Appendix B: Geotechnical Investigations

GEOLOGIC, SOILS AND DRAINAGE ASSESSMENT
SEPTEMBER RANCH
CARMEL VALLEY
MONTEREY COUNTY, CALIFORNIA

For
Preparation of a Revised Environmental Impact Report
To
The County Of Monterey Planning and Inspection Department

Prepared For: Michael Brandman Associates
415 Linden Way
Pleasanton, California 94556

Attention: Mr. Jason Brandman
Project Manager

June 30, 2003

June 30, 2003
File: 24236/Geol

Mr. Jason Brandman
Michael Brandman Associates
415 Linden Way
Pleasanton, California 94556

SUBJECT: Geologic, Soils and Drainage Assessment for the September Ranch Project, Carmel Valley, Monterey County, California.

Dear Mr. Brandman:

Kleinfelder is pleased to submit our geologic, soils and drainage assessment report for the September Ranch project in Monterey County, California. The accompanying report summarizes the results of our field investigation, data collection and review, and geologic interpretation.

Recent geologic history recorded in the rocks and sediments in the vicinity of September Ranch is complex and subject to multiple interpretations. Possible deformation and uplift of Holocene deposits, active faulting and a complex fluvial history of the Carmel River add to the complexity of the region.

The Hatton Canyon fault is observed at the north and south extents of September Ranch terrace. The fault and Monterey bedrock exposed along the southwest and south sides of the September Ranch terrace probably act as a groundwater barrier between the southwest and south portions of the terrace and the Carmel River aquifer. The absence of a bedrock high and the geomorphic coalescing surfaces in the northwest portion of the terrace suggests that groundwater in that part of the terrace communicates with the alluvium in the Carmel River Valley. From a geologic perspective, groundwater in the September Ranch terrace appears to sourced from 1) direct infiltration of rainwater, 2) from the 570-acre September Ranch watershed north of the terrace and 3) underflow from the Carmel River aquifer.

Groundwater in the September Ranch terrace east of the Hatton Canyon fault may be restricted to the east portion of the terrace by a fault barrier. The precise location and degree of permeability of the fault plane is not presently known.

As described in our proposal to Michael Brandman Associates, dated March 19, 2002 and as modified by Brandman, our investigation was limited to geologic evaluation by ground truthing previous mapping effort by other investigators and evaluation of soils and drainage characteristics at the site. This study is to be used as input to the groundwater modeling investigation to be conducted by Kennedy/Jenks Consultants. Conclusions regarding potential impacts of the site geology with respect to hydrogeologic conditions are provided in the report.

If you have any questions regarding the findings or conclusions presented in our report, please contact us at your convenience.

Respectfully Submitted,

KLEINFELDER, INC.

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MONTEREY COUNTY, CALIFORNIA

TABLE OF CONTENTS

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SEPTEMBER RANCH
CARMEL VALLEY
MONTEREY COUNTY, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our geologic, soils, and drainage assessment for the September Ranch project in Monterey County, California. The location of the project site with respect to surrounding cultural and topographic features is shown on the Site Vicinity Map, Plate 1. A photographic overview of the ranch is shown on the Site Aerial Photograph, Plate 2.

1.1 SITE DESCRIPTION

The September Ranch project encompasses 891-acres in and adjacent to Carmel Valley located about 2.5 miles east of State Highway 1 in Monterey County, California. The property is currently undeveloped, with the exception of horse stables and appurtenant facilities located in the lower portions of the site fronting Carmel Valley Road. The lower portion of the property is relatively flat lying and is underlain by alluvial and colluvial soils and forms the long meadow area presently used for horse stables and pasture.

The majority of the remainder of the property consists of moderate to steep uplands, vegetated predominantly with chaparral and a mix of pine, oak and bay woodland. Soils on the hill slopes are generally shallow and rocky; and the site is characterized by extensive outcrops of shale bedrock, which supports the uplands of the site. Development of the project site is proposed to include large residential parcels located generally along the ridgelines where the terrain is suitable for building.

1.2 PURPOSE AND SCOPE OF SERVICES

The purpose of this geologic, soils and drainage assessment is to identify and assess geologic conditions that may impact groundwater conditions at the site. This study is a portion of a Revised Environmental Impact Report prepared for the County of Monterey Planning and

Inspection Department prepared by Michael Brandman Associates. Our scope of services included the following:

- Research and review of available geologic and soils reports, publications and maps that pertain to the site and vicinity;
- Review of stereo-paired aerial photographs covering the site for the presence of geomorphic features relating to structural and hydrogeologic conditions at the site;
- Conducting a geologic reconnaissance of the site by a Certified Engineering Geologist and Hydrogeologist to observe and document surface features and to "ground truth" and modify, as appropriate, mapping efforts by others;
- Evaluation of rainfall data, soil type and drainage patterns at the site;
- Constructing a geologic cross sections based on our reconnaissance mapping and mapping by others showing slope profile and interpreted near surface geologic materials and structures; and
- Evaluating the researched data with respect to hydrogeologic conditions and preparing this report with conclusions that may affect groundwater at the site.

Stereoscopic aerial photographs of the site were reviewed for lineations, tonal changes, or other geomorphic features that may relate to geologic conditions such as faults and landslides. Photographs reviewed for the project include August 27, 1997 aerial photographs of the site (flight AV5496-3, photographs 6 and 7, Scale: 1:24,000). An annotated aerial photograph is presented on the Site Aerial Photograph, Plate 2. A Certified Engineering Geologist visited the site on January 29, 2003 to observe surface geologic conditions. Our field investigation included a reconnaissance surface mapping.

1.3 PREVIOUS INVESTIGATIONS

The geology of the Carmel area was first described in Lawson (1893). Lawson mapped the geologic units near the mouth of the valley and demonstrated the influence of faulting on the topography. Beal (1915) and Galliher (1930) described the regional stratigraphy and geologic structure in the Monterey area. Because the focus of these early efforts was on bedrock mapping, the Quaternary geology of the region was largely uninterpreted. Bowen (1965, 1969a, 1969b) mapped the Monterey and Seaside 7.5-minute quadrangles with emphasis on the Tertiary stratigraphy. Brown (1962) and Younse (1980) mapped the Rancho San Carlos and Laureles Grade/Robinson Canyon areas, respectively. Their work resulted in the refinement of the stratigraphy and structure of the Tertiary sedimentary rocks in Carmel Valley.

Preliminary geologic mapping presented in Clark and others (1974) suggested that several faults in the study area were potentially active. Bryant (1985) reviewed published mapping, performed a limited reconnaissance of the area, and concluded that previously mapped faults were not sufficiently active to require zonation by the State Geologist. However, analysis of Quaternary mapping by Dupré (1990b), recent detailed mapping and trenching by geotechnical consultants, unpublished mapping by Clark (1984-1995) and Clark and others (1997), and investigation of geologic hazards of Carmel Valley by Rosenberg (1993) indicate that Holocene and late Pleistocene faulting has occurred, the extent and nature of which were previously unrecognized. Subsequent work by Rosenberg and Clark (1994), and Clark and others (1997) confirmed this movement along strike-slip and thrust faults in the study area (including the Hatton Canyon fault that crosses September Ranch). Using California Geological Survey criteria, faults that show activity during Holocene time (latest 11,000 years) are defined as active.

Several geologic investigations have been completed at the project site that include specific studies for the September Ranch property. These investigations include studies by Geoconsultants, Inc. (July 1981, March 1995); David Keith Todd, Consulting Engineers, Inc. (27 February 1985, 17 September 1993, 18 May 1993, 11 May 1995, 1 October 1996); and Terratech, Inc. (12 June 1995).

For reference in the following discussion, a compilation of geologic mapping prepared for this investigation and a portion of Clark and others (1997) are presented as the Site Geologic Map (Plate 3) and Vicinity Geologic Map (Plate 4), respectively. References cited for the compilation of this report are presented in the reference section at the end of this report.

2.0 GEOLOGIC SETTING

2.1 REGIONAL GEOLOGY

The September Ranch area, situated near the western extent of the Carmel River Valley, lies within the Coast Ranges Geomorphic Province, a discontinuous series of northwest-southeast trending mountain ranges, ridges, and intervening valleys characterized by complex folding and faulting. The general geologic framework of the Central Coast Area of California is illustrated in studies by Page (1965), included as the Regional Geologic Map (Plate 5), as well as in studies by Jennings and Strand (1958).

Geologic structures within the Coast Ranges Province are generally controlled by a major tectonic transform plate boundary. This right-lateral strike-slip fault system extends from the Gulf of California, in Mexico, to Cape Mendocino, off the coast of Humboldt County in northern California and forms a portion of the boundary between two global tectonic plates. In this portion of the Coast Ranges Province, the Pacific plate moves north relative to the North American plate, which is located east of the transform boundary. Deformation along this plate boundary is distributed across a wide fault zone, which includes the San Andreas, Hayward, Calaveras, and San Gregorio faults. Together, these and other faults are referred to as the San Andreas fault system. The general trend (about N30W) of the faults within this system is responsible for the strong northwest-southeast structural grain of most geologic and geomorphic features in the Coast Ranges Province.

The large wedge of geologic material west of the San Andreas fault that generally is underlain by Cretaceous Age (about 140 to 65 million years old) granitic basement rock is referred to as the Salinian block (Regional Geologic Map). September Ranch is included within the Salinian tectonic block. The Salinian Block is bounded by the San Andreas fault on the east and the Sur-Nacimiento fault zone on the west. Geologically, the study area has a crystalline basement of Upper Cretaceous granitic rocks of the Salinian block and older metasedimentary rocks of the schist of the Sierra de Salinas of probable pre-Cretaceous age.

Resting non-conformably upon these basement rocks in the Monterey area is a sedimentary section that ranges in age from middle Miocene to Holocene (about 24 million years ago to present) and has a composite thickness of as much as 3,600 feet. The Miocene rocks record quiet marine waters with abundant microscopic lifeforms (forams and diatoms). Later, in the Pliocene and Pleistocene, the ocean retreated and non-marine fluvial environments abound. These Cenozoic age rocks are typically folded and faulted into a series of generally northwest-southeast trending folds and faulted blocks, largely as a result of predominantly right-lateral strike-slip stresses related to movement along the San Andreas fault system. The inland valleys, including the Carmel Valley, are filled with unconsolidated to semi-consolidated alluvium (stream channel and over-bank deposits) of Quaternary age (about the last 1.6 million years).

Regional geomorphic features within the Carmel and Monterey areas are the result of a complex geologic history of uplift and folding ultimately caused by the interaction between the North American and Pacific tectonic plates. About 760,000 years ago, much of California's Central Valley was a great freshwater inland sea referred to as Corcoran Lake. The ancient lake drained out of the southern end of the Central Valley and flowed to the Pacific Ocean along the antediluvian Salinas River to the Monterey Bay (La Joie, K., U.S.G.S, personal communication; Martin, 1999; Bartow, 1991). The Monterey Bay and the offshore Monterey Canyon are the result of erosion as large quantities of detrital material was transported from the Sierra Nevada to the Pacific Ocean via the Salinas River. The Salinas River etched into and widened the northwest-southeast trending valleys that were formed by the two tectonic plates grinding past each other.

About 560,000 years ago, continued tectonic uplift and displacement on the San Andreas fault closed the Salinas Valley outlet of Corcoran Lake to the Pacific. This tectonic change permanently shut off Central Valley drainage to the Monterey region (Bartow, 1991). Shutting the southern outlet of the Central Valley caused the waters of Corcoran Lake to rise and eventually to spill over and carve through the soft soils at Carquinez Strait northeast of the Golden Gate. The new outlet filled the basin now referred to as the San Francisco Bay.

Its headwaters removed, the Salinas River became an underfit river in an overly large ancient fluvial system. Regional geomorphic evidence suggests some of the ancient river flow from Corcoran Lake may have drained through the Carmel Valley depositing the granite gravel and cobble terraces now suspended along the valley margins.

2.2 AREA AND SITE GEOLOGY

The predominate bedrock exposed at the surface on September Ranch is the marine sedimentary rock of the Miocene Monterey Formation (Tm). The Monterey rocks are overlain by an assortment of Quaternary age unconsolidated materials. In the vicinity of September Ranch these unconsolidated materials include: terrace deposits (Qt and Qt_1); landslide deposits (Qls); and alluvium (Qal). Plate 3 depicts the surface distribution of these geologic materials near September Ranch. Colluvium probably interfingers with alluvium around the basin margins. However, colluvial deposits, although present on the slopes of September Ranch, are not generally important to hydrogeologic conditions and are not described in this report. Descriptions of the geologic materials present at September Ranch vary in the available literature. For consistency and ease of understanding, the above unit designations have been selected and will be used throughout this report. The following sections describe the geologic setting on and near September Ranch.

2.2.1 Stratigraphy

2.2.1.1 Salinian Basement

Miocene age and younger formations that outcrop at September Ranch rest non-conformably on granite and schist of the Salinian basement complex. A distinctive schist unit crops out on the east side of Laureles Grade. This unit has been referred to as part of the "Sur Series" (Trask, 1926) and more recently as the "Schist of the Sierra de Salinas" (Ross, 1976). The schist probably underlies a portion of the northern Salinian block in the vicinity of September Ranch. The schist is dusky blue to dusky yellowish-brown, and fine- to medium-grained. Although Cretaceous granitic rocks intrude the schist, the age of the schist is uncertain; estimates range from Paleozoic (Bowen and Gray, 1959) to Mesozoic (Ross, 1976). The Cachagua granodiorite represents a small part of the Monterey and Seaside quadrangles, cropping out near Laureles Grade. The Cachagua is a transitional unit between the Monterey mass and the adjoining quartz diorite to the southeast (Ross, 1976).

2.2.1.2 Monterey Formation

Locally, Monterey Formation may rest directly on the basement crystalline rocks at depth below September Ranch. In the Carmel area the Monterey Formation crops out in two main areas: in the hills south of the Carmel River and west of Robinson Canyon, and in the hills north of the Carmel River.

The Monterey Formation consists of gently folded, well-stratified, friable to moderately strong, siliceous shale, siltstone, and local sandstone. At the project site, most exposures of the Monterey formation consist of diatomite and porcellinite. In general, the Monterey Formation is relatively impermeable and considered to be a non-water bearing unit (Kapple et al., 1984). The basal sandstone is locally fractured (secondary porosity) and in places may produce domestic well yields that range between 15 and 30 gallons per minute (gpm) (Kapple et al., 1984). Surface exposures of the Monterey Formation make up a significant area of the September Ranch site. Good surface exposures of well stratified Monterey Formation can be observed north of the southeast corner of September Ranch and along Carmel Valley Road immediately east of September Ranch.

The Monterey Formation in the Carmel Valley area is divided into three lithostratigraphic units by Bowen, 1965. The basal unit was designated the Los Laureles sandstone and is not exposed at September Ranch. The middle unit of the Monterey Formation, referred to as the Aguajito Shale Member (Bowen, 1965), is as much as 600 m thick. It is thin-bedded and laminated, light brown to white porcelanite with very thin clay partings between the porcellinite beds and with thin interbeds of waxy-yellow to brown chert. This unit contains a thin pelletal and oölitic phosphorite interbed near its base. Benthic foraminifers are diagnostic of lower middle bathyal depths (Younse, 1980) and of early Mohnian (middle to late Miocene, 10 to 9 million years ago) age.

The upper unit, Canyon del Rey Diatomite Member (Bowen, 1965) is as much as 170 m thick. It is mainly very thick bedded and faintly laminated, very pale orange to white diatomite with thin interbeds and lenses of dark-brown chert and two thick interbeds of light-gray vitric tuff. A rock sample collected from near the base of this unit south of Canyon del Rey yielded benthic foraminifers diagnostic of upper (300–500 m) to upper middle bathyal (500–1,500 m) depths and of an early Mohnian (late Miocene) age (Kristin McDougall, written commun., 1994 as cited by Clark and others, 2000). Another sample from near the top of this unit east of Laureles Grade is diagnostic of inner neritic (50–100 m) depths and of a Mohnian (late Miocene) age (Kristin McDougall, written commun., 1994 as cited by Clark and others, 2000), indicating a shallowing of marine conditions during deposition of this upper unit.

2.2.1.3 Terrace Deposits

Elevated fluvial terraces are exposed mainly on the north side of the Carmel River on discontinuous topographic benches and as erosional remnants capping hilltops. These terrace deposits consist of weakly consolidated to semiconsolidated, moderately to well graded, fine- to coarse-grained silty sand with pebble to cobble gravel. The terrace deposits are weakly to moderately cemented, and locally are strongly cemented with carbonate in the upper few feet; some are capped by moderately to well developed soils, some have duripans; expansive soils are locally present. At September Ranch the elevated terraces are generally identified by the presence of well-rounded granite cobbles weathering out of the deposits. Terrace thickness is highly variable, and is locally as much as 60 feet. At least some of the fluvial terrace deposits in Carmel Valley correlate with marine terrace deposits of Pleistocene age on the Monterey Peninsula (Williams, 1970); however, discontinuous outcrops and intervening young faults make these correlations difficult.

The terrace materials were deposited during times of higher base level by the Carmel River or proto-Carmel River and later eroded down through as the ultimate base level (sea level) dropped in the late Pleistocene. Therefore, the higher the terrace is above the valley floor, the older it is. There are two ages of terraces sets that are distinguished in this report based on elevation, detrital content and degree of induration.

The older terraces (Qt) are of Pleistocene age and generally consist of granitic cobbles and sand that in places are well cemented. They are suspended on the slopes of September Ranch ranging in elevation from about 110 to 690 feet above mean sea level. The terraces are separated in elevation probably because of successive deposition, erosion, and uplift due to faulting or folding.

The younger terrace (Qt_1), herein referred to as the September Ranch terrace, extends from beyond the southwestern boundary of September Ranch to the base of the hills approximately 660 feet north of Carmel Valley road. The terrace stretches along the Carmel river from Canada De La Segunda in the southeast to near the mouth of Roach Canyon at the southwest corner of the ranch property (Site Aerial Photograph, Plate 2 and Site Geologic Map, Plate 3). This terrace deposit consists of unconsolidated sand and gravel. The terrace surface lies at an elevation of about 95 to 185 feet.

The September Ranch terrace is delineated on its southwest margin by a distinct escarpment. The escarpment extends from a knoll ("Knoll" adjacent to the southwest margin of the September Ranch terrace, Plate 1) to the southeast limit of the terrace near Canada De La Segunda. The Knoll is underlain by a Monterey-bedrock core that is mantled with terrace deposit (Qt_1, Plate 3) of unknown thickness.

The terrace of September Ranch is not an isolated geomorphic feature; it is one of several apparently contemporaneous deposits that are situated at about the same height above Carmel River mostly along the north side of the river. Further to the southeast, terraces that appear to be of the same age are located along both the north and south banks of the river. The height of this terrace above the modern Carmel River channel, minor degree of cementation, and absence of incision by streams flowing onto the terrace suggest that the September Ranch terrace is probably Holocene age.

2.2.1.4 Landslide deposits

Several landslides of varying size are mapped in the September Ranch highlands. These are bedrock landslides within the Monterey Formation. The largest landslides are in the west portion of the property where geologic structure is such that weak shale beds project obliquely out of the slope. Many of the younger slides are probably early Holocene as indicated by poorly to moderately defined scarps, hummocky topography, and well-developed drainages. The upland landslides mapped at September Ranch are not correlated to hydrogeologic conditions at the site, and are not discussed further in this report.

A landslide deposit at the south end of the September Ranch terrace (Qls_1, Plate 3) is partially indurated and may not be related to the upland landslides on September Ranch. There is no obvious source for the landslide from the September Ranch side of the valley. The absence of a headscarp defining a source area on September Ranch and presence of landslide debris on the south side of Carmel Valley suggests that the Qls_1 landslide may be a remnant of a large landslide that slid across the valley before historic time. A landslide spanning the river valley would have obstructed streamflow until the river-level adjusted or until the obstruction was breeched. The landslide appears to be offset by the Hatton Canyon fault (Vicinity Geologic Map, Plate 4, location note 19) (Clark and others, 1997).

2.2.1.5 Alluvial deposits

The major aquifer system in the Carmel Valley drainage basin is the permeable Holocene Alluvium including fluvial sand and gravel alluvium (Qal, Site Geologic Map, Plate 3) adjacent to the Carmel River. The recent alluvium is generally described as poorly consolidated boulders, gravel, sand, and silt deposited by the Carmel River. Large quantities of groundwater are pumped by local water purveyors from this source to serve the residential and recreational customers in the Carmel River basin and the Monterey Peninsula (Todd, December 1992). The gravel content is variable and is locally abundant within channel and lower point bar deposits. The thickness of the younger flood-plain alluvial deposits is generally less than 20 feet. They typically are incised within older flood-plain deposits, which are not distinguished on the Site Geologic Map.

Roach Canyon and Canada De La Segunda form the boundaries of the northwest and southeast sides of the September Ranch property, respectively. The canyons are characterized by narrow ribbons of recent alluvium deposited by ephemeral streams. Although no major investigations have been conducted on these long and narrow canyons, it is inferred by Todd (December 1992) that groundwater storage and availability is limited in these narrow canyons.

2.2.2 Geologic Structure

2.2.2.1 Faults

Beal (1915) and Galliher (1930) mapped, but did not name, a group of northwest-southeast striking, nearly vertical reverse faults that displace Monterey shale against Pleistocene terrace deposits in Hatton Canyon. Work by Rosenberg and Clark (1994) shows the Hatton Canyon fault to extend 7 miles northwest from Carmel Valley Road to near Point Joe on the coast. Rosenberg and Clark (1994) mapped two segments on the Hatton Canyon fault that traverse the September Ranch property. However, work by Terratech Inc. (Jeff Schuyler, February 2003, personal communication) and by Kleinfelder for this investigation suggests that the northern fault segment of Rosenberg and Clark (1994) may be the surface expression of an anticline. This alignment is tentatively mapped as an anticlinal fold in this report.

The Hatton Canyon fault is marked by intensely fractured, steeply dipping Monterey Formation in an area of otherwise gently dipping beds (Rosenberg and Clark, 1994). On Carmel Valley Road, the fault offsets landslide and terrace deposits (map locality 19, Plate 4). The Hatton Canyon fault according to Clark and others (1997) dips to the south at about 80°, and extends to a depth of about 4 miles.

At September Ranch, the location of the Hatton Canyon fault is defined by offset terraces and a trench exposure just north of the September Ranch terrace (Terratech trench TR-4B, Jeff Schuyler, February 2003, personal communication). Another fault exposure is located at the south side of the September Ranch terrace where landslide material is offset in the erosional cut south of Carmel Valley Road (Site Geologic Map, Plate 3 and location 19 on the Vicinity Geologic Map, Plate 4, J.C. Clark, February 2003, personal communication). A Kleinfelder geologist visited the landslide-offset site adjacent to Carmel Valley Road to verify the fault's presence at this location.

Along the projected trend of the Hatton Canyon fault in the Younger Terrace ($Qt_{1,}$ Site Geologic Map), a hydrogeologic barrier is inferred at the September Ranch (map locality 18, plate 4). The barrier was proposed by Todd Engineering (December 1992) based on the lack of interference on wells in Carmel Valley during pumping conducted at September Ranch. A fault barrier is also suggested through the younger (Qt_1) terrace by the high yield of the Old Hatton well drilled in 1931 (Roy Alsop, Sr., oral commun., as cited in Thorup, 1976, p. 8), and the low yield of adjacent wells south of the terrace (Meffley and Brown, 1974). Alternatively, this hydrogeologic barrier could be an ancestral channel cut into shale bedrock (D.K. Todd, 1985, as cited in Oliver, 1991, p. 2). However, driller's logs for the Hatton well and the adjacent 1990 SR1 well record a sequence of shale underlain by sand and gravel, which in turn is underlain by shale. The repeated section of shale indicates reverse faulting, and does not support the ancestral channel interpretation (Rosenberg and Clark, 1994).

In 1991, a construction excavation at Pacific Meadows revealed an exposure of the Hatton Canyon fault referred to as the Water Tank exposure (Rosenberg and others, 1997). At this location, the fault is reported to offset Monterey shale against a fluvial terrace deposit and landslide deposits. Colluvium overlying the fault thins abruptly on the upthrown side of the fault; however, the fault strand is obscure within the colluvium. Upp Geotechnology (1991) later excavated an exploratory trench about 60 feet east of the Water Tank exposure. The trench exposed near-vertical dipping terrace deposits faulted against steeply dipping shale beds and landslide deposits in a 12-foot-wide zone of faulting (Rosenberg and others, 1997).

The total displacement along the Hatton Canyon fault is unknown, but similar terrace deposits located about 400 feet south of the Water Tank exposure are approximately 100 feet lower in elevation. This suggests at least 100 feet of vertical offset during Quaternary time. Several strands of the fault also offset landslide and colluvial deposits by about 6 to 12 inches (Rosenberg, 1993).

Dating of offset colluvium yielded a $_{14}$C age of 2,080±40 yr B.P. on the fault (Rosenberg and others, 1997). Faulted landslide deposits at Pacific Meadows suggest Holocene movement (Rosenberg and others, 1997, Rosenberg, February 2003, personal communication). Also suggestive of Holocene activity is the inferred hydrogeologic barrier at September Ranch in the younger terrace (Qt_1) deposit. Recent activity is also indicated by several earthquakes that align with the Hatton Canyon fault.

2.2.1.6 Folds

Generally, Monterey bedding is nearly flat lying in the Carmel region. Several gentle folds are mapped at September Ranch. These folds appear to be associated with and are proximal to the mapped trace of the Hatton Canyon fault. Alternatively, the folds could be ductile deformation caused by more regional forces. A southeast-northwest trending anticline is suggested by the shallow north and south dipping strata of the Monterey Formation near the center of the property. Sympathetic synclinal folding has also been noted along the northern and southern portions of the property. The folds are depicted on the Site Geologic Map, Plate 3.

2.2.3 Geomorphology

Morphologically the lower most portion of the site consists of a gently swelled alluvial terrace stretching along Carmel Valley Road that is bordered by a knoll ("Knoll" on Site Vicinity Map, Plate 1) and river-cut bank on the south and rugged uplands to the north. The higher ground of September Ranch is made up of approximately north-south trending ridges and steep-walled canyons that plunge southward toward Carmel Valley. The ridges are locally modified by side canyons, erosional gullies, landslides, colluvial wedges and old river terraces. The central north-to-south-draining canyon of September Ranch is deeply incised into Monterey bedrock and has a normal primary and secondary dendritic drainage pattern (Drainage Map, Plate 9). Side drainages that flow into Roach Canyon on the west side of September Ranch are distorted, beheaded and not dendritic due to interruptions by landslides. Drainages that lead to Canada De La Segunda are parallel to subparallel, steep-gradient uninterrupted channels except in the northeast corner of the property where a large bedrock landslide has altered the drainage courses.

On the south side of Carmel Valley Road, the crest of the Knoll separating the Qt_1 terrace from the Carmel River valley is approximately 60 feet above the lowest elevation of the terrace surface and 100 feet above the elevation of the Carmel River. Based on the presence of Monterey

Formation outcrop along the south flank of the Knoll, the core of the Knoll is inferred to be relatively impermeable and probably forms a partial or full hydrogeologic separation (barrier) between the young terrace deposit and the alluvium of Carmel Valley. Northwest of the Knoll the Qt_1 terrace surface slopes downward and appears to merge and probably interfinger with the alluvium of the Carmel River Valley. From a geomorphic perspective, groundwater may flow between the porous sediments of the Qt_1 terrace deposits to the Carmel River aquifer along the northwest margin of the terrace deposit. However, this observation does not take into account subsurface conditions that are not apparent at the surface and that may affect communication between these two aquifers.

The gentle swell of the Qt_1 suggests the Carmel River (or a subsidiary channel) once flowed through the narrow terrace gap on the Ranch property. The absence of incised terrace material where the major south draining channels debouch from the uplands to the north onto Qt_1 indicates that: 1) the terrace surface is young and 2) most of the water flowing from the upland area of September Ranch dissipates by quickly infiltrating into the porous terrace material.

2.3 HYDROLOGIC SETTING

2.3.1 September Ranch Terrace Deposit

The September Ranch terrace deposit (Qt1) has been an area of concern based on its potential as a groundwater source (Todd, 27 February 1985, December 1992, 18 May 1993a, 18 May 1993b, 17 September 1993, 11 May 1995, 4 April 1996, 1 October 1996, 14 March 1997, 28 March 1997). The terrace deposit appears to be a good water producer based on historical pumping information (Roy Alsop, Sr., oral commun., cited in Thorup, 1976) and recent pumping data (Todd, December 1992, and 28 March 1997). The water in the September Ranch terrace is apparently partially sourced from streams originating in the uplands of the ranch that discharge their water to the porous materials that make up the terrace.

2.3.2 Structural Controls and Potential Barriers

Based on mapped location of the Hatton Canyon fault and best available well locations at September Ranch, the September Ranch wells may all be southwest of the Hatton Canyon fault (Geologic Map, Plate 3, Cross Section A – A', Plate 6, and Geologic Cross Sections C' – C' through E – E', Plate 7). If this location is correct, the wells are not located in a portion of the aquifer that would be confined by the fault. It is not presently known if the Hatton Canyon fault offsets alluvial material within the September Ranch terrace. If the fault extends upward to near the terrace surface, it could form a full or partial (leaky) barrier to groundwater flow.

2.4 SOILS

Generally, the soils in the uplands portion of September Ranch, which occupies about 95 percent of the property, consist of a relatively thin (less than two feet thick) regolith of weathered bedrock and colluvium. These upland soils are collectively mapped within the Santa Lucia soil series. The soils in stream canyons and the near-surface materials of the Younger Terrace (Qt_1) deposit are thicker than upland soils and consist of finer-grained materials. The following soil descriptions are derived from the Soil Survey of Monterey County (U.S. Soil Conservation Service, 1978). The soil units described below are shown on the Site Soils Map, Plate 8.

2.4.1 Santa Lucia series

The Santa Lucia series consists of well-drained upland soils. These soils formed in material underlain by hard shale mostly of the Monterey Formation where slopes range from 28 to 75 percent. The vegetation consists of annual grasses, oats, buckwheat, scrub oaks, a few scattered thickets of brush, and a few coastal oaks. The soils lie at elevations up to 3,000 feet where mean annual precipitation is 12 to 25 inches, mean annual air temperature is about 60° F, and the average frost-free season is about 200 to 250 days. Area summers are hot and dry, and winters are cool and moist.

In a representative Santa Lucia series profile, the surface layer is gray and grayish brown, strongly acid shaly clay loam over hard, fractured shale at a depth of 24 inches. Permeability is moderate. Santa Lucia soils are used mostly for range, and some gently rolling and hilly areas are used for dry-land grain. Santa Lucia series soils mapped at the site consist of Santa Lucia shaly clay loam on 2 to 15 percent slopes (SfD shown on the Site Soils Map, Plate 8), Santa Lucia shaly clay loam on 15 to 30 percent slopes (SfE), Santa Lucia shaly clay loam on 30 to 50 percent slopes (SfF), and Sg-Santa Lucia-Reliz association (Sg). These soil types are described below.

<u>SfD - Santa Lucia shaly clay loam, 2 to 15 percent slopes.</u>

This is an undulating to rolling soil on ridge tops and foot slopes or in narrow valleys. It has a profile similar to the one described as representative of the series, but depth to shale typically is 20 to 40 inches. Slopes are mostly about 9 percent. Runoff is medium, and the erosion hazard is moderate. Roots can penetrate to a depth of 20 to 40 inches. The available water capacity is 2 to 5.5 inches. This soil is used mostly for dry-land grain and range.

<u>SfE - Santa. Lucia shaly clay loam, 15 to 30 percent slopes.</u>

This is a moderately steep soil on uplands. Slopes are mostly about 20 percent. Included with this soil in mapping were small eroded areas. Runoff is medium, and the erosion hazard is moderate. Roots can penetrate to a depth of 20 to 40 inches. The available water capacity is 2 to 5.5 inches. This soil is used for range and dryland grain and for homesites or building sites.

<u>SfF - Santa Lucia shaly clay loam, 30 to 50 percent slopes.</u>

This is a steep soil on uplands. It has the profile described as representative of the series. Slopes are mostly greater than 45 percent. Included with this soil in mapping were areas of Lopez, Gazos, and Reliz soils making up about 10 to 15 percent of the acreage, and some Santa Lucia soils that have slopes of less than 30 or more than 50 percent. Also included were soils that have a light brownish gray surface layer and a light yellowish brown subsoil; soils that are very similar to Santa Lucia soils, but less than 20 inches deep to bedrock; soils that are neutral to mildly alkaline or very strongly acid; and some soils on which sheet or rill erosion is moderate.

Runoff is rapid, and the erosion hazard is high. Roots can generally penetrate to a depth of 20 to 40 inches, but some roots extend into the fractured shale. The available water capacity ranges from 2 to 5.5 inches, depending on the amount of shale fragments in the soil.

Sg - Santa Lucia / Reliz association.

The steep and very steep soils in this association are on uplands. Slopes are 30 to 75 percent. Santa Lucia soils make up 35 percent of this association and Reliz soils 25 percent. Santa Lucia soils are in areas that have a northern exposure, and Reliz soils are on ridge tops or in areas that have a southern exposure. Lopez soils on ridge tops and on side slopes that have a southern exposure make up 20 percent of the association. The rest consists of areas of Chamise, Gazos, Nacimiento, San Benito, and Los Osos soils and rock outcrop; some areas that have slopes of less than 30 percent or more than 75 percent; and some areas on ridge tops, that have a surface layer of pale brown, strongly acid shaly clay loam 3 inches thick and a subsoil of light yellowish brown, very strongly acid shaly clay loam underlain by fractured shale at a depth of about 15 inches. These inclusions are commonly severely eroded.

The Santa Lucia soil has an available water capacity of 2 to 5.5 inches, and roots can penetrate to a depth of 20 to 40 inches. Runoff is rapid or very rapid, and the erosion hazard is very high. The soils in this association are used for wildlife habitat and watershed. A few areas are used for rangeland for stock.

2.4.2 Lockwood series

The Lockwood series consists of well-drained soils that formed in alluvium that was derived from siliceous shale. These soils are on alluvial fans and inland and coastal terraces. These soils rest on slopes of 0 to 15 percent. The vegetation is mainly annual grasses and a few thick stands of buckwheat and chamise and a few scattered oaks. The Lockwood series is generally located at elevations of 70 to 1,200 feet, mean annual precipitation of 12 to 35 inches, the mean annual air temperature of 57° to 60° F, and the frost-free season of 150 to 350 days. Summers where Lockwood soils are found are hot and dry inland; winters are generally cool and moist.

In a representative profile, the surface layer is gray, very strongly acid to neutral shaly loam about 26 inches thick. The subsoil is gray, neutral shaly heavy loam and brown, mildly alkaline shaly clay loam that extends to a depth of 82 inches. The substratum is pale brown, mildly alkaline loam to a depth of 86 inches or more. Permeability is moderately slow. Roots penetrate to a depth of more than 60 inches.

Lockwood soils are used mostly for irrigated field and row crops. Some areas are used for apricots, walnuts, and alfalfa and for dryland grain, irrigated pasture, and annual range as well as for recreation and wildlife habitat. Lockwood soil mapped at the September Ranch site is the Lockwood shaly loam on 2 to 9 percent slopes (LeC on the Site Soils Map)

<u>LeC-Lockwood shaly loam, 2 to 9 percent slopes.</u>

This is a gently sloping to moderately sloping soil on alluvial fans and terraces. It has a profile similar to the one described as representative of the series, but the surface layer is shaly clay loam in some places. Slopes are mostly 5 percent. Included with this soil in mapping were small areas of Lockwood shaly loam, 0 to 2 percent slopes. Also included were areas of Fluvents, Stony, and Elder, Gazos and Pacheco soils; some rock outcrops; and areas where slopes are as steep as 30 percent. The soils are black, slightly acid, shaly and very shaly loams that are underlain by brown very gravelly sandy loam. They contain 45 to 50 percent gravel and 10 to 20 percent cobbles. The available water capacity is 6 to 8 inches. Run-off is slow or medium, and the erosion hazard is slight or moderate. This soil is used mostly for field crops, walnuts, apricots or alfalfa.

2.4.3 Chualar Series

The Chualar series consists of well-drained soil that formed in alluvium derived from granitic and schistose rocks on alluvial fans and terraces on slopes of 0 to 9 percent. The vegetation consists of annual grasses, shrubs and a few scattered oaks. The soil is located at elevations up to 2,000 feet where mean annual precipitation is 12 to 25 inches, the mean annual air temperature is 57 to 60 F, and the frost-free season is about 250 days. Soil summers are warm and dry.

In a representative profile, the surface layer is dark grayish brown mildly alkaline loam and sandy loam about 21 inches thick. The subsoil extends to a depth of 59 inches. The upper 34 inches is yellowish brown and brown neutral to moderately alkaline sandy loam, sandy clay loam, and fine gravelly sandy loam. The lower 4 inches is brown, neutral fine gravelly coarse sandy loam. The substratum is brown, neutral gravelly coarse sand that extends to a depth of at least 80 inches. Permeability is moderately slow, and the available water capacity is 7.5 to 9 inches. Roots penetrate to a depth of more than 60 inches. Chualar soils are used mostly for irrigated row and field crops. They are also used for irrigated pasture, dryland grain, or range. Chualar soil mapped at September Ranch is CbC-Chualar loam on 5 to 9 percent slopes (CbC, Site Soils Map)

CbB - Chualar loam, 5 to 9 percent slopes.

This is a moderately sloping soil on fans and some terraces. It has a profile similar to the one described as representative of the series, but the surface layer is loam to light sandy clay loam that is commonly 10 to 20 inches thick and ranges from 9 to 40 inches. The subsoil is generally 20 to 36 inches thick, but ranges from 5 to 36 inches. The substratum varies considerably over short distances; and below a depth of 40 inches this soil, in places, is underlain by gravel, cobbles, or clay deposits. Slopes are mostly 9 percent. Included with this soil are some small areas that have a strongly acid or medium acid subsoil and substratum, and some areas that have slopes of less than 5 percent or of 9 to 15 percent. Some areas of rill and sheet erosion and a few gullies were also included. Runoff is medium, and the erosion hazard is moderate. This soil is used mostly for dryland grain and range.

2.4.4 Pico series

The Pico series consists of well-drained soils that formed on flood plains in alluvium derived from sedimentary rocks on slopes of 0 to 2 percent. The vegetation is mainly annual grasses and a few scattered coast live oaks. The elevation is commonly 50 to 100 feet, but ranges to 1,700 feet in some narrow valleys. The mean annual precipitation is 10 to 14 inches, the mean annual air temperature is about 58° F, and the frost-free season is about 235 days. Summers are warm and dry.

In a representative profile, the surface layer is grayish brown, mildly alkaline and moderately alkaline fine sandy loam about 18 inches thick. The underlying material is light brownish gray and pale brown, strongly calcareous stratified fine sandy loam, silty clay loam, sandy loam, very fine sandy loam, and sand that extends to a depth of 72 inches or more. Permeability is moderately rapid, and the available water capacity is 7.5 to 9 inches. Roots penetrate to a depth of more than 60 inches. Pico series mapped at the site is Pico fine sandy loam (Pf, Site Soils Map)

Pf – Pico fine sandy loam

This is a nearly level soil on flood plains. It has the profile described as representative of the series. Included with this soil in mapping were areas of Metz soils making up about 15 percent of the acreage. Small areas of Mocho, Salinas, Pacheco, and Tujunga soils also were included. If runoff is slow, and the erosion hazard is slight. If left exposed during periods of high winds, the soil is subject to some soil blowing. Some areas are used for dryland grain and pasture.

2.4.5 Xerorthents, dissected.

These are steep to extremely steep soils on bluffs along major rivers, on steep escarpments of fans and terraces, and on the banks of deeply entrenched streams and gullies that have narrow bottoms. Slopes are typically 50 to 65 percent, but range from 35 to 90 percent. The elevation ranges from 200 to 2,500 feet. The annual precipitation ranges from 12 to 40 inches. The vegetation consists of sparse annual grasses and forbs, brush, and some scrub oaks and digger pine.

These soils consist mostly of unconsolidated or weakly consolidated alluvium that commonly contains pebbles, and cobbles. Textures are mostly sandy loam or coarse sandy loam and are gravelly or cobbly. The banks are commonly moderately eroded and have areas of severe erosion. The potential for erosion and deposition of soil material is high.

Included in mapping were small areas of Santa Lucia soils. Some areas of rock outcrop and areas where the indurated substratum is exposed were included along the banks. Runoff is rapid and very rapid, and the erosion hazard is high or very high. Drainage, subsoil permeability, depth of the root zone, and available water capacity all vary within short distances.

This land is used for watershed, wildlife habitat, and annual range for limited grazing. Some areas are used for building sites. There is a potential hazard of sediment deposition onto adjacent roads and land

2.5 DRAINAGE

Drainage courses at the site are the result of surface-water erosion controlled by relatively uniform bedrock. The central September Ranch canyon is incised by a typical dendric drainage pattern. The Drainage Map, Plate 9, for the project site depicts primary watercourses along with secondary and a few tertiary drainages. Generally, drainage courses at the site are irregular only where they have been interrupted by local deep-seated landslides such as in the northwest and northeast property corners. The absence or low number of tertiary drainages at the scale shown on Plate 9 suggests that the geomorphic features at the site are probably geologically young and downcutting is still adjusting to the latest sea-level change. Section 2.2.3 above further discusses drainage patterns at the project site.

For the most part, drainage courses on site are free flowing and are not choked with vegetation or debris. Observed channel bottoms were composed of sandy or clayey soil with little gravelly surface material. Surface water generally flows relatively unimpeded to the terrace deposit lying adjacent to the base of the ridges.

2.5.1 1998 Flood Event

In February 1998, a record rainfall of 18.14 inches was recorded at San Clemente Dam near Carmel Valley Village. The next highest monthly rainfall was 16.05 inches recorded in January 1995. The average rainfall for February is 4.16 inches. The total amount of streamflow that flowed under the Highway One Bridge and into the Pacific Ocean in February 1998 was estimated at nearly 150,000 acre-feet, breaking the old record of 135,000 acre-feet in March 1983. The average amount of streamflow in February at the Highway One Bridge is 16,500 acre-feet. In comparison, water use for the entire Monterey Peninsula in 1999 was less than 20,000 acre-feet (MPWMD, 1998).

The February 3, 1998 flood event peaked at over 11,000 cubic feet per second, or nearly 5 million gallons per minute of flow. This flood event was similar to the January 1995 flood event in terms of Carmel River flow. However, tributaries draining from the Rancho San Carlos area were at record levels in February 1998 due to very heavy rainfall over the local coastal mountains (MPWMD, 1998).

The 36-mile-long Carmel River flows from the Santa Lucia and Sierra de Salinas Mountains through steep ravines and canyons, winds through the Carmel Valley, and joins the Pacific Ocean just south of Carmel. As agriculture was developed at the Carmel River mouth, the floodplain was drained and filled, water was diverted, wells were dug, and the river was confined by levees in a narrow artificial channel.

The fertile soils of the floodplain nurtured both livestock and vegetables. Later, as dams were built upstream to store water for human uses, the summer flow in the lower river and the lagoon diminished. Houses were built just north of the lower river. In the past, major floods, like those of 1862 and 1911, merely enriched the soil of the floodplain. Now, when water overflows or breaches the levees, repairs cost millions of dollars (Arnold, 1998). According to Tim Greenwald, the superintendent at Rancho Cañada golf coarse, the 1998 flood washed away 80,000 cubic yards of soil from the 12th fairway alone and covered 60 percent of the course in silt (Williams, 2000).

2.5.2 Watersheds

Three watersheds are imprinted on the September Ranch property. The central canyon of the ranch ranges from an elevation of about 1,000 feet at a point about 2,000 feet north of the ranch's north property line to about 140 feet at Qt_1. This canyon, referred to by Todd (1992) as the September Ranch watershed, occupies about 570 acres (Drainage Map. Plate 9). The Roach Canyon watershed, which predominately lies west and northwest of the ranch, is about 944 acres. The Canada De La Segunda watershed, which predominately lies east and southeast of the ranch, is about 1,867 acres (Todd, December 1992).

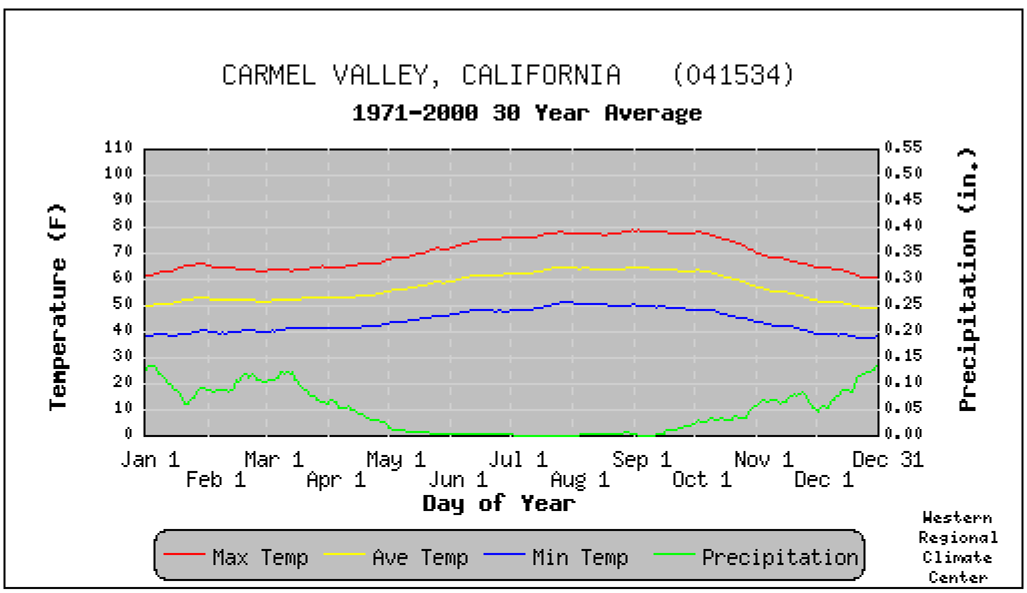
2.5.3 Recharge

The Mediterranean climate of Carmel Valley is typically wet in winter and dry in summer. Precipitation, surface and subsurface drainage from the September Ranch watershed (which is sourced from precipitation), and possibly underflow from the Carmel River aquifer are the only known sources of recharge to the groundwater to the September Ranch terrace. The following table and chart give 30-year precipitation averages which are probably similar to that at September Ranch.

CARMEL VALLEY, CALIFORNIA (041534)
PERIOD OF RECORD MONTHLY CLIMATE SUMMARY
PERIOD OF RECORD: 1/ 1/1959 TO 6/30/1978

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Total Precipitation (in.)	3.65	3.05	2.60	1.48	0.29	0.10	0.03	0.09	0.20	0.64	2.32	2.82	17.26

Source: Western Regional Climate Center, wrcc@dri.edu



Data are smoothed using a 29-day running average.

This above data are provided by NCDC Station Listing for NWS Cooperative Network located at the north end of the Carmel Valley landing strip: Latitude: 36°29'West, Longitude: -121°44'North, and elevation: 430 feet. This station is about 7.5 miles southeast of September Ranch and should present a conservative precipitation range. September Ranch is about 3¼ miles from the Pacific Ocean and is probably influenced more than the Carmel Valley area by weather including fog from the west.

3.0 HYDROGEOLOGIC CONDITIONS

A discussion of specific hydrogeologic conditions that effect September Ranch along with suggestions for additional studies to increase the geologic understanding of the site are provided below.

3.1 ROACH CANYON AND CANADA DE LA SEGUNDA

The narrow ribbons of recent alluvium in Roach Canyon and Canada De La Segunda are inferred by Todd (December 1992) to have limited groundwater storage and availability. However, it is noted that these narrow canyons bounding September Ranch both have significantly larger watersheds than the drainage area that contributes to the September Ranch aquifer. If the argument is advanced that the September Ranch aquifer is independent of and isolated from the Carmel Valley aquifer (Todd, December 1992) then its water source would be limited to the approximately 570 acre watershed extending through the approximate center of September Ranch (Drainage Map, Plate 9). The Roach Canyon watershed is about 944 acres and the Canada De La Segunda watershed is about 1,867 acres (Todd, December 1992). Assuming approximately equal watershed characteristics, these two narrow canyons together should generate about 4.5 times as much water as the watershed that supplies the September Ranch aquifer. These recent alluvial deposits may be beneficial sources of water.

3.2 ESCARPMENT BETWEEN THE SEPTEMBER RANCH TERRACE AND THE CARMEL VALLEY

The escarpment between the September Ranch terrace and the Carmel Valley alluvium extends from west of the Knoll adjacent to the southwest margin of the September Ranch terrace (Plate 1) to the southeast limit of the terrace near Canada De La Segunda (Plate 7, Cross Section B-B'). The top of the Knoll is mantled with terrace deposit (Qt_1, Plate 3). The origin of this escarpment is speculative and has been discussed by Todd (December 1992) and others. Generally, the presence of a Monterey-bedrock high exposed in the south flank of the Knoll suggests that there may have been uplift of this area along a fault extending through the approximate axial-center of the September Ranch terrace. The uplift of Monterey bedrock forming the escarpment and presence of terrace material on top of the Knoll support both the presence of and Holocene age of the Hatton Canyon fault.

3.3 CARMEL VALLEY ALLUVIUM CORRELATION WITH THE SEPTEMBER RANCH TERRACE

The area along the southwest portion of September Ranch between the mouth of Roach Canyon and the Knoll south of the ranch property is mapped as Holocene Alluvium (Qal) of the Carmel Valley. From a geomorphic perspective, based on the coalescing elevations of the Carmel Valley alluvium and the north portion of the September Ranch terrace ($Qt_{1,}$), these two features appear to interfinger north of the Knoll. This correlation is also suggested by a linear south to north progression of Cross Sections (Plate 7) along the September Ranch terrace. It is therefore concluded that groundwater southwest of the mapped trace of the Hatton Canyon fault, in part, may be sourced from the Carmel Valley aquifer.

Water derived from the September Ranch watershed may be restricted (or partially restricted, depending on the elevation and permeability of the fault plane) in the narrow strip of terrace deposit northeast of the Hatton Canyon fault.

3.4 THE SEPTEMBER RANCH LANDSLIDE AND TERRACE DEPOSIT

The partially indurated landslide deposit at the south end of the September Ranch terrace (Qls_1, Plate 3) may provide clues to the origin of the geomorphic character of the area in the vicinity of September Ranch. There are no landslide deposits mapped on September Ranch that would have sourced the Qls_1 landslide material and there are numerous landslides mapped south of Carmel River. (It is understood that an opposing argument would state that the source of the Qls_1 landslide material may have eroded without a trace.)

It has been suggested (Todd, December 1992) that a large landslide originated on the hillslopes on the south side of the river and swept across the river valley and shut off most of the river's flow. A landslide of such size could have occurred in Pleistocene time when the climate was wetter. The Carmel River (or a tributary, perhaps the stream of Canada de la Sugunda) may have occupied the narrow channel between the toe of the Qls_1 landslide and the eroded bank exposing

Monterey shale north of the landslide. During the time of this hypothetical constriction of the river in the narrow channel, the alluvium of the September Ranch terrace was deposited. Later, the river breeched the landslide dam and reestablished itself at a somewhat lower elevation abandoning the September Ranch terrace.

3.5 WELLS AT SEPTEMBER RANCH

If the September Ranch wells are southwest of the fault trace as shown on the Site Geologic Map (Plate 3), then they would probably be in hydrologic contact with the Carmel River aquifer through the northwest part of the QT_1 terrace deposit. Vertically exaggerated Cross Sections B – B’ and C – C’ (Plate 7) indicate that the presence of uplifted Monterey rock south of the Hatton Canyon fault would act as a groundwater barrier. Cross Section E – E’ (Plate 7), located near the north end of the September Ranch terrace suggests that the terrace deposit is in hydrologic communication with alluvium of Carmel Valley. However, depending on the height of the bedrock uplift along Cross Section E – E’, a partial barrier may be present that would be observed during pumping when groundwater is low.

Whether or not the Hatton Canyon fault would act as a groundwater barrier would depend, in part, on how active the fault is relative to the age of the terrace deposit materials. That is, if the fault offsets the terrace deposit, it could form a barrier or a leaky barrier. However, if the fault has not experienced movement since deposition of the terrace material, it would not extend upward into the alluvium and would not be a groundwater barrier. Rosenberg and Clark (1994) and Clark and others (1997) indicate that northwest of September Ranch Hatton Canyon fault offsets materials dated at about 2,080 years B.P. This age suggests that the fault may offset the September Ranch terrace. However, to our knowledge, there are no data available at present that directly supports a conclusion of faulting in the September Ranch terrace.

3.6 ADDITIONAL INVESTIGATION

Todd Engineers (27 February, 1985) reported that an unused well known as the Old Hatton well was located in the middle of the September Ranch terrace. The well was replaced by the SR1 well in September 1990. The Old Hatton well, according to Todd (27 February 1990), was drilled by Mr. Roy Alsop Sr., of Salinas in 1931 and initially produced 1,000 gpm of potable water. Cal-Am reportedly bought water from this well during periods of drought when the wells in the Carmel Valley river alluvium were dry. When water was purchased in about 1966 the Old Hatton well produced 400 gpm (Thorup, 1977). This observation suggests the Old Hatton well is hydrologically independent from the Carmel Valley wells. This should be examined by review of the original pumping data referenced by Thorup (1977).

The location of the Hatton Canyon fault in the September Ranch terrace should be further investigated to delineate its precise location and its relative position with respect to the wells at September Ranch. Because the fault may be located at a depth that cannot economically be reached by exploratory trenching, magnetometer or seismic-refraction surveys should be considered. A magnetometer survey detects changes in the magnetic field associated with offset materials and changes in elevation of water at depth. A seismic-refraction traverse can show an abrupt change in groundwater depth that may indicate the location of a fault barrier. Neither of these geophysical methods is invasive and both are well suited for the terrain of the September Ranch terrace.

3.7 SUMMARY

Recent geologic history recorded in the rocks and sediments in the vicinity of September Ranch is complex and subject to multiple interpretations. Possible deformation and uplift of Holocene deposits, active faulting and a complex fluvial history of the Carmel River add to the complexity of the region.

The Hatton Canyon fault is observed at the north and south extents of September Ranch terrace (Site Geologic Map). The fault is characterized as an active, up-on-the-south, steeply dipping, strike-slip fault (Clark and others, 1997, Rosenberg and others, 1994). The presence of Monterey bedrock, possibly deformed terrace deposit, and escarpment along the southwest and south sides of the September Ranch terrace are potentially the result of Holocene movement of a splay of the Hatton Canyon fault. The Hatton Canyon fault and Monterey bedrock beneath the September Ranch terrace probably act as a groundwater barrier between the southwest and south portions of the terrace and the Carmel River aquifer. The absence of a bedrock high and the geomorphic coalescing surfaces in the northwest portion of the terrace suggests that groundwater in that part of the terrace communicates with the alluvium in the Carmel River Valley. From a geologic perspective, groundwater in the September Ranch terrace appears to sourced from 1) direct infiltration of rainwater, 2) the 570-acre September Ranch watershed north of the terrace and 3) underflow from the Carmel River aquifer. Groundwater in the September Ranch terrace east of the Hatton Canyon fault may be restricted to the east portion of the terrace by a fault barrier. The precise location and degree of permeability of the fault plane is not presently known.

4.0 ENVIRONMENTAL IMPACTS AND MITIGATION

4.1 SIGNIFICANCE CRITERIA

The following significance criteria for the hydrogeologic project setting were formulated based on the findings of the geologic portion of this investigation reported herein, *State CEQA Guidelines*, professional judgment, and knowledge of the project area. From a perspective geologic conditions specifically related to this study, the proposed project would result in a significant effect on the environment if it would result in:

- Interruption of significant amounts of surface water from the September Ranch watershed to infiltration into the Carmel River Valley alluvium;
- Interruption of groundwater underflow from the September Ranch aquifer to the Carmel Valley aquifer;
- Accelerated erosion, resulting in a substantial reduction in on-site soil productivity, revegetation potential, or siltation/sedimentation of receiving waters;
- Exposure of people or property to slope-failure-related hazards such as landslides, debris flows, or other ground failures; or
- Substantial change in topography or ground surface relief features.

These potential effects are addressed in the following Sections.

4.1.2 Impact: Interruption of surface water from the September Ranch watershed to infiltration loci in the Carmel River Valley alluvium

Groundwater that is not consumed by plants, infiltration, or evaporation currently flows overland from the highlands in the north portion of September Ranch to the Carmel River. However, based on the virtual absence of stream-channel incision on the September Ranch terrace, it is inferred that only minor quantities of surface water complete the journey to the river. Because only small amounts of surface water would, under natural conditions, reach Carmel River from September Ranch, as observed from geomorphic evidence covering a period of more than the last 11,000 years (Holocene Age), the potential for added degradation of recharge water to the Carmel River due to development of the project site is considered less than significant.

Mitigation: None required

4.1.3 Impact: Interruption of groundwater underflow from the September Ranch aquifer to the Carmel Valley aquifer

Low permeability Monterey Formation, exposed at the base of the embankment along the south and southwest margin of the September Ranch terrace, and the mapped Hatton Canyon Fault bisecting the terrace deposit, probably act as groundwater barriers and limit the amount of groundwater that is transmitted to the Carmel Valley Aquifer from the area of September Ranch. Groundwater may move between the Carmel Valley Aquifer and the September Ranch terrace deposit near the northwest portion of the terrace where these barriers appear to be absent. However, based on the interpreted subsurface conditions, it is inferred that only limited amounts of water moves from one groundwater system to the other because of the subsurface barriers. Again, based on the probable presence of restrictive, natural groundwater barriers, over drafting of the terrace deposit aquifer at September Ranch probably would have little or no affect on groundwater in the Carmel Valley Aquifer. The potential for added degradation of groundwater source for the Carmel Valley Aquifer due to development of the project site is considered to be minimal and not significant.

Mitigation: None required

4.1.4 Impact: Accelerated erosion, resulting in a substantial reduction in on-site soil productivity, revegetation potential, or siltation/sedimentation of receiving waters

Under natural conditions, potential for soil erosion from channalized flow or sheet wash across the September Ranch property is classified as moderate to high. In the absence of more detailed site-specific information, the County shall use the Natural Resources Conservation Service's Soil Survey of Monterey County in determining the suitability of soil for particular land uses. The County shall require the developer to prepare and implement erosion-control and landscape plans for the September Ranch development project. The plans shall be prepared by a registered civil engineer or certified professional in the fields of erosion and sediment control and shall be subject to approval of the public works director for the County. The erosion component of the plan must at least meet the requirements of Storm Water Pollution Prevention Plans (SWPPPs) required by the California State Water Resource Control Board.

Through site monitoring, the County shall ensure that all measures included in the developer's erosion control and landscape plans are properly implemented. The County shall designate areas with severe soil limitations by erosion, for open space or similar use if adequate measures cannot be taken to ensure the structural stability of these soils. This shall be designated at the project-specific level though a geotechnical study. Because these policies and programs require the analysis of soil and slope conditions prior to development and are based on findings presented in the geotechnical report, the implementation of measures to prevent erosion, and the exclusion of development in areas where adequate measures shall be taken to ensure the structural stability of soils and slopes, this impact is considered less than significant.

Mitigation: None required

4.4.5 Impact: Exposure of people or property to slope-failure-related hazards such as landslides, debris flows, or other ground failures

Before issuing a grading permit, the County shall require that a geotechnical report be prepared and peer reviewed for the proposed development that will include discussions of soils that have limitations as substrates for construction or engineering purposes, including limitations concerning slope stability and soils that have low-strength and shrink-swell potential. The County shall require that engineering and design techniques be recommended and implemented to address these limitations. Development design and resources within the proposed development area that may be used to offset impacts associated with slope-failure-related hazards shall be considered in the preparation of the geotechnical report and the County shall ensure that such resulting designs are implemented during development of the site. Because such hazards shall be mitigated during site development, this impact is considered less than significant.

Mitigation: None required

4.4.6 Impact: Substantial change in topography or ground surface relief features.

The County shall require that grading plans be submitted to the County's geotechnical reviewer. The grading plans shall be reviewed and approved by a Certified Engineering Geologist and Registered Geotechnical Engineer as conforming with the geotechnical report and County grading requirements. Because grading shall be required by the County to meet County requirements adverse impact to topography shall be mitigated during site development, this impact is considered less than significant.

Mitigation: None required

As a consequence of proposed September Ranch project implementation, no significant impacts with respect to be above described issues are anticipated. The impacts analysis may change should modifications of the proposed project become inconsistent with County, State or other regulations.

5.0 LIMITATIONS

This investigation excludes the assessment of environmental, geotechnical, or geologic-hazard characteristics. Services such as chemical analysis of soil and groundwater or evaluation of development characterization including landslide and fault activity were not included in our scope of services.

This report may be used only by Michael Brandman Associates and by members of the project design team, and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than Michael Brandman Associates and its design team who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the clients or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

The conclusions in this report are for the revised EIR report as described in the text of this report. Our field reconnaissance does not provide a warranty as to the conditions that may exist beneath the entire site. It is possible that variations in soil conditions and depth to bedrock and groundwater could exist at the site and may require additional studies, consultation, and possible design revisions.

6.0 REFERENCES

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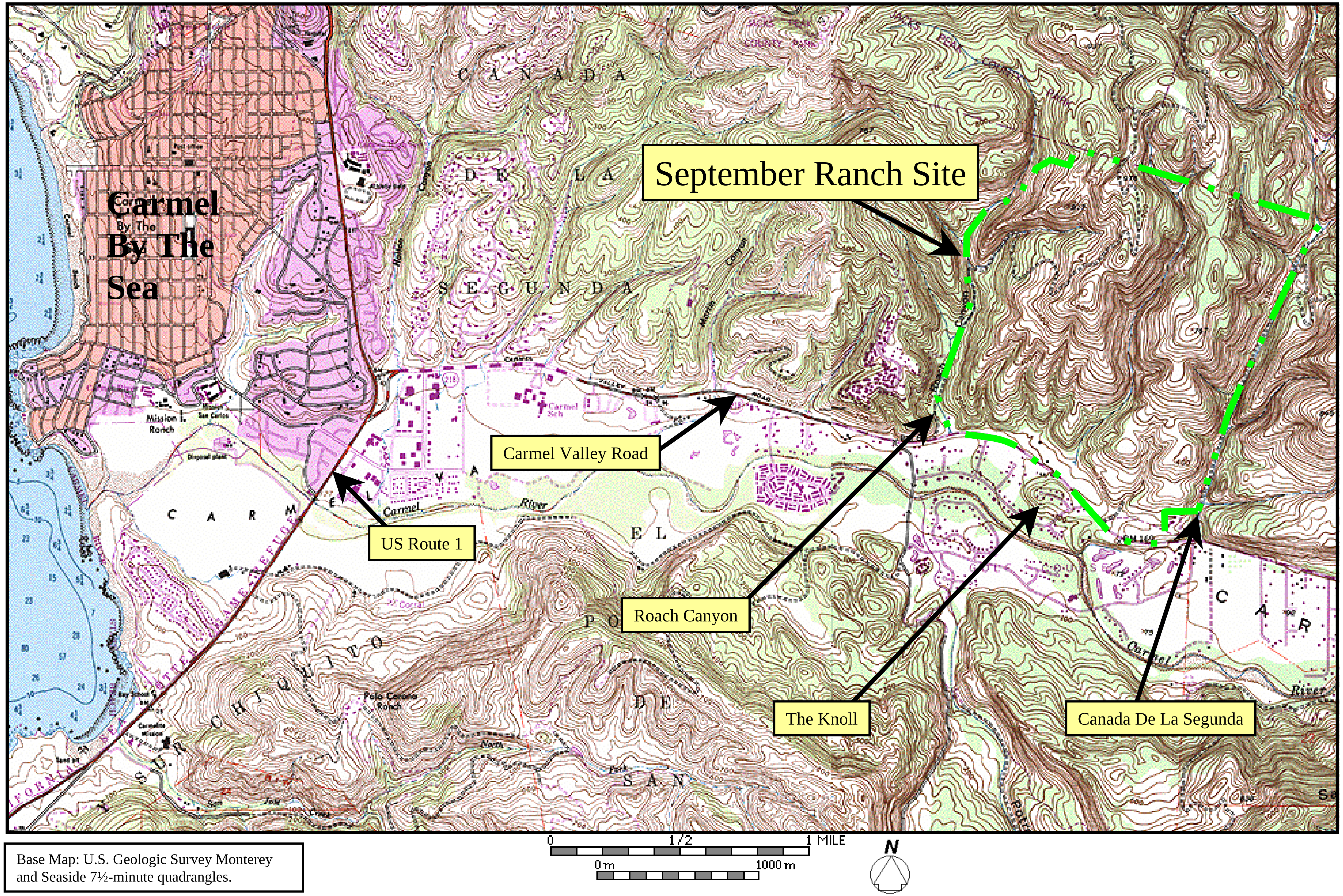

Base Map: U.S. Geologic Survey Monterey and Seaside 7½-minute quadrangles.

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Site Vicinity Map

September Ranch
Carmel Valley, California

PLATE

1

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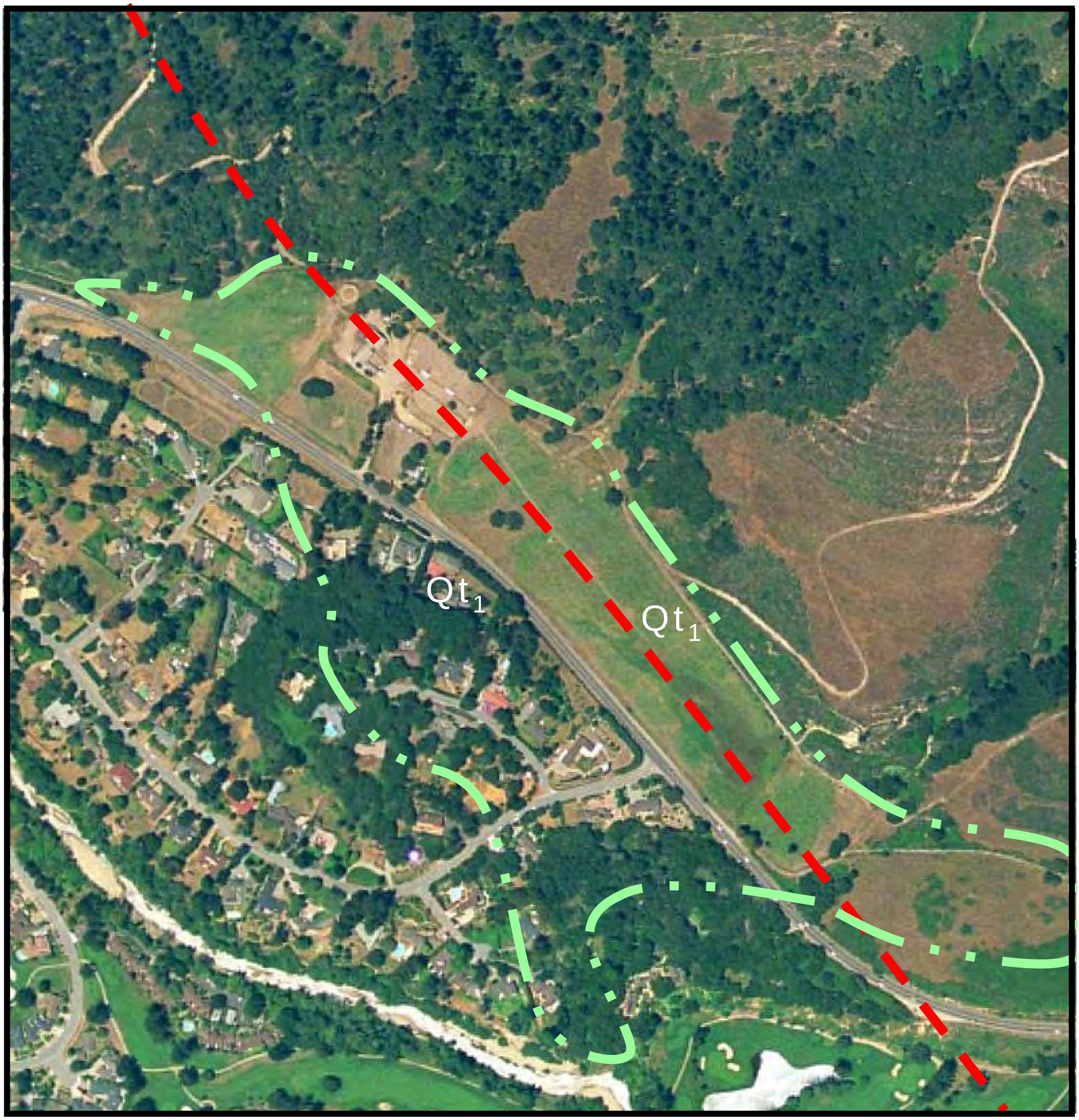

Appx. Scale
hundred feet
0 2 4 6 8

N

Original in Color

Approximate aerial extent of younger terrace deposit (Qt_1)
Approximate trace of Hatton Canyon fault

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Site Aerial Photograph

September Ranch
Carmel Valley, California

PLATE 2

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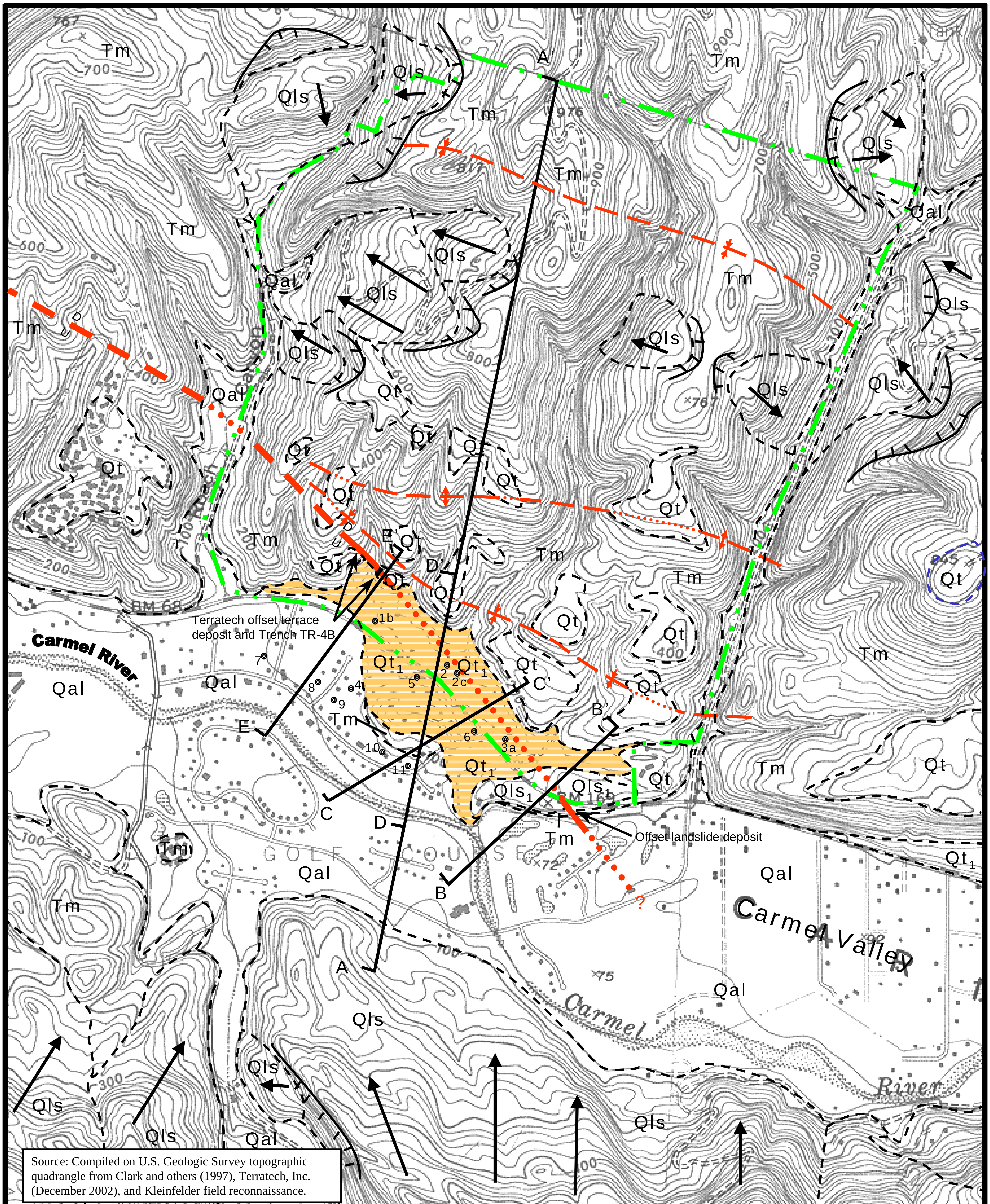

Scale (hundred feet)

0 4 8 12 16

Original in color

Original scale: 1 in. = 800 ft.

⊚ Well Id. Nos

1b	Well B (Todd, May 1993)
2	Old Hatton well (Todd, May 1993)
2c	Well C (Todd, May 1993)
3a	Well A (Todd, May 1993)
4	Stein well
5	Tarantino well
6	Campisi well
7	Hahs well
8	Chaplin well
9	Ask well
10	Avila well
11	Stewart well

Geologic Units

Qal	Alluvial deposits (Holocene)
Qt_1	Young Terrace deposits (Quaternary)
Qt	Older Terrace deposits (Quaternary)
Qls	Landslide deposits (Quaternary)
Tm	Monterey Formation (Miocene)

Map Symbols

- September Ranch Property Line
- E – E' Line of Cross Section (Shown on Plate x)
- Geologic contact, approximately located
- D / U ? Fault, dashed where approximate, dotted beneath younger unbroken material, queried where uncertain, U on upthrown side, D on downdropped side
- Anticline, approximately located, dotted beneath younger unfolded material
- Syncline, approximately located, dotted beneath younger unfolded material
- Direction of landslide movement
- Landslide escarpment

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Site Geologic Map

September Ranch
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PLATE 3

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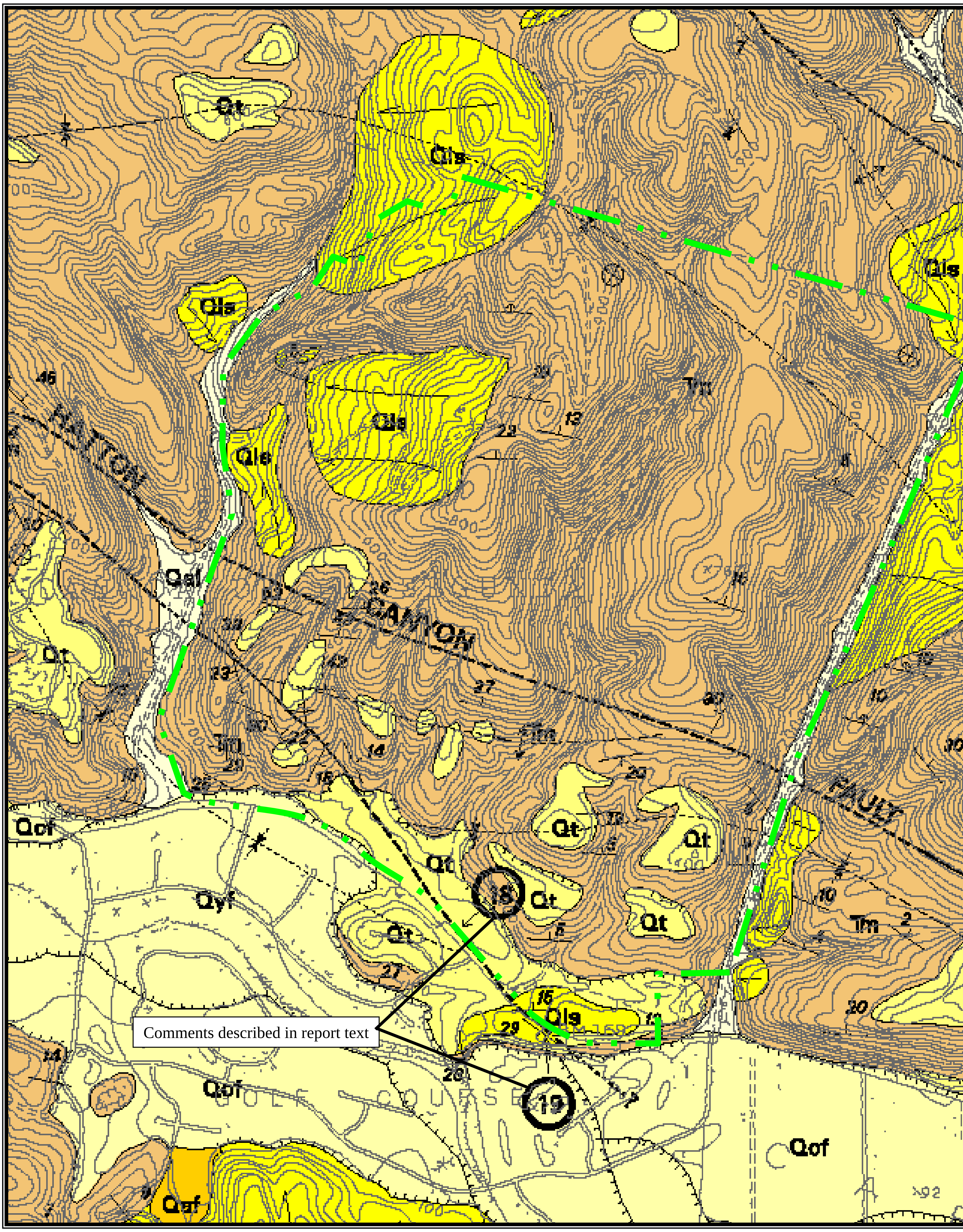

Base Map, Portion of: Clark, C.C., Dupré, W.R., Rosenberg, L.I., 1997, Geologic Map of the Monterey and Seaside 7.5-Minute Quadrangles, Monterey County, California: A Digital Database, U.S. Geologic Survey, Open-File 97-30

N

Scale

0 500 1000 1500 2000

Feet

Explanation

(green dashed line)	September Ranch property line	Qal	Alluviual deposits (Holocene)
(hachured line)	inner edge of terrace deposit	Qyf	Younger flood-plain deposits (Holocene)
22	strike and dip of beds	Qof	Older flood-plain deposits (Holocene)
(arrows)	axis of syncline and anticline	Qt	Terrace deposits (Pleistocene)
(heavy line)	Hatton Canyon Fault	Qls	Landslide deposits (Quaternary)
		Tm	Monterey Formation, porcelanite (Miocene)

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Vicinity Geologic Map

September Ranch
Carmel Valley, California

PLATE

4

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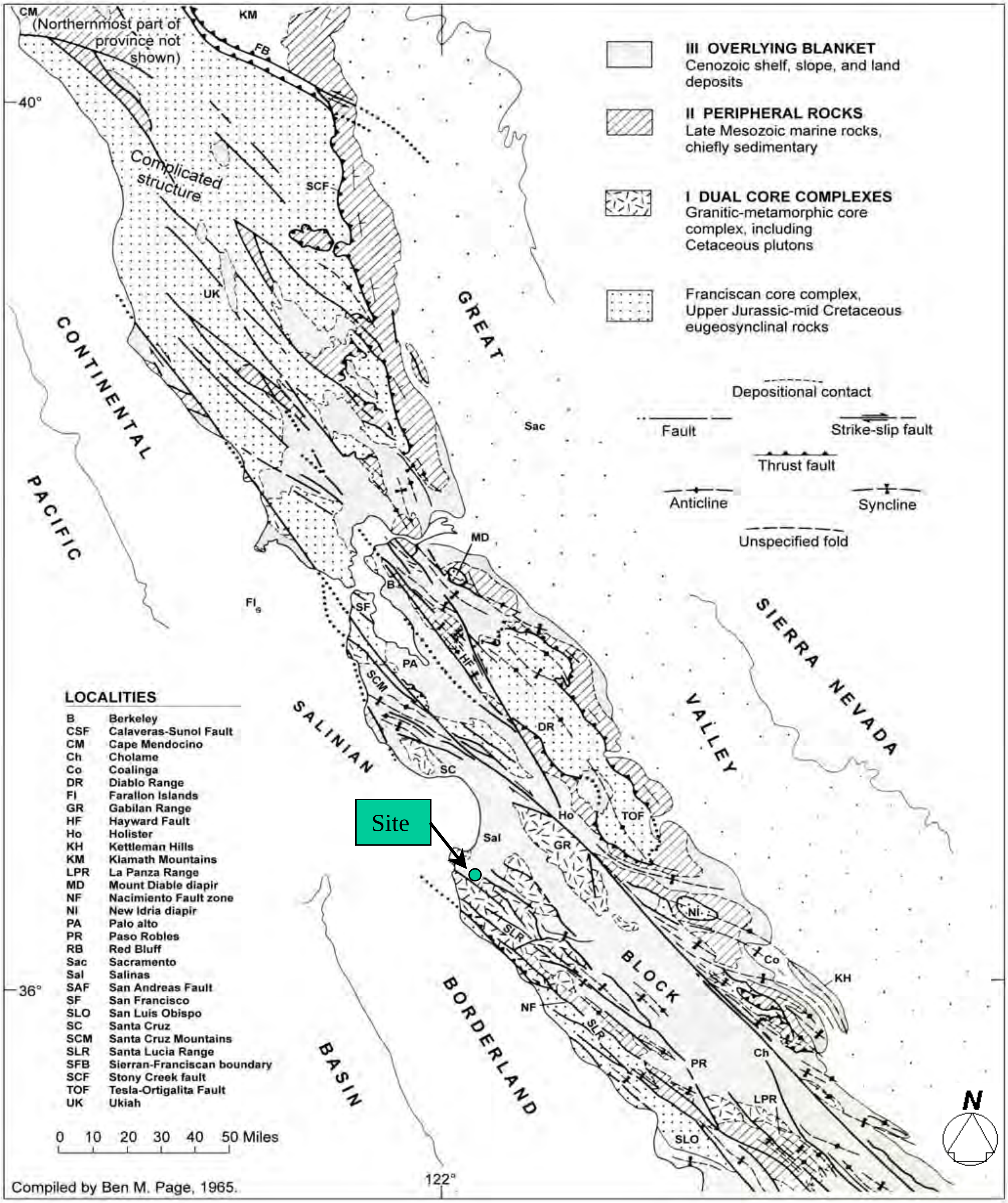

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Regional Geologic Map

September Ranch
Carmel Valley, California

PLATE
5

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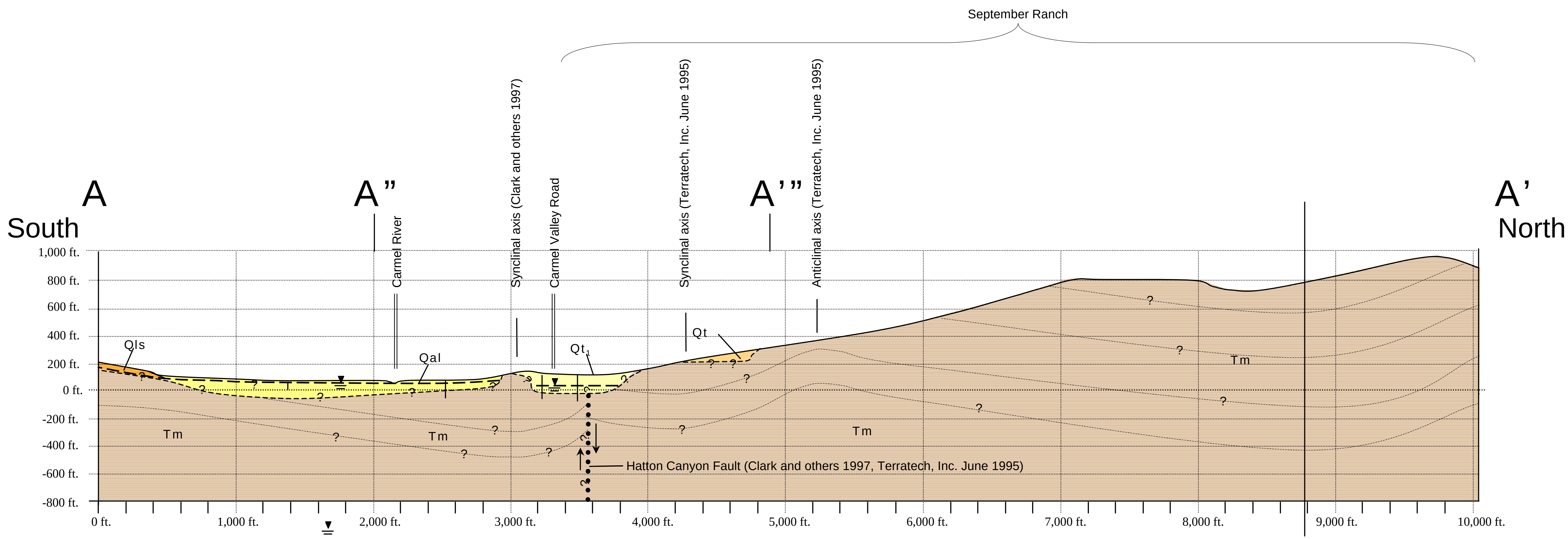

Explanation

▼	Water table
Qal	Alluviun (Holocene)
Qls	Landslide (Quaternary)
Qt_1	September Ranch terrace (Quaternary)
Qt	Terrace deposit (Quaternary)
Tm	Monterey Formation (Miocene)

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Geologic Cross Section

September Ranch
Carmel Valley, California

PLATE 6

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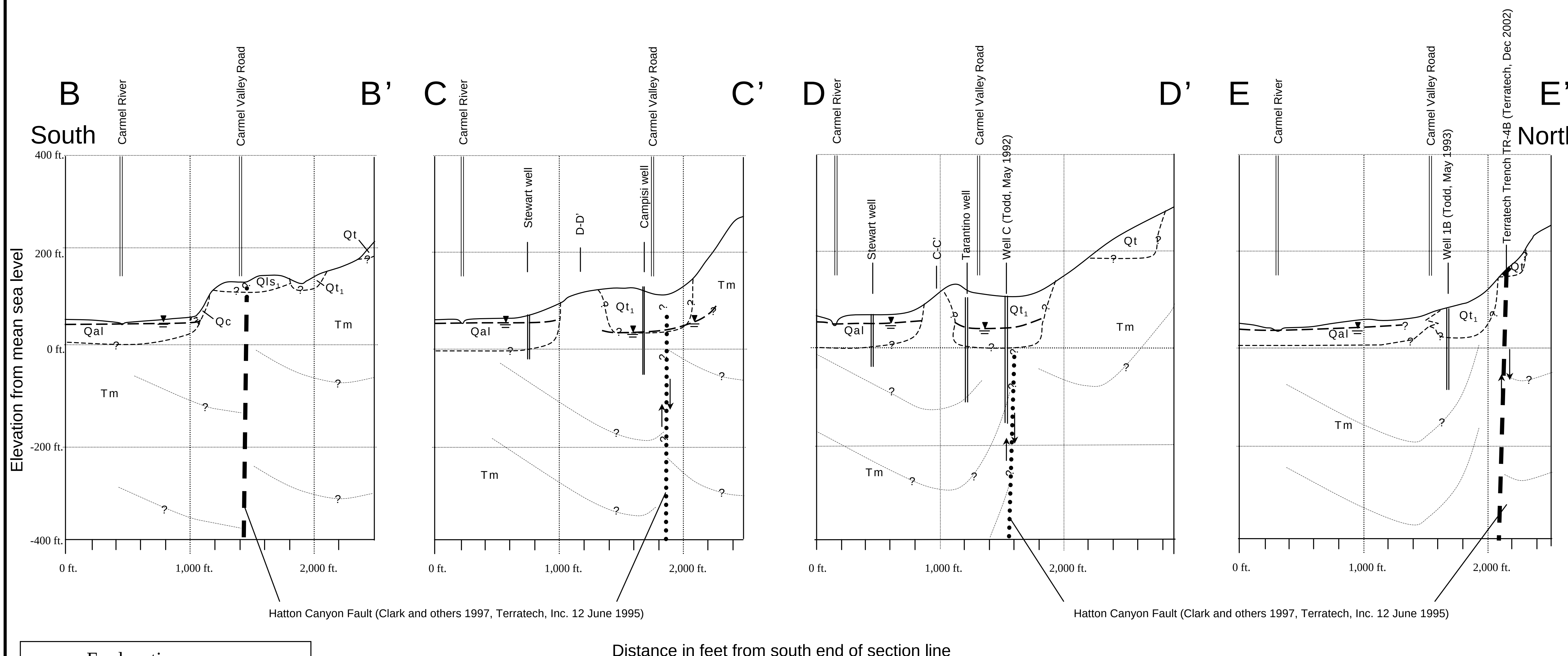

Explanation

▼	Water table
Qc	Colluvium (Holocene)
Qal	Alluviun deposits (Holocene)
Qt_1	September Ranch terrace (Quaternary)
Qls	Landslide deposit (Quaternary)
Qt	Terrace deposits (Quaternary)
Tm	Monterey (Miocene)

4 X vertical exaggeration.

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Geologic Cross Sections (with vertical exaggeration)

September Ranch
Carmel Valley, California

PLATE
7

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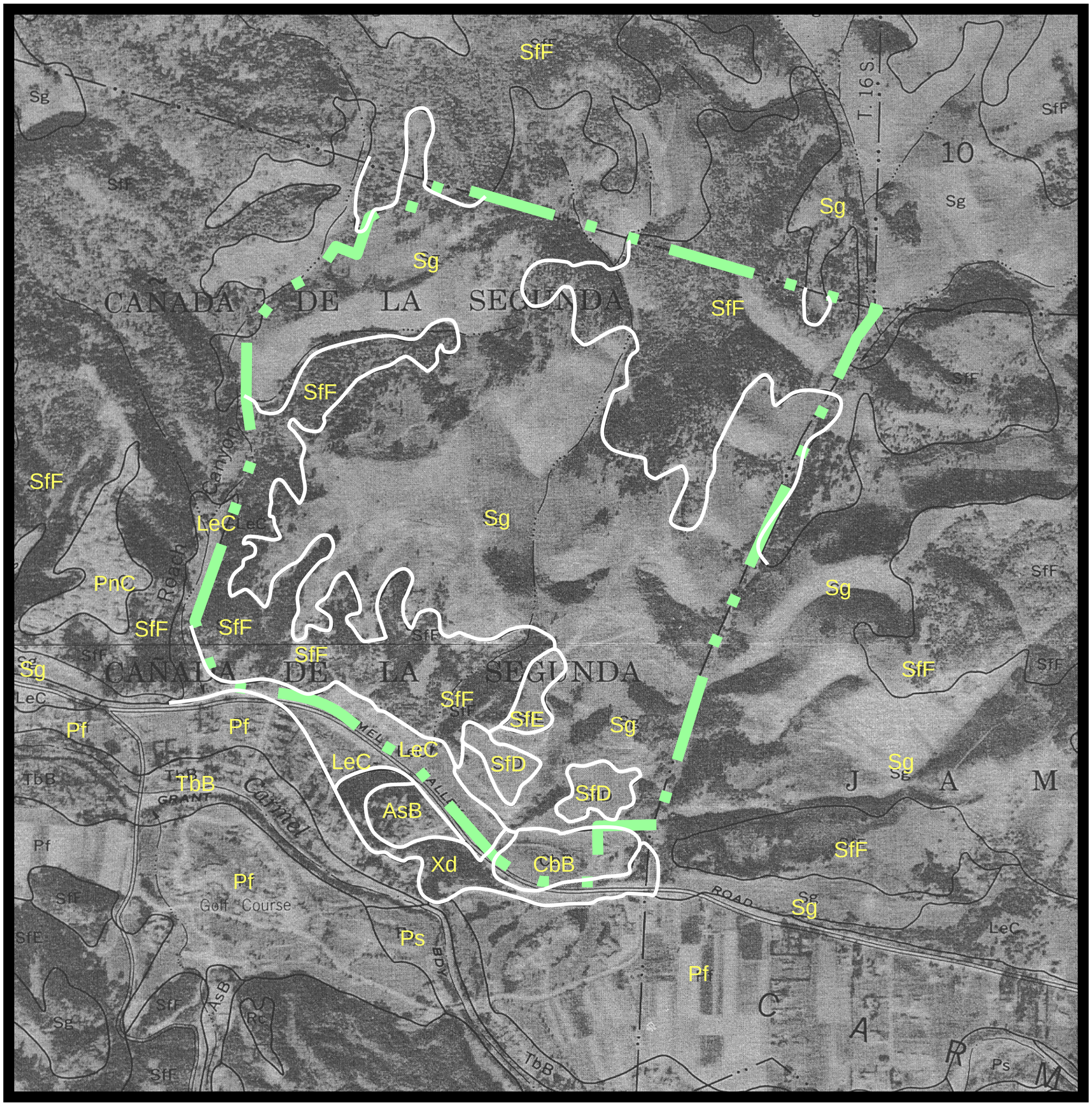

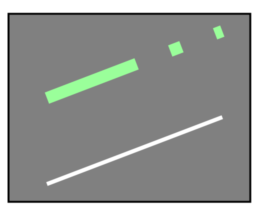

September Ranch property line

Soils contact (soil units described in report text)

Appx. Scale
thousand feet

0 1 2 3 4

N

Original in Color

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Site Soils Map

September Ranch
Carmel Valley, California

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PLATE

8

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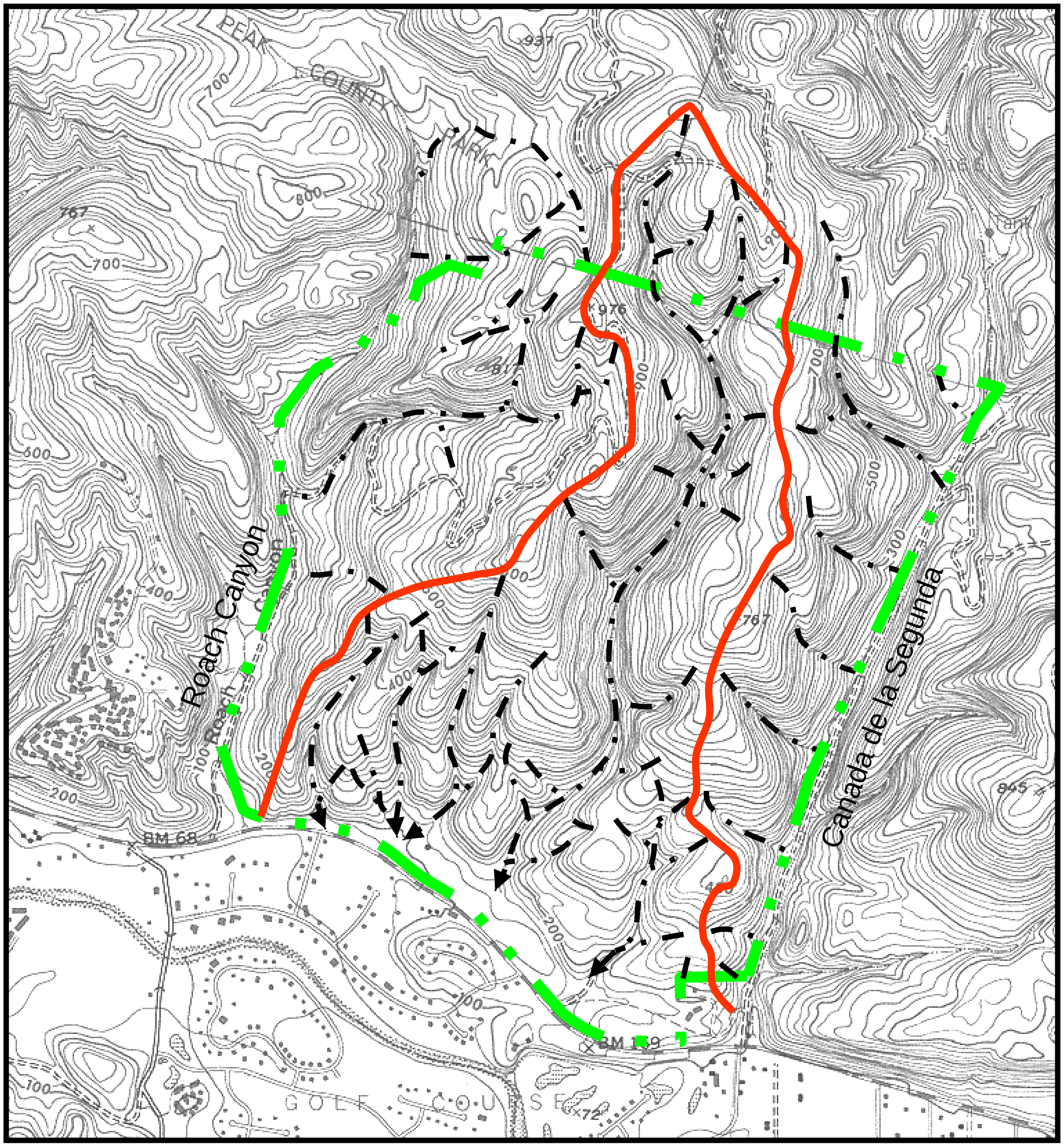

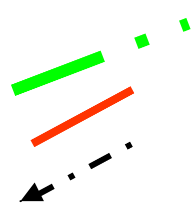

Appx. Scale
thousand feet

Original in Color

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Drainage Map

September Ranch
Carmel Valley, California

PLATE
9

PROJECT NO.: 24236

APPLICATION FOR AUTHORIZATION TO USE

Geologic, Soils And Drainage Assessment
September Ranch
Carmel Valley
Monterey County, California
24236/Geol
June 30, 2003

Kleinfelder, Inc.
365 Victor Street, Suite L
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