Allan E. Seward Engineering, Inc., "Surface and Subsurface Geologic Evaluation, San Fernando Valley Spineflower Occurrences" (August 2004)

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Original in Matt Carpenter's Office

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August 13, 2004

Job No: 04-1155SF-9

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Attn: Mr. Mark Subbotin

Subject: **SURFACE AND SUBSURFACE GEOLOGIC EVALUATION** ***San Fernando Valley Spineflower Occurrences***

Project: Newhall Ranch, Magic Mountain Entertainment and Commerce Center Areas Los Angeles County, California

Gentlemen:

The following report presents the results of our expanded geologic evaluation of the San Fernando Valley spineflower occurrences that were discovered by others on Newhall Ranch and adjacent areas in northwestern Los Angeles County.

1.0 INTRODUCTION

Three occurrences of the San Fernando Valley spineflower (*Chorizanthe parryi* var. *fernandina*) were initially discovered on Newhall Ranch at Airport Mesa, Grapevine Mesa, and San Martinez Grande Canyon (see index map, Figure 1). However, because this plant was long thought to be extinct until its recent discovery on Ahmanson Ranch, little was known regarding the range of growing conditions within which the plant will germinate and reproduce. Limited descriptions previously indicated that the spineflower was originally found in sandy to gravelly soils in washes, riverbeds and upland areas primarily on the margins of the San Fernando Valley at the base of the Santa Susana Mountains, San Gabriel Mountains and Simi Hills

We subsequently completed preliminary surveys to document the regional geologic and soil units and to describe the surface conditions at the occurrences mapped by Dudek and Associates, Inc. (Dudek). The results of our surveys on Newhall Ranch were presented in our report dated October 1, 2002. However, because we did not have permission at that time to complete subsurface explorations or obtain samples for laboratory testing, our report only described the conditions observed at the surface in the field. In addition, the winter preceding our initial survey in 2002 was one of the driest on record and therefore the plant distribution was probably not typical.

Subsequent plant surveys by Dudek in 2003 following a more typical winter revealed much more extensive occurrences of San Fernando Valley spineflower. In addition to larger occurrences observed at the Airport Mesa, Grapevine Mesa, San Martinez Grande Canyon and Magic Mountain Entertainment occurrences, new occurrences were discovered at Potrero Canyon, Long Canyon and the Valencia Commerce Center. Permission was subsequently obtained from the Department of Fish and Game to conduct more detailed surveys of the old and new occurrences in order to develop a conservation plan for the various spineflower occurrences. This additional work included the excavation, sampling and logging of subsurface test pits in both occupied and unoccupied sites and laboratory testing in order to help define the conditions preferred by the spineflower. The following report presents the results of our recent surface and subsurface geologic surveys, laboratory testing, and analyses. Data from our previous surveys in 2002 are also included for completeness.

2.0 SCOPE AND METHOLOGY OF STUDY

2.1 General Scope of Work

The general purpose of our investigations was to complete surface and subsurface field studies, conduct limited laboratory testing, and provide data, analyses and conclusions regarding the geologic and soils conditions existing at the mapped spineflower occurrences in order to assist in the development of a spineflower conservation plan for the Newhall Ranch Specific Plan area, Valencia Commerce Center and Magic Mountain Entertainment site. Our work was completed in collaboration with Dudek, the lead biological consultant, and with Wallace Laboratories, who was contracted to conduct extensive testing to define the chemical, textural and nutrient parameters for the soils supporting the spineflower. The limits of spineflower occurrences mapped by Dudek are shown on our maps with color-coded polygons. For purposes of discussion, the mapped spineflowers have been grouped into six primary occurrences, designated as Airport Mesa, Grapevine Mesa (including new occurrences at Long Canyon), Potrero Canyon, San Martinez Grande Canyon, The Valencia Commerce Center, and at Magic Mountain Entertainment. The

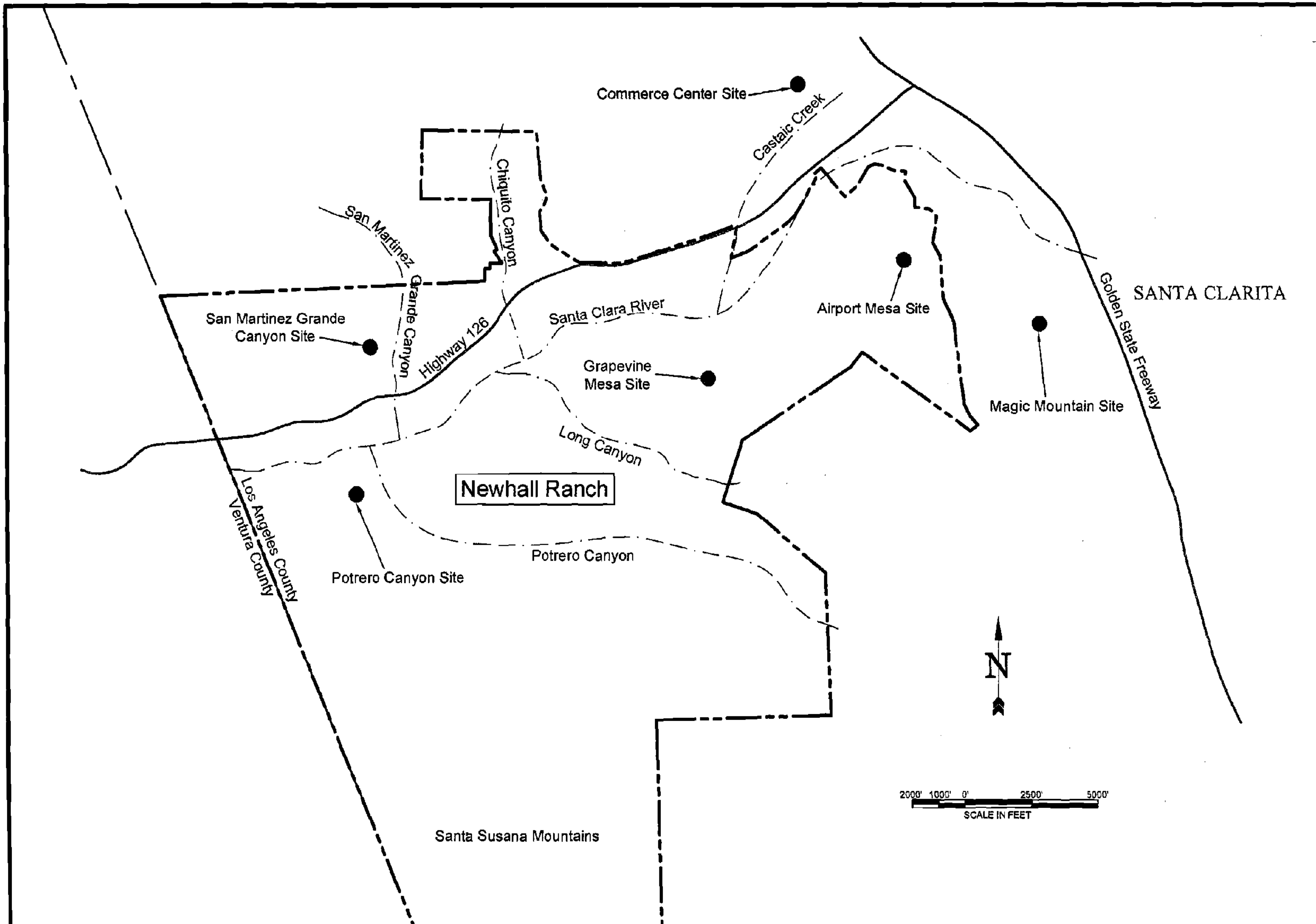

Figure 1. Index map of San Fernando Valley spineflower occurrences at Newhall Ranch and vicinity.

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scope of our subsurface explorations, surface surveys and laboratory testing is presented below.

2.2 Subsurface Investigation

A total of 39 shallow soil test pits were excavated to document conditions at representative localities from five of the six main occurrences, excluding the Valencia Commerce Center (see index map). In order to help define limiting parameters and assess potential transplant sites, samples were obtained both from occupied sites and unoccupied sites with similar surface conditions. The locations of each of the 39 pits are shown with a roman-numeral designation on the attached geologic and soils unit maps (Figures 6 to 12). The pits were initially excavated with a shovel to depths of 6.5 to 17.5" and selected holes were probed with a core sampler to a maximum depth of 42". Selected samples were obtained by this firm and by a representative of Wallace Laboratories for testing. The color, composition, consistence, strength, plasticity, moisture content and structure of the soil materials observed in the pits were recorded in the field on standard log forms (see Appendix B for logs). Surface conditions, including the down-slope bearing and gradient, general spineflower dimensions, and evidence of surface disturbance at each pit were also described (see Table II in Appendix B for summary). A representative of Dudek and Associates was also present during this phase of work and surveyed each site location with a GPS unit and collected biologic data.

2.3 Surface Surveys

We previously conducted surface survey at 96 plant stations representative of occurrences mapped by Dudek at the Airport Mesa, Grapevine Mesa, and San Martinez Grande Canyon occurrences. For ease of reference, we lumped groups of similar, adjacent polygons into subareas with alphanumerical designations at each occurrence and the surface stations were given letter designations at each subarea. We also completed surface surveys at 13 stations at the Magic Mountain Entertainment site in 2002, which were not previously presented because this site is not a part of Newhall Ranch . The results of this work are presented herin. During the current phase of work, we completed surveys at an additional 175 surface stations to document conditions at new occurrences and where the 2003 occurrences were substantially larger (see Table I in Appendix B for summary). The stations were located at specific plant locations so that both the average (macro) and plant-specific (micro) slope gradients could be measured. The surface stations were selected, where possible, to represent both the typical spineflower occurrences and the limits of down-slope bearings and gradients of the various polygons surveyed.

2.4 Laboratory Testing

In order to help document the conditions of the soil below the spineflower occurrences and at selected unoccupied sites, we collected samples for laboratory testing. Samples were collected from each pit at the depths indicated on the logs accompanying this report. Testing completed at our lab included moisture content on all samples and percent minus #200 sieve analyses and Atterberg limits tests as needed to verify the classification of the soils. We used the unified soil classification system (USCS) developed by Casagrande (1948) for use in soils engineering, updated per current ASTM criteria. A representative of Wallace Laboratories collected additional samples and ran extensive tests to document the soil texture, trace elements, pH, nutrient content, etc. We reviewed the results of their soil texture testing for our analysis. Wallace Laboratories determined the sand/silt/clay composition of each sample and classified the soil texture per USDA criteria (described in Birkeland, 1999) rather than ASTM criteria. The USDA classification turned out to be much more informative for this study.

2.5 Geologic Analyses

For our analyses, we first reviewed regional geologic maps of the area and data obtained during our previous geologic investigations of Newhall Ranch to determine the geologic units mapped at each occurrence. We then reviewed the regional, USDA soil survey maps of the area to determine the regional soil unit assigned to the shallow material developed on the underlying geologic units (per the soil survey for the Antelope Valley area by the USDA, 1969). The distribution of these units at each occurrence is shown on the attached geologic and soil units maps (Figures 6 to 12 in Appendix A). General descriptions for each mapped formation and soil unit are presented in the explanation at the end of the appendix. Our analyses focused on evaluating trends in geologic and soils conditions at each occurrence. In particular, we assessed similarities in geologic units, soil units, material composition, moisture content, and soil color at each site. We also analyzed surface conditions including the bearing and gradient of the slopes (see Figures 2 to 4 for plots) and evidence for previous disturbance. The conclusions from our analyses are presented below in Section 5.

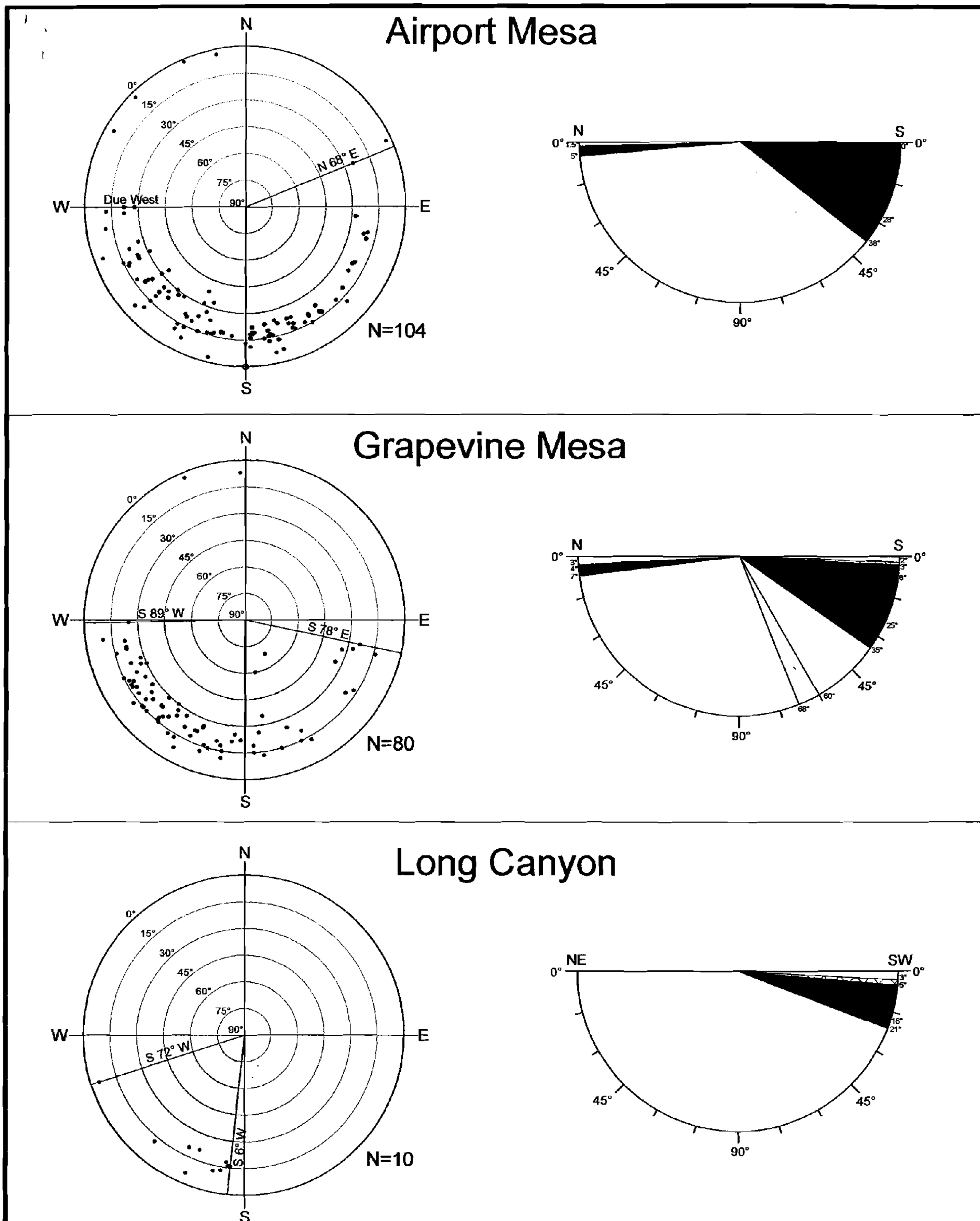

Figure 2. Overview plots of measured slope bearings and graphical slope gradient ranges (macro-gradients are colored and micro-gradients are hatched) for each occurrence (see appendix for subarea plots and detailed explanation on Figure 4).	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 04-1155SF-9
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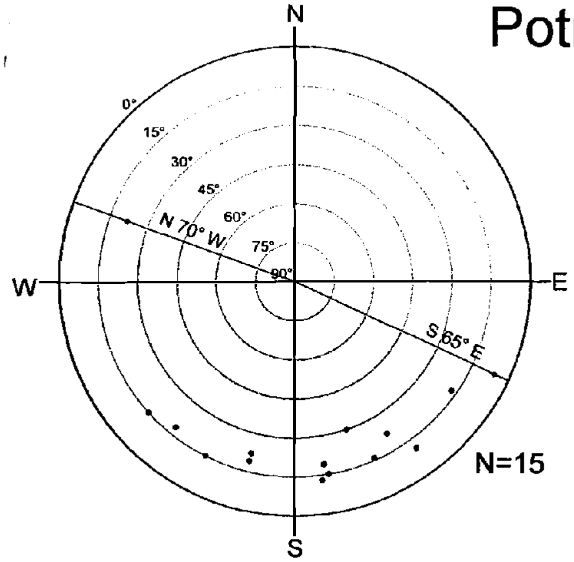
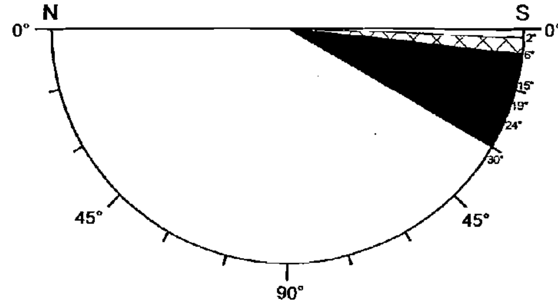
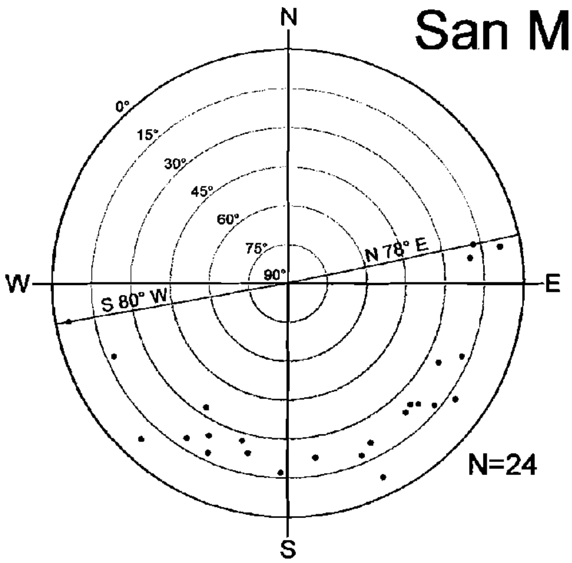
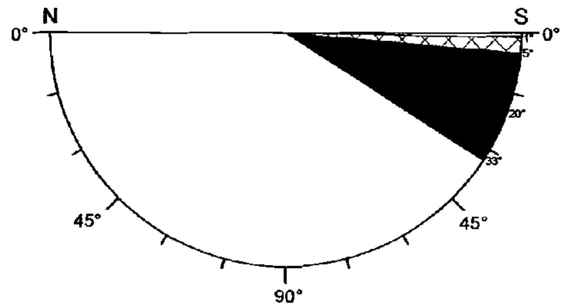
Potrero Canyon



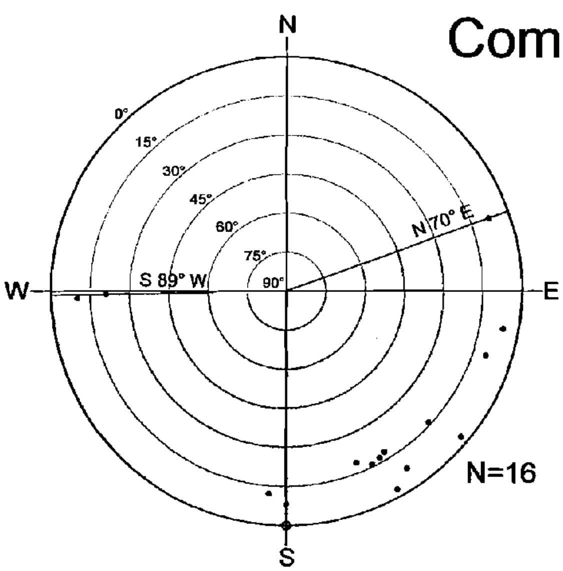


San Martinez Grande Canyon





Commerce Center



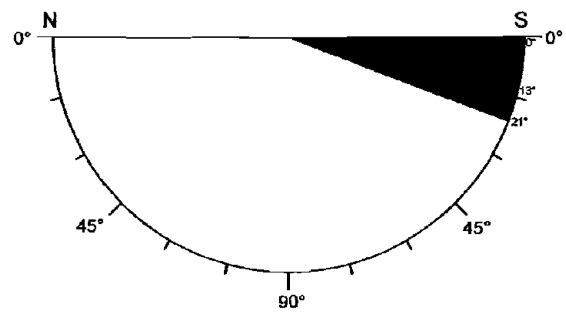


Figure 3. Overview plots of measured slope bearings and graphical slope gradient ranges (macro-gradients are colored and micro-gradients are hatched) for each occurrence (see appendix for subarea plots and detailed explanation on Figure 4).	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 04-1155SF-9
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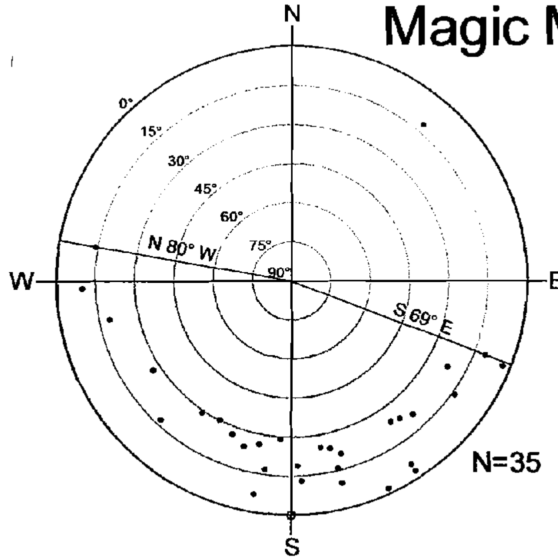
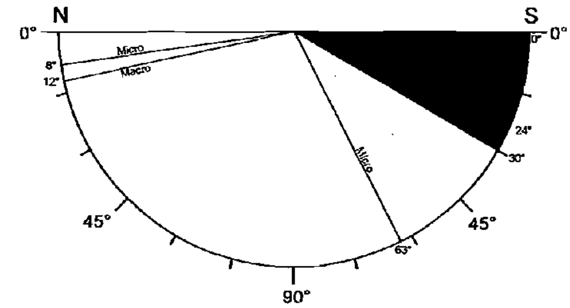
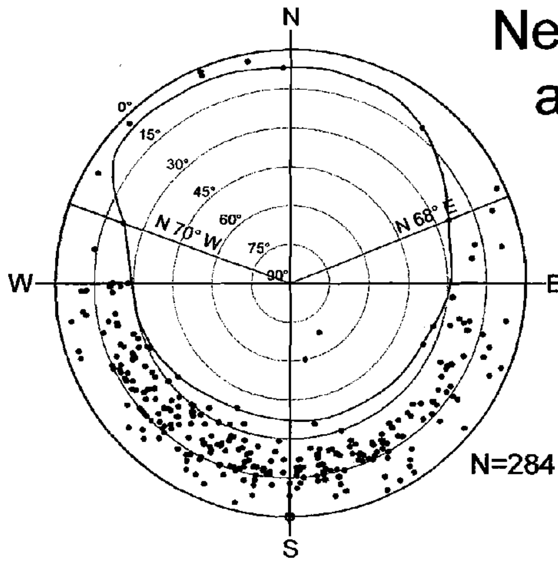
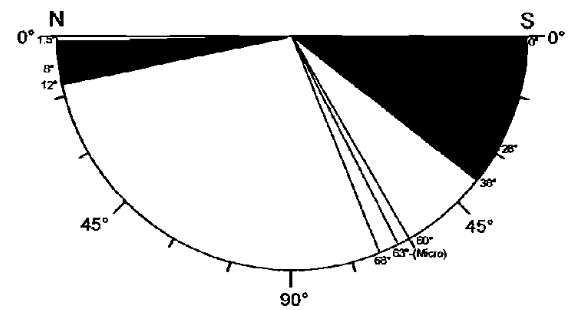
Magic Mountain Entertainment





Newhall Ranch and Vicinity





Explanation for Graphical Representations of Slope Geometry

The slope geometry at each site is represented by two figures. The plot on the left illustrates the range of observed bearings color-coded in yellow. The red dots graphically represent the bearing and macro-slope gradient measured at each plant station. Bearings are shown relative to true north or south and the gradient is indicated by the concentric lines shown at 15° increments (0° = horizontal and 90° = vertical). N indicates the number of plant stations measured.

The plot on the right graphically illustrates the range of measured slope gradients for each hemisphere. The range of overall (macro) slope gradients at each measured plant is shown in maroon and the range of local (micro) slope gradients is shown with a hatch pattern.

Figure 4. Overview plots of measured slope bearings and graphical slope gradient ranges (macro-gradients are colored and micro-gradients are hatched) for each occurrence and the explanation for Figures 2 through 4 (see appendix for subarea plots).	ALLAN E. SEWARD ENGINEERING GEOLOGY, INC.	*Job No.:* 04-1155SF-9
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3.0 GEOLOGIC SETTING

The subject portions of Newhall Ranch and vicinity are in the Transverse Ranges geomorphic province of southern California in the eastern portion of the Ventura depositional basin. The Ventura basin was produced by tectonic downwarping in the geologic past to produce a large-scale synclinal structure in which a thick sequence of Cenozoic sediments have accumulated. These sediments have been lithified into a sequence of sedimentary rock that have subsequently been uplifted, tilted and tectonically deformed in late Cenozoic times.

Bedrock underlying the Potrero Canyon and San Martinez Grande Canyon areas consists primarily of siltstone, mudstone, and interbedded sandstone of the Pliocene marine Pico Formation. The Pico Formation is conformably overlain by interbedded sandstone, siltstone and mudstone of the Plio-Pleistocene, non-marine Saugus Formation. The Long Canyon area straddles the contact between these two units. The Saugus Formation has been differentiated into lower and upper members on some portions of Newhall Ranch. Bedrock underlying the Grapevine Mesa area consists of the lower member. The Airport Mesa area is underlain by the upper member to the south and undifferentiated Saugus Formation to the north. Undifferentiated Saugus Formation is also mapped at the Valencia Commerce Center Site. At Airport Mesa, Grapevine Mesa, Potrero Canyon, and the Valencia Commerce Center, the majority of the spineflowers occur where Quaternary alluvial terrace deposits overlie the bedrock. At Magic Mountain Entertainment, the bedrock is completely covered by terrace deposits. At San Martinez Grande Canyon, the most extensive occurrences were found on an ancient landslide that may in fact involve some disturbed terrace deposits. At Long Canyon most of the spineflower occurs on older alluvium.

The terrace deposits typically consist of interbedded sand, pebbly sand and sandy silt, with a cobble- to boulder-rich layer commonly present at the base. A thick, well-developed soil is generally present on the mesa surfaces, which corresponds with the Zamora clay loam soil unit. Aside from the surface soil, the lithology and depositional environment of the terrace deposits is very similar to the upper member of the Saugus Formation. Slope areas at each occurrence are typically underlain by a weathered zone with poor soil development. Accumulations of poorly sorted colluvium overlie portions of the slopes, particularly at the base of slopes and in narrow swales. Most of the soils on these slopes classify as Castaic-Balcom silt clay loam and terrace escarpments, with smaller areas of Saugus loam. Alluvium and older alluvium have been deposited in the larger drainages.

4.0 DISCUSSION OF SITE CONDITIONS

4.1 Airport Mesa

San Fernando Valley spineflower that germinated both in 2002 and 2001 or earlier (color-coded green and yellow on Figure 6) was mapped by Dudek in the vicinity of Airport Mesa. Much more extensive occurrences were mapped in 2003, at elevations ranging from approximately 1015 to 1295 (color-coded blue on Figure 6). The mapped polygons were grouped into 11 subareas (AM-1 through AM-11) for reference in our surface surveys (see Table I in Appendix B for survey data). Most of the subareas are located on terrace deposits (Qt) or Saugus Formation (TQs and TQsu) located immediately down slope from Qt. Subareas 7 through 10 are located on upper Saugus Formation (TQsu), although remnants of the terrace deposits could remain in these areas as well. Mapping by the USDA (1969) indicates that most of the spineflower occurrences are growing on Castaic-Balcom silty clay loam (CmF), except for subarea 6, which is mapped as Zamora clay loam (ZaC). The slope aspect parameters are graphically illustrated for each subarea in Figures 13 and 14 (see Appendix B) and summarized in Figure 2. Most plants occurred on south-facing slopes with bearings ranging from due west to N68E, and macro-slope gradients were generally between 7 and 30°. At the few stations where spineflowers were located on north-facing slopes, the gradient was less than 5°.

In addition to the 45 surface stations surveyed during our previous investigation, we completed surveys at 59 new surface stations (see Table I in Appendix B for summary of data obtained and Figure 6 for locations). A total of 11 subsurface pits were excavated, sampled, and logged in the vicinity of Airport Mesa (see Table II in Appendix B for summary). Eight of the explorations were located at spineflower plants, one station (AM-II) was located within a mapped polygon but at a spot where no spineflowers were observed, and two (AM-VI & AM-IX) were located at unoccupied spots with similar surface conditions and slope aspect. Per USCS nomenclature, most of the surface materials classify as silty sand (SM) and the materials obtained in the test pits varied from silty sand (SM) to silty clay (CL-ML). Per the USDA soil survey classification system, the materials classify as loam to sandy loam, with varying concentrations of gravel. The overall development of soil stratigraphy was generally poor owing to the generally steep slope gradients (which result in ongoing erosion and creep), and the organic O horizon was generally absent. The Munsell color of the soil is dominantly brown (10YR 5/3) to yellowish brown (10YR 5/4) and varied from light yellowish brown (10YR 6/4) to dark grayish brown (10YR 4/2) to locally olive brown (2.5Y 5/4). Subareas 1, 2, 3, 6, 7, 8, 9 and 10 have been disturbed by cattle grazing in the past. Subareas 2, 3 and 5 were cleared of vegetation and locally graded in 2000 for agricultural purposes and some spineflowers germinated on disturbed fills in these areas. Vegetation in the undisturbed areas was typically sparse, with a mix of barren patches, small annual grasses, and local buckwheat and sagebrush. Small rodent burrows were commonly observed at all of the subareas except for subarea 7.

4.2 Grapevine Mesa and Long Canyon

Dudek mapped occurrences of spineflowers on the west side of Grapevine Mesa during their 2002 surveys (color-coded yellow and green on Figure 7). More extensive occurrences were mapped on the west side of the mesa in 2003 and small occurrences were also discovered on the east side of the mesa (color-coded blue). The mapped polygons were grouped into 11 subareas (GM-1 through GM-11) for reference in our surface surveys. Nearly all of the occurrences were found on terrace deposits (Qt) or immediately adjacent portions of the lower Saugus Formation (TQsl) at elevations ranging from 1025 to 1305. The mapped polygons correspond almost entirely with the terrace escarpment (TsF) regional soil unit (USDA, 1969), except for minor encroachment into the Zamora clay loam (ZaC) on the margins of the mesa and a few small occurrences on Saugus loam (ScF). Most spineflower plants occurred on south-facing slopes, with bearings ranging from S89W to S78E (see Figure 2). A few small occurrences were observed on gentle north-facing slopes. Except for a few isolated individuals observed along a creek bank in 2002, the macro-slope gradients on south-facing slopes ranged from 7 to 35°.

In addition to 51 stations surveyed in 2002, we added 30 additional stations during the current study (see Table I for summary of data and Figure 7 for station locations). A total of 8 subsurface test pits (designated GM-I through GM-VIII) were sampled and logged in the Grapevine Mesa area, 6 of which were at occupied sites and 2 (GM-VI and GM-VIII) were at unoccupied sites. The related species *staticoides* was found at station GM-VI. Per USCS nomenclature, most of the surface materials classify as silty sand (SM), locally ranging to sandy silt (ML). The materials observed in the test pits ranged from silty sand (SM) to clayey sand (SC). Per the USDA soil surface classification system, the material classified primarily as sandy loam to loamy sand locally, with varying concentrations of gravel. The overall development of soil stratigraphy was generally found to be poor and the organic O horizon was generally lacking or very thin (<1"). The Munsell color of the soils is generally dark grayish brown (10YR 4/2) to brown (10YR 5/3). Most of the

Grapevine Mesa occurrences are undisturbed by man, although a few occurrences were observed on an old dirt road and on cuts along roads. The vegetation consists of sparse annual grasses and scattered bushes of buckwheat and sagebrush separated by local barren patches. Animal burrows were locally present, but less common than at Airport Mesa.

In 2004 Dudek discovered several small spineflower patches to the west of Grapevine Mesa on the north side of Long Canyon at elevations ranging from 1045 to 1180 (see Figure 8). The mapped polygons were lumped into 3 subareas (LC-1 through LC-3) for reference in our surface surveys. Most of these occurrences are located on, or immediately adjacent to older alluvial deposits (Qoa). Much of the adjacent Saugus Formation is sandstone, providing a local source of granular material for the alluvium. All of the spineflower occurrences coincide with undifferentiated Castaic and Saugus soils (CnG3). All of the spineflowers were found in southwest-facing slopes with bearings ranging from S6W to S72W and macro-slope gradients ranging from 5 to 21° (see Figure 2).

A total of 10 surface stations were surveyed and 3 subsurface test pits (LC-I through LC-III) were logged and sampled. Two of the pits were at occupied sites (LC-I and III) and one (LC-II) was at an adjacent unoccupied site where the related species *staticoides* was found. Data from our surface surveys are presented in Table I and conditions observed in the test pits are presented on the attached logs and summarized in Table II (see Appendix B). The observed materials commonly classified as clayey sand (SC) and ranged from silty clay (CL) to sand (SP-SM) per USCS criteria. Per USDA soil survey criteria, the soils classify as loam or sandy loam with varying amounts of gravel. Development of soil stratigraphy was generally poor and the organic O horizon was generally lacking. The Munsell color ranged from dark grayish brown (10YR 4/2) to yellowish brown (10YR 5/4) and locally ranged to light olive brown (2.5Y 5/3) and olive brown (2.5Y 4/3). The spineflower was primarily found in undisturbed sites, except for one occurrence growing in an old dirt road, at subarea LC-3. The vegetation generally consisted of sparse annual grasses and bushes of sagebrush and buckwheat, separated by barren patches. Scattered rodent burrows were observed in proximity to the spineflower occurrences.

4.3 Potrero Canyon

Dudek also discovered new occurrences of spineflower at elevations ranging from 1015 to 1195 near the western end of Potrero Canyon during their 2003 surveys (see Figure 9). The mapped polygons were lumped into 3 subareas (PC-1 through PC-3) for reference in our surface surveys. Most of these occurrences were found on terrace deposits (Qt) or immediately adjacent Pico Formation bedrock (Tp). At subarea PC-3, two small occurrences were discovered on Pico Formation bedrock. The regional soil unit per USDA (1969) is mapped as Castaic-Balcom silty clay loam (CmF) at subareas 1 and 3 and terrace escarpments (TsF) at subarea 2. The spineflowers were generally observed on south-facing slopes (bearings ranging from S65E to N70W locally) with macro-slope gradients ranging from 6 to 30° (see Figure 3).

A total of 15 surface stations were surveyed at spineflower occurrences. In addition, 7 soil test pits were sampled and logged in the Potrero Canyon area, 4 located at occupied sites (PC-I, PC-II, PC-IV and PC-V) and 3 located at unoccupied sites (PC-III, PC-VI, and PC-VII). Data from our surface surveys are presented in Table I, and conditions observed in the test pits are presented in the attached logs and summarized in Table II (see Appendix B). The materials were generally found to contain a higher percentage of clay compared to the other sites, reflecting the fine-grained nature of most of the Pico Formation bedrock sediment source in Potrero Canyon. Per USCS criteria, the shallow soils generally classify as lean clay (CL) to silty clay (CL-ML) at the occupied sites found on terrace deposits. These soils correspond with loam and silt loam per USDA soil survey criteria. At test pit PC-V, the soils were sandier (SP-SM) because they developed on a sandstone interbed in the Pico Formation. These materials correspond with sandy loam soil developed on loamy sand bedrock. Development of soil stratigraphy was generally poor and the organic O horizon was generally absent or thin (< 0.5"). The Munsell soil color is generally brown (10YR 5/3) to yellowish brown (10YR 5/4), but ranged to dark grayish brown (10YR 4/2) to light brownish gray (10YR 6/2) and even olive brown (2.5Y 4/3 to 5/3). The spineflower sites were generally undisturbed by man except that some parts of subarea PC-1 have been brushed in the past. This area has also been used to graze cattle in the past. The vegetation generally consists of annual grasses and barren patches between bushes of buckwheat and sagebrush. Rodent burrows were locally observed along with the spineflower occurrences.

4.4 San Martinez Grande Canyon

Dudek previously mapped spineflower occurrences that germinated on the west side of San Martinez Grande Canyon in 2002 and in 2001 or earlier. Additional mapping by Dudek in 2003 identified more extensive occurrences at elevations ranging from 1035 to 1240 (color-coded blue on Figure 10). We previously grouped the polygons into 3 subareas, (SM-1 through SM-3) for reference in our surface surveys. However, no new surface surveys were completed at this site because the area burned between Dudek's 2003 plant survey and our field survey. The majority of the occurrences are mapped on an ancient landslide that developed in the Pico Formation (Tp). Terrace deposits may also be included in the landslide debris. Based on radiocarbon dating of landslides in the area with similar geomorphic expression, this landslide is probably on the order of 10,000 years old. The spineflowers at subarea SM-3 and the new polygon on the ridge to the northeast are underlain by Pico Formation bedrock (Tp). Review of conditions in the field suggests that these occurrences are probably underlain by sandstone or silty sandstone interbeds. This area is mapped as eroded Castaic-Balcom silty clay loam regional soil unit per USDA (1969). The slopes at the spineflower occurrences generally face south with bearings ranging from S80W to N78E and macro-slope gradients between 5 and 33° (see Figure 3).

A total of 24 surface stations were surveyed in 2002 (see Table I in Appendix B for results). No new surface surveys were completed in 2003 because the area burned. Four soil test pits were sampled and logged in the vicinity of San Martinez Grande Canyon. Test pits SM-I and SM-II were located at unoccupied sites and SM-III and SM-IV were located at occupied sites (see Appendix B for logs and summary Table II). Per USCS criteria, the soil materials at the occupied sites classify as silty sand (SM), silt (ML) and clayey sand (SC) with only minor gravel. Per the USDA soil survey system, the shallow soils classify as loam and sandy loam, with some clay loam at depth. Development of soil stratigraphy was generally poor and the organic O horizon was generally absent. The Munsell soil color is commonly brown (10YR 4/3-5/3) to pale brown (10YR 6/3) and ranges to grayish brown (10YR 5/2) to olive brown (2.5Y 4/3-4/4) and light yellowish brown (2.5Y 6/3). The mapped occurrences are generally unaltered by man, but the area has been used extensively for cattle grazing. The vegetation is sparse with intermixed patches of bare ground, small annual grasses, and scattered bushes of primarily buckwheat and sagebrush. Animal burrows are generally uncommon.

4.5 Valencia Commerce Center

During their 2003 plant surveys, Dudek discovered several small spineflower occurrences on the elevated, central portion of the Valencia Commerce Center, at elevations ranging from 1070 to 1205 (see Figure 11). The mapped polygons were lumped into 3 subareas (designated as CC-1 through CC-3) for reference during our surface surveys. Most of the spineflower occurrences were found on terrace deposits (Qt) or adjacent portions of the Saugus Formation. All of the occurrences are located on eroded Castaic-Balcom silty clay loam (CmF2) or marginal portions of the Zamora clay loam (ZaC) regional soil units per USDA (1969). The spineflowers were primarily found on southwest-facing slopes, with bearings ranging from S89W to N70E, and macro-slope gradients between 0 and 19° (see Figure 3).

A total of 16 surface stations were surveyed at the three subareas (see Table I in Appendix B for details). No subsurface explorations were completed at this occurrence. The surface materials were generally found to range from silty sand (SM) to sandy silt (ML). Based on the association with the Zamora clay loam, the soil materials at depth probably have a more significant clay component (SC or CL). The organic O horizon was generally absent or very thin. The Munsell soil colors are generally yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/4) and range to grayish brown (10YR 5/2). Vegetation was generally sparse with small annual grasses and scattered buckwheat. The mapped occurrences include relatively undisturbed areas and areas cleared of brush in the past. Disturbance from rodent burrows was commonly observed.

4.6 Magic Mountain Entertainment

Dudek mapped spineflowers at two primary subareas in 2002 at the Magic Mountain Entertainment occurrence. Additional surveys in 2003 documented an expanded geographic distribution, with elevations ranging from approximately 1145 to 1260 (see Figure 12). The mapped polygons were grouped into 5 subareas for reference in our surface surveys (MM-1 through MM-5). The majority of the occurrences are located on terrace deposits (Qt) and the remaining plants are growing on older alluvium (Qoa). The occurrences on the terrace deposits correspond to Castaic-Balcom silty clay loam (CmF) and Saugus loam (ScF) regional soil units per USDA (1969). The plants growing on older alluvium correspond to Sorrento loam (SsB) at subarea MM-5 and to Metz loam (MgB) at subarea MM-3. The spineflowers were generally found on south-facing slopes with bearings ranging between N80W and S69E and macro-slope gradients between 0 and 30°

(see Figure 4). Gentle slopes to slightly north-facing slopes are present at the alluvial sites.

We initially surveyed 13 surface stations based on Dudek's survey in 2002. An additional 22 surface stations were surveyed for the current study (see Table I in Appendix B for details). Six soil test pits were sampled and logged at this site, 4 at occupied sites (MM-I through MM-IV) and 2 at unoccupied sites (MM-V and MM-VI). Our soil test pit logs are presented in Appendix B and the data are summarized in Table II. The surface soils are dominantly silty sand (SM) and clayey sand (SC) per USCS criteria. The soils classify as loam to sandy loam at occupied sites per USDA, soil survey criteria. The soil stratigraphy was generally poorly developed and the organic O horizon is generally absent or very thin (< 3/8"). The Munsell soil colors range from pale brown (10YR 6/3) to dark grayish brown (10YR 4/2). The vegetation was generally sparse with small annual grasses and scattered buckwheat. The mapped occurrences are generally undisturbed by man but rodent burrows were generally common and evidence of past cattle grazing was observed.

5.0 CONCLUSIONS

The data obtained during this assessment indicate that there are a number of geologic and geomorphic conditions that are fairly consistent at each occurrence site:

1. From a geologic standpoint, the vast majority of spineflower occurrences mapped at the various sites occur on or immediately adjacent to alluvial terrace deposits, which form large mesas roughly 150 to 200 ft above the Santa Clara River. The majority of the other occurrences occur on exposures of Saugus Formation (mostly upper member), younger terrace deposits, older alluvium or recent alluvium. The sediments in the younger terrace deposits, alluvium, and local artificial fill at occupied sites were derived primarily from the Saugus Formation. The composition of these materials and the original alluvial depositional environment are similar for all of these materials. Rare exceptions to this trend were observed at Potrero and San Martinez Grande Canyon, where the spineflowers occur on the marine-deposited Pico Formation and landslide material. However, the available data indicates that sandstone interbeds likely underlie these sites and the landslide underlying most of the occurrences at San Martinez Grande Canyon may include disturbed terrace deposits as well.

2. Review of regional soil units mapped by the USDA (1969) at the various sites indicates that most of the spineflower occurrences are found on Castaic-Balcom silty clay loams,

30 to 50% slopes (CmF & CmF2) and terrace escarpments (TsF), which are mapped on the steep slopes descending from the larger terrace/mesa surfaces. These two units are mapped at 84% of our surface stations. Although CmF is described as a silty clay loam, the texture data obtained from Wallace Labs indicates that the soils from these units are actually loams and sandy loams per Birkeland (1999). Spineflower occurrences were also locally observed on Zamora clay loam, 2-9% slopes (ZaC), which coincides with sites on the margins of the terrace/mesa surfaces. Local spineflower occurrences were also documented on undifferentiated Castaic and Saugus soils, 30 to 65% slopes, severely eroded (CnG3), Metz loam, 2 to 5% slopes (MgB), Saugus loam, 30 to 50% slopes (ScF), and eroded (ScF2), and Sorrento loam, 2 to 5% slopes (SsB).

Review of the parameters reported by the USDA (1969) for each regional soil unit reveals a number of similarities at the mapped occurrences. All of the units are reported as having 14 to 16 inches of precipitation annually, an average annual temperature of 63°F and a frost-free season ranging from 275 to 300 days, except for ZaC, which is reported as having a frost-free season ranging from 240 to 300 days. The pH is generally reported to range from 6.1 to 7.0 for units on sloping ground, i.e. 15 to 65% (ScF, TsF, CmF and CnG3) and a range of 6.1 to 8.2 is reported for units developed on gentle slopes, i.e. 2 to 9% (ZaC, MgB and SsB). Testing by Wallace Laboratories indicates that most of the soils at occupied sites are slightly more acidic than basic, with values generally ranging from 6.0 to 7.5 Where reported, the soil fertility is described as very low (CnG_3) to low (ScF) on sloping ground and moderate (MgB and Zac) to high (SsB) on gentle ground. The available water holding capacity ranges from 4 to 9 inches for units on sloping ground and from 5 to 11 inches on gentle ground. Except for local occurrences on ZaC, the soil profiles at the sites observed are generally young with poorly developed stratigraphy.

3. Regardless of the geologic or soils unit mapped at each occurrence, the soil material underlying the occupied spineflower sites falls into a fairly narrow compositional range (see Figure 5). Plots of soil texture data from Wallace Labs indicate that the material within 6 inches of the ground surface (the depth range of most of the spineflower roots observed) is loam or sandy loam (per the USDA/soil survey classification system presented in Birkeland, 1999), with varying gravel fractions. The sand content is typically greater than 50% (57% on average) but can range from approximately 30 to 70%. The material descriptions from our surface surveys are slightly skewed toward the coarse fraction, probably due to preferential erosion of the finer fraction during rainfall and runoff. The silt content ranges from approximately 20 to 48% (32% on average) and

the clay content ranges from 5 to 22% (12% on average). However, the silt content is dominant over the clay content in every location tested, with silt to clay ratios ranging from 1.82 to 5.79 and averaging 2.97. These data suggest that the spineflower distribution may be limited to soils within this composition range. Comparison of this range with data from the unoccupied sites indicates that some plot outside of the noted ranges, but some plot within the range, indicating that other factors are controlling the spineflower distribution at these specific locations. Textural data from deeper samples indicates that a wider but still restricted range of soils can be present below the typical root depths. The soils engineering classification of the soil materials (ASTM criteria) described in our logs and surface surveys were less informative than the soil survey classification. Whereas the materials in the upper 6 inches at occupied sites fall strictly within the sandy loam and loam designations, the materials classify in several categories using the ASTM criteria because the materials straddle the sand/fines boundary (i.e., 50% sand) and the plasticity boundary between silts and clays (i.e., PI=7). Therefore, the materials ranged from silty sand (SM) to clayey sand (SC) on the coarse end (% sand > 50%) to silt (ML) and lean clay (CL) on the fine end.

4. The Munsell color of the surface soils (dry) is very consistent with a hue of 10YR, values ranging from 3 to 6 (but dominantly 4-5), and the chroma ranging between 2 and 4. This corresponds to various shades of brown, grayish brown and yellowish brown. Colors obtained from our subsurface explorations were determined on damp to moist soils, but were still generally consistent with the dry surface soil colors, except that the hue locally ranged to 2.5Y, which corresponds to shades of olive brown. The limited range of colors may correspond to a restricted range in the concentration and oxidation state of iron in the soils supporting the spineflowers.

5. Based on our surface survey data, the vast majority of spineflower occurrences are found on slopes with a south-facing component (see Figures 2 to 4). A few occurrences range onto slopes with a northeasterly or northwesterly trend. The more northerly trends are generally restricted to gently sloping drainages, hilltops and disturbed roadways. The 2003 surveys showed a wider range of slope bearings than the 2002 surveys, which likely reflects the wetter winter preceding the 2003 surveys.

6. The overall (macro) slope gradients generally ranged from 3 to 38°. However, the majority occur on slopes with gradients between 7 and 30° (roughly 12 to 60% slopes). Gradients locally shallowed to horizontal and isolated individuals were observed on slopes inclined up to 68°. The slope gradients observed at specific plants (micro) were