layers associated with landslides or faulting.

9.0 ENGINEERING CHARACTERISTICS OF SOILS

9.1 Soil Compressibility and Hydro-consolidation

Extensive subsurface explorations and laboratory testing were performed during our investigations to assess the extent and depth in each development area of compressible soils and of soils prone to hydro-consolidation (due to the addition of water). Recommendations for removal of unsuitable compressible and hydro-consolidation-prone soils and replacement with compacted fill for mitigation of potential settlement are presented on the Geologic/Geotechnical maps in our referenced reports. In general, recommended removal depths ranged from 4 to 55 ft across the subject portions of Newhall Ranch.

9.2 Potential Expansion of Soils

Limited Expansion Index testing was performed on representative samples of bedrock and surficial soil materials. Based on this testing, expansion potential of site alluvial materials generally classifies as low to medium. However, expansion potential of some of the fine-grained deposits derived from the Pico Formation at Homestead West and the WRP site classifies as high. Expansion potential of the fine-grained portions of the Pico and Saugus Formation generally classifies as medium to high. Recommendations for mitigation of potential impacts of expansive site soils on the proposed development, including structural reinforcement of foundations and grading removals, are provided in the referenced reports and are summarized in the attached **Table B1**.

9.3 Potential Corrosivity of Soils

Limited corrosivity testing (resistivity, sulfate content, chloride content, and pH) was performed on representative samples of the bedrock and surficial soil materials.

Based on the measured sulfate content values, corrosivity of site soils to concrete ranges from non-corrosive (negligible) to severely corrosive and corrosivity to concrete of fine-grained soils associated with the Pico Formation bedrock and associated secondary deposits generally classifies as severely corrosive. Recommendations for the type of cement required to mitigate the corrosive effects of these soils on concrete are provided in the referenced reports.

Based on the measured resistivity values, corrosivity of site soils to buried metals generally classifies as moderately corrosive to severely corrosive. Recommendations for protection of steel reinforcement and metal pipes against soil corrosivity are provided in the referenced reports.

Based on the measured pH values, acidity of site soils is not significant.

9.4 Shear Strength of Soils

Samples were collected to determine the shear strength of the bedrock and surficial units mapped at the site. A total of 209 direct shear and reshear tests were completed on undisturbed and remolded samples from the subject portions of the site, as presented in the referenced reports. These shear strengths were used as the basis for evaluating stability of critical landslides, natural slopes, and proposed cut and fill slopes. The strengths were also used to aid in evaluation of bearing capacity of site soils.

9.5 Rippability

The alluvial and terrace deposits at the site are generally uncemented and can be graded using standard equipment. Bedrock of the Saugus Formation is generally slightly to moderately indurated, with P-wave velocities generally below 6,000 ft/sec. This unit can generally be graded with standard, heavy equipment (D-8R and larger dozers), but single-shank ripping may be required in the more indurated, unweathered portions. The shallow portion of the Pico Formation, generally above a depth of 30 to 40 ft, is generally weathered and slightly to moderately indurated, with P-wave velocities generally less than

7,000 ft/sec. The deeper unweathered portion of the Pico Formation is commonly very compact with little fracturing and poorly developed bedding planes. P-wave velocities in the Pico Formation are anticipated to range from 6,500 to 10,000 ft/sec, which indicates that this rock may be difficult for D-9R and D-10R dozers to rip. Blasting may therefore be needed in the deeper, indurated portions of the Pico Formation. This will most likely affect the Homestead West and Potrero Ridge portions of Homestead and the WRP site. Irregular fragments generated by blasting and heavy ripping should be disposed of as discussed in the referenced reports.

10.0 SEISMIC CONSIDERATIONS

10.1 Introduction

The southern California region is seismically active and commonly experiences strong ground shaking resulting from earthquakes along active faults. Earthquakes along these faults are part of a continuous, naturally occurring process, which has contributed to the characteristic landscape of the region. The southern California region is traversed by the San Andreas fault, which is a transform boundary between the Pacific Plate and the North American Plate. The San Andreas fault is part of a system of northwest-striking, right-lateral faults that generally are historically active, as evidenced by the June 28, 1992 Landers (M7.3) earthquake.

The project site is located in the Transverse Ranges Geomorphic Province of southern California. The Transverse Ranges consist of a series of west-trending mountains and intervening valleys, which is contrary to the northwest geomorphic trend that is typical of most of California and reflects the underlying structural (geologic) trend. These ranges are largely the result of north-south compression, which has resulted in west-trending folds and trust faults. Associated faults in the vicinity of the site included the Santa Susana, Oak Ridge, Del Valle, and Holser reverse/thrust faults. The January 17, 1994 Northridge (M6.7) earthquake occurred on a south-dipping thrust fault which uplifted the Santa Susana Mountains at least 40 cm.

Geologic hazards that may be produced by a seismic event (earthquake) include Ground Rupture, Ground Motion, and Ground Failure.

10.2 Ground Rupture

10.2.1 General

There are no active faults currently known to exist on Newhall Ranch, as defined by the Alquist-Priolo Act. However, review of the Los Angeles County Seismic Safety Element indicates that a strand of the Holser fault traverses the Airport Mesa area on Mission Village. This strand is part of the "Holser structural zone" mapped by Weber, 1982. The strands of the Holser fault mapped in the safety element are designated as active based on interpreted intersections with active faults mapped to the east (San Gabriel) and to the west (San Cayetano). The safety element also shows the potentially active Del Valle fault traversing the Homestead Central portion of Homestead. The mapped trace of this fault was tentatively extended to the south in our September 19, 1994 report to connect with the Salt Creek fault previously mapped roughly on strike to the south of Potrero Canyon. The results of our investigation of these faults is summarized below and discussed in detail in the referenced reports for Mission Village (reports dated July 20, 2004 and July 22, 2004) and for Homestead (report dated September 30, 2005). No faults were observed on Landmark Village or the WRP site.

10.2.2 Faulting at Homestead

Detailed geologic investigations, including 2,655 lineal feet of trenching and 4 bucket-auger borings were completed to evaluate the location of the Del Valle fault on Homestead Central and to assess whether it connects with the Salt Creek fault previously mapped to the south of Potrero Canyon, as was speculated in our September 19, 1994 report.

In summary, the Del Valle fault was documented in close proximity to the published fault trace location mapped north of the Santa Clara River. The subsurface explorations were surveyed in the field with a Trimble GPS unit to provide accurate locations. The fault was also found to displace older alluvial deposits with up to 60 ft of reverse-sense movement. The exact age of the alluvium could not be determined in our investigation, but the geologic data indicate that the fault has been active in late Quaternary, and possibly Holocene times. However, our explorations did not find evidence for a connection between the Del Valle fault and the Salt Creek fault, or evidence for extension of the Del Valle fault south of the Santa Clara River on VTT 060678. Owing to the evidence for late Quaternary activity and the significant structural and stratigraphic changes across its trace, a Building Setback was designated for the Del Valle fault on Homestead Central. Detailed recommendations for the Del Valle fault and minor secondary faults observed on other portions of the Homestead site are presented in our September 30, 2005 report.

10.2.3 Faulting at Mission Village

Published geologic maps by Weber (1982), Winterer and Durham (1962), Dibblee (1996) and Treiman (1986) suggested the possible existence of faulting in the Airport Mesa area on Newhall Ranch. Weber (1982) defined a broad zone of possible fault-related features and lineaments near the southeastern end of the Holser Fault as the “Holser structural zone”. The southern portion of this zone includes the Airport Mesa area. Detailed review of aerial photographs and topography of the area indicated geomorphic conditions indicative of faulting along two alignments, designated as the Saddle Lineament to the south and the Airport Mesa Lineament to the north. Detailed geologic investigations, including 4,820 lineal ft of trenching and 17 bucket-auger borings, were therefore conducted by AESEGI in order to confirm the existence, lateral extent and activity of possible faults in this area. The details of this fault investigation are presented within our July 20, 2004 fault investigation report for the Airport Mesa Area.

In summary, our investigation revealed that the Saugus Formation bedrock at Airport Mesa has been tectonically deformed to produce several east-plunging folds and local faulting. The overlying Qt terrace deposits are also tectonically deformed along the Saddle and Airport Mesa Lineaments. The block between the two lineaments was found to have been uplifted at least 40 ft as a result of folding and reverse faulting within the last 100,000 (±) years. A zone of normal faults was discovered in the terrace deposits overlying the trace of the anticlinal fold on the northwestern portion of Airport Mesa. This style of deformation is consistent with tensional stresses at the crest of a tightening anticline. The anticline intersects the Airport Mesa Lineament and minor, oblique strike-slip faults were encountered between the lineament and the anticline. The fault and fold structures are therefore considered to be related.

Based on the observed geologic conditions and discussions with Dr. Roy Shlemon regarding the age of the materials cut by faulting and the style of deformation, Building Setbacks were recommended for the Airport Mesa and Saddle Lineaments and for the anticline (see referenced 7/20/04 report). In addition, because of the potential for sympathetic movement during earthquake-generated shaking, zones of restricted development are also recommended between the two lineaments, in the area between the Airport Mesa Anticline and the Airport Mesa Lineament/Fault, and for 100 ft beyond the recommended Building Setbacks. Critical and essential facilities, as defined in the CBC, are prohibited in this area and a minimum 8 ft fill cap and increased structure reinforcement are recommended for any proposed structures.

A monoclinal warp is present on the eastern portion of the site. This warp is more pronounced on trend to the east, where it roughly coincides with the contact between terrace deposits to the north and the Saugus Formation to the south. Minor cracks and flexural, bedding plane slips occurred near this fold at Stevenson's Ranch during the 1994 Northridge earthquake and building setbacks were recommended on the Westridge project and for the Stevenson's Ranch school site. Subsurface explorations, including 1879 lineal ft of trenches and dozer cuts were conducted on the Mission Village site to evaluate potential ground rupture hazard along this warp. This work indicates that the monocline dies out along strike and is not present west of Middle Canyon. Evidence for folding was observed east of Middle Canyon, but no significant faults were found to be associated with it. The potential for primary ground rupture along the warp is therefore concluded to be negligible within the life of the proposed development.

The Lion Canyon, or Del Valle, anticline traverses the northeastern margin of Lion Canyon. Initial geologic explorations along this structure revealed the presence of anomalously steep dipping bedding and sheared clay near the fold axis. Subsurface explorations, including 907 lineal feet of backhoe and excavator trenches, were therefore conducted to evaluate potential fault rupture hazard along the fold. No faulting was found, and unbroken terrace deposits were found to overlie the steeply dipping sheared clay bed. The potential for primary ground rupture along the fold was therefore considered to be negligible within the life of the proposed development.

10.3 Ground Motion

10.3.1 Probabilistic Ground Motion Evaluation

Potential seismic ground motions at Newhall Ranch were initially estimated in our referenced report dated December 4, 1995. The reported ground acceleration values were estimated based on the assigned maximum probabilistic earthquake magnitudes of nearby faults. This deterministic procedure complied with County of Los Angeles policies in effect at the time. The county subsequently adopted the use of true probabilistic procedures that account for uncertainty in the magnitude of future earthquakes and for the uncertainty of the ground acceleration associated with an earthquake of known magnitude, in compliance with state guidelines (Peterson et al, 1996) and current building codes. Potential ground motions were therefore re-evaluated for each development area using probabilistic procedures, as described in the referenced reports. **Table 5** presents a summary of the design basis ground motions (10% probability of exceedance in 50 years) estimated for each development area, which were used in our liquefaction assessments. Upper bound ground motions (10% chance of exceedance in 100 years) were determined, where needed, to assess liquefaction potential for proposed school sites.

The most likely source of the future potential design accelerations is a 6.5 M earthquake on the Santa Susana reverse fault. This fault crops out south of Newhall Ranch, on the south flank of the Santa Susana mountains. However, the fault dips to the north below Newhall Ranch. Other sources of potentially significant ground motions include the nearby Northridge (eastern Oak Ridge) fault, Holser fault, San Cayetano fault and San Gabriel fault, as well as the larger but more distant San Andreas fault.

10.3.2 Response Spectrum

Parameters for calculation of the California Building Code response spectrum are provided in the referenced reports for each development area. Soil profile types at the subject sites range from S_D in the alluvial areas to S_B in the bedrock areas. The remaining parameters applicable to all of the development areas are as follows:

- Seismic Zone = 4
- Seismic Source Type = B
- Seismic Zone Factor Z = 0.4
- Near Source Factor N_a = 1.3
- Near Source Factor N_v = 1.6
- Seismic Coefficient C_a = 0.44 N_a (For Soil Type D); = 0.40 N_a (For Soil Type B)
- Seismic Coefficient C_v = 0.64 N_v (For Soil Type D); = 0.56 N_v (For Soil Type B)

10.4 Ground Failure

Ground failure is a general term describing seismically induced, secondary permanent ground deformation caused by strong ground motion. This includes liquefaction, lateral spreading, seismic settlement of poorly consolidated materials (dynamic densification), differential materials response, sympathetic movement on weak bedding planes or non-causative faults, slope failures, and shattered ridge effects.

The potential for liquefaction and associated lateral spreading and seismic settlement of alluvial soils is evaluated and described in the referenced reports for each development area. The methods and procedures utilized in this analysis comply with County of Los Angeles standards and are discussed in detail in the appendices of the referenced reports. Recommendations to mitigate adverse impacts from liquefaction on future potential development at the site are also provided in the referenced reports. Recommendation measures for mitigation generally consist of removal and recompaction of loose soils subject to liquefaction. Alternate mitigation options include use of mat foundations, and/or pile foundations.

Differential materials response refers to the difference in response that various materials display when subjected to seismic waves. Where materials with different densities or strengths are in contact, differential response to the seismic energy may cause distress along the contact. The combination of dynamic densification and differential settlement along with differential materials response is a potential cause of future distress and instability along cut/fill and bedrock/alluvium contacts. It is, therefore, recommended that lots underlain by transitions between different materials types (ex. bedrock to fill, bedrock to alluvium, etc.) be over excavated as recommended in the referenced reports to minimize potential adverse impacts to future development.

Potential earthquake-induced slope failures include activation and reactivation of landslides, rock falls, debris flows, and surficial failures. Review of the Seismic Hazard Mapping Act (SHMA) maps for the Val Verde and Newhall Quadrangles indicates that many of the existing natural slopes within the subject development areas are within designated areas in which investigation is required to evaluate the potential for earthquake-induced landslides. Landslides and surficial failures have been mapped by this firm in the vicinity of the proposed development. Existing landslides which could potentially impact the proposed development have been evaluated and appropriate mitigation measures recommended, as presented in the referenced reports. The stability of natural and constructed slopes which could potentially affect the proposed development has also been evaluated and appropriate mitigation measures recommended in the referenced reports. Mitigation measures include grading removal of landslides, stabilization of landslides and slopes that do not satisfy the stability requirements of Los Angeles County, building setbacks, and redesign to avoid unstable slopes or to reduce slope gradients to a stable configuration. The potential for earthquake-induced slope failures to adversely impact the proposed development is considered negligible, provided that our recommendations and those of the Supervising Civil Engineer are incorporated into the proposed design and implemented during construction.

Minor, secondary movement can occur along planes of weakness in the bedrock as a result of strong ground motion, uplift, compression, or flexural slip during a seismic event. The specific location of future potential sympathetic movement along weak planes, such as inclined clay beds and minor faults, cannot be reliably predicted on a site-specific basis at this time. Over-excavation of weak, clay-rich bedding planes of the Saugus Formation and subsequent placement of a certified compacted fill cap has been recommended in the referenced reports to mitigate potential hazards from expansive material. Where subsidiary, minor faults are exposed at pad grade, the pad area below any proposed structures should also be over-excavated and replaced with compacted fill. If extensive minor faults or bedding plane shears are exposed at pad grade, such as along the axis of a fold, deeper over-excavation removals may be warranted, depending on conditions observed in the field. The compacted fill cap will help reduce potential surface effects from potential secondary, sympathetic movement along bedding planes and subsidiary minor faults during future nearby earthquakes. Portions of Mission Village where over-excavation is recommended along the monoclinal warp and Lion Canyon anticline are denoted on the maps presented in the referenced reports.

Shattered ridge effects (ground cracking) can occur along the top of narrow ridgelines where ground motions are amplified. Shattered ridge effects were observed on Potrero Ridge following the 1994 Northridge earthquake. However, the proposed grading will eliminate the narrow ridgeline conditions at most areas of proposed development and thereby eliminate the causative topographic condition. Where tank sites are proposed along narrow ridgelines, a minimum 20 ft setback from the edge of the bedrock is recommended to mitigate potential distress to the tank structures from shattered ridge effects during future earthquakes.

11.0 WELLS

11.1 Oil Wells

The Munger Map Book and the California Department of Conservation Division of Oil, Gas and Geothermal Resources (DOGGR) were consulted to determine the number and locations of oil wells on the subject development areas and to assess their abandonment status. A total of 153 oil wells are indicated to exist within the subject development areas and the associated envelope of potential grading disturbance. This includes 51 oil wells at Mission Village, 5 oil wells at Landmark Village, and 97 oil wells on Homestead. No oil wells are known to exist on the WRP Site. The locations of these wells are noted on the Geologic/Geotechnical Maps included in the referenced reports.

Available abandonment records on file with the DOGGR were obtained for each oil well and copies of the abandonment reports are presented in the referenced reports. **Table 6** presents a summary of all of the documented oil wells along with their coordinates, abandonment status, and date of abandonment (as of our last report), where applicable. The DOGGR will need to review the original abandonment files relative to the proposed development and assess if the abandonment measures meet the latest DOGGR requirements. It should be noted that the DOGGR discourages construction of buildings above or in close proximity to abandoned oil wells. Space should be provided to allow access in case additional abandonment becomes necessary in the future. Special mitigation, such as a venting system and gas barrier around the foundation, may be required for any structures proposed above, or in close proximity to an abandoned oil well.

If any leaking or undocumented oil wells are encountered during grading operations, their locations should be surveyed and the current well conditions evaluated immediately. Soils in the vicinity of oil wells could be contaminated with petroleum products spilled during operation of the wells. Oil wells may have associated mud pits that could also contain materials considered to be hazardous under current environmental regulations. If potentially hazardous materials are encountered during future grading operations, they should be assessed and mitigated.

11.2 Water Wells

Review of LACFCD water well data indicates that at least 20 water wells have been drilled on the subject portions of Newhall Ranch. This includes one (1) well on Mission

Village (in Middle Canyon), one (1) well at the Onion Field, one (1) well below Grapevine Mesa at Mesas West, five (5) wells in Chiquito Canyon, and thirteen (13) wells at Landmark Village and adjacent portions of the Santa Clara River. Prior to development, the location and abandonment status of these wells should be confirmed and proper abandonment completed in compliance with State and County guidelines.

12.0 GENERAL CONCLUSIONS AND RECOMMENDATIONS

12.1 Earthwork Recommendations

12.1.1 Introduction

All grading on the subject portions of Newhall Ranch shall be observed and tested by the Project Geotechnical Engineer, Engineering Geologist and/or their authorized representatives, in accordance with the recommendations provided in the Recommended Earthwork Specifications provided in **Appendix B** and referenced reports, and in accordance with the requirements of the current California Building Code.

12.1.2 Site Preparation

The purpose of site preparation is to remove unsuitable materials from the project site and to grade the site to provide a firm base for compacted fill, building foundations, etc. All concrete pavement, undocumented artificial fill, rubble, vegetation, topsoil, organics, unconsolidated alluvium, slopewash, and soft or disturbed soils shall be removed from ground surfaces on which compacted fill will be placed. Deleterious material, including topsoil may either be separately stockpiled for later reuse as topsoil in landscaped areas or properly disposed of offsite. Excavated areas shall be observed by the Geotechnical Engineer or his representative prior to placing fill.

12.1.3 Removals and Benching

In order to provide a firm, uniform bottom on which to place fill, all unconsolidated alluvium, slopewash, colluvial soils, artificial fill (including trench backfill), and severely weathered terrace deposits and bedrock should be removed from areas on which fill will be placed. The estimated removal depths in alluvial areas range from 4 ft to 55 ft in the subject development areas, as recommended the referenced reports.

All landslide and surficial failure materials should be removed as recommended in the referenced reports. The exact depth and extent of these removals will be decided during grading operations when field observations and location-specific evaluations can be made.

Removal depths recommended for each area are based on subsurface investigations and laboratory testing that we have performed, on proposed fill depths and intended uses, on analyses of potential for liquefaction and earthquake-induced settlement, and on our geologic and geotechnical judgment.

At locations where removals are limited by adjacent constraints (such as existing roadways, oak trees or conservation areas), horizontal setback of proposed structures from the removal bottom limits should be established using at a 1:1 (h:v) projection down from the edge of the proposed structures to the removal bottom limits prepared during grading. Smaller setbacks may be used if the footing foundations that support the edges of the proposed structures extend beneath the 1:1 projection (see **Figures B1** and **B2** in **Appendix B** for details).

12.1.4 Preparation of Removal Bottom Areas

The ground surface on which fill will be placed shall be ripped to a minimum depth of six inches, brought to optimum moisture content or above, thoroughly mixed to obtain a near uniform moisture condition and uniform blend of materials, and then compacted to the required percentage of maximum dry density per the latest ASTM Test Method D1557.

12.1.5 Dewatering During Removals

Ground water is not expected to impede the grading operations over most of the site. However, ground water may be encountered during grading of the deeper cut areas at Valencia Blvd. Ground water may also be encountered where deeper alluvial removals are recommended at the upper end of Chiquito Canyon, the southwestern portion of Homestead Central, the central portion of Homestead West, along the northern margin and eastern portion of Onion Field, in the southwestern portion of Landmark Village, and in the lower portion of Middle Canyon. The grading contractor should be prepared to implement dewatering measures as necessary, to achieve the required grading and recommended removals below the ground water in these areas.

Where recommended removals encounter ground water, dewatering may need to be performed. This may be accomplished by providing an adequate excavation bottom slope and sumps to enable pumping of water as the removal excavation proceeds. Alternatively, ground water may be lowered by installing dewatering well points or unsuitable soils below the water table may be improved in place via measures such as shallow compaction grouting or surcharge. The need for dewatering will vary depending on the season when the removals are performed and the amount of annual precipitation that occurs.

12.1.6 Over-Excavation

All cut lots and all transitional lots (i.e., lots with transitions between bedrock, fill, terrace deposits, and alluvium) should be over-excavated to a depth of at least 5 ft beneath design grade and all street subgrades should be over-excavated to a depth of at least 3 ft. This over-excavation will provide relatively uniform support conditions for structures, mitigate potential for differential settlement under static loading conditions, and mitigate potential for differential materials response under earthquake loading conditions. If the maximum depth of fill proposed within a cut/fill transition lot exceeds 15 feet, the thickness of the fill cap should be one-third of the deepest fill thickness below any proposed structure (see **Figure B3** regarding Transitional Cut Lot and Cut-Fill Lot Conditions in **Appendix B**).

If excavation of native materials (i.e. bedrock) in a lot exposes materials with high expansion potential and/or expansive materials interbedded with materials with low expansion potential, then over-excavation should extend to a depth of 8 feet. Cut and transition lots located in areas of steeply dipping bedrock should also be over-excavated to a depth of 8 feet. If these lots are underlain by weak bedding planes or geologic shear zones, deeper over-excavation may be required. Cut pads that expose minor faults should be over-excavated, as described in the referenced reports for Mission Village and Homestead. These conditions should be evaluated and addressed on a case by case basis during the Grading Operations.

Steep natural slopes and existing cut slopes for oil well pads and access roads are locally common on the site. Where fills are proposed to cover these slopes, the slopes should be laid back to reduce potential for differential fill settlement. These conditions should be evaluated and addressed in detail at the Grading Plan stage.

12.1.7 Fill Materials

Onsite soils that are free of debris, over-size rocks, topsoil and organic matter may be used as sources for compacted fills. Rock and other irreducible material with a maximum dimension greater than eight (8) inches may not be placed in the fill except as discussed below. Rocks or hard fragments larger than four (4) inches in dimension shall not compose more than 25 percent of the fill and/or lift Oversized rock fragments that have been reduced to the specific maximum rock fill size (see **Figure B4**, Rock Disposal, in **Appendix B**), may be incorporated into the fill in rockfill windrows. Where fill depths are too shallow to allow disposal of large rocks, special handling or removal may be required (see Recommended Earthwork Specifications, **Appendix B**).

12.1.8 Fill Compaction

All fill material should be placed in uniform lifts not exceeding eight (8) inches in thickness (loose) and compacted to the minimum specified percentage of maximum dry density per ASTM Test Method D1557. Additional field compaction requirements are presented in **Appendix B**, Recommended Earthwork Specifications. **Appendix B** also includes recommended specifications for placement of trench backfill.

For fills deeper than 40 feet, the portion of fill placed more than 40 feet below proposed grade should be compacted to a minimum of 93 percent of the maximum dry density. To ensure compliance, these areas should be delineated at the 40-Scale Grading Plan stage.

12.1.9 Proposed Fill Slopes

Fill slopes up to 188 ft in height are proposed on the subject portions of Newhall Ranch. Based on stability analyses of the highest fill slopes proposed in each of the development areas, the slopes satisfy the stability requirements of Los Angeles County at the proposed gradients (see referenced reports for details).

Fill slope inclination should not be steeper than 2:1 (h:v). The fill material within approximately one equipment width (typically 15 feet) of the slope face should be constructed with cohesive material obtained from on-site soils. Preferably, the finished fill-slope face should be constructed by over-building the slope and cutting back to the compacted fill material. Alternatively the slope may be constructed at the design grade and the slope face wheel-rolled to achieve adequate compaction.

Stability Fills are recommended where cut-slope faces will expose fill-over-bedrock, alluvium-over-bedrock or Quaternary Terrace Deposits-over-bedrock conditions. These fills should be constructed with a keyway at the toe of the fill slope. The keyway should be at least equipment width, and as specified in the referenced reports, and should extend a minimum depth of 3 ft into the firm undisturbed earth. The project Engineering Geologist or his representative shall observe and approve the keyway bottom prior to backfilling with Compacted Fill. Unless otherwise noted, stability fills are recommended for the entire slope and back cut gradients should be no steeper than 2:1 (h:v).

Where fill slopes are constructed above natural ground with a gradient of 5:1 (h:v) or steeper, all topsoil, colluvium, and unsuitable material should be removed and a keyway should be constructed at the toe of the fill slope. The keyway should be at least 15 ft wide unless specified otherwise, and should extend at least 3 ft into firm undisturbed earth (see **Appendix B,** Fill Slope Over Natural Slope diagram**, Figure B5**). The project Engineering Geologist/Geotechnical Engineer, or his representative, shall observe and approve the keyway bottom prior to backfilling with compacted fill.

Where fill slopes toe out on relatively level natural ground, removals should extend beneath the surface that projects from the toe of the slope at a 1:1 (h:v) projection downward to the recommended removal depth (see **Appendix B,** Fill Slope Toeing Out on Flat Alluviated Canyon**, Figure B6**). Fill slopes proposed above a cut slope should be constructed as shown in **Figure B8**.

Where sliver fill slopes are proposed, it is recommended that the slope be constructed throughout with a Stability Fill that is keyed in at the toe of slope (see **Appendix B,** Stability/Buttress Fill and Backdrains Detail**, Figure B7**).

12.1.10 Proposed Cut Slopes

A total of 175 cut slopes ranging from 25 to 260 ft in height are proposed on the Mission Village (47) and Homestead (128) portions of Newhall Ranch. Some of these slopes were subdivided based on variations in orientation, resulting in a total of 212 cut slopes evaluated (57 on Mission Village and 155 on Homestead). Geologic conditions were evaluated at each cut slope and cross sections illustrating the anticipated 3-dimensional geometry were prepared. The stability of each slope was analyzed and appropriate mitigation was recommended, as described in the referenced reports for each site. Mitigation measures recommended for unstable slopes included construction of buttresses and stability fills, redesign to reorient the slope to reduce adverse bedding conditions, and reduction of the slope gradient and/or addition of benches to reduce the driving force.

Permanent cut slopes should be constructed at an inclination no steeper than 2:1 (h:v) with appropriate terrace benches unless specifically reviewed and approved by the project Geotechnical Engineer. All permanent cut slopes that will expose terrace deposits or alluvium should be constructed as stability fills. Temporary cut slopes shall be evaluated during the Grading Plan stage. Potential unstable subsurface conditions exposed during construction, such as adverse bedding, joint planes, zones of weakness or exposed seepage, may require either flatter slopes than specified above, construction of benches, or construction of buttress or stability fills. We recommend that an Engineering Geologist observe all cut slopes and backcuts during grading operations and provide appropriate recommendations if necessary.

12.1.11 Natural Slopes

Natural slopes proposed to remain adjacent to proposed development on the subject development areas have gradients ranging from 5:1 (h:v) to nearly vertical. The steepest slopes on the subject site are at the bluffs adjacent to the Santa Clara River and on the margins of the Potrero Ridge. The steeper slopes are typically supported by very resistant sandstone/conglomerate beds of the Saugus and Pico Formations. Moderately steep, high slopes also occur where unweathered Pico Formation or where resistant, antidip sandstone of the lower member of the Saugus Formation underlies the slope.

Cross sections were constructed where natural slopes are in close proximity to proposed building pads, in order to analyze the existing and proposed conditions. Where warranted for gross stability, Building Setbacks have been delineated on the Geologic/Geotechnical Maps included in the referenced reports. Natural slope areas susceptible to debris flow hazard are addressed in **Section 12.5** of this report.

12.2 Restricted Use Areas

12.2.1 Introduction

Areas with geologic hazards that will remain after completion of the proposed grading and implementation of the recommended mitigation measures should be designated on the Final Map as Restricted Use Areas. Preliminary limits of proposed Restricted Use Areas for faulting, potentially unstable slopes, and landslides are shown on the Geologic/Geotechnical Maps for future reference in the referenced reports. Additional Restricted Use Areas may also be required where existing constraints, such as roadways, oak trees and conservation areas, limit completion of the recommended grading removals.

12.2.2 Building Setbacks for Faulting

Building Setback Zones have been designated to mitigate potential ground rupture hazard associated with the Del Valle fault zone and with the Holser Structural Zone wherein construction is limited per the criteria set forth in the Alquist-Priolo Act. Details of our fault investigations and resulting Building Setbacks are provided in the referenced reports for each site.

Pipelines within the Building Setback Zones, and within the associated zone of restricted development at Airport Mesa (including gas, water, storm drain and sewer) should be constructed to tolerate some flexure. It would also be prudent to install emergency shut off valves on gas and water lines that traverse these zones in case the lines are broken during a future earthquake.

12.2.3 Zone of Restricted Development

A zone of restricted development was recommended adjacent to building setbacks for faulting at Airport Mesa on the Mission Village project. Critical and essential facilities, (as defined in the CBC) are prohibited in this zone. If any non-critical/essential structures are proposed in this zone, they should be constructed on a minimum 8ft-thick fill cap and additional reinforcement beyond standard design codes should be incorporated into the concrete foundations to mitigate distress from potential secondary ground deformation.

12.2.4 Building Setbacks for Potentially Unstable Slopes

Building Setback lines are shown on the Geologic/Geotechnical Maps included in the referenced reports for each development area where development is proposed adjacent to natural slopes that warrant a Building Setback in excess of the standards set forth in the Los Angeles County and California Building Codes. The use of deepened foundations or walls instead of the recommended Building Setback may be considered on a case-by-case basis at the Grading Plan stage. The graded areas within the Building Setback areas should be placed into Restricted Use Areas on the Final Map. The standard setbacks from ascending and descending slopes provided in the Los Angeles County and California Building Codes should also be followed.

12.2.5 Building Setbacks for Non-structural Fills

At locations where removals are limited by existing constraints, such as adjacent roadways, oak trees or conservation areas, horizontal setback of proposed structures from the removal bottom limits should be established using a 1:1 (h:v) projection down from the edge of the proposed structures to the removal bottom limits prepared during grading. Smaller setbacks may be used if the footing foundations that support the edges of the proposed structures extend beneath the 1:1 projection. Building setbacks for the above-noted fill conditions and possible alternative mitigation options should be reviewed at the Grading Plan stage and confirmed during Grading.

12.2.6 Restricted Use Areas for Landslides

If an existing landslide (or a portion of an existing landslide) that does not satisfy the stability requirements of Los Angeles County will be left in place following completion of approved grading operations, the subject landslide area should be placed in a Restricted Use Area on the Final Map. Mitigation measures for each landslide mapped on the site are summarized in the referenced reports for each development area. Preliminary boundaries of Restricted Use Areas are shown on the Geologic/Geotechnical Maps provided in the referenced reports for Mission Village and Homestead for future reference.

12.2.7 Geotechnical Notes

Areas of unmitigated alluvial materials subject to significant hydroconsolidation and settlement should be designated with a geotechnical note on the final map in compliance with Los Angeles County policies. Landslide areas that satisfy the County of Los Angeles requirements for slope stability and will remain following completion of proposed grading operations should also be designated with a geotechnical note on the Final Map, unless testing demonstrates that the landslide material is not subject to future settlement.

12.3 Drainage Control

12.3.1 Surface Drainage and Erosion Control

Ground surface drainage gradients should be configured to prevent ponding and to promote drainage of surface water away from building foundations, slabs, edges of pavements and sidewalks, tops of slopes, and toward suitable collection and discharge facilities. Surface water runoff should be collected in lined ditches or drainage swales, via non-erodible drainage devices, which should discharge to paved roadways or to existing watercourses. If the ditches/swales discharge onto unpaved ground, provisions should be made to control potential erosion.

Even if carefully planned erosion control measures are implemented, areas of erosion may develop during the first few rainy seasons after the project is completed. Therefore, the conditions of the graded site surface should be routinely monitored, particularly following periods of heavy rainfall. Identified areas of erosion should be repaired as soon as practical in order to prevent their enlargement.

12.3.2 Control of Subsurface Water

Fill slopes, Buttress Fills and Stability Fills shall be provided with subsurface drainage. A typical backdrain detail is shown on **Figure B7, Appendix B**. Also, subdrains should be constructed along the bottom of canyon fills. The locations of canyon subdrains should be determined at the Grading Plan stage and reviewed during grading. A typical canyon subdrain detail is presented on **Figures B9** and **B11, Appendix B**.

The proposed grades for the western portion of the Valencia Boulevard road alignment are at, or below, the interpolated historic high ground water level, and are locally below ground water levels encountered in our subsurface explorations. A subdrainage system will therefore be required below the Valencia Boulevard. roadway and more extensive backdrain systems will be required for the stability fills recommended for slopes adjacent to the roadway. The design of the subdrain and backdrain systems for Valencia Boulevard should be evaluated in detail at the Grading Plan Stage. If the grade of Valencia Boulevard is raised above the anticipated ground water table, the expanded subdrain and backdrain systems noted above may not be necessary.

12.4 Shrinkage and Bulking

Bulking is defined as the increase in volume of a material when excavated and subsequently placed as compacted fill. Shrinkage is defined as the reduction in volume of a material when excavated and subsequently placed as compacted fill. Preliminary estimates of shrinkage/bulking of site materials are summarized in **Tables 7** and **8** (**Appendix A**). These estimates are based on the measured in-situ densities of the site materials and assume that the excavated site materials will be compacted on average to 92 percent of Maximum Dry Density, per ASTM Test Method D1557. The shrinkage and bulking factors noted in Tables 7 and 8 are only estimates. Actual volume changes from cut to fill will depend on the compacted fill densities and mixing achieved during grading.

Minor subsidence may occur where thick fills are proposed above alluvial materials and minor swelling may occur in the bedrock due to unloading in the deeper cut areas. The extent and impacts of subsidence and swelling should be reviewed at the Grading Plan stage. The Supervising Civil Engineer should design pad grades with sufficient flexibility to accommodate a possible shortage or excess of fill of up to 10 percent of the total yardage graded.

12.5 Debris Flow Hazard

Based on review of the tentative tract map designs, topographic base maps, and field mapping of the site, potential debris flow hazard relative to proposed development locally exists at Mission Village, Chiquito Business Park, Chiquito Estate Lots, Potrero Ridge, Long Canyon, and Mesas West. No debris flow hazard is expected at Landmark Village or at the WRP Site because no natural slopes will remain on, or immediately adjacent to, either site following construction. Slope areas subject to potential debris flow that will remain adjacent to pad areas following construction are noted on the Geologic/Geotechnical Maps contained in the referenced reports for Mission Village and Homestead. Measures available to mitigate potential debris flow hazard include:

1. Building Setbacks
2. Removal of loose, surficial material
3. Construction of slough diversion walls
4. Construction of impact walls
5. Construction of debris basins
6. Control of run-off
7. Planting of deep-rooted vegetation
8. Construction of stability fills

Several of these options are graphically illustrated in **Figure B10** (**Appendix B**).

Building Setbacks recommended for mitigation of potentially unstable slopes will mitigate potential debris flow hazards at most locations. Design revisions are recommended for potentially unstable slopes and debris flow hazards in the northern canyon of the Chiquito Estate Lots area. Appropriate mitigation measures/options should be addressed in detail at the 40-scale Grading Plan stage.

12.6 Hydro-consolidation

Based on our hydro-consolidation test data, existing soils below the depth of removals recommended in the referenced reports do not have significant potential for collapse as a result of hydro-consolidation.

12.7 Expansion Potential of Soils

It is anticipated that expansion potential of fill derived from most on-site materials will range from very low to medium. However, material with high expansion potential was encountered in upper Chiquito Canyon, in Pico Formation mudstone, and in clayey “red beds” within the Saugus Formation. Expansion potential of fill soils exposed at rough grade should be classified based on Expansion Index testing performed at completion of grading. Footing foundations and slabs-on-grade should be designed in accordance with the recommendations provided in **Table B1**, based on this expansion potential classification.

12.8 Foundations

Shallow spread footings for foundation support of both residential and commercial structures can adequately be founded on certified fill compacted as recommended in the referenced reports. Pile or mat foundations may be needed at local areas where it is not feasible to remove compressible or unstable soils. Support for structures that will exert large loads to the foundations should be addressed at the Grading Plan stage. Recommendations for allowable bearing capacity for preliminary design of shallow footing foundations embedded in certified compacted fill are provided in the referenced reports. The allowable bearing pressure should be confirmed by further field and laboratory testing of the site soils before use in design. Lateral resistance provided by site soils to foundations should be provided at the Grading Plan stage.

12.9 Soil Corrosivity

Resistivity, sulfate content, chloride content, and pH tests were performed on representative materials from each of the proposed development areas. Based on the measured resistivity values, corrosivity of site soils materials to buried metals classifies as moderately to severely corrosive (Los Angeles county classification). Based on the measured sulfate content values, corrosivity of site soils to concrete classifies as negligible to severe (UBC classification). Based on the measured pH values, site soils typically are near-neutral (i.e., neither acidic nor alkaline). Measured chloride concentrations in site soils were low.

For purposes of planning, it may be assumed that either Type I or Type II Portland cement may be used in concrete placed in contact with soils at most of the site. However, soils with significant sulfate content are locally present on the Homestead and WRP sites. Concrete placed in contact with these soils will require Type V Portland cement, a water/cement ratio no higher than 0.45, and a compressive strength of at least 4,500 psi.

Recommendations for mitigation of soil corrosivity to buried concrete and metal should be revised/expanded based on testing performed during the Grading Plan stage. As a minimum, final recommendations for mitigation of soil corrosivity to concrete should conform to the requirements of the CBC and final recommendations for mitigation of soil corrosivity to buried metals should be established by a corrosion specialist.

12.10 Retaining Walls

Geotechnical parameters for design of conventional, cantilever retaining walls will be provided, as needed, in the Grading Plan stage.

12.11 Pavement Design

Recommendations for vehicle pavement sections will be provided at the Grading Plan stage.

12.12 Sewage Disposal

It is our understanding that sewage disposal will be by public sanitary sewers.

13.0 LIMITATIONS

This report has been prepared by Allan E. Seward Engineering Geology, Inc. for the exclusive use of the Newhall Land and Farming Company and its design consultants for the specific site discussed herein. This report should not be considered transferable. Prior to use by others, this firm must be notified, as additional work may be required to update this report.

In the event that any modification in the location or design of the proposed development is planned, the conclusions and recommendations contained in this report will require a written review by this firm with respect to the planned modifications.

The proposed development is located in southern California, a geologically and tectonically active region, where large magnitude, potentially destructive earthquakes are common. Therefore, ground motions from moderate or large magnitude earthquakes could affect the project site during the design life of the proposed structure(s).

Typically, faulting is confined to the area adjacent to a known fault. However, absolute assurance against future fault displacement is not possible in tectonically active regions because new faults can form over time as the orientation and magnitude of deformational forces change in the earth's crust. Therefore, the location and magnitude of new ground surface ruptures during a seismic event cannot be anticipated.

In performing these professional services, this firm has used the degree of care and skill ordinarily exercised under similar circumstances by reputable geologists and geotechnical engineers practicing in this or similar localities. The data presented in this report are based on results of pertinent field and laboratory testing. It should be recognized that subsurface conditions can vary in time, and laterally, and with depth at a given site. Since the conclusions and recommendations presented in this report are based on our observations and testing, our **conclusions** and **recommendations** are **professional opinions** and are **not meant** to be a control of nature. Therefore, we make no other **warranty** either **expressed** or **implied**.

This report may not be duplicated without the written consent of this firm.

This opportunity to be of service is greatly appreciated. If you have any questions regarding this report please give us a call.

Respectfully submitted,

Brian Swanson, CEG 2055
Associate Geologist

Martin J. Goodman, GE 2146
Principal Geotechnical Engineer

Reviewed by:

Eric J. Seward, CEG 2110
Principal Engineering Geologist
Vice President

The following attachments and appendices complete this report.

Distribution: (2) The Newhall Land and Farming Company
Attn: Mr. Matt Carpenter
(3) Impact Sciences
Attn: Mr. Tom Worthington

REFERENCES

Reports by: Allan E. Seward Engineering Geology, Inc.

Mission Village

1. **Geologic Report**
   Fault Investigation for Airport Mesa Area
   Mesas Entertainment, Newhall Ranch
   Castaic, California
   Dated July 20, 2004 – J: 04-1703H-1

2. **Geologic and Geotechnical Report**
   Review of Vesting Tentative Tract Map
   (Dated June 14, 2004)
   Vesting Tentative Tract 61105
   Mesas East
   Newhall Ranch, California
   Dated July 22, 2004 – JN: 04-2023-4

3. **Geologic and Geotechnical Report – Addendum No. 1**
   Response to Los Angeles County Geologic
   Review Sheet dated October 21, 2004
   and Soils Engineering Review Sheet dated
   October 26, 2004
   Geologic and Geotechnical Report
   Revised Vesting Tentative Tract Map (dated
   11/15/04)
   Vesting Tentative Tract 61105
   Mission Village
   Newhall Ranch, California
   Dated December 22, 2004 – JN: 04-2023-4

4. **Geologic and Geotechnical Report – Addendum No. 2**
   Response to Los Angeles County Geologic
   Review Sheet dated January 26, 2005
   and Soils Engineering Review Sheet dated
   February 22, 2005
   Geologic and Geotechnical Report
   Review of Revised Vesting Tentative Tract
   Map (dated 6/1/05)
   Vesting Tentative Tract 61105
   Mission Village
   Newhall Ranch, California
   Dated June 13, 2005 – JN: 05-2023-4

5. **Middle Canyon Spring**
   Hydrogeologic Assessment and Impact
   Evaluation Report
   Prepared by GSI Water Solutions, Inc. and
   AESEGI, in Association
   with GeoSyntec Consultants
   Dated September, 2007 (Job No: 1155PG)

Landmark Village

6. **Geologic and Geotechnical Report**
   Vesting Tentative Tract 53108, Dated 6/11/00
   River Village, Newhall Ranch
   Castaic, California
   Dated September 27, 2000 – JN: 00-1702R-4

7. **Geologic and Geotechnical Report – Addendum No. 1**
   Response to County Comments (Review
   Sheets dated 12/12/00 and 1/2/01)
   Vesting Tentative Tract 53108, Map dated
   6/11/00
   River Village, Newhall Ranch
   Castaic, California
   Dated February 10, 2001 – JN: 01-1702R-4

8. **Geotechnical Letter Report**
   Review of Impacts of Potential Differential
   Settlement on Proposed Road Gradients
   Landmark Village – VTTM 53108
   Newhall Ranch
   Los Angeles County, California
   Dated August 27, 2007 – JN: 07-1702R (12)

Homestead

9. **Geologic and Geotechnical Report**
   Review of Vesting Tentative Tract Map
   060678 (Dated 8/3/05)
   Homestead
   Newhall Ranch, California
   Dated September 30, 2005 – JN: 05-2062-4

REFERENCES

WRP Site

10. **Preliminary Geologic/Geotechnical Report**
Proposed Water Reclamation Plant
Newhall Ranch Project
Castaic, California
Dated June 10, 2004 – JN: 04-1707-1

11. **Geologic and Geotechnical Report**
Review of Soil-Cement Liner Plans (Dated 4/24/06)
North Bank of Santa Clara River
Water Reclamation Plant
Newhall Ranch
Castaic Area, Los Angeles County, California
Dated May 3, 2006 – JN: 06-1707-1

12. **Geologic and Geotechnical Report**
Review of Grading Plans (Dated 3/13/06)
Proposed Water Reclamation Plant
Newhall Ranch Project
Castaic, Los Angeles County, California
Dated June 19, 2006 – JN: 06-1707-1

13. **Geotechnical Report**
Review of Storm Drain Plans
P.D. No. 2606
Proposed Water Reclamation Plant
Castaic Area, Los Angeles County, California
Dated September 8, 2006 – JN: 06-1707-1

REFERENCES

Reports For Newhall Ranch Specific Plan

Reports by: Allan E. Seward Engineering Geology, Inc.

14. **Preliminary Geologic Report**
Newhall Ranch
Santa Clarita Valley Area
Los Angeles County, California
Dated September 19, 1994 – JN: 94-1155-1

15. **Geologic Report – Addendum No. 1**
Response to County Comments
Newhall Ranch Specific Plan (NRSP)
Los Angeles, California
Dated December 4, 2005 – JN: 95-1155-1

16. **Preliminary Geologic Feasibility Report**
Offsite Extensions of Magic Mountain Parkway and Valencia Blvd. to Newhall Ranch
Santa Clarita, California
Dated December 13, 1995 – JN: 95-1155E-1

17. **Geologic Report – Addendum No. 2**
Response to County Comments
Newhall Ranch™ Specific Plan (NRSP)
Los Angeles, California
Dated May 13, 1996 – JN: 96-1155-1

18. **Geologic Report – Addendum No. 3**
Response to County Comments
Newhall Ranch™ Specific Plan (NRSP)
Los Angeles, California
Dated September 25, 1996 – JN: 96-1155A3-1

19. **Supplemental Geologic Feasibility Report**
Offsite Extensions of Magic Mountain Parkway and Valencia Blvd. to Newhall Ranch
Santa Clarita, California
Dated November 21, 1996 – JN: 96-1155E2-1

20. **Geologic Report**
Response to County Comments (Review Sheet dated 7/3/97)
Vesting Tentative Parcel Map 24500 (Revised 7/25/97)
Valencia, California
Dated July 21, 1997 – JN: 97-1155-4

21. **Second Response to Comments**
Newhall Ranch DEIR
Dated July 24, 1997 – JN: 97-1155C2-1

22. **Response to K. McCown Commentary within Editorial Section of Signal Dated 6/7/98**
Dated July 27, 1998 – JN: 98-1155C1-1

Reports by: R.T. Frankian & Associates

23. **Report of Geotechnical Reconnaissance, Proposed Newhall Ranch Project™**
Castaic, California
Dated September 19, 1994 – JN: 94-013-F

24. **Geotechnical Response to Letter Dated July 31, 1995, County of Los Angeles Public Works, Newhall Ranch ™ Specific Plan 94-087**
Newhall Ranch Project™
Castaic, California
Dated December 6, 1995 – JN: 94-013-F

25. **Grading Plan Review, Preliminary Geotechnical Review, Proposed Extensions of Valencia Boulevard and Magic Mountain Parkway to Newhall Ranch™**
Valencia, California
Dated December 12, 1995 – JN: 94-013-F

26. **Response to County Remarks**
Geotechnical Engineering Review Sheet
Dated March 28, 1996
Newhall Ranch™ Specific Plan (NRSP) 94-087
Proposed Newhall Ranch™ Project
Castaic, California
Dated May 15, 1996 – JN: 94-013-F

27. **Response to County Comments of September 18, 1996**
Newhall Ranch™ Specific Plan
Dated September 26, 1996 – JN: 94-013-F

28. **Proposed Offsite Extension of Valencia Boulevard**
Slope Stability Analysis
Proposed Newhall Ranch Project™
Castaic, California
Dated December 6, 1996 – JN: 94-013-F

29. **Response to County Remarks**
Geotechnical Engineering Review Sheet Dated July 3, 1997
Proposed Newhall Ranch Project ®
Vesting Tentative Parcel Map 24500
Valencia, California
Dated July 24, 1997 – JN: 94-013-F

REFERENCES

Published

CDCDMG, 1997, Guidelines for evaluating and mitigating seismic hazards in California: California Department of Conservation Division of Mines and Geology Special Publication 117.

CDCDMG, 1998, Seismic Hazard Zones Map for the Newhall Quadrangle Released February 1, 1998, California

CDCDMG, 1997, Seismic Hazard Evaluation of the Newhall 7.5-Minute Quadrangle, Los Angeles County, California: Open-File Report 97-11.

CDCCGS, 2002, Seismic Hazard Zone Report for the Val Verde 7.5-Minute Quadrangle, Los Angeles and Ventura Counties, California: Seismic Hazard Zone Report 076.

Dibblee, T.W., Jr., 1996, Geologic Map of the Newhall Quadrangle, Los Angeles County, California: Dibblee Geological Foundation, Map DF-56.

Dibblee, T.W., Jr., 1993 Geologic map of the Val Verde Quadrangle, Los Angeles and Ventura Counties, California: Dibblee Geologic Foundation, Map DF-50.

Hart, E.W., 1997, Fault-rupture hazard zones in California: California Division of Mines and Geology Special Publication 42, 24 p.

Martin, G.R., and Lew, M., 1999, Recommended procedures for implementation of DMG Special Publication 117 - Guidelines for analyzing and mitigating liquefaction hazards in California: Southern California Earthquake Center, 63 p.

Petersen, M.D., Bryant, W.A., Cramer, C.H., Cao, T., Reichle, M.S., Frankel, A.D., Lienkaemper, J.J., McCrory, P.A., and Schwartz, D.P., 1996, Probabilistic seismic hazard assessment for the State of California: California Department of Conservation Division of Mines and Geology Open-File Report 96-08, 33 p.

SUMMARY OF PROPOSED DEVELOPMENT

Development Area	Latest Plan Date[1]	Acreage	No. of Lots	No. of Dwelling Units	Proposed Usage*	Highest Cut slope	Highest Fill slope	Pertinent Report Dates
Mission Village	6/1/05	1250	594	5331	SF, MF, A, R, C, P, S, OS, WT	130'	145'	July 22, 2004 December 22, 2004 June 13, 2005
Landmark Village	6/11/00	291	702	1444	SF, MF, A, C, R, P, S, OS	25'	25'	September 27, 2000 February 10, 2001 August 27, 2007
Homestead (Comprehensive)	8/3/05	2886.4	1349	5686	See Below	260'	175'	September 30, 2005
Chiquito Business Park	8/3/05	283.2	52	210	MF, BP, OS	180'	140'	September 30, 2005
Chiquito Estates	8/3/05	150.8	38	19	SF, OS, PF, WT	125'	70'	September 30, 2005
Homestead Central	8/3/05	306.2	238	899	SF, MF, OS, P, R	90'	138'	September 30, 2005
Homestead West	8/3/05	304.6	102	651	SF, MF, OS	260'	137'	September 30, 2005
Onion Field	8/3/05	350.5	133	644	SF, SFC, MF, OS, P, S	N/A	26'	September 30, 2005
Potrero Ridge	8/3/05	216.7	112	88	SF, OS, R, PR	140'	175'	September 30, 2005
Long Canyon North & South	8/3/05	653.0	581	986	SF, MF, OS, P, R, S, FS, WT	195'	141'	September 30, 2005
Mesas West	8/3/05	621.4	93	2189	MS, OS, PF, P, R, S, WT (offsite)	200'	112'	September 30, 2005
WRP Site	4/11/06	21.5	1	N/A	WRP	30'	30'	June 10, 2004 May 3, 2006

[1] The latest plan evaluated by this firm for submittal to the County of Los Angeles

* Usage Abbreviations: SF=Single Family Detached; SFC=Single Family Detached (Condominium); MF=Multi Family (Condominium); A=Apartments; BP=Business Park; C=Commercial (mixed use); OS=Open Space; PF=Public Facility; P=Park; R=Recreation area; S=School; FS=Fire Station; WT=Water Tank; WRP=Water Reclamation Plant. Roadways, bridges, bank protection, basins and drainage improvements are also proposed.

SUMMARY OF SUBSURFACE EXPLORATIONS

June 19, 2006
September 8, 2006

DEVELOPMENT AREA	TRENCHES		BORINGS			CONE PENETRATION TESTS
	NUMBER	LINEAL FT OF FAULT TRENCHES AND DOZER CUTS	BUCKET AUGER	HOLLOW STEM	ROTARY WASH	
Mission Village	472	7,606	106	45	6	22
Landmark Village	65	N/A	4	13	8	64
Homestead	682	2,655	204	82	25	158
WRP Site	30	N/A	0	23	4	31
Total	1,249	10,261	314	163	43	275

UPDATED SUMMARY OF LARGE LANDSLIDES AS ORIGINALLY DEFINED IN OUR DECEMBER 4, 1995 REPORT

Landslide Designation	Development Area Affected	Geologic Units Involved	Updated Landslide Conditions and Impact on Proposed Development	Updated Mitigation
I	Homestead Estate Lots	Tp	No proposed development (Estate lots abandoned)	None
II	Homestead Estate Lots	Tp	No proposed development (Estate lots abandoned)	Restricted Use area around toe on Homestead West
III	Homestead Estate Lots	Tp	No proposed development (Estate lots abandoned)	None
IV	Homestead Estate Lots	Tp	No proposed development (Estate lots abandoned)	None
V	Homestead Central	Tp	Landslide limits reduced based on subsurface investigation; No proposed development on landslide	Restricted Use Area
VI	Chiquito Estate Lots	Tp	Estate Lot design revised to avoid landslide	Restricted Use Area
VII	Chiquito Estate Lots	Tp	Subsurface investigations indicates there are actually several smaller landslides; Design revised to avoid larger landslides	Larger landslides placed in Restricted Use Area; Remainder to be mitigated by removal and/or stabilization
VIII	Chiquito Estate Lots	Tp	Subsurface investigations indicate that there is not a large landslide at this location.	Any landslide material to be removed
IX	Chiquito Business Park	Tp/Qt	Subsurface investigations indicate that there are several smaller landslides at this location. Slope underlies Chiquito Canyon Road, but no improvements proposed.	Place toe area in Restricted Use Area
XVI	Mission Village	TQsu/Qt	Subsurface investigations indicate that this is only one small landslide, which coincides with a proposed fill slope.	Complete Removal
XVII	Mission Village	TQsu	Subsurface investigations indicate that there are several landslides in the area of proposed development.	Complete Removal
XVIII	Mission Village	TQsu	Landslide confirmed with subsurface explorations; Westridge Blvd. alignment proposed at toe.	Landslide calculates stable with a factor of safety in excess of L.A. County

SUMMARY OF SUBSURFACE EXPLORATIONS

				requirements with proposed fill at toe; Portions of landslide subject to settlement to be removed prior to placement of fill

NOTE: Landslides X through XV are in the Potrero Canyon area and will be addressed by others.

SUMMARY OF GROUND WATER CONDITIONS

Development Area	Observed Ground Water Conditions (Alluvium)	Interpolated Historic High Ground Water (Alluvium)	No. of Piezometers Installed
Mission Village	15 to >35 ft	0 to 30 ft	10
Landmark Village	6 to > 28 ft	0 to 20 ft	11
Homestead (Comprehensive)	7 to >50 ft	3 to 57 ft	14
Chiquito Business Park	16 to >41 ft	9 to 37 ft	2
Chiquito Estates	25 to >45 ft	20 to 25 ft	0
Homestead Central	15 to >47 ft	8 to 57 ft	4
Homestead West	25 to >50 ft	16 to 40 ft	0
Onion Field	7 to >30 ft	3 to 12 ft	5
Potrero Ridge	No Alluvium	No Alluvium	0
Long Canyon North & South	34 to >40 ft	20 to 30 ft	0
North margin of Potrero Canyon	23 to >30 ft	9 to 20 ft	3
Mesas West	Greater than 14 ft	10 to 20 ft	0
WRP Site	15 to 40 ft	10 to 35 ft	7

SUMMARY OF DESIGN-BASIS ACCELERATIONS

DEVELOPMENT AREA	UNWEIGHTED (6.5M) GROUND ACCELERATIONS (*)	MAGNITUDE WEIGHTED (7.5M) GROUND ACCELERATIONS	COORDINATES USED
Mission Village	0.88g	0.59g	34.4167 118.6258
Landmark Village	0.87g	0.59g	34.4243 118.6386
Chiquito Canyon Area	0.93g	0.63g	34.4196 118.6559
Homestead Central	0.96g	0.64g	34.4102 118.6708
Long Canyon and Onion Fields	0.92g	0.62g	34.4072 118.6444
Potrero Canyon	0.98g	0.65g	34.3956 118.6653
Mesas West	0.88g	0.59g	34.4167 118.6258
WRP Site	0.97g	0.65g	34.4063 118.6903

* Peak horizontal ground motion with a 10% chance of exceedance in 50 years in site alluvial materials

MISSION VILLAGE OIL WELLS
(Wells on-site or within potential Grading Envelope)

OPERATOR	WELL DESIGNATION	SECTION	TOWNSHIP	RANGE	ABANDONED?	DATE
Exxon Mobil Corp	Newhall Land & Farming Co 1	23	4N	17W	Y	5/19/94
Exxon Mobil Corp	Newhall Land & Farming Co 3	24	4N	17W	Y	11/10/88
Exxon Mobil Corp	Newhall Land & Farming Co 4	19	4N	16W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 5	24	4N	17W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 6	24	4N	17W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 7	24	4N	17W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 8	24	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 10	23	4N	17W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 11	24	4N	17W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 12	24	4N	17W	Y	8/23/88
Exxon Mobil Corp	Newhall Land & Farming Co 13	24	4N	17W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 14	24	4N	17W	Y	2/16/94
Exxon Mobil Corp	Newhall Land & Farming Co 15	24	4N	17W	Y	8/6/93
Exxon Mobil Corp	Newhall Land & Farming Co 16	24	4N	17W	Y	10/6/92
Exxon Mobil Corp	Newhall Land & Farming Co 17	24	4N	17W	Y	8/12/93
Exxon Mobil Corp	Newhall Land & Farming Co 19	19	4N	16W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 20	19	4N	16W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 21	19	4N	16W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 22	24	4N	17W	Y	10/6/92
Exxon Mobil Corp	Newhall Land & Farming Co 23	24	4N	17W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 24	19	4N	16W	Y	5/8/96
Exxon Mobil Corp	Newhall Land & Farming Co 25	24	4N	17W	Y	12/16/94
Exxon Mobil Corp	Newhall Land & Farming Co 26	19	4N	16W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 27	24	4N	17W	Y	4/13/94
Exxon Mobil Corp	Newhall Land & Farming Co 28	19	4N	16W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 29	19	4N	16W	Y	11/30/90

MISSION VILLAGE OIL WELLS
(Wells on-site or within potential Grading Envelope)

OPERATOR	WELL DESIGNATION	SECTION	TOWNSHIP	RANGE	ABANDONED?	DATE
Exxon Mobil Corp	Newhall Land & Farming Co 30	19	4N	16W	Y	11/8/95
Exxon Mobil Corp	Newhall Land & Farming Co 31	19	4N	16W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 32	24	4N	17W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 33	24	4N	17W	Y	1/15/87
Exxon Mobil Corp	Newhall Land & Farming Co 34	19	4N	16W	Y	1/18/91
Exxon Mobil Corp	Newhall Land & Farming Co 35	19	4N	16W	Y	10/17/86
Exxon Mobil Corp	Newhall Land & Farming Co 39	24	4N	17W	Y	1/18/91
Exxon Mobil Corp	Newhall Land & Farming Co 40	24	4N	17W	Y	10/6/92
Exxon Mobil Corp	Newhall Land & Farming Co 41	19	4N	16W	Y	8/23/88
Exxon Mobil Corp	Newhall Land & Farming Co 42	24	4N	17W	Y	9/21/94
Exxon San Joaquin Production Co.	Newhall Land & Farming Co 46	23	4N	17W	Y	8/22/91
Exxon Mobil Corp	Newhall Land & Farming Co 48	19	4N	16W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 49	19	4N	16W	Y	5/8/96
Exxon Mobil Corp	Newhall Land & Farming Co 56	23	4N	17W	Y	10/6/92
Exxon Mobil Corp	Newhall Land & Farming Co 58	13	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 59	18	4N	16W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 63	13	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 64	13	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 65	13	4N	17W	Y	4/13/94
Exxon Mobil Corp	Newhall Land & Farming Co 66	18	4N	16W	Y	11/9/90
Exxon Mobil Corp	Newhall Land & Farming Co 67	13	4N	17W	Y	1/6/99
Exxon Mobil Corp	Newhall Land & Farming Co 69	18	4N	16W	Y	4/6/89
Exxon Mobil Corp	Newhall Land & Farming Co 71	18	4N	16W	Y	11/9/90
Exxon Mobil Corp	Newhall Land & Farming Co 72	13	4N	17W	Y	12/4/92
Exxon Mobil Corp	Newhall Land & Farming Co 76	13	4N	17W	Y	1/6/99

LANDMARK VILLAGE OIL WELLS

(Wells on-site or within potential Grading Envelope)

OPERATOR	WELL DESIGNATION	SECTION	TOWNSHIP	RANGE	ABANDONED?	DATE
Exxon Mobil Corp	Newhall Land & Farming Co 2	14	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 9	14	4N	17W	Y	9/21/94
Exxon Mobil Corp	Newhall Land & Farming Co 45	23	4N	17W	Y	6/27/55
Exxon Mobil Corp	Newhall Land & Farming Co 54	23	4N	17W	Y	4/9/56
Exxon Mobil Corp	Newhall Land & Farming Co 77	14	4N	17W	Y	9/21/94

HOMESTEAD OIL WELLS
(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
CHIQUITO BUSINESS PARK						
Chevron USA, Inc.	Blair 5	15	T4N	R17W	Y	9/14/1953
Chevron USA, Inc.	Boobier 1	15	T4N	R17W	Y	10/6/1948
Exxon Mobil Corp.	Castaic Junction Gas Unit #1 1	15	T4N	R17W	Y	12/7/1957
LBth Inc.	Blair 7	15	T4N	R17W	Y	9/26/2000
LBth Inc.	Blair 27	15	T4N	R17W	Y	9/26/2000
Union Oil Co. Operator	Liebhart 1	15	T4N	R17W	Y	3/8/1962
Union Oil Co. Operator	Liebhart 2	15	T4N	R17W	Y	2/17/1955
CHIQUITO ESTATE LOT						
Amax Petroleum Corp	Barbour 1	16	T4N	R17W	Y	3/5/1961
Amax Petroleum Corp	Barbour 2	16	T4N	R17W	Y	2/24/1961
Amax Petroleum Corp	Barbour 3	16	T4N	R17W	Y	2/5/1957
Black Hawk Resources Corp.	Newhall Land & Farming Co 1-16	16	T4N	R17W	Y	6/2/1983
Pancanadian Petroleum Co.	Newhall Land & Farming Co 1-16	16	T4N	R17W	Y	9/16/1985
Rothschild Oil Co	Barbour 1	16	T4N	R17W	Y	4/21/1953
HOMESTEAD CENTRAL						
Nuevo Energy Co.	Lincoln 3	16	T4N	R17W	Y	12/29/1960
HOMESTEAD WEST						
Chevron USA, Inc.	Newhall Land & Farming Co 10 1	20	T4N	R17W	Y	9/9/1957
Mobil Oil Corp.	Newhall Land & Farming Co 3	20	T4N	R17W	Y	11/2/1953
Nahama & Weasant Energy	Newhall Land & Farming Co 1	20	T4N	R17W	Y	6/29/1965

HOMESTEAD OIL WELLS
(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
Nahama & Weasant Energy	Del Valle 1-20	20	T4N	R17W	Y	3/27/1990
Nuevo Energy Company	Newhall Land & Farming Co 1	20	T4N	R17W	Y	4/26/1943
Quintana Petroleum Corp.	Newhall SCP 1	20	T4N	R17W	Y	1/5/1982
Quintana Petroleum Corp.	Newhall SCP 2	20	T4N	R17W	Y	2/4/1982
Scope Industries	Newhall Land & Farming Co 2	20	T4N	R17W	Y	2/25/1952
Quintana Petroleum Corp.	Newhall Land & Farming Co 1-21	21	T4N	R17W	Y	7/13/1987

ONION FIELD (and river area)

Oryx Energy Co.	Rancho San Francisco 67	21	T4N	R17W	Y	5/5/1982
Texaco E & P Inc.	Newhall Land & Farming Co 1	21	T4N	R17W	Y	12/19/1956
Texaco E & P Inc.	Newhall Land & Farming Co 2	21	T4N	R17W	Y	9/19/1956
Texaco E & P Inc.	Newhall 1	22	T4N	R17W	Y	3/27/1970
Medallion Calif Prpts Co.	Rancho San Francisco 156	27	T4N	R17W	Y	12/27/1994
Oryx Energy Co.	Rancho San Francisco 41	27	T4N	R17W	Y	7/25/1994
Oryx Energy Co.	Rancho San Francisco 62	27	T4N	R17W	Y	10/25/1983
Oryx Energy Co.	Rancho San Francisco 86	27	T4N	R17W	Y	9/23/1982
Oryx Energy Co.	Rancho San Francisco 134	27	T4N	R17W	Y	7/14/1981
Oryx Energy Co.	Rancho San Francisco 104	28	T4N	R17W	Y	7/14/1981

POTRERO RIDGE

Medallion Calif Prpts Co.	Rancho San Francisco A 1	27	T4N	R17W	Y	5/26/1984
Medallion Calif Prpts Co.	Rancho San Francisco 20	27	T4N	R17W	Y	7/25/1994
Medallion Calif Prpts Co.	Rancho San Francisco 23	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 25	27	T4N	R17W	Y	1/19/1999

HOMESTEAD OIL WELLS
(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
Medallion Calif Prpts Co.	Rancho San Francisco 26	27	T4N	R17W	Y	2/23/2000
Medallion Calif Prpts Co.	Rancho San Francisco 27	27	T4N	R17W	Y	7/25/1994
Medallion Calif Prpts Co.	Rancho San Francisco 29	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 45	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 47	27	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 66	27	T4N	R17W	Y	1/23/1998
Medallion Calif Prpts Co.	Rancho San Francisco 102	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 107	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 114	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 116	27	T4N	R17W	Y	1/19/1999
Medallion Calif Prpts Co.	Rancho San Francisco 127	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 136	27	T4N	R17W	Y	2/23/2000
Medallion Calif Prpts Co.	Rancho San Francisco 137	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 140	27	T4N	R17W	Y	1/15/1981
Medallion Calif Prpts Co.	Rancho San Francisco 146	27	T4N	R17W	Y	2/23/2000

LONG CANYON AREA

Oryx Energy Co.	Newhall Land & Farming 1	22	T4N	R17W	Y	12/16/1955
Quintana Petroleum Corp.	Newhall Land & Farming Co Trifield 1	22	T4N	R17W	Y	6/1/1982
Medallion Calif Prpts Co.	Rancho San Francisco 18	26	T4N	R17W	Y	11/27/1992
Medallion Calif Prpts Co.	Rancho San Francisco 44	26	T4N	R17W	Y	8/28/2000
Medallion Calif Prpts Co.	Rancho San Francisco 50	26	T4N	R17W	Y	7/25/1994
Medallion Calif Prpts Co.	Rancho San Francisco 52	26	T4N	R17W	Y	11/27/1992
Medallion Calif Prpts Co.	Rancho San Francisco 53	26	T4N	R17W	Y	7/28/2003
Medallion Calif Prpts Co.	Rancho San Francisco 54	26	T4N	R17W	Y	1/19/1999

HOMESTEAD OIL WELLS

(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
Medallion Calif Prpts Co.	Rancho San Francisco 55	26	T4N	R17W	Y	7/25/1994
Medallion Calif Prpts Co.	Rancho San Francisco 65	26	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 69	26	T4N	R17W	N	
Medallion Calif Prpts Co.	Rancho San Francisco 71	26	T4N	R17W	Y	1/4/1999
Medallion Calif Prpts Co.	Rancho San Francisco 72	26	T4N	R17W	Y	9/14/2000
Medallion Calif Prpts Co.	Rancho San Francisco 80	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 97	26	T4N	R17W	Y	1/6/1997
Medallion Calif Prpts Co.	Rancho San Francisco 105	26	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 115	26	T4N	R17W	Y	6/19/1999
Medallion Calif Prpts Co.	Rancho San Francisco 118	26	T4N	R17W	Y	3/1/2001
Medallion Calif Prpts Co.	Rancho San Francisco 119	26	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 120	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 122	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 125	26	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 128	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 129	26	T4N	R17W	Y	1/6/1997
Medallion Calif Prpts Co.	Rancho San Francisco 132	26	T4N	R17W	Y	3/26/2001
Medallion Calif Prpts Co.	Rancho San Francisco 141	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 143	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 144	26	T4N	R17W	Y	1/23/1998
Medallion Calif Prpts Co.	Rancho San Francisco 147	26	T4N	R17W	Y	1/6/1997
Medallion Calif Prpts Co.	Rancho San Francisco 148	26	T4N	R17W	Y	1/6/1997
Medallion Calif Prpts Co.	Rancho San Francisco 152	26	T4N	R17W	Y	12/30/1992
Oryx Energy Co.	Rancho San Francisco 8	26	T4N	R17W	Y	5/26/1981
Oryx Energy Co.	Rancho San Francisco 15	26	T4N	R17W	Y	3/30/1987

HOMESTEAD OIL WELLS
(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
Oryx Energy Co.	Rancho San Francisco 57	26	T4N	R17W	Y	4/18/1986
Oryx Energy Co.	Rancho San Francisco 59	26	T4N	R17W	Y	12/22/1980
Oryx Energy Co.	Rancho San Francisco 61	26	T4N	R17W	N	---
Oryx Energy Co.	Rancho San Francisco 69	26	T4N	R17W	N	---
Oryx Energy Co.	Rancho San Francisco 75	26	T4N	R17W	Y	5/5/1982
Oryx Energy Co.	Rancho San Francisco 79	26	T4N	R17W	Y	4/18/1986
Oryx Energy Co.	Rancho San Francisco 84	26	T4N	R17W	Y	4/18/1986
Oryx Energy Co.	Rancho San Francisco 109	26	T4N	R17W	N	---
Oryx Energy Co.	Rancho San Francisco 123	26	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 21	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 28	27	T4N	R17W	Y	1/6/1997
Medallion Calif Prpts Co.	Rancho San Francisco 58	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 101	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 108	27	T4N	R17W	N	---
Medallion Calif Prpts Co.	Rancho San Francisco 112	27	T4N	R17W	Y	3/11/1996
Medallion Calif Prpts Co.	Rancho San Francisco 113	27	T4N	R17W	Y	1/23/1998
Medallion Calif Prpts Co.	Rancho San Francisco 124	27	T4N	R17W	Y	1/23/1998
Medallion Calif Prpts Co.	Rancho San Francisco 142	27	T4N	R17W	Y	3/11/1996
Medallion Calif Prpts Co.	Rancho San Francisco 145	27	T4N	R17W	Y	3/11/1996
Medallion Calif Prpts Co.	Rancho San Francisco 154	27	T4N	R17W	Y	1/23/1998
Oryx Energy Co.	Rancho San Francisco 17	27	T4N	R17W	Y	5/1/1984
Oryx Energy Co.	Rancho San Francisco 46	27	T4N	R17W	Y	3/30/1987
Oryx Energy Co.	Rancho San Francisco 48	27	T4N	R17W	Y	4/18/1986
Oryx Energy Co.	Rancho San Francisco 56	27	T4N	R17W	Y	12/22/1980
Oryx Energy Co.	Rancho San Francisco 63	27	T4N	R17W	Y	1/15/1981

HOMESTEAD OIL WELLS
(Wells on-site or within potential Grading Envelope)

Operator	Well Designation	Section	Township	Range	Well Abandoned?	Date
Oryx Energy Co.	Rancho San Francisco 110	27	T4N	R17W	Y	4/18/1986
Oryx Energy Co.	Rancho San Francisco 111	27	T4N	R17W	Y	2/23/2000
Oryx Energy Co.	Rancho San Francisco 121	27	T4N	R17W	Y	3/30/1987
Oryx Energy Co.	Rancho San Francisco 131	27	T4N	R17W	Y	6/23/1986
Oryx Energy Co.	Rancho San Francisco 135	27	T4N	R17W	Y	11/2/1982
Oryx Energy Co.	Rancho San Francisco 138	27	T4N	R17W	Y	5/1/1984
Medallion Calif Prpts Co.	Rancho San Francisco 64	35	T4N	R17W	Y	12/23/1998

MESAS WEST

Exxon Mobil Corp.	Newhall Land & Farming Co 46	23	T4N	R17W	Y	3/15/1991
Exxon Mobil Corp.	Newhall Land & Farming Co 52	23	T4N	R17W	Y	4/19/1991
Exxon Mobil Corp.	Newhall Land & Farming Co 56	23	T4N	R17W	Y	5/22/1992
Exxon Mobil Corp.	Newhall Land & Farming Co 57	23	T4N	R17W	Y	10/25/1956
Exxon Mobil Corp.	Newhall Land & Farming Co 78	23	T4N	R17W	Y	11/29/1990
Exxon Mobil Corp.	Newhall Land & Farming Co 18	24	T4N	R17W	Y	6/23/1992
Exxon Mobil Corp.	Newhall Land & Farming Co 22	24	T4N	R17W	Y	4/27/1992
Exxon Mobil Corp.	Newhall Land & Farming Co.53	24	T4N	R17W	Y	9/9/1993
Oryx Energy Co.	Rancho San Francisco 155	26	T4N	R17W	Y	1/13/1981

Table 7

SUMMARY OF SHRINKAGE FACTORS

Unit	Shrinkage Factors (%)								
	Mission Village	Landmark Village	Homestead						WRP Site
			Chiquito Canyon Business Park	Chiquito Canyon Estate Lots	Homestead Central	Homestead West	Potrero Ridge, Long Canyon & Onion Field	Mesas West	
Qal/Qoa	8 to 14	12 to 16	10 to 15	10 to 15	8 to 12	11 to 15	6 to 16	10 to 16	8 to 16
Qsw	4 to 14	--	10 to 16	10 to 16	10 to 16	6 to 12	10 to 16	8 to 16	--
Qls *	1 to 6	--	0 to 5	0 to 5	0 to 3	0 to 3	0 to 3	0 to 3	--
af	12 to 18	15 to 20	8 to 14	10 to 18	12 to 18	8 to 14	10 to 16	12 to 18	10 to 15
Qt	10 t o 16	--	8 to 16	8 to 12	--	2 to 8	8 to 12	10 to 16	5 to 10
TQs & Tp [+] (0-3')	0 to 4	--	0 to 5	0 to 5	0 to 5	0 to 5	0 to 5	0 to 5	0 to 5

* Use minimum end of shrinkage range for landslide removals greater than 25 ft deep.

[+] Denotes typical, upper weathered zone in bedrock below surficial material that is prone to shrinkage when placed as compacted fill.

SUMMARY OF BULKING FACTORS

Table 8

Unit	Bulking Factors (%)								
	Mission Village	Landmark Village	Homestead						WRP Site
			Chiquito Canyon Business Park	Chiquito Canyon Estate Lots	Homestead Central	Homestead West	Potrero Ridge, Long Canyon & Onion Field	Mesas West	
Bedrock (> 3') [‡]	0 to 6	0 to 10	0 to 5	0 to 6	0 to 6	2 to 8	0 to 6	0 to 6	0 to 8

[‡] Use maximum end of range for materials removed from cuts >40' deep

APPENDIX B

RECOMMENDED EARTHWORK SPECIFICATIONS

The following specifications are recommended to provide a basis for quality control during the placement of compacted fill or backfill, as applicable.

1. Areas on which compacted fill will be placed shall be observed by Allan E. Seward Engineering Geology, Inc. (AESEGI) prior to the placement of fill.

2. All drainage devices shall be properly installed and observed by AESEGI and/or the owner's representative(s) prior to placement of backfill.

3. Fill soils shall consist of imported soils or on-site soils which are free of organics, cobbles, and deleterious material, provided that each material is approved by AESEGI. AESEGI shall evaluate and/or test the import material for its conformance with the report recommendations prior to its delivery to the site. The contractor shall notify AESEGI at least 72 hours prior to importing material to the site

4. The thickness of the controlled lifts in which Fill is placed shall be compatible with the type of compaction equipment used. The fill materials shall be brought to Optimum Moisture Content or above, thoroughly mixed during spreading to obtain a near uniform water content and a uniform blend of materials, and then placed in lifts with a pre-compaction thickness not exceeding 8 inches. Each lift shall be compacted to the specified percentage of Maximum Dry Density determined in accordance with ASTM Test Method D1557. Density testing shall be performed by AESEGI to verify relative compaction. The contractor shall provide proper access and level areas for testing.

5. Rocks or rock fragments less than eight (8) inches in the largest dimension may be utilized in the fill, provided they are not placed in concentrated pockets. However, rocks larger than four (4) inches in dimension shall not be placed within three (3) feet of finish grade.

6. Rocks greater than eight (8) inches in largest dimension shall be taken offsite, or placed in areas designated by the Geotechnical Engineer to be suitable for rock disposal.

7. Where space limitations do not allow for conventional fill compaction operations, special backfill materials and procedures may be required. Pea gravel or other select fill can be used in areas of limited space. A sand and Portland Cement slurry (2 sacks per cubic-yard of slurry mix) shall be used in limited space areas for shallow backfill near final pad grade, and pea gravel shall be placed in deeper backfill near drainage systems.

8. AESEGI shall observe the placement of fill and conduct in-place field density tests on the compacted fill in order to check adequacy of in-situ water content and relative compaction. Where measured in-situ density of compacted fill soil is lower than the required relative compaction, the soil shall be water-conditioned and recompacted until adequate relative compaction is achieved.

9. The Contractor shall achieve with the specified relative compaction out to the finish slope face of fill slopes, buttresses, and stabilization fills, as set forth in the specifications for compacted fill. This may be achieved either by overbuilding the slope and cutting back as necessary, by direct compaction of the slope face with suitable equipment, or by other procedures which produce the required result.

10. Any abandoned underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or others not discovered prior to grading are to be removed or treated to the satisfaction of the Geotechnical Engineer and/or the controlling agency for the project.

11. The Contractor shall have suitable and sufficient equipment during a particular operation to handle the volume of fill being placed. When necessary, fill placement equipment shall be shut down temporarily in order to permit proper compaction of fill, correction of deficient areas, or to facilitate required field testing.

12. The Contractor shall be responsible for the satisfactory completion of all earthwork in accordance with the project plans and specifications.

13. Final reports shall be submitted after completion of earthwork and after the Geotechnical Engineer and Engineering Geologist have finished their observations of the work. No additional excavation or filling shall be performed without prior notification to the Geotechnical Engineer and/or Engineering Geologist.

14. Whenever the words "supervision", "inspection", or "control" are used, they shall mean <u>observation</u> of the work and/or testing of the compacted fill by AESEGI to assess whether substantial compliance with plans, specifications and design concepts has been achieved. However, these words do not refer to direction by AESEGI of the actual work of the Contractor or the Contractor's workers.

APPENDIX B

RECOMMENDED SPECIFICATIONS
FOR PLACEMENT OF TRENCH BACKFILL

1. Trench excavations in which backfill will be placed shall be free of trash, debris or other deleterious materials prior to backfill placement, and shall be observed by a representative of Allan E. Seward Engineering Geology, Inc. (AESEGI).

2. Except as stipulated herein, soils obtained from the excavation may be used as backfill if they are free of organics and other deleterious materials.

3. Rocks generated by trench excavation operations that do not exceed three (3) inches in largest dimension may be used as trench backfill material. However, material larger than 3-inches in dimension may not be placed within 12 inches of the top of pipes. No more than 30 percent of the backfill volume shall contain particles larger than 1-½ inches in dimension, and particles larger than 1-½ inches in dimension shall be well mixed with finer soil.

   Soils (other than aggregates) with a Sand Equivalent (SE) greater than or equal to 30 (as determined by ASTM Standard Test Method D2419) or other soils authorized by the Geotechnical Engineer or his representative in the field, may be used for bedding and shading material in pipe trenches.

4. Trench backfill other than bedding and shading shall be compacted by mechanical methods as tamping sheepsfoot, vibrating or pneumatic rollers, or other mechanical tampers to achieve the specified density. The backfill materials shall be brought to Optimum Moisture Content or above, thoroughly mixed during spreading to obtain a near uniform water content and uniform blend of materials, and then placed in horizontal lifts with a pre-compaction thickness not exceeding 8 inches. Trench backfills shall be compacted to the specified percentage of Maximum Dry Density determined in accordance with ASTM Test Method D1557. No jetting shall be permitted in utility trenches.

5. The Contractor shall select the equipment and procedure for achieving the specified density without damage to the pipe, the adjacent ground, existing improvements, or completed work.

6. Observations and field tests shall be performed during construction by AESEGI to confirm that the required degree of compaction has been achieved. Where achieved compaction is less than that specified value, the water content shall be adjusted as

APPENDIX B

necessary and additional compactive effort shall be made until the specified compaction is achieved. Field density tests may be omitted at the discretion of the Geotechnical Engineer or his representative in the field.

7. Whenever, in the opinion of AESEGI or the Owner's Representative(s), an unstable condition is being created either by cutting or filling, the work shall not proceed until an investigation has been made and the excavation plan has been revised, if deemed necessary.

8. Fill material shall not be placed, spread, or rolled during unfavorable weather conditions. When the work is interrupted by heavy rain, fill operations shall not be resumed until field tests by AESEGI indicate the water content and density of the fill materials and of the fill surface over which they are to be compacted satisfy the requirements of the specifications.

9. Whenever the words "supervision", "inspection", or "control" are used, they shall mean observation of the work and/or testing of the compacted fill by AESEGI to assess whether substantial compliance with plans, specifications and design concepts has been achieved.

APPENDIX B

DRAINAGE AND EROSION CONTROL RECOMMENDATIONS

Slopes and pads for this project shall be designed to direct surficial runoff away from structures and to reduce water-induced surficial erosion/sloughing. Permanent erosion control measures shall be initiated immediately following completion of grading. All constructed slopes will undergo some erosion when subjected to sustained water influx. To maintain appropriate long-term drainage and erosion control, the following points shall be incorporated in slope protection, landscaping, irrigation, and modifications to slopes, pads and structures:

1. All interceptor ditches, drainage terraces, down-drains and any other drainage devices shall be maintained and kept clear of debris. A qualified Engineer should review any proposed additions or revisions to these systems in order to evaluate their impact on slope erosion.

2. Retaining walls shall have adequate freeboard to provide a catchment area for minor slope erosion. Periodic inspection, and if necessary, cleanout of deposited soil and debris shall be performed, particularly during and after periods of rainfall.

3. The future developers shall be made aware of the **potential problems**, which may develop **when drainage is altered** by landscaping and/or by construction of retaining walls and paved walkways. Ponded water, water directed over slope faces, leaking irrigation systems, **over-watering,** or other conditions which could lead to excessive soil moisture, **must be avoided**.

4. Surficial slope soils may be subject to water-induced mass erosion. Therefore, a suitable proportion of slope planting shall have root systems which will extend well below three feet. We suggest consideration of drought-resistant shrubs and low trees for this purpose. Intervening areas can then be planted with lightweight surface plants with shallower root systems. All plants shall be lightweight and require low moisture. Any loose slough generated during planting of shrubs, trees, and other surface plants shall be removed from slope faces.

5. Construction delays, climate/weather conditions, and plant growth rates may necessitate additional short-term, non-plant erosion control measures such as matting, netting, plastic sheets, deep (5-feet) staking, etc.

APPENDIX B

6. Significant erosion can be initiated by seemingly insignificant events such as rodent burrowing, human trespass (footprints, etc.), small concentrations of uncontrolled surface/subsurface water, or poor compaction of utility trench backfill on slopes.

7. High and/or fluctuating water content in slope materials is a major factor in slope erosion and/or slope failures. Therefore, all possible precautions shall be taken to maintain moderate and uniform soil moisture in soil and rock slopes. Slope irrigation systems shall be properly operated and maintained and irrigation system controls shall be placed under strict control.

APPENDIX B

EROSION CONTROL REFERENCES

1. "Slope Protection for Residential Developments", National Academy of Sciences, Washington D.C. (1969).

2. "Guide for Erosion and Debris Control in Hillside Areas", Department of Building and Safety, City of Los Angeles. (1970).

3. "Slope Stability Report", Orange County Department of Building and Safety (1973).

4. "Guides for Erosion and Sediment Control", Soil Conservation Service, Davis, California, U.S. Department of Agriculture (1977).

5. "Rain-Care and Protection of Hillside Homes", brochure undated, published by Building and Safety Division, Los Angeles County Engineer.

6. "Guidelines for Erosion and Sediment Control Planning and Implementation: Office of Research and Monitoring", U.S. Environmental Protection Agency (1972).

7. "Resource Conservation Glossary", Soil Conservation Society of America (1970).

8. "Standards and Specifications for Soil Erosion and Sediment Control Developing Areas", Soil Conservation Service, U.S. Department of Agriculture (1975).

9. "Homeowners Guide for Debris and Erosion Control", Los Angeles County Flood Control District (undated).

10. "Grading Guidelines (8 pages, stapled sheets)", Building and Safety Division, Department of County Engineer, County of Los Angeles (undated, but probably about 1977).

11. "Biotechnical Slope Protection and Erosion Control", Donald H. Gray and Andrew T. Leiser, Robert E. Krieger Publishing Company, Malabuv, Florida, 1989.

APPENDIX B

CONSTRUCTION DIAGRAMS

APPENDIX B

FOOTING FOUNDATION AND SLAB-ON-GRADE PARAMETERS

Minimum Footing Design Parameters

Expansion Classification (UBC)	Expansion Index (UBC)	Footing Embedment (inches)				Continuous Footing Reinforcement
		One Story and Two Stories		Three Stories		
		Perimeter	Interior	Perimeter	Interior	
Very Low	0 to 20	18	12	24	18	Per structural requirements
Low	21 to 50	18	12	24	18	One # 4 Rebar Top and Bottom
Medium	51 to 90	24	18	30	24	One # 4 Rebar Top and Bottom
High	91 to 130	30	18	36	30	Two # 4 Rebars Top and Bottom

Footing width ≥ 2.0 feet.

Minimum Slab-On-Grade Design Parameters

Expansion Classification (UBC)	Expansion Index (UBC)	Slab Subgrade Presoaking	Slab Reinforcement	Minimum Slab Thickness	Compacted Granular Material Below Slab[1]
Very Low	0 to 20	None	#3 Rebar at 24" each way	4 inches	2 inches of clean sand
Low	21 to 50	120 percent of Optimum Moisture Content[2] to 18 inches depth	#3 Rebar at 18" each way		
Medium	51 to 90	130 percent of Optimum Moisture Content to 24 inches depth	#4 Rebar at 16" each way	5 inches	4 inches of granular bases
High	91 to 130	140 percent of Optimum Moisture Content to 36 inches depth	#4 Rebar at 14" each way	6 inches	6 inches of granular base

[1] Plus 2-inch cushion of compacted sand over membrane vapor retarder at interior locations.

[2] Optimum Moisture Content, per ASTM Test Method D1557.