Appendix C: Hydrogeologic Report

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Final Report

Project Specific Hydrogeologic Report – September Ranch Project Carmel, California

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Project Specific Hydrogeologic Report
September Ranch Project, Carmel, California
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Final Report – 28 December 2004

Project Specific Hydrogeologic Report
September Ranch Project - Carmel, California

Executive Summary

The September Ranch project is located adjacent to the Carmel Valley about 2.5 miles east of State Highway 1 in Monterey County, California (the Site). Water for the project (including 109 new homes) is proposed to be supplied by an existing well and planned additional supply wells on the property. The proposed project demand is 57.21 acre-feet per year. The proposed project involves the subdivision of 891 acres into 94 market-rate residential lots, 15 units of inclusionary housing on 3.2 acres, and a 20.2 acre lot for the existing equestrian facility; 792.9 acres are proposed as open space. Other appurtenant facilities and uses would include separate systems for the distribution of potable water, water tanks for fire suppression, sewage collection and treatment system, waste water treatment system, drainage system, internal road system, common open space, tract sales office and security gate.

The findings in this report are intended to update and supplement the September Ranch Final EIR with particular focus on the sustainable groundwater yield estimates that are necessary to satisfy the requirements of the California Environmental Quality Act (CEQA). In this Report Kennedy/Jenks Consulting concludes that that the September Ranch Aquifer (SRA), which underlies the proposed project Site, contains an adequate and reliable water supply for the proposed project. This conclusion is based on a historical record of variable rainfall and on a detailed understanding of the groundwater resources in the SRA. In short, even in the driest years on record, sufficient rainfall and recharge occurred as to ensure sufficient water stored within the SRA to meet project demand.

This Report also concludes that the project demand will have a de minimis effect on the adjacent Carmel Valley Aquifer (CVA), in light of the significant water resources in the CVA. This Report examines the water demand in the CVA, and compares that demand against the available water resources in the CVA. This Report calculates the demand based upon a collection of water pumping and water rights data from a number of locations and concludes that the exercise of water rights by September Ranch will have no effect on those water rights that are more senior to, or of the same priority as, September Ranch. This Report also examines the connection between the SRA and the CVA and concludes that in its natural state, and under proposed project conditions, rainfall within the September Ranch basin available for recharge that exceeds the storage capacity of the SRA will be "rejected" (because of lack of storage space) and instead will be stored within the CVA.

A detailed listing of the conclusions of this Report is contained in Section 8 (entitled Conclusions).

Section 1: Introduction and Project Description

This Project Specific Hydrogeologic Report – September Ranch Project (Report) has been prepared by Kennedy/Jenks Consultants, Inc. (Kennedy/Jenks) at the request of the Monterey County Planning and Building Inspection Department for the September Ranch (SR) Project. The September Ranch project encompasses 891 acres in and adjacent to the Carmel Valley located about 2.5 miles east of State Highway 1 in Monterey County, California (the Site). Water for the proposed project of the proposed 109 new homes will be supplied by an existing well and planned additional supply wells on the property.

Kennedy/Jenks, as a sub-consultant to Michael Brandman Associates, is supporting the preparation of a comprehensive and defensible Revised Environmental Impact Report (REIR) for the Monterey County Planning and Building Inspection Department. Kennedy/Jenks is responsible for the hydrogeologic analysis and reviewing existing information as well as additional geologic information prepared by Kleinfelder Inc. (Kleinfelder) in early 2003. Kleinfelder's work included field reconnaissance to evaluate the presence of a stratigraphic or structural high along the southwest side of the September Ranch basin that is essential in defining the physical boundary of the September Ranch groundwater basin. Results of our analysis are presented herein.

1.1 Objectives

The objective of this hydrogeologic analysis is to assess the viability of groundwater from the September Ranch Aquifer as a long-term source of water for September Ranch. This study includes an assessment of the degree of connection and effect that groundwater production at the September Ranch site would have on nearby groundwater users, primarily in the Carmel River Watershed. This study also evaluates the relative seniority of other possibly-effected water rights holders.

Preparation for this report included a review of the existing Final EIR (Denise Duffy & Associates, 1998) and related documents and this report supplements the Final EIR's findings as deemed necessary to provide sufficient and substantial evidence in the determination of sustainable yield to supply the project demand.

This report and its findings are intended to update and supplement the September Ranch Final EIR with particular focus on the sustainable groundwater yield estimates. These long-term yield estimates are necessary to satisfy the requirements of the California Environmental Quality Act (CEQA) and to understand the significance of relative water rights for the area allowing for the potential diversion of Carmel River water and the extraction of the associated Carmel Valley Aquifer (CVA) groundwater. Results herein are also intended to provide required information under CEQA to address the issues of water resources and water rights in terms of characterizations of habitat species protection, urban growth management, and hydrogeologic environment.

1.2 Project Background

The September Ranch project is a proposed housing subdivision development in Monterey County. In 2001, the 6th District Court of Appeals invalidated the Final EIR prepared for the project and nullified the County's certification of the Final EIR based on the issue of water. The inadequate analysis of baseline water use and the introduction of new information after the close of the public review and comment periods were the primary issue in the Court's decision to vacate approval of the September Ranch project by the Monterey County Board of Supervisors. The Final EIR was submitted on 6 March 1998 and a Volume 2 Supplemental Information in Response to Additional Public Comments was submitted on 27 May 1998.

Because numerous site-specific hydrogeologic and geologic investigations have been conducted at the Site since the late 1980s (e.g., Todd Engineers, 1992, 1993, and 1997; Kleinfelder, 2003), no field data was acquired as part of the preparation of this Report. Rather, analyses presented in this Report are independent interpretations of data collected as part of the above-mentioned investigations.

1.2.1 Baseline Water Usage

Kennedy/Jenks' analysis does not include an independent evaluation of the baseline water usage. During the certification of the Final EIR the County Supervisors determined that a baseline of 51 acre-feet per year was appropriate. This amount, however, included within the baseline water pumped after the initiation of the EIR process, and also included water pumped as part of an aquifer test. This methodology was found by the Court of Appeal to be flawed based upon the period of the pumping, the inclusion of water pumped for an aquifer test, and the failure to present documented water usage from prior to the initiation of the EIR:

> "… there is no objection to the EIR's methodology of estimating historical water use on property where no documentation is available to verify actual use. But estimating water used for irrigation where there was no substantial evidence to show that the property was in fact irrigated does not accurately reflect existing conditions. Appellant's argument that it was entitled to use this amount of water for irrigation is not the same as actual use. As various courts, including this one, have held, the impact of the project must be measured against 'real conditions on the ground.'"

Therefore, this report uses an amount of three (3) acre-feet per year as the appropriate baseline for pre-existing project conditions. This amount was determined by the County as the relevant condition prior to and at the time of the 1995 project application. The amount is based on water usage for a single residence (0.5 AFY) and the amount of water applied for 50 horses (45 gallons per horse per day for a total of 2.5 AFY). The selected baseline appears to be reasonable and representative of aggregate average water usage of undeveloped nonresidential land-use in the Camel Valley.

1.3 Approach and Scope of Work

The basic approach to assessing the long-term source of water for the September Ranch, and whether September Ranch holds the necessary water rights (whether groundwater rights or riparian rights), is to perform a water balance that results in a “best estimate” of groundwater stored in the September Ranch groundwater basin (also referred to as the September Ranch Basin or the September Ranch Aquifer ("SRA")) during normal and below average rainfall periods. Based on available hydrogeologic data, the most reasonable method to estimate available groundwater storage for the project is simply to identify the difference between total recharge from precipitation (the quantity of water that is available to be added to the SRA each year) and rejected groundwater outflow into the adjacent Carmel Valley Aquifer (the quantity of water that leaves the SRA and is this unavailable for use) during normal and below average rainfall periods; essentially a hydrologic balance for the September Ranch watershed.

Rejected groundwater outflow is the seasonally variable level of groundwater that exceeds the storage capacity of the September Ranch Aquifer (SRA) and, after satisfying Project demands, is then “spilled” or discharged into the Carmel Valley Aquifer ("CVA"). The SRA has limited connectivity with the CVA, which is adjacent to and considered outside of the September Ranch basin.

The water balance evaluation requires an understanding of the hydrologic connectivity between SRA and CVA – i.e. the amount of groundwater exchange between the two systems. The analysis is done in two steps: 1) understand the geologic and hydrogeologic physical connection between the two aquifers; and 2) calculate the actual groundwater exchange between the two systems. In this case, in light of the very limited hydrologic connection between the SRA and the CVA, exchange of groundwater will only occur when available groundwater exceeds the SRA storage capacity.

In addition to assessing the long-term yield of the SRA and its availability to meet Project demand, this hydrogeologic evaluation does the following:

- evaluates the existence of a long-term water supply for the project;
- evaluates the availability of the long-term water supply in light of September Ranch's subordinated riparian rights; and
- evaluates the potential effects of September Ranch's pumping on nearby water supplies.

Results are presented herein as a “Supplemental” Project Specific Hydrogeologic Report that follows guidelines similar to those set forth in Chapter 19.03 of the Monterey County Code (Title 19). The following sequence of analyses was performed leading up to the conclusions of the adequacy of September Ranch's water rights and whether there exists a sustainable yield of water for the proposed project.

1. Reviewed pertinent documents that contain field data collected for the purpose of evaluating the geometry and properties of the SRA and the northern most portions of the CVA that has limited hydraulic connection to the SRA.

2. Constructed a computer model to represent the SR watershed, the SRA, and part of the CVA.

3. Estimated seasonal groundwater storage in the SRA.

4. Estimated of groundwater recharge.

5. Prepared a water balance for the SR watershed and groundwater basin.

6. Estimated the groundwater gradient within the SRA and between the two aquifers.

7. Estimated the exchange of groundwater between the SRA and CVA.

8. Performed analysis of Sustainable Yield.

1.4 Project Description and Setting

The proposed project involves the subdivision of 891 acres into 94 market-rate residential lots, 15 units of inclusionary housing on 3.2 acres, and a 20.2 acre lot for the existing equestrian facility; 792.9 acres is proposed as open space. Other appurtenant facilities and uses would include separate systems for the distribution of potable water, water tanks for fire suppression, sewage collection and treatment system, waste water treatment system, drainage system, internal road system, common open space, tract sales office and security gate.

The project site is located approximately 2.5 miles east of State Highway 1 on the north side of Carmel Valley Road in Monterey County, California. It is bounded on the south by the Brookdale Drive residential subdivision; on the west by the senior community of Del Mesa Carmel; on the east and northeast by approved, but not fully developed residential subdivisions and on the northwest by Jacks Peak Regional Park. Immediately to the west of the Site is the 15-acre Roach Canyon open space area owned by the County of Monterey.

The September Ranch project site area is shown on Figure 1. The southern portion of the property is relatively flat lying and is underlain by alluvial and colluvial soils, forming 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, characterized by extensive outcrops of shale bedrock, which supports the uplands of the site (Kleinfelder, 2003). Elevation at the September Ranch site ranges from 70 to 968 feet above sea level (AMSL)

Section 2: Hydrologic Setting

The hydrologic setting is pertinent to the hydrogeologic evaluation of the September Ranch watershed because of its high degree of isolation from neighboring water resources. The primary source of recharge to the September Ranch groundwater basin is rainfall, and recharge is dependent on the efficiency of drainage and percolation. A brief discussion of surface water resources is presented in this section to make the reader aware of the watershed's simplistic drainage pattern and the lack of significant surface water sources.

2.1 Physiography

The northern portion of the Site consists essentially of north-south trending ridges and three canyons (September Ranch, Roach, and Canada de la Segunda, Figure 1) sloping southward to the Carmel River Valley. The drainages are generally deeply incised and have steep canyon walls. The ridges are locally modified by side canyons, erosional gullies, landslides, colluvial wedges and old river terraces (Kleinfelder 2003).

The southern portion (Figures 1 and 2a) of the Site is a flat to gently sloping, east-west trending elongated terrace bounded on the north by the sharp slope break with the ridges and on the south by a low knoll (the Knoll in this Report and Kleinfelder [2003], Plate 1). The shale Knoll is depicted on Figure 2 at the end of Section M-M'. The terrace is depicted on Figure 2 in light blue, also representing the surface area expression of the September Ranch groundwater basin. The Knoll separates the terrace from the Carmel River channel; the top of the knoll is approximately 60 feet above the lowest elevation of the terrace surface and 100 feet above the elevation of the Carmel River (Kleinfelder 2003).

2.2 Hydrometeorologic Setting

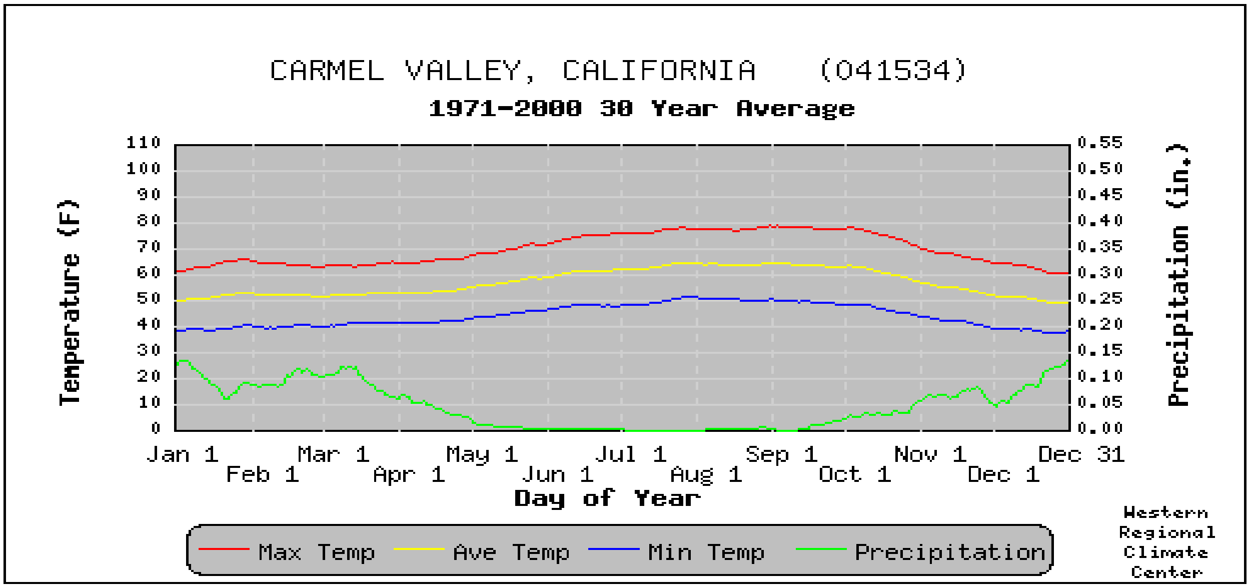
For brevity and consistency, hydrometeorologic characteristics of the September Ranch site discussed below include only a summary of the discussion in Kleinfelder (2003). Because the September Ranch land and groundwater basin are relatively isolated from adjacent watersheds, the main source of recharge is from precipitation; a more detailed discussion of recharge is presented in Sections 3.3 and 6.

September Ranch Subdivision Project is about 3¼ miles from the Pacific Ocean in the Carmel Valley and its climate is influenced by fog from the west. The Mediterranean climate of Carmel Valley is typically wet in winter and dry in summer. The following summary Table identifies the 20-year average precipitation within the general project area. The Chart presents 30-year rainfall and temperature data for a location which is similar to that at September Ranch.

Climate Summary of Record: 1/ 1/1959 to 6/30/1978 - Carmel Valley, California (041534)

	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



Note: Data are smoothed using a 29-day running average

Table 1 presents rainfall data recorded at the San Clemente Dam, which is located approximately 17 miles upstream from the proposed project site. Rainfall is calculated to be approximately 21.4 inches in average rainfall years according to the MPWMD rainfall records. As discussed in Todd (1992), the average rainfall at the September Ranch site is assumed to be 15.1% less than that recorded at the San Clemente Dam based on the California Department of Forestry Fire and Resource Assessment Program (FRAP) contour map.

In the analysis presented in this Report, rainfall amounts at the San Clemente Dam are reduced by 15.1% to develop rainfall data for the September Ranch property. Data in Table 1 are used specifically to assess potential recharge to the SRA on a monthly basis. Accordingly, Table 1 presents total precipitations for water years 1996 (19.02"), 1997 (18.40"), and the first four months of 1998 (winter) as representative "average" rainfall years (Todd [1992] estimated 17.4 inches). Average precipitation for representative drought water years 1987 through 1991 was 11.0 inches.

2.3 Soils

An extensive discussion of site soils is presented in Kleinfelder (2003) and is summarized here. Soils present on the September Ranch terrace include Lockwood series shaly loam (LeC), Chualar loam (CbB), xerorthents dissected (Xd), and Arroyo Seco gravelly sandy loam (AsB) (Kleinfelder 2003, Plate 8).

LeC 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 CbB has a surface layer of loam to light sandy clay loam that is commonly 10 to 20 inches thick. The substratum varies considerably over short distances and in places is underlain by gravel, cobbles, or clay deposits. The Xd soils consist mostly of unconsolidated or weakly consolidated alluvium that commonly contains pebbles, and cobbles. AsB soils are gently sloping soil on alluvial fans and plains. The soils are grayish brown, neutral to mildly alkaline gravelly sandy loam.

2.4 Geology

The Site geology is summarized in this section and is discussed more fully in Kleinfelder (2003) which also discusses the regional geology and stratigraphy. The geology at the Site is shown on the Site Geologic Map presented in Kleinfelder (2003).

The basal geologic unit at the Site is the Aguajito Shale member of the Miocene Monterey Formation (Tm), consisting generally of thin-bedded siliceous shale (Kleinfelder 2003, Geoconsultants 1995, Todd 1992). The Tm is exposed in the hills in the northern portion of the Site, on the Knoll in the southeast part of the Site, and has been encountered in water wells and detected in vertical electric sounding (VES) probes conducted at the Site (Todd 1997).

The Tm is overlain by several unconsolidated clastic sedimentary deposits. The oldest unit present in the southern part of the Site is older alluvium terrace deposits which have been divided by Todd (1992) into three groupings of deposits (listed from the youngest):

- Alluvium (Qg and Qa) and colluvium (Qcol) landslide deposits that occur in the northern and southern parts of the Site (Geoconsultants 1995, Kleinfelder 2003, Todd 1992);
- Younger, primary water bearing unit Qoa_1 shown as Qt_1 in Kleinfelder (2003); and
- Older low-permeability Qoa_2 that is classified as an aquitard separating Qoa_1 and the underlying Tm. This unit impedes groundwater flow between the SRA and CVA at certain locations (see Sections 3.1, 3.4, and 6).

2.4.1 The Hatton Canyon Fault

As presented in Kleinfelder (2003), a trace of the Hatton Canyon Fault (the name of a group of northwest-trending, steeply-dipping reverse faults (Rosenberg and Clark 1994)) apparently crosses the Site. This trace crosses the Site from northwest to southeast, slightly southwest of the slope break dividing the flatter southern portion of the Site from the hilly northern portion of the Site (see Kleinfelder 2003). As shown on the geologic map presented in Kleinfelder (2003), trenches excavated by Terratech in December 2002 apparently show landslide deposits offset along this trace, suggesting that the fault is active.

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 (Kleinfelder, 2003 Geologic Map, Plate 3, Cross Section A – A', Plate 6, and Geologic Cross Sections C' – C' through E – E', Plate 7). 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.

Based on Kleinfelder's 2003 findings discussed briefly above, there is no evidence currently known to suggest that the Hatton Canyon fault serves as a hydraulic barrier or conduit of groundwater to influence water resources in the SRA or influence the SRA's hydraulic connection with the CVA.

2.5 Surface Water Resources and Drainage

The drainages dissecting the northern portion of the September Ranch site area (Figure 1) generally flow only during precipitation events. The Carmel River flows generally parallel to the southern boundary of the Site and is located approximately 800 feet to the south at the closest approach. Streamflow in the Carmel River can vary greatly over the year, with the greatest streamflow in the winter and the lowest in the summer (MPWMD 1990).

As described in Kleinfelder (2003), drainage courses at the site are the result of surface-water erosion controlled by relatively uniform bedrock. The central September Ranch canyon is incised in a typical dendritic drainage pattern. 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 (see Figure 3 in Kleinfelder [2003]).

Observed channel bottoms of the drainage courses are 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. Drainages do not dissect the terrace, suggesting that the surface water infiltrates the terrace and recharges the groundwater (Todd 1992).

The central watershed area (the drainage area where flow would be directed toward the SRA (Figure 1) was estimated at 571 acres and 570 acres by Todd (1997) and Kleinfelder (2003), respectively. For this Report, the central watershed was estimated at approximately 561 acres, adjusting for elevations based on a "summed-element" method of calculation performed in a geographic information system (GIS). Recharge is discussed more fully in Section 3.3.

Section 3: Groundwater Resources

The two primary objectives of this study are to assess: 1) the SRA's groundwater storage capacity, and 2) the hydraulic connectivity with adjacent portions of the CVA. The groundwater resource at September Ranch consists of the groundwater that can be extracted from storage in the September Ranch groundwater basin (September Ranch basin), shown in light blue color on Figure 2a.

3.1 Current Groundwater Resource Conditions

Current groundwater usage at the Site (which is not considered for purposes of the CEQA baseline) is primarily for pasture irrigation. The current pumping from the single production well located at the Site is approximately 99 AFY (Todd, 2002). More pumping occurs in the six summer months from June to December than during the remaining six months of the year, with the summer extractions totaling approximately 59 AF. Water pumping is also somewhat heavy in the spring of each year resulting in the extraction of 38 AF on average.

Water levels at the closest non-September Ranch well – the Brookdale Well – exhibited drops in water levels on the order of 5 to 7 feet corresponding to the usage months of the September Ranch well. However, water levels in this well have consistently recovered later in the year to about 40 feet MSL as indicated by available water level data collected since 1996.

3.2 September Ranch Groundwater Basin and Aquifer

The September Ranch groundwater basin can be described as a small and nearly "closed" basin bounded almost entirely by Monterey Shale (Tm). In this independent evaluation of hydrogeologic evidence collected by others, Kennedy/Jenks concludes that the September Ranch basin is bounded on the north by the hills, on the south by the Knoll, on the east by exposed Tm east of the Knoll, and on the southwest it contacts the CVA across a subsurface ridge of Qoa_2 (see Cross-section M-M' on Figures 2a and 2c).

The surface area of the September Ranch basin, as defined by the lateral reach of the water table, changes with seasonal variations of the water table and with yearly variations in rainfall. The basin area is relatively *larger* during average rainfall years and *smaller* during below average rainfall periods. The saturated surface area is about 51.8 acres in average rainfall periods (e.g. water year 1997) and about 49.2 acres in below average periods (e.g. water years 1998, 1999, and 2000; see Table 2).

The fluctuations in basin size between average and drought periods affect the storage volumes estimates calculated from wells and VES data for the three aquifer boundaries and properties (Qoa_1, Qoa_2, and Tm). Details of groundwater storage are discussed in Section 3.2.

There are two main water bearing units – together called the September Ranch Aquifer - that are delineated within the September Ranch groundwater basin. The main water-bearing unit in the September Ranch basin is the Qoa_1, although some water is stored in the Qoa_2 and Tm

(Todd 1997). To assess groundwater storage, the shape of the basin boundaries has to be understood. The shape of the basin is shown in Figure 3 and Figure 4. The elevation of the top of Tm is depicted on Figure 3. The contours on Figure 3 indicate that the Tm is shallower to the east and deepens to the west, forming a depression, or “trough” in the west and southwest part of the basin. The elevation of the top of Qoa_2 is depicted on Figure 4, and indicates that the top of the Qoa_2 is deepest in the central part of the basin and shallow on the southwest part of the basin. Together, these indicate that the Qoa_1, the more transmissive unit and the main portion of the aquifer at the Site, is thickest in the central to western parts of the basin.

In addition, Figure 4 in conjunction with Figures 2b and 2c illustrate the ridge of Qoa_2 bounding the southwest side of the basin. The length of this boundary is about 1,620 feet, or approximately 20 percent of the basin boundary. Contours of equal elevations of the top of Qoa_2 and depiction of the ridge-like feature (elevation 60 feet above mean sea level [AMSL]) of the aquitard are illustrated on Figure 3 and Figure 4.

Cross section M-M’ (Figure 2c) shows the only portion of the September Ranch basin in hydraulic contact with the CVA. Evidence of this limited connectivity was first interpreted from borings, water well logs, and VES survey conducted by Todd (1992) and Todd (1997). This study provides an independent assessment of the shape of the September Ranch basin and degree of connectivity between the SRA and the CVA. Kennedy/Jenks independently constructed a three-dimensional (3-D) model of the physical boundaries of the basin (See Figure 2b) using existing data, including that presented in Todd (1997) and Kleinfelder (2003).

In the Final EIR, the September Ranch basin was treated as an aquifer with a finite storage and in limited communication with the adjacent CVA. Kennedy/Jenks concurs with this conclusion and notes that recent evidence does not suggest otherwise. More discussion on hydraulic connectivity is presented in Section 6.

3.3 Groundwater Storage

This analysis included an independent estimate of groundwater storage by using existing groundwater elevation data as presented in Todd 1992 and 1997. Kennedy/Jenks refined Todd’s estimates by constructing more detailed elevation contours of the three hydrologic formations, Qoa_1, Qoa_2, and the Monterey Shale. A 3-D GIS was used to calculate volumes for the aquifer units.

Groundwater stored beneath the September Ranch Project site is entirely within the nearly closed basin bounded almost entirely by Monterey Shale (described in Section 3 and 3.1 and depicted on Figure 2a). The limited hydraulic connectivity with the CVA occurs only when groundwater levels in the SRA are higher than the top of the Monterey Shale bedrock such that seasonally excess groundwater from the SRA would spill over and serve as recharge to the CVA (Section 6). This is known as "rejected recharge" in that the spilling water cannot recharge the SRA (as the SRA is full), and so the water is rejected from the SRA and instead goes to the CVA.

The available groundwater storage was calculated for this Report by plotting the elevations of the top of the Qoa_2 aquitard and the top of the Tm from well logs, soil borings, and VES data from the September Ranch site and from neighboring domestic wells in the CVA immediately south of the September Ranch project area into a 3-D GIS (Figure 2a). The data was presented in Todd (1992) and Todd (1997).

The top-of-formation elevations of the Tm and Qoa2 are combined on Figure 5 to show the extent of the functional bottom of the September Ranch basin. Groundwater elevation contours for 21 November 1996 (water levels recorded prior to the major aquifer test of late 1996) are also shown on Figure 5. The thickness of the saturated Qoa1, and therefore the functional thickness of the available storage in the entire September Ranch basin, can be estimated using Figure 5 by subtracting the top of formation elevation from the water table elevation.

Data for Calculating Storage for Normal Rainfall Year

It is important to note that a conservative calculation of aquifer storage is primarily a function of actual recorded water levels, which are themselves entirely dependent on surface recharge (Table 3, data provided by the MPWMD 2003). Hence, in selecting yearly water level data for calculating storage for normal and below average rainfall periods, average and below normal surface recharge values are used (instead of annual total rainfall amounts) as indicators of normal and below average groundwater recharge periods.

The groundwater elevations for the water years 1997 and 1998 (October through December of 1997 and January through September of 1998) were used to represent average rainfall years in calculating storage. Estimates for pumping at the Site are based on available pumping data (Todd 2002) and P.G. & E. electricity consumption billings from 1996. Table 3 presents a listing and graphical summary of CVSIM results (MPWMD, 2003) of surface recharge for CVA AQ3. Surface recharge in the CVSIM model represents the amount of surface water on a monthly basis that is available to recharge groundwater. As shown in Table 3, a total of 7,085 AF of surface recharge was recorded in 1997 and 7,664 AF for 1998. These are fairly average recharge values as graphically indicated in Table 3.

Data for Calculating Storage for Below Average Rainfall Year

The water year 1999 was used to represent a water-year that received markedly below average surface recharge of 5,091 AF (Table 3). This value is the second lowest surface recharge value calculated by the MPWMD since 1981; the lowest groundwater recharge occurred in 1994 of only 4,720 AF (Table 3). Hence, a conservative aquifer storage value is attained by using water levels recorded in the 1999 low surface recharge year. It is important to point out that data from 1999 was used instead of water levels from drought years 1987 – 1991 simply because water levels were not available for these years, noting that the September Ranch wells were installed after the 1991 drought.

Results of this analysis of "seasonal storage" are presented in Table 2 and summarized below:

Average Rainfall Seasons	Qoa1 (AF)	Qoa2 (AF)	Total (AF)	Below Average Rainfall Seasons	Qoa1 (AF)	Qoa2 (AF)	Total (AF)
12/1997 Fall	167	102	269	12/1998 Fall	183	104	287
3/1998 Winter	217	106	323	3/1999 Winter	193	105	297
6/1998 Spring	220	106	327	6/1999 Spring	185	104	289
9/1998 Summer	192	105	297	9/1999 Summer	170	102	273
Yearly Average	199	105	304		183	104	287

The groundwater storage in the September Ranch basin was previously estimated by Todd (1992) at 261 acre-feet (AF) for Qoa_1, and 121 AF in the lower permeability Qoa_2, giving an average total estimated storage of about 382 AF. Todd (1992) developed the storage estimates by using an average thickness and depth of the $Qoa_1$and Qoa_2 units. But despite Todd's use of an average thickness, the base of each aquifer unit is actually irregular in elevation and the groundwater surface elevation is dependent on seasonal rainfall. Thus, we believe that Todd's methodology unduly inflates the estimated quantity of groundwater storage in the SRA. We also note that on 23 August 1994 the MPWMD entered in a Memorandum of Understanding with the September Ranch Partners which used the value of 261 AF as estimated storage.

Our independent analysis of seasonal storage presents a refinement of the original Todd estimates. Our analysis estimates that about 304 AF is available in storage in average rainfall years and about 286 AF in a below average year. The 304 AF amount for average rainfall years falls between the original Todd estimate of 382 AF and the number used in the MOU with the MPWMD.

3.4 Groundwater Recharge

Groundwater recharge in the September Ranch basin is primarily through infiltration of precipitation. The September Ranch terrace is largely recharged by streams originating in the uplands of the ranch that discharge (drain) water to the alluvium and Qoa_1 that make up the primary water-bearing zone of the terrace (Kleinfelder 2003). Drainage within the September Ranch watershed is fairly efficient because of the well-defined (high relief) ridges (see the red line marking the watershed boundary on Figure 1) that influence the convergence drainage pattern within the watershed. Surface water generally flows relatively unimpeded to the terrace deposit lying adjacent to the base of the ridges (see Figure 1 and Kleinfelder [2003], Plate 3).

The amount of monthly and seasonal recharge for the site was developed with rainfall data collected at the San Clemente Dam approximately 17 miles upstream of the Site.

$$\text{Total Recharge} = \text{Rainfall} - \text{ET} - \text{surface runoffs} \quad (1)$$

A 15.1 percent reduction factor was used to calculate monthly rainfall at the September Ranch site (see Section 2.2 on Hydrometeorologic Settings). Calculated total recharge in inches is listed in Table 1 for the Site for average rainfall years of 1996 and 1997 and for the below average water years of 1987 through 1991.

Monthly rainfall values were applied to the watershed area of 561 acres with an evapotranspiration (ET) loss-factor of 70% and an infiltration based on Soil Conservation Service method TR-55. The 15.1% reduction and the 70% ET loss factors were used in the analysis presented in Todd (1992) with concurrence by the MPWMD. Recharge estimates were developed by subtracting surface runoff from precipitation on a monthly basis. Resultant monthly recharge values are listed in Table 1 and annual cumulative recharge is summarized below:

Recharge calculations based on rainfall data at the San Clemente Dam:

Average Water Year	San Clemente Dam Rainfall (in)	September Ranch Site Precipitation Over 561 Acres (AF)	Net Recharg with ET-loss of 70% Adjusted for Infiltration (AF)	Below Average Water Years	San Clemente Dam Rainfall (in)	September Ranch Site Precipitation Over 561 Acres (AF)	Net Recharge with ET-Loss of 70% Adjusted for Infiltration (AF)	Net Recharge with ET-Loss of 85% Adjusted for Infiltration (AF)
1996	22.4	889.1	262.0	1987	11.02	437.4	131.2	65.6
1997	21.7	860.1	244.0	1988	11.07	439.4	131.8	65.9
				1989	12.80	508.0	152.4	76.2
				1990	13.09	519.6	155.9	77.9
				1991	16.87	669.9	182.2	81.7
Yearly Average			253				151	73

Note: estimated runoffs were subtracted from ET-loss for corrected recharges rates (see Table 1).

The Final EIR invalided by the Court of Appeal used 242 acre-feet-year (AFY) of recharge for average years and zero recharge for drought years. The analysis above indicates that range from 244 to 262 AF of potential recharge is available to the September Ranch terrace during an average rainfall year. It is Kennedy/Jenks' opinion that for below average rainfall years a zero recharge is unrealistic given the Mediterranean climate. We maintain that an ET loss-factor of 70% is realistic for both average and below average precipitation years.

The MPWMD and the Monterey County Health Department has taken the position that during severe droughts all infiltrated moisture is completely taken up by vegetation and other losses resulting in zero recharge being available to the groundwater basin. To address this difference in opinion and for comparative analysis, a very conservative 85% ET loss-factor is used for this EIR for below average rainfall years. The 85% ET results in lower recharge values with estimates ranging from 65.6 AFY to 81.7 AFY and an average of 73 AFY (which still exceeds the estimated demand of 57 AF for the proposed project).

3.5 Groundwater Gradient

Typical groundwater flow patterns in the SRA and the CVA are illustrated on Figure 3 and Figure 4. The groundwater elevations on these figures were recorded on 21 November 1996, prior to a large-scale aquifer test. The groundwater on this date flowed from the east end of the September Ranch basin from Canada de le Segunda, where groundwater is at 52 feet AMSL, towards Roach Canyon in the west where groundwater is at 41 feet AMSL (Well D). The groundwater gradient magnitude shown on these figures is approximately 0.0025 feet per foot (ft/ft) in the eastern half of the basin and about 0.0022 ft/ft in the western half of the basin where the SRA meets the CVA. This is a relatively shallow gradient that indicates a low velocity. The northwest to west gradient direction is generally parallel to the Carmel River flow direction.

This study also focused on the difference in groundwater gradients between:

- Four quarters or seasons in a year; and
- Average rainfall periods and below average years.

The objective of this more detailed analysis of groundwater gradient is to quantify the volume of groundwater exchange between the SRA and CVA across the ridge of Qoa_2 (see Figure 2c), given that we have established only extremely low level of connectivity between the two water resources. The approach is to examine the direction of groundwater gradient based on water levels in the SRA and those in the CVA. The most suitable and available data to support this analysis are the water levels measured in Wells B and D located in the September Ranch basin, and Wells E the Brookdale well, located in the CVA. These wells are located roughly linearly, across Cross Section M-M'.

In this analysis, we emphasize that it is not enough to base our use of data and seasonal gradient characterizations on rainfall amounts generally, but we must also assess the corresponding surface recharge rates in normal and below average precipitation periods.

The reason for the focus on surface recharge rates (rather than total rainfall) is that the cumulative volume of surface recharge directly influences groundwater level. In contrast, a certain quantity of the total rainfall at the Site is eventually discharged by surface runoff into the Carmel River, and hence does not influence groundwater levels. A good example of this is the intense rainfall month of February in 1998 (18.24 inches) which largely did not influence groundwater levels because the majority of the intense rains became runoff into the Carmel River. For this reason, we picked our data sets of groundwater levels with equal emphasis on surface recharge rates as represented in the CVSIM subunit 3 results (Table 3).

<u>Normal rainfall and surface recharge years</u>

We consider that the most representative period of normal rainfall and surface recharge to characterize groundwater gradients are years 1996 (8090 AF), 1997 (7085 AF), and 1998 (7664 AF) [Tables 1 and 3]. Since there was a 270 gpm 47-day aquifer test conducted during late 1996 thru February 1997 (Section 3.4.1), water levels measured in late 1997 through the 1st three quarters of 1998 were used to calculate gradients and thus to avoid the post aquifer testing recovery period of lower than normal water levels.

Below Normal rainfall and surface recharge years

We consider that the most representative below average rainfall and surface recharge years are 1987 through 1991 (Tables 1 and 3). Since water level data are not available for these years in the SRA, we picked a comparable period of low rainfall in water year 1999 (5091 AF of recharge and 17.41 inches of rainfall) to serve as surrogate data set for this analysis.

Figure 6 graphically illustrates groundwater elevations collected from Wells B, D, E, and Brookdale and groundwater flow directions for: A) an average rainfall and surface recharge water year of 1997; B) a below average rainfall water year of 1999; and C) the record drought period of 1989 and 1990. Data are presented by quarters or for seasons in the year. The boundary between SRA and CVA is depicted on Figure 6 to illustrate groundwater flow direction between the two systems.

The following is a summary of groundwater gradients calculated for these wells and are illustrated as flow directions in Figure 6. The negative sign indicates groundwater flow from the SRA to the CVA.

Average Rainfall Water Year 1997/98	**Gradient Between Wells D, E and Brookdale**	**Below Average Rainfall Water Year 1998/99**	**Gradient Between Wells D, E and Brookdale**	**Below Average Rainfall Fall Qtr 1989**	**Gradient Between Wells E and Brookdale**
12/1997 Fall	-0.0014	12/1998 Fall	-0.0016	9/1989 Fall	-0.013
3/1998 Winter	-0.0059	3/1999 Winter	-0.0022		
6/1998 Spring	-0.0030	6/1999 Spring	-0.0020		
9/1998 Summer	-0.0021	9/1999 Summer	-0.0042		
Average	-0.0031	Average	-0.0025	-	-

Note: negative sign indicates groundwater flow from the SRA to the CVA

Water level data from several seasons were compared to assess gradient direction and magnitude. Within the September Ranch basin, groundwater typically flows toward Well C (located near the pumping well SR 1). Near the SRA-CVA contact at the southwest part of the SRA, flow is generally southerly from the SRA to the CVA. A more detailed discussion of groundwater exchange is presented in Section 6

3.5.1 Groundwater Gradient In Aquifer Tests

The groundwater gradient before and during an extensive 47-day aquifer test concluded in the winter of 1996/1997 is shown in Todd (1997). The direction of the groundwater gradient prior to the aquifer test, in the September Ranch basin and the adjoining CVA, was northwest to west as discussed above and as depicted on Figure 3 and Figure 4.

The groundwater elevations contoured during the aquifer test suggest a greater influence on water levels in the September Ranch basin compared to water levels in the CVA, although it appears the aquifer test did have some influence on the CVA. The 270 gallons per minute (gpm) pumping rate almost instantly created a groundwater divide at the hydraulic contact between the two systems and at Well D. The divide shifted further southwest to Well E on day 19 of the test. The groundwater divide shifted back towards Well D on 12 January 1997 near the end of the test. The occurrence and shifting of the groundwater divide is indicative of impeded or constricted flow due to the ridge-like feature made up of mainly Qoa_2 aquitard material at the location of M-M' or between Wells D and E (Figure 4). It is likely that the movement of groundwater in this area is both; A) impeded by the less-permeable material and B) constricted above the ridge-like structure in the Qoa_1 material, the path of less resistance.

Kennedy/Jenks agrees with the comments by the MPWMD that results and interpretation of the 1996 47-day aquifer test are debatable, and that the response in wells closer to the Carmel River is less than expected, probably due to the suspected effect that concurrent rainfall and high river flows had on water levels during the aquifer test.

However, water levels in Well D in both the 1992 and 1996 aquifer tests recovered at slow rates after the pumping tests. Based on its location, we believe that water levels in Well D are responding first to recharge in the SRA and secondarily to recharge from the CVA. In the CVA, the large volume of river recharge along the Carmel River after rainfall sends rejected outflow towards the SRA. Kennedy/Jenks concludes that the rise in water levels after the test in Well D is in response to the rise in water levels within the SRA due to groundwater recharge from infiltration and drainage of the September Ranch uplands. It is recorded that overall water levels rose slowly and stayed depressed in the summer and fall of 1997.

We also suggest that it required a unique condition (with multiple stimuli including a concurrent 47-day aquifer test with a pumping rate of 270 gpm and a large rain event) to produce an appreciable exchange of groundwater from the CVA to the SRA. Specifically, the drawdown during the pumping test created a significant gradient towards the SRA at the location of the groundwater divide (apparent in the pumping test groundwater level contours). The gradient towards the SRA was further enhanced by excess water level rise in the CVA due to excess recharge in the Carmel River basin, sending appreciable rejected underflow towards the SRA. This interpretation is supported by the rapid rise in water levels after rainfall in the CVA which we believe is due to the increase in river stage and the rise in groundwater levels in the CVA. The overall water level rise in the CVA is consistent with those in wells closer to the Carmel River. These unique conditions are not expected to be replicated with the lower and slower pumping rates projected for the Project because the total extractions during the 47 day test would roughly equal the total extractions expected during one year of project operations.

Section 4: Review of Water Rights

4.1 Introduction

As described in Section 3, there is relatively little exchange of water between the SRA and the CVA. Based on the groundwater gradient, the exchange that may occur is dominantly in the direction from the SRA to the CVA. With this information in mind, pumping in the SRA is unlikely to affect the CVA. This is important because of the numerous water rights held by other pumpers to the waters of the CVA.

This analysis focused on collecting and evaluating the appropriate information to:

1. Identify the water rights held by the September Ranch Partners for the property;

2. Identify quantities associated with relevant superior water rights to those of September Ranch; and

3. Determining whether pumping in the SRA might negatively affect the superior water rights.

4.2 Water Rights Associated with the September Ranch Property

In the fall of 2002 the County retained Downey Brand LLP to perform an independent review of the water rights of September Ranch and to determine what water rights (if any) were associated with that parcel of land. (For a more detailed explanation of California water rights, see section 4.3.1 of the Draft EIR prepared by Michael Brandman Associates, entitled "Overview of California Water Rights"). Downey Brand LLP's review was based on a chain of title of deeds and other conveyance documents for the September Ranch parcel (gathered by an independent researcher) that went back to the original patenting of the parcel. After reviewing the complete chain of title in January of 2003 Downey Brand LLP concluded that the September Ranch parcel is riparian to the Carmel River.

However, due to an agreement that is part of the chain of title (between the predecessors-in-interest of September Ranch Partners and Cal-Am) the riparian right held by September Ranch has been subordinated to the pre-1914 rights held by Cal-Am. In order to effectuate this subordination, Downey Brand LLP assigned a priority date to September Ranch which was more junior than the priority date of Cal-Am's pre-1914 rights. For purposes of analyzing the relative priority of the water rights, Downey Brand LLP assumed that September Ranch's riparian right was also subordinated to other riparian parcels. While this assumption may not be supported by an actual review of the chain of title for other riparian properties, it was appropriate because it made Downey Brand LLP's conclusions more conservative. In other words, the use of the assumption decreased the margin of error associated with determining whether September Ranch's exercise of its riparian right would harm any other senior water rights holder.

4.3 Analysis of Information to Arrive at Relevant Water Rights

A summary of information gathered for this analysis is presented as Appendix C. There are multiple sources of data included in the data gathering effort. The data gathered and discussed in Appendix C were condensed and evaluated as described below.

4.3.1 SWRCB WRIMS Database

The Water Rights Information Management System (WRIMS) database managed by the State Water Resource Control Board was used to collected data for the water rights analysis. Use of the database required substantial preprocessing of data and holder of rights locations. The method used was as follows:

1. The rich text format (RTF) file provided was manually entered into a spreadsheet database because there was no expedient means of converting the file and SWRCB could not provide an electronic file that could be easily converted into a spreadsheet or database format. Duplicate records were eliminated.

2. The data that were classified as of type "STATE" were assembled, since they represent those records that could include riparian water rights and pre-1914 rights. All of the other data types were for post-1914 appropriative rights that are therefore subordinate to September Ranch

3. A map that shows the Carmel River Watershed with the township, range and section delineations consistent with the U.S. Geological Survey topographic mapping was prepared as shown on Figure 7. From this map those areas that are tributary to Aquifer subunits 1 and 2 (AQ1 and AQ2 respectively) were identified (Table 6) and are summarized below.

Areas Tributary to Aquifer Subunits 1 and 2

Township (South)	Range (East)	Section Numbers
16	4	All
17	4	All
16	3	All
17	3	All
17	2	All
16	2	1 – 5, 8-12, 13-17, 20-24, 25-29, 32-36

Those water rights found in Aquifer subunits 1 and 2 were not considered further for this analysis because the water balance analysis used herein accounts for these water rights by only examining that flow of water that exists *after* diversions in Aquifer subunits 1 and 2. The water balance will be the basis for determining the potential effects of pumping in the SRA on the CVA and are discussed in Section 6.

4. The records in the WRIMS database that remained after removing all record types except for "STATE" and removing all record types associated with the point of diversion locations found in Table 6 and summarized above, are those potential riparian and appropriative water rights in Aquifer subunits 3 and 4 (AQ3 and AQ4) which are relevant for consideration to evaluate the potential effects of pumping in the SRA.

4.3.2 Water Rights Decision 1632 Tables 5, 12, and 13 and WRD 95-10

Since the remaining data in the WRIMS database does not distinguish between riparian and appropriative water rights, Tables 5, 12, and 13 from Water Rights Decision 1632, were reviewed because they contain some limited information on those entities that filed water rights claims and the basis (riparian, pre and post 1914 appropriative, and groundwater) for the claim.

Water Rights Decision 1632 - Table 15 is entitled Prior Right Protests; Table 12 is entitled Protests Based Upon Riparian Claims and Table 13 is entitled Carmel River Watershed – SWRCB Determination of Priority and Quantities Obtained from Stipulations, Applications, or Protests (AFA).

Based on the information contained in those tables, the remaining data in the WRIMS database were reviewed to remove those entries that were based on an application number (i.e. post-1914 appropriative). Any record from Table 12 that was based on a tributary to the Carmel River was also removed since it is assumed that most of the tributaries are in Aquifer Subunits 1 and 2. Table 12 does not provide any information on the location of the water diversion. Based on p. 22 of WRD 95-10, Cal-Am's pre-1914 appropriative rights are set at 1,137 AFA. It should be noted that p. 40 of WRD 95-10 allows Cal-Am to divert a maximum of 14,106 AFA from the Carmel River "until unlawful diversions from the Carmel River are ended." The analysis described in Section 4.5 relied upon the results of CVSIM provided by MPWMD which accounts for all Cal-Am diversions from the Carmel River, not just those exercising the pre-1914 appropriative rights.

4.3.3 MPWMD Pumping Reports

MPWMD pumping reports for 2002 were reviewed and pumping in AQ1 and AQ2 were not considered for the reasons described in Section 4.2.1 above. Those records that remained for AQ3 and AQ4 were compared to the information in the WRIMS database that remained after applying earlier filters. For those entities that remained, the actual 2002 production values were compared with claims made as part of Statements of Diversion submitted to the SWRCB and entered into the WRIMS database. In most cases, the estimated diversions made in the Statements of Diversions were much higher than those reported as actual usage to MPWMD.

Then, those entities in AQ3 and AQ4 that reported pumping to MPWMD but did not report the pumping to the SWRCB were assumed to be riparian users. The actual pumping in 2002 for each of these riparian users was summed to provide a point of reference for the quantities. The information is presented in Table 7 and summarized below.

MPWMD 2002 Pumping Data in AQ3 and AQ4

Aquifer Subunit	Total Pumped and Reported to MPWMD (AFA)(excludes Cal-Am)	Total Reported as STATE to SWRCB (AFA)	Total Not Reported to SWRCB (AFA)
3	1,161	513	648
4	786	570	216

4.4 Relevant Water Rights

Table 8 summarizes those water rights that remained after applying the appropriate filters to remove irrelevant records. Under the theory of the data analysis model used for this report, those records that remain represent riparian rights holders and pre-1914 appropriative Cal-Am rights of 1,136 AFA.

The data from the different sources were reviewed and an estimate made up of the maximum annual use that these water rights holders may represent. Where available, the information from Table 13 of WRD 1632 was used, otherwise, the Maximum Annual Use in the WRIMS database was used. In the case where neither of these information sources was available, the maximum direct diversion rate was applied for 365 days per year to estimate a total maximum use.

The 2002 estimated pumping in AQ3 and AQ4 from MPWMD were each increased by 20% to represent the inherent variability in pumping as well as under-pumping and unreported pumping by riparian users. It is estimated that 20% is appropriate because of the limited potential for additional large development, and hence additional large water demands, in the area of influence of the Carmel River. In addition, in most cases, actual pumping is much lower than the water rights claims that have been documented with the SWRCB.

Some of the WRIMS records that remain are for APPLC, which appears to indicate that even though the entity has a riparian right they have chosen to file for an appropriative right as well, or based on other information, that the entity is a riparian rights holder.

Based on this evaluation, there appears to be a maximum annual use of up to 4,550 AFA for riparian rights and pre-1914 appropriative rights holders in AQ3 and AQ4. Although there is not sufficient information to better allocate these water rights holders to AQ3 and AQ4, an estimate based on pumping reported to MPWMD is that 60% of the pumping may occur in AQ3 and 40% in AQ4. At these ratios, AQ3 may represent about 2,705 AFA and AQ4 may represent about 1,845 AFA of water use by riparian and pre-1914 appropriators.

This maximum annual use number is conservative in that it assumes that the maximum use cited by an entity is pumped. Based on the MPWMD pumping data, actual water use appears to be significantly lower than that which an entity cites.

This evaluation does not include the following:

- Estimates of future demands for riparian water based on changes/maturing of land uses because such estimates would be extremely speculative.

- Conclusive identification of all pre-1914 appropriative rights holders. It appears likely that all of the significant pre-1914 water rights have been identified through the methodology used by KJC. In addition, the conservative factors built into the methodology should cover other unidentified pre-1914 right holds.

- Confirmation of points of diversion in WRIMS database for accuracy and cross-referencing with assessors parcel numbers or other information that could improve the accuracy of locating water rights users. Once again, however, the conservative factors built into the methodology should cover any errors in this area.

4.5 Conclusions of Water Rights Evaluation

As may be expected, there is considerable water use in AQ3 and AQ4 that may fall into the category of riparian or pre-1914 water rights holders. In order to evaluate whether pumping in the SRA could affect these potentially senior water rights that have been identified in the CVA, several things should be considered.

- There is extremely limited hydraulic connectivity between the SRA and the CVA AQ3; and in most cases, it is likely to be flow from the SRA to the CVA AQ3. It is extremely unlikely for the hydraulic gradient to allow flow from the CVA AQ3 to the SRA. Therefore, it is expected that there is almost no effect of pumping in the SRA to the CVA AQ3.

- To evaluate whether the exercising of September Ranch's riparian rights would impact those water rights identified in this report that are (or potentially are) senior within the CVA, one must determine whether there is more water available than is needed, and if so, how much water is available. Analyses of CVSIM water balance simulation model results provided by MPWMD for AQ3 and AQ4 were prepared with results as follows:

  - CVA AQ3 - Based on the 45 year CVSIM simulation results provided, the water balance in AQ3 is such that the average difference between the inflow and the outflow is about 7,500 AFY. During the 1984 – 1991 dry period, the average difference between the inflow and the outflow in AQ3 is about 6,800 AFA. When compared to the approximately 2,705 AFA that is needed to meet the estimated maximum annual use in AQ3 described above, it appears that sufficient groundwater is available in storage in AQ3 on average as well as during a dry period to meet the needs of the riparian and pre-1914 appropriative rights holders. Therefore, since there appears to be sufficient water in AQ3 with excess flow to meet the needs of the riparian and pre-1914 appropriate rights holders, pumping in the SRA will not have significant effect on water rights holders in AQ3.

  - CVA AQ4 - The analogous analysis of the 45-year CVSIM simulation results provided for AQ4 indicates that the average difference between the inflow and the outflow is about 2,500 AFY. During the 1984 – 1991 dry period, the average difference between the inflow and the outflow in AQ4 is about 2,300 AFA. When compared to the approximately 1,845 AFA that is needed to meet the estimated maximum annual use in AQ4, it appears that sufficient groundwater is available in storage in AQ4 on average as well as during a dry period to meet the needs of the riparian and pre-1914 appropriative rights holders. Therefore, since there appears to be sufficient water in AQ4 with excess flow to meet the needs of the riparian and pre-1914 appropriate rights holders, pumping in the SRA will not have significant effect on water rights holders in AQ4.

- Aggregate CVA AQ3 and AQ4 - Since the distribution of riparian and pre-1914 appropriators in AQ3 and AQ4 were estimated and have not been confirmed, it is appropriate to evaluate the water availability in aggregate for AQ3 and AQ4 against the aggregate water rights for AQ3 and AQ4 based on a water balance as summarized below:

  Inflow – Outflow AQ3 for 45 years = 7,500 AFA
  Inflow – Outflow AQ4 for 45 years = 2,500 AFA
  Total Inflow – Outflow for AQ3 and AQ4 for 45 years = 10,000 AFA

  Total Riparian and Pre-1914 Riparian Water Rights for AQ3 and AQ4 = 4,550 AFA which is less than 10,000 AFA available

  Inflow – Outflow AQ3 for 1984 – 1991 dry period = 6,800 AFA
  Inflow – Outflow AQ4 for 1984 – 1991 dry period = 2,300 AFA
  Total Inflow – Outflow for AQ3 and AQ4 for 1984 to 1991 dry period = 9,100 AFA

  Total Riparian and Pre-1914 Riparian Water Rights for AQ3 and AQ4 = 4,550 AFA which is less than 9,100 AFA available

Since there appears to be sufficient water on aggregate in AQ3 and AQ4 to meet the needs of the riparian and pre-1914 appropriate rights holders, pumping in the SRA will not have an effect on those water rights users. Moreover, potential spillage from the SRA is not needed to meet the maximum use in AQ3 and is likely to be part of excess outflow from AQ3 to AQ4. Kennedy/Jenks concludes then any reduction in rejected flow (spillage) from the SRA will not have significant affect on the Carmel River and its underlying aquifer. This conclusion is further supported by the fact that actual use is often much lower than that cited for submittal to the SWRCB.

Section 5: Water Demand

According to the Final EIR, the water demand of the September Ranch project at build-out is expected to be 57.21 AFY. This is based upon interior and exterior water use at homes, use at the equestrian center, and system losses. The baseline water demand and the projected water demand at build-out have changed since the Final EIR as follows:

	Revised EIR (2004)	Final EIR (1998)
Pre-existing Project Condition Baseline	3 AFY	45 AFY
Current Condition Water Usage	99 AFY	99.39 AFY
Projected September Ranch Project Demand	57.21* AFY	61.15[a] AFY
Difference between Pre-existing Baseline and Project	54.21 AFY	16.15 AFY

** Todd (1997) assumed a demand of 66.7 AFY, based upon consumption of 55.6 AFY and a 20% sustainability margin.*
a September Ranch Final EIR - 1998.

The estimates of annual water demand for the proposed project are based on average water use of 0.50 AFY for single-family residences and 0.231 AFY per unit for multi-family areas. The total housing demand, including landscaping, is 50.5 AFY, with 3 AFY for the equestrian center and 3.71 AFY for system losses. The total demand excludes water needed to irrigate the pastures because the pasture is assumed to either not require irrigation water or to be watered using reclaimed wastewater (the Final EIR assumes that reclaimed wastewater would be used to irrigate the pasture).

The Final EIR estimates that about two-thirds of the production would occur between June and November and correspondingly one-third of the production would occur between December and May (roughly similar to the current demand). The metered pumping rate currently at the site is about 99 to 110 AFY. According to Todd (2002), an average of 99.39 AF per water year was pumped from September Ranch wells between October 1998 and September 2001. From June 1998 to September 1998, 40.41 AF was pumped and 67.72 AF was pumped between October 2001 and July 2002. The average weekly pumping rate between June 1998 and July 2002 was 2.23 AF and the median was 2.49 AF. As a result, there would be a reduction of 41.79 AFY of demand from 99 AFY current usage to 57.21 AFY at project build-out. Compared to pre-existing baseline usage, there is a projected increase of 54.21 AFY of demand from 3 AFY pre-existing condition to 57.21 AFY project requirement.

Section 6: Groundwater Exchange Between the CVA and SRA – A Water Balance

Based on available hydrogeologic data and the results of groundwater storage and recharge estimates presented in Section 3, the method of a water balance presented herein is the most reliable approach in estimating the degree of connectivity – or groundwater exchange - between the two aquifers. Following this method of analysis, a second evaluation of connectivity between the CVA and SRA is presented in Section 6.1 for the Darcy flux method of estimating groundwater flow across the hydrologic barrier between the two systems.

A water balance is the net groundwater storage resulting from the difference between recharge into the September Ranch basin and the expected water production and outflow of "rejected" groundwater from the September Ranch basin to the CVA.

$$\text{Change in groundwater storage = Inflow – Outflow, more specifically} \quad (3)$$

Change in groundwater storage = recharge to the September Ranch basin – usage and runoff.

Kennedy/Jenks performed an independent analysis of Site-specific recharge based on rainfall data collected at the San Clemente Dam, discussed in Section 3.3. Calculated recharge values presented in Table 1 are carried over for use in the water balance equation above and results are presented in Table 4 and discussed below.

The water balance analysis was performed for the extended drought years of 1988 through 1991 and for the average rainfall water years of 1996 and 1997. We note that water balance calculations are based on recharge and outflow data and do not require actual water levels in the analysis. Yearly total inflow or recharge is distributed into four quarters or seasons and is reduced to account for runoffs (Section 3.3). The yearly outflow is simply the project demand of 57.21 AFY (Section 5). Total flow then represents available groundwater in storage and flow between the SRA and CVA given the right conditions.

The following is a summary of yearly total flow or change in storage in AF. The cumulative drawdowns are calculated as fall or rise of the water table per unit change in aquifer storage; values are carried over from one season to another in the course of a water year. The drawdown (negative signs) or water level rise (positive values) are based on a specific yield (S_y) of 0.33, derived from a Neumann solution of the 1992 Well C aquifer test data. The Neumann solution is used in unconfined aquifers (Kruseman and de Ridder (2000). Predicted changes for water levels in Table 4 are summarized below.

Average Rainfall Years	Inflow (AF)	Project Usage (AF)	Total Flow (AF)	Cumulative Drawdown (ft)	Below Average Rainfall	Inflow (AF)	Project Usage (AF)	Total Flow (AF)	Cumulative Drawdown (ft)
1996	262.1	-57.21	204.9	13.73	1987	65.5	-57.21	8.3	0.56
1997	244.0	-57.21	186.8	26.32	1988	65.9	-57.21	8.7	0.59
					1989	76.4	-57.21	19.2	1.29
					1990	78.0	-57.21	20.8	1.40
					1991	81.9	-57.21	24.7	1.66

In either the average water year or below-average water years, the exceedance of natural recharge over use can have two effects: 1) potentially generates a net gain in storage or 2) excess groundwater as rejected flow into the CVA. The calculated cumulative water level increase suggests that groundwater storage will not be depleted even in drought years. These *estimates* of water level increases are generally consistent with groundwater measurements taken in the field, meaning even in below average rainfall periods the water levels have not been observed to fall significantly. Therefore we suggest that the estimated water level increases and their consistency with field data serve as ground-truthing parameters for a water balance.

The total flow or net gain in storage in water years with average rainfall suggests that there is between 187 and 205 AFY of water that is available for exchange between the SRA and CVA (that is, to flow from the SRA to the CVA). In extended drought periods, there is approximately 8 to 25 AFY of available rejected flow for exchange. These two sets of storage results categorically suggest that in either normal or drought precipitation periods pumping the projected project demand from the SRA will not result in a reduction of groundwater storage volume in the CVA.

Kennedy/Jenks concurs with the analysis presented in Todd (1992) and Todd (1997), that in average rainfall years and above average rainfall years the CVA and SRA would be in equilibrium, meaning that both aquifers would have insignificant net flow between them (Todd 1997). This is because the independent sources of recharge to both aquifers meeting or exceeding the water demand in both systems. We believe based on current calculations that this is valid for the project pumping scenario of 57.21 AFY where the amount of recharge is estimated to be between 244 and 262 AFY in average rainfall years and 65 to 81 AFY in below average years (Table 1).

6.1 Groundwater Exchange Between the SRA and CVA Based on Darcy Flux Calculations

The purpose of the following analysis is to present another method of calculating groundwater exchange between the two aquifers. The specific benefit in the following is to provide an *independent check on the seasonal variability of limited groundwater exchange* between the two aquifers. It is noted that the calculated volume of groundwater exchanged as Darcy Flux is less reliable in this situation than those presented above because of the uncertainty in the hydraulic conductivity value of 0.14 gal/day/ft^2 estimated for the Qoa_2 aquifer unit. Nonetheless, the reason for and advantage in these flux calculations are that they are dependent on the seasonal variability in groundwater levels; whereas, the above analysis only accounts for the difference between inflow and outflow, yearly.

The hydrostratigraphic details of limited connectivity between the SRA and CVA was discussed in Section 3.0 and 3.1. The following focuses on the hydraulic exchange of groundwater between the two systems. As suggested in Section 3.4, flow of groundwater or rejected recharge is typically from the SRA towards the CVA as depicted on Figure 6 for both average and below average rainfall periods. Groundwater flow from the CVA to the SRA is probably rare and would require specific combined conditions such as an aquifer test where a well in the SRA is pumped at a high flow rate aquifer test and a concurrent rainfall event (conditions met during the 1996/1997 aquifer test) (see Section 3.4.1).

Calculations of the groundwater exchange based on Darcy flux (Freeze and Cherry 1987) is discussed below using the groundwater gradient information discussed in the previous section. Table 5 contains details and assumptions used for the Darcy calculations. The Dupuit formulation of Darcy flux (Fetter 1994) was used for the unconfined groundwater in the Qoa_1 water-bearing zone due to its variable gradients across the section M-M' (Figure 2). Groundwater flux for the Qoa_2 was provided by Darcy's equation:

$$Q = K\ i\ A, \text{ where} \qquad (2)$$

Q is the Darcy flux (AFY), K is the hydraulic conductivity of the water bearing material (gallons per day per square–foot), i is groundwater gradient (ft/ft) across the profile M-M', and A is the cross-sectional area of the profile M-M' (ft^2).

Hydraulic conductivity values (K) represent the degree of transmissiveness of groundwater in a particular permeable material. The K-values used in this study were derived by Todd (1997) from the 1996/1997 aquifer test. The pumping test yielded only the K-value for the Qoa_1 aquifer of 28.0 gal/day/ft^2. The K-value for the Qoa_2 was derived from a permeameter test of a single core, which yielded a value of 0.14 gal/day/ft^2. These values were used to calculate flow across the two systems.

The groundwater gradient (i) and cross-sections area (A) are dependent on the fluctuations in seasonal water levels. Their values are reported in Table 5. The following is a summary of groundwater exchange rates in terms of Darcy flux between the SRA and CVA in acre-feet per quarter (AFQ).

Season / Quarter	Q (AFQ) for Qoa1 Average Rainfall Water Year 1998	Q (AFQ) for Qoa2 Average Rainfall Water Year 1998	Q (AFQ) for Qoa1 Below Average Rainfall Water Year 1999	Q (AFQ) for Qoa2 Below Average Rainfall Water Year 1999	Q (AFQ) for Qoa1 Below Average Rainfall Water Year 1989	Q (AFQ) for Qoa2 Below Average Rainfall Water Year 1989
Fall	0.0	-0.0046	0.0	-0.0057	0.0	-0.0408[a]
Winter	-0.4995	-0.0213	-0.0566	-0.0077		
Spring	-0.1026	-0.0108	-0.0180	-0.0070		
Summer	-0.0257	-0.0074	0.0	-0.0136		
Annual Total (AFY)	-0.6278	-0.0441	-0.0746	-0.0340		
Annual Total for Combined Qoa1 and Qoa2 (AFY)		-0.6719		-0.1085		-0.0408

Note: negative sign indicates groundwater flow from the SRA to the CVA. Q values are in acre-feet per quarter (AFQ)

(a) Well D was installed after 1989, so water level data is not available. Water levels and flux assumed constant for all four quarters.

These results suggest that exchange of groundwater between the two systems is greatest in the winter months, primarily through Qoa_1, with up to 0.4995 AF for three months. The least exchange occurs in the Fall months, primarily through the lower Qoa_2 (0.0046 AF for three months).

Results of the Darcy calculations also suggest that the overall exchange of groundwater in the Qoa_2 is relatively small, with a maximum amount of 0.04 AFY in the average rainfall years. This low volume of exchange between the two systems can be attributed to: 1) the ridge of Qoa_2 separating the SRA and CVA, and 2) the low hydraulic conductivity of the Qoa2. Groundwater must flow over the ridge of Qoa_2 or through it; hence, in either case flow is both impeded and constricted moving between the SRA and CVA. This is supported by the Darcy results of no flow in Qoa_1 in the fall months (see Table 5 and the summary above). Specifically, groundwater levels in Qoa_1 must be higher than the top elevations of the Qoa_2 in the area of M-M' to achieve appreciable rejected flow to the CVA. In the fall months, storage is depleted and water levels (40 to 41 feet AMSL) fall one to two feet below the top of the Qoa_2, which is at approximately 43 feet AMSL. The Darcy flux through the Qoa_1 is zero for the fall months and summer months of water year 1999 as a result.

Due to the uncertainty in the hydraulic conductivity values for the Qoa_2, Kennedy/Jenks believes that this methodology is unreliable for estimating the actual volume of groundwater exchange between the SRA and CVA based on calculations of Darcy flux. The Darcy estimates of exchange are on the order of 0.6 to 1 AFY which in our opinion is unrealistically minor. Therefore, we place greater confidence in the results of the water balance (groundwater exchange) between the two systems with the values stated above of 182 to 201 AFY.

Section 7: Sustainable Yield - Potential Effect on the Aquifer

Sustainable yield can be considered as the amount of naturally occurring groundwater that can be extracted from an aquifer on a sustained basis, economically and legally, without impairing the native groundwater quality or creating an undesirable effect such as environmental damage (Fetter, 1994). Because of the isolation of the SRA from other groundwater resources, sustainable yield in the SRA can be more precisely considered as the amount of groundwater that could be pumped out of the SRA without seriously depleting groundwater storage. A legal factor in the Project's sustainable yield is that the proposed project groundwater usage must not adversely affect other users with senior water rights.

Kennedy/Jenks estimates, based on the estimated amount of yearly recharge, that the annual amount of groundwater available from the SRA aquifer during average rainfall periods is between 244 and 262 AFY for all users within the SRA. These values (244 AFY and 262 AFY) are the total amount of recharge calculated based on the 70% ET loss over a 561-acre watershed for average rainfall periods. Kennedy/Jenks also estimates that a conservative amount of 65 AFY to 81 AFY of groundwater is available for all wells within the SRA based on an 85% ET loss for extended below average rainfall periods. Wells other than SR1 within the SRA with production records are listed below.

Other Production Wells Within the SRA	Production Rate (AFY)
Tarantino (Todd, 1997)	0.35
Campisi (Todd, 1997)	1.3
Spicher (Todd, 1997)	0.5
Steine (Todd, 1997)	0.5
Total Production Four Wells (MPWMD, 1993)	0.88
Total Production Four Wells (MPWMD, 1995)	0.79
Total Production Four Wells (MPWMD, 1996)	0.62
Averaged Total Usage	0.76

The sustainable yield for the Project is then the available amount of groundwater minus the usage of these four known domestic wells. The sustainable yield calculations are presented in Table 9 and summarized below.

	Available Groundwater In the SRA[1] (AFY)	Averaged Usage of Other SRA Users (AFY)	Project Sustainable Yield[2] (AFY)
Average Precipitation Period	244 – 262	0.76	243 – 261
Below Average Precipitation	65 - 81	0.76	64 – 80

Notes: 1- Based on total recharge within the September Ranch watershed; 2 – Project sustainable yield is the amount of naturally available groundwater in the SRA minus the current total usage by other SRA users.

The estimated average amount for other SRA users is 0.76 AFY, making a total of 57.9 AFY with the Project demand (57.21 AFY). The estimated annual recharge in average rainfall years ranges from 244 and 262 AFY and in drought years ranges between 65 AFY and 81 AFY. Subtracting the average use of other wells in the SRA from the recharge indicates the sustainable yield for the Project in average rainfall years is 243 AFY to 261 AFY, and in below-average years is 64 AFY to 80 AFY. The estimated water use for the Project at build-out is 57.21 AFY, and so the Project water use is within the sustainable yield for the SRA, including the Project and other users.

The effect of pumping in the September Ranch basin in average rainfall years does not affect the CVA significantly because recharge to the SRA exceeds groundwater usage in the September Ranch basin, as discussed above and in Section 3. The effect of pumping in the September Ranch basin in drought years on the CVA is also not significant because recharge to the SRA is likely to remain an average of 73 AFY, still in excess of planned total usage of 57.9 AFY by all wells within the SRA.

7.1 Effects of Long-term Pumping

The above conclusion centers on the finding discussed in Section 2 (Hydrologic Setting) that the September Ranch basin is fairly isolated in terms of hydrogeology with *limited* exchange of groundwater between the SRA and CVA largely because of the approximate neutral gradient between them (Section 3.4) and the high ridge of relatively impermeable material. We have taken into consideration that the CVA Subunit 3 (Figure 1, blue shaded area) collocates with the westernmost portion of the SRA west of the Knoll. This portion of the CVA occupies about 35% of the total SRA aquifer and is the most productive portion of the SRA. Additional pumping wells would most likely be proposed in this area due to the presence of the relatively thick Qoa_1 water bearing unit, as compared to water bearing zones encountered elsewhere in the September Ranch basin.

Even with planned future additions of pumping wells in this portion of the SRA, and given that the project usage limit is 57.21 AFY, it is likely that the groundwater in the SRA and CVA would maintain similar water levels – i.e. near neutral gradient. There are two contributing factors to the sustained neutral gradient with project demand: 1) groundwater levels have always been slightly higher in the SRA than the downgradient CVA due to the SRA watershed's higher topography and hence flow towards the CVA; and 2) the relatively small usage in the SRA compared to the large amount of storage in AQ3 of the CVA.

Table 5 and Figure 6 compare groundwater gradients (or differences in water levels) between Well E and Brookdale Well (located in the SRA and CVA, respectively) for average, below average, and drought periods. The groundwater gradient is typically around 0.0020 ft/ft, with flow towards the CVA. Kennedy/Jenks concludes based on the water balance (Section 6) that it is unlikely that the proposed usage of groundwater in the SRA would induce further declines in water levels in neighboring wells.

The effect on the CVA water resources must also be assessed in terms of overall surface-water outflow from the CVA – more specifically as to this project, we must examine water coming out of AQ3 and AQ4. The amount of annual outflow as reported in the CVSIM model is an indicator of the Carmel River baseflow. The CVSIM model calculates baseflow whenever the storage capacities in AQ1 through AQ4 are exceeded. In the CVA, groundwater storage is normally exceeded during peak flow months from December through May. The baseflow then determines the amount of surface-water and groundwater (subsurface) outflows on a monthly basis in each of the CVA aquifer units.

The averaged surface outflows in normal precipitation years (e.g. 1996 and 1997) are 91,849 AF in AQ3 and 90,830 AF in AQ4 (CVSIM data). Surface outflows during below normal rainfall years (e.g. 1987 through 1991) are 7,530 AF in AQ3 and 6,149 AF in AQ4. The years 1987 through 1991 are considered as critically dry years when the groundwater storage in the CVA was recorded at its lowest volume since 1981 (Table 3 CVSIM results). The driest year was 1990 with surface flows declining to 2,554 AF in AQ3 and 1,315 AF in AQ4. CVSIM data indicate that outflows in the CVA during the summer months of June through November 1990 are mostly of subsurface nature (i.e. groundwater) and which notably did not diminish as compared to normal rainfall years. Surface-water flow in 1990 did decline and its occurrence was restricted to the winter months from December through May, similar to normal rainfall periods.

Kennedy/Jenks concludes that a long term deficit of 57.21 AFY due to Project demand in the SRA would have a de minimis effect on the much larger volume of surface-water outflows in the CVA during normal and below average rainfall years. Insignificant effect on the CVA's surface water resources also means no probability of prolonged or permanent impacts on the ecology and biological within the confluence of the Carmel River.

Impacts on biology can be a result of a prolonged or permanent decrease in baseflow due primarily to prolonged draught condition. Since a river baseflow is directly proportional to the amount of surface outflow and that the volume of surface outflow in the CVA is much larger than the amount of groundwater diverted for use by the Project, it follows then there would be an insubstantial change in the baseflow of the Carmel River due to the relatively small amount of loss from Project usage.

Current groundwater usage with a cumulative pumpage at the single Site production well is about 99 AFY (Todd, 2002). The projected Project demand of 57 AFY represents a <u>saving</u> of 42 AFY of groundwater usage. Compared to pre-existing baseline usage, there is a projected <u>increase</u> of 54.21 AFY of demand from 3 AFY pre-existing condition to 57.21 AFY project requirement (see Section 5). Currently, significant usage occurs in the seven summer months from June to December, amounting to about 59 AF. Pasture irrigation resumes in the Spring of each year, harvesting another 38 AF on average. Water levels at the closest non-September Ranch well – the Brookdale Well – exhibited drops in water levels on the order of 5 to 7 feet corresponding to the usage months of the September Ranch well. With the smaller Project demand, water levels at the Brookdale well and other nearby wells would experience less decline than the current condition. Water levels in the Brookdale well will recover to about 40 feet MSL as currently indicated by available water level data collected since 1996.

Kennedy/Jenks recommends that any future pumping wells in the September Ranch basin should be located based on long-term pumping tests designed and executed appropriately to yield information on the radius of influence of potential multiple pumping wells. Moreover, representative transmissivities for the three aquifer units (Qoa_1, Qoa_2, and Tm) should be available for informed decisions on placement of future wells so as to minimize their effects on neighboring wells (particularly in the westernmost project area where the two aquifers are in direct hydraulic contact).

Section 8: Conclusions and Recommendations

8.1 Conclusions

1. Kennedy/Jenks concludes that a conservative estimate of groundwater available long term from the SRA aquifer is about 244 to 262 AFY. Sustainable yield is the amount of water that can be extracted from storage in the SR basin without affecting other users with senior water rights at a long term basis. There is a smaller amount of sustainable yield of 64 to 80 AFY in below average rainfall years.

   The watershed area, rainfall records, and estimates of ET and infiltration, indicate that the recharge into the September Ranch basin exceeds the existing water demand of about 110 AFY and the projected Project demand of 57.2 AFY. The extra recharge is a potential rejected flow that is available to flow to the CVA. In average rainfall years, the rejected flow is between 187 and 205 AF. In extended drought periods it is approximately 8 to 25 AF.

2. Drainage within the September Ranch watershed is fairly efficient because of the well-defined (high relief) ridges that influence the convergent drainage pattern within the watershed. Surface water generally flows relatively unimpeded to the terrace deposit lying adjacent to the base of the ridges. The alluvial deposit forming the terrace is entirely the Site aquifer. Shallow groundwater within the watershed is almost completely captured by the terrace deposit materials.

3. The SR basin is fairly isolated in terms of hydrogeology with limited exchange of groundwater between the SRA and CVA largely because of their approximate neutral gradients and the high ridge of relatively impermeable material. From the numerous water level record searches, data suggest a consistent and minor groundwater gradient (0.0022 ft/ft) from the east to the west. At the southwest boundary of the September Ranch basin (where it has limited connection with the CVA) the gradient direction is typically southward, from the SRA to the CVA.

   A unique set of conditions is required to induce flow from the CVA to the SRA. For example, the drawdown during the 1996/1997 47-day aquifer test created a significant gradient towards the SRA at the location of the groundwater divide (apparent in the pumping test groundwater level contours). The gradient towards the SRA was probably further steepened by a groundwater level rise near the Carmel River due to the high river level.

   Groundwater stored beneath the September Ranch Project site is entirely within the nearly closed basin bounded by Monterey Shale. The limited hydraulic connectivity with the CVA occurs only when groundwater levels are higher than the top of the Monterey Shale bedrock such that seasonally excess groundwater would spill over and serve as recharge to the CVA. Hence, September Ranch groundwater storage within the closed basin is defined by isolated groundwater that is not available for recharge to the CVA.

   During average rainfall and below average rainfall years, calculations predict an increase in groundwater storage. This effect is due to the exceedance of natural recharge over usage in the September Ranch basin. Rather than an actual increase in storage, the extra water flows from the SRA to the CVA over the high ridge of Monterey Shale.

4. Current groundwater usage with a cumulative pumpage at the single Site production well is about 99 AFY (Todd, 2002). The projected Project demand of 57 AFY represents a saving of 42 AFY of groundwater usage. Compared to pre-existing baseline usage, there is a projected increase of 54.21 AFY of demand from 3 AFY pre-existing condition to 57.21 AFY project requirement (see Section 5). Kennedy/Jenks concludes that a long term deficit of 57.21 AFY due to Project demand in the SRA would have a de minimis effect on the much larger volume of surface-water outflows in the CVA during normal and below average rainfall years. Surface outflow is directly proportional to the amount of baseflow. It is concluded that there would be an insubstantial change in the baseflow of the Carmel River due to the relatively small amount of loss from Project usage.

5. Based on the Carmel Valley Simulation Model (CVSIM) results provided by MPWMD for AQ3, the water balance in AQ3 is such that based on the 45 year simulation results provided, the average difference between the inflow and the outflow is about 7,500 AFY. During the 1984 – 1991 dry period, the average difference between the inflow and the outflow is about 6,800 AFA. When compared to the approximately 2,705 AFY that is needed to meet the maximum annual use in AQ3, it appears that sufficient water is available in storage in AQ3 on average as well as during a dry period to meet the needs of the riparian and pre-1914 appropriative rights holders.

   The analysis of the 45-year CVSIM simulation results provided for AQ4 indicates that the average difference between the inflow and the outflow is about 2,500 AFY. During the dry period of 1984 – 1991, the average difference between the inflow and the outflow in AQ4 is about 2,300 AFA. When compared to the approximately 1,845 AFA that is needed to meet the estimated maximum annual use in AQ4, it appears that sufficient groundwater is available in storage in AQ4 on average as well as during a dry period to meet the needs of the riparian and pre-1914 appropriative rights holders. As there appears to be sufficient water in AQ4 with excess flow to meet the needs of the riparian and pre-1914 appropriate rights holders, pumping in the SRA will not have a significant effect on water rights holders in AQ4.

   As there appears to be sufficient water in AQ3 and AQ4 in aggregate to meet the needs of the riparian and pre-1914 appropriate rights holders for both aquifer sections beneath the Carmel River confluence, pumping in the SRA is unlikely to affect the CVA. Kennedy/Jenks concludes then any reduction in rejected flow (spillage) from the SRA will not have significant affect on the Carmel River and its underlying aquifer.

6. Due to the uncertainty in the hydraulic conductivity values for the aquitard Qoa_2, Kennedy/Jenks cannot precisely establish the actual *limited* volume of groundwater exchange between the SRA and CVA based on calculations of Darcy flux. The exchange is estimated to be between 0.10 and 0.67 AFY from the SRA to the CVA. This is significantly less than the predicted rejected recharge.

7. Kennedy/Jenks agrees with the comments by the MPWMD that results and interpretation of the 1996 47-day aquifer test is arguable, given the unknown magnitude of the effect that

concurrent rainfall and river level rise had on the response in wells closer to the Carmel River.

However, water levels in Well D after both the 1992 and 1996 aquifer tests recovered at slow rates. Based on its location, we believe that water levels in this well responded first to recharge in the SRA and second to recharge in the CVA. Moreover, it is recorded that overall water levels rose slowly and stayed depressed in the summer and fall of 1997. If there were higher rates of groundwater recovery after the 1996 test in all wells then it is likely due to the suspected effect that concurrent rainfall and high river flows had on water levels during the aquifer test.

8.2 Recommendations

Kennedy/Jenks recommends that any future pumping wells in the September Ranch basin should be located based on long-term pumping tests designed and executed appropriately to yield information on the radius of influence of potential multiple pumping wells. Moreover, representative transmissivities for the three aquifer units (Qoa_1, Qoa_2, and Tm) should be available for informed decisions on placement of future wells so as to minimize their effects on neighboring wells (particularly in the westernmost project area where the two aquifers are in direct hydraulic contact).

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