RIPARIAN CORRIDOR MONITORING REPORT
CARMEL RIVER
2009

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I. INTRODUCTION

The mission of the Monterey Peninsula Water Management District (MPWMD) is to manage, augment, and protect water resources for the benefit of the community and the environment. The Monterey Peninsula relies entirely on local water resources, primarily surface and groundwater from the Carmel River, to meet water supply needs. As an independent Special District, created by an act of the California State legislature in 1977, MPWMD has the power to regulate water production and distribution within its boundaries which include the Monterey Peninsula and much of the Carmel River watershed.

Since the early 1980s, MPWMD has integrated water supply management with an active program to mitigate for the impacts from water extraction including restoration of degraded natural resources in the Carmel River. The 1990 Water Allocation Program Environmental Impact Report (EIR) documented environmental degradation associated with water extraction. In 1995, the State Water Resources Control Board (SWRCB) found that the California-American Water (CAW) had been illegally diverting 10,730 acre-feet per year from the Carmel River and its alluvial aquifer. To help mitigate the degradation of the Carmel River, the MPWMD established mitigation programs in fisheries, riparian restoration, and erosion protection. Historically, water diversion has been one of the primary impacts to the Carmel River.

Over the last century, the Carmel River has undergone a transformation from a wide, meandering, shallow watercourse to a moderately incised channel. Major alterations in the hydrologic regime began in 1921 with the construction of the San Clemente Dam and Reservoir and in 1948 when the Los Padres Dam and Reservoir was built. A combination of floodplain development, trapping of sediment load behind the dams, and gravel mining in the channel bottom downstream of the dams, has led to channel incision. As the Carmel River transformed into a moderately incised channel, the population continued to grow on the Monterey Peninsula.

Increased community development and a severe two-year drought (1976-1977) put an enormous amount of pressure on the limited water resources. Groundwater levels declined to unprecedented lows causing widespread mortality to riparian vegetation. El Nino events between 1978 and 1983 created high flows which destabilized the alluvial portion of the denuded riparian bank. The degradation of the river corridor and decline of the wildlife habitat galvanized efforts within the community to find solutions to the environmental problems. In 1983, after 83 percent of riverfront property owners approved a benefit assessment zone along the river to help fund projects, MPWMD began a restoration program.

Healthy riparian corridors are an essential part of a river's overall health. Riparian corridors provide erosion control, shade; improve water quality and habitat for aquatic and terrestrial species. Species that benefit from a healthy riparian corridor include the California red-legged frog *(Rana aurora draytonii)* and steelhead trout *(Oncorhynchus mykiss)* which are both listed as threatened under the Federal Endangered Species Act in the Carmel River watershed. The riparian corridor along the Carmel River primarily consists of red and arroyo willow (*Salix* ssp.), black cottonwood (*Populus* ssp.), white alder (*Alnus* ssp.), and sycamore (*Plantanus* ssp.).

In studies contracted by the MPWMD a close connection has been demonstrated between groundwater pumping and the health of the riparian vegetation and increased channel instability (McNeish 1986, ’88, ’99, ‘91a, ‘91b). It was determined that plant stress was directly related to soil water availability and depth to groundwater and that mitigation was necessary in the form of irrigation if all four of the following criteria were met (McNeish, 1986).

1. Dry river channel
2. Drop in the water table by greater than 2feet/ week or seasonally 8 feet or more below the elevation of the river channel
3. Unacceptable soil moisture levels
4. Unacceptable vegetation stress

To determine these conditions MPWMD developed a monitoring system to measure plant stress, soil moisture, and depth to groundwater. When necessary, supplemental irrigation is applied to help mitigate the effects of unacceptable vegetation stress. This report summarizes the 2009 monitoring methods and results.

II. SITE DESCRIPTIONS

The 36-mile-long Carmel River drains 255 square miles of the central coast of California. The watershed includes the Santa Lucia Mountains to the south and the Sierra del Salinas Range to the north. Bedrock in the basin consists mainly of Sur Series crystalline rock (granite, gneiss, schist), Monterey Shale and sandstone (Page and Matthews, 1984). Upper reaches on the Carmel River flow through steep-sided canyons, while the lower 16 miles is a relatively flat alluvial valley to the ocean. Mean annual rainfall varies from approximately 14 inches along the northeast perimeter of the basin to over 40 inches in the high peaks (up to approximately 5,000 feet in elevation) of the southern portion (James, 1999). The total rainfall for 2009 was 18.14 inches (CAW, 2009). The average annual runoff at the San Clemente Dam site is 68,800 acre-feet (James, 2009). The bankfull flow near the mouth of the river is approximately 2,200 cubic feet per second (cfs). The largest flow event recorded on the Carmel River occurred on March 10, 1995, where the river discharge peaked at 16,000 cfs.

In order to accurately assess vegetation stress throughout the flat alluvial valley, MPWMD designated four vegetation monitoring sites. These sites are: Rancho Cañada, San Carlos, Valley Hills, and Schulte. Rancho Cañada and San Carlos are located in the lower portion of the alluvial valley and Valley Hills and Schulte are located in the mid portion of the alluvial valley (Fig. 1). All sites are relatively close to a CAW production well.

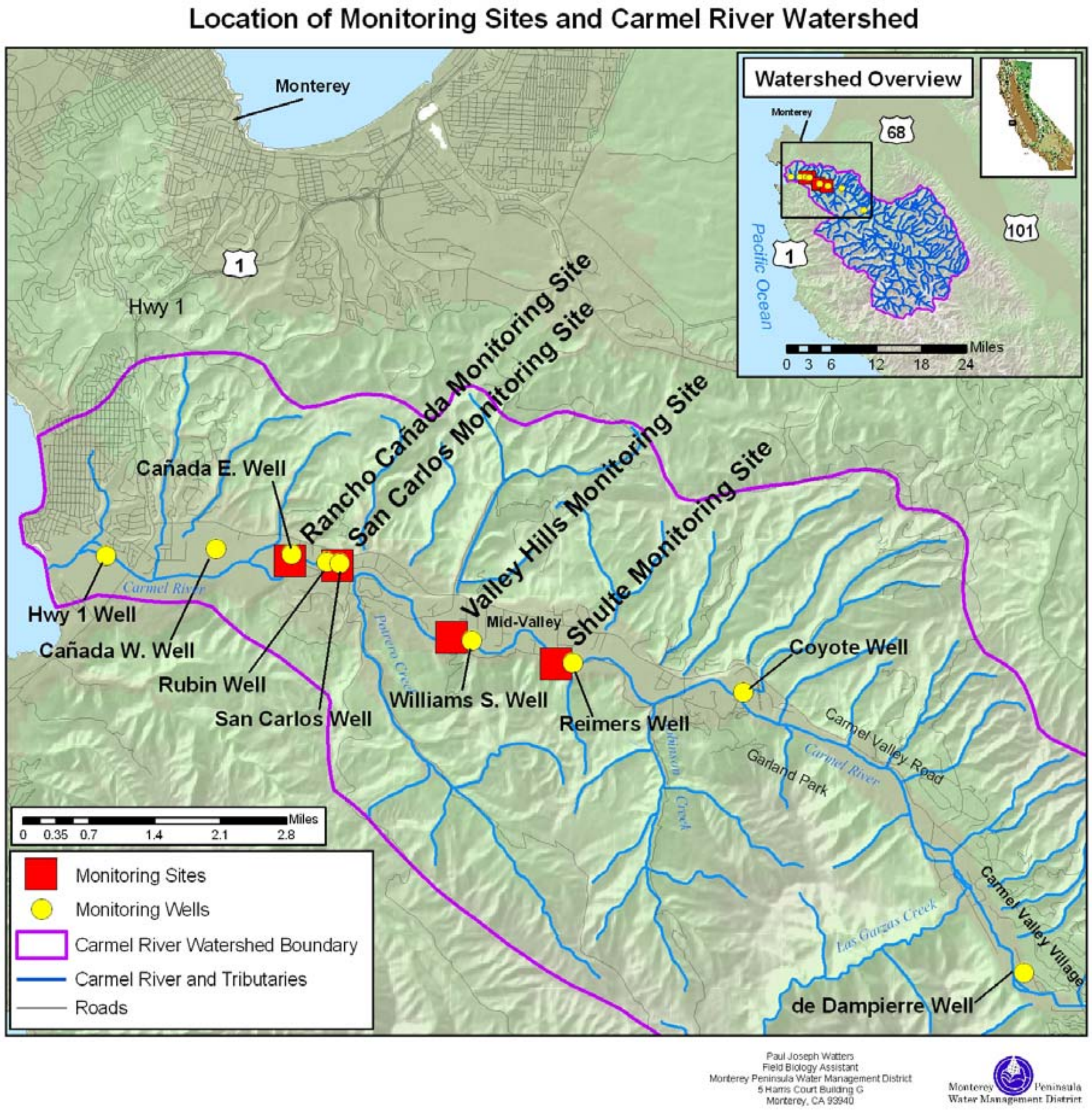

Figure 1. The four vegetation monitoring sites and the Carmel River watershed

The Rancho Cañada monitoring site is located 3.24 miles upstream of the Carmel River mouth in the vicinity of CAW's Cañada production well. This well has the capacity to pump up to 5 cubic feet/second and can negatively effect riparian vegetation. The north bank is comprised of relatively young riparian vegetation that is part of restoration efforts by the Rancho Cañada Golf course. Thus, the vegetation on the north bank is watered by irrigation run-off from the adjacent golf course. The south bank is a more mature stand of willows and cottonwoods of which the majority is watered by an irrigation system operated by the Hacienda Carmel Community Association.

The San Carlos monitoring site is located 3.60 miles upstream of the Carmel River mouth. This site encompasses one of the largest mature riparian areas remaining in lower Carmel Valley. It consists of a high terrace with large black cottonwoods and relatively steep banks consisting mostly of red and arroyo willows. Depending on the water year, CAW's San Carlos Production Well is sometimes operated in the late summer if the river is completely dry. However, if surface water is present they do not operate it because the California Department of Health has determined it to be under the influence of surface water.

The Valley Hills monitoring site is located 5.60 miles upstream of the Carmel River mouth. This restoration site, installed in 1992, is 1,500 linear feet along the river channel and is located adjacent to agricultural lands. It is comprised mainly of red and arroyo willows and black cottonwoods. The Cypress production well is adjacent to the site with a pumping capacity of 3.03 cubic feet/second.

The Schulte Restoration Project monitoring site is located 6.70 miles upstream of the Carmel River mouth and consists mostly of black cottonwoods and red and arroyo willows. This restoration project was completed in January of 1988 and consisted of 3,200 lineal feet of channel realignment and floodplain modification. The Schulte production well is slightly downstream of the monitoring site with a pumping capacity of 1.24 cubic feet/second.

III. METHODS

Consistent with the methods used in the past three years the 2009 Riparian Vegetation Monitoring Program (RVMP) included assigning a canopy rating, and measuring depth-to-groundwater and soil moisture. Photos were taken of monitoring trees and the river corridor to document vegetation canopy cover change over time. All sites were monitored weekly from May through October.

Canopy Rating

Canopy Rating (CR) methods have been used by MPWMD to assess vegetation health since the 1980s. The canopy rating that was used for the 2009 RVMP (Tbl.1) was based on MPWMD historic canopy rating scales. However, additional 'rates' were added to better assess vegetation conditions.

Willow (*Salix* spp.) and black cottonwood (*Populus* spp.) trees of varying age were selected from both the terrace and river's edge at each site. Three cottonwoods were labeled C1, C2, C3, and three willows were labeled W1, W2, W3 at each site. The trees were flagged for easy identification. Each week the monitoring trees' canopy was evaluated based on the canopy rating scale and assigned a rating. A photograph was taken to document the monitoring trees' canopy.

Canopy Rating Scale	
1	Green, obviously vigorous
2	Some visisble yellowing
3	Leaves mostly yellowing
4	< 10% Defoliated
5	Defoliated 10% to 30%
6	Defoliated 30% to 50%
7	Defoliated 50% to 70%
8	Defoliated 70% to 90%
9	> 90% Defoliated
10	Dormant
11	Dead

Table 1: MPWMD Canopy Rating Scale for the RVMP

Groundwater Monitoring

For this report, four wells were monitored for depth to groundwater (Tbl. 2). Two monitoring wells, Cañada East and San Carlos were used to characterize the depth to groundwater within the lower portion of the Carmel River alluvial aquifer. Two 'upstream' monitoring wells, Williams South and Reimers, were used to characterize depth to groundwater values in the mid valley portion of the Carmel River alluvial aquifer. Groundwater levels were monitored each week.

Soil Moisture Measurement

Tensiometers were used at all four vegetation monitoring sites to determine soil moisture. Each site has one tensiometer station located near the river low on the bank.

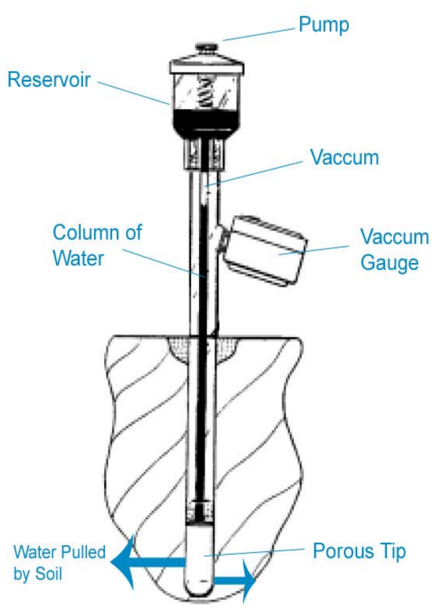

Figure 2: A tensiometer consists of a sealed tube, a porous tip, a vacuum gauge, and a reservoir pump. The tube is buried with the porous tip at the bottom and water is hand-pumped into the tube from the reservoir. Once the column of water in the tube is filled, the device is left alone. Over time, the soil pulls the water out of the tube though a porous tip. A vacuum gauge then measures the attractive forces of the surrounding soil on the water filled column.

Each station consists of two tensiometers buried so that the perforated ends are placed at 18 inches and 36 inches below the surface (Fig. 2). A gauge reading is recorded in centibars and algaecide treated water is pumped into the column to reset the gauge. During this monitoring season all gauges functioned properly.

Table 2. Attributes of the Carmel River Alluvial Aquifer Monitoring Wells Selected for Monitoring

Name	Year Drilled	River Mile	Distance to River (feet)	Well Depth (feet)	Date of Maximum Measured Depth to Groundwater	Maximum Measured Depth to Groundwater (feet)
Cañada East	1978	3.13	360	100	10/22/2004	43.8
San Carlos	1983	3.65	170	68	10/25/2007	33.51
Williams South	1984	5.57	90	100	10/25/2007	60.1
Reimers	1988	6.72	150	122	10/25/2007	29.07

Data Analysis Methods

All data was entered into Microsoft Excel spreadsheets. Average Canopy Ratings (ACR) were calculated by summing the canopy rating and dividing by the total number of either cottonwood or willow trees monitored at each site. Monitoring photos were downloaded to the computer, named, and placed into an appropriate folder. All photo names contained the site name, tree number and date. No calculations were applied to depth-to-groundwater data. Tensiometer data was converted from centibars to bars by dividing centibars by 100. All data was graphed.

IV. RESULTS

Rancho Cañada

The monitoring season began with willows and cottonwoods both having an ACR of 1.0, and ended the monitoring season with an ACR of 1.7 and 3.0, respectively. The ACR for willows was constant from May to mid September, and then climbed to 1.7 during the last month of monitoring. The ACR for cottonwoods increased from 1 to 1.3 in the beginning of August and remained constant until the first week of September when the ACR rose to 2.0 (Fig.3). The cottonwood ACR continued to increase though the end of the monitoring season, with a final rating of 3.0.

From May through the first week in October the depth-to-groundwater at Cañada East groundwater monitoring well dropped a total of 23.88ft from 20.44ft to 44.32ft below surface. A major storm event with heavy precipitation in the second week of October brought the depth back to 34.23ft for the close of the monitoring season (Fig.3).The greatest drop in depth was 3.35ft in 7 days, occurring in mid July.

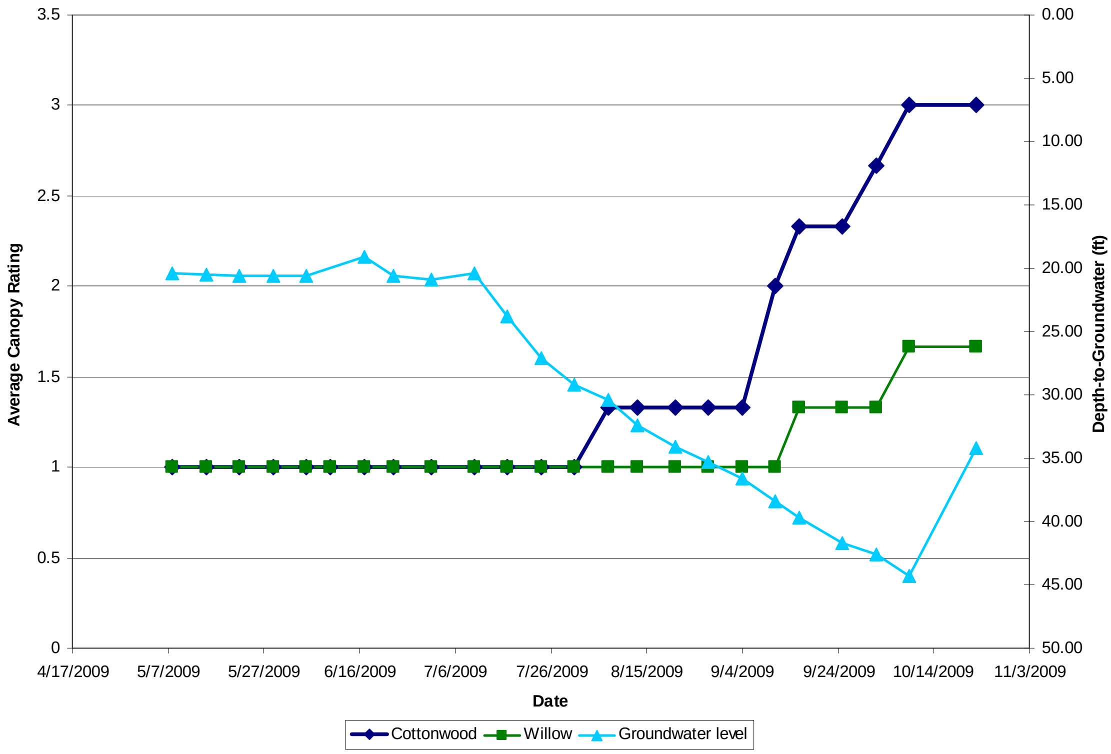

Figure 3: Average Weekly Canopy Rating for cottonwoods and willows at Cañada vs. depth-to-groundwater at the Cañada East monitoring well.

San Carlos

Willows and cottonwoods at the San Carlos site both began the monitoring season with an ACR of 1.0 and ended the monitoring season with an ACR of 4.0 and 3.0, respectively. The ACR for willows increased to 1.3 in early August, and remained constant until the first week of September when it rose to 1.7. The willow ACR steadily increased until reaching a plateau at 4.0 in the end of October. The ACR for cottonwoods was constant at 1.0 until the end of September when it climbed to 1.7. Thereafter, the ACR steadily increased, reaching 3.0 at the end of the monitoring season (Fig.4).

From May through the first week of October the depth-to-groundwater at San Carlos Deep monitoring well dropped a total of 8.10ft from 13.51ft to 21.61ft below the historical floodplain (Fig.4). Heavy precipitation in the second week of October brought the depth back to 13.89ft for the close of the monitoring season. The greatest drop in depth occurred in early September when the water level dropped 0.76ft in 9 days.

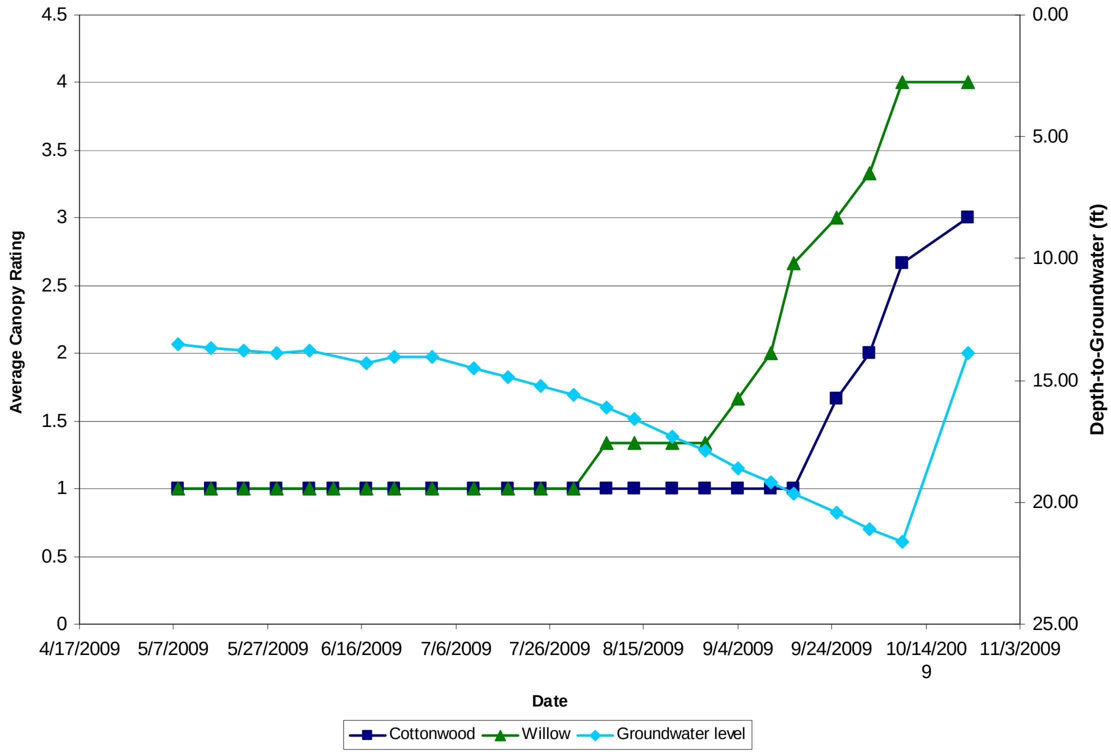

Figure 4: Average Weekly Canopy Rating for cottonwoods and willows at San Carlos vs. depth-to-groundwater at the San Carlos monitoring well.

Valley Hills

Monitored willows and cottonwoods both began the monitoring season with an ACR of 1.0 and ended the monitoring season with an ACR of 5.0 and 1.3, respectively. The ACR for willows began to increase late August, had a brief plateau at 1.3, and then steadily increased to 5.0 at the end of the monitoring season. The ACR for cottonwoods remained constant at 1.0 until the beginning of October when it increased to 1.3. The ACR was 1.3 through the end of October (Fig.5).

The depth-to-groundwater at Williams South monitoring well dropped a total of 20.51ft from 26.65ft to 46.86ft below surface May through the first week in October (Fig.5). Large amounts of rain in the second week of October brought the depth back to 30.08 ft for the end of the monitoring season. The greatest drop in depth occurred the first week in October when the depth increased 5.03ft in 7 days.

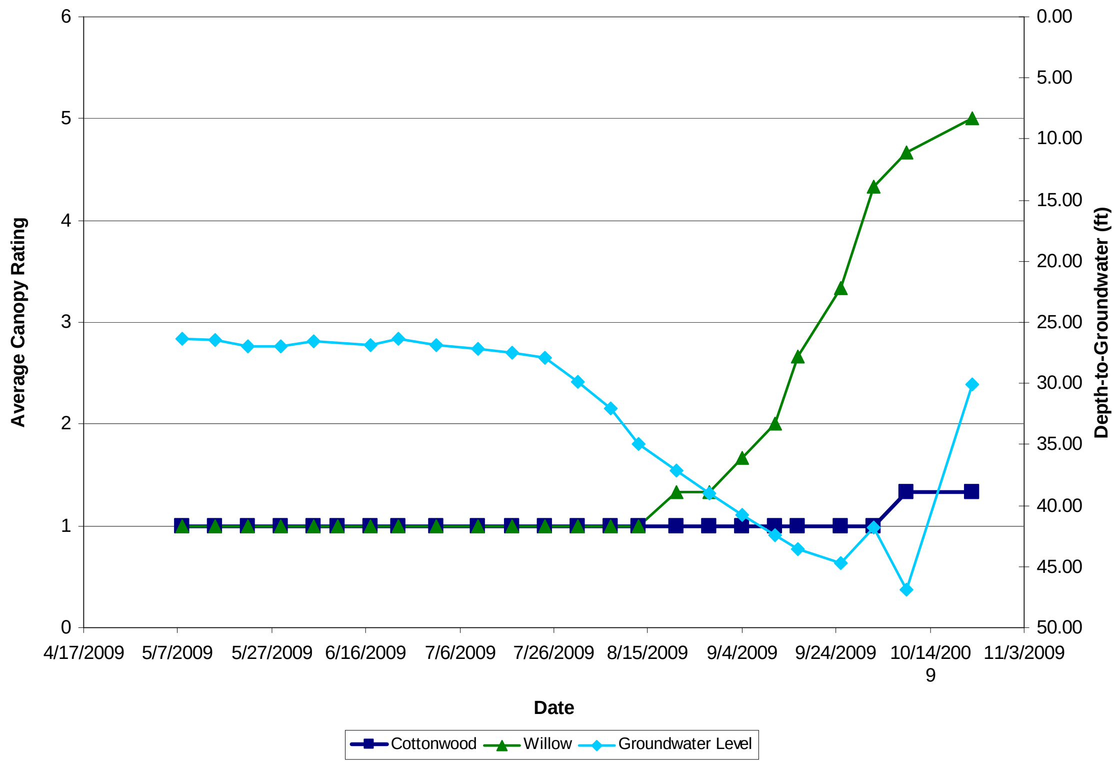

Figure 5: Average Weekly Canopy Rating for cottonwoods and willows at Valley Hills vs. depth-to- groundwater at the Williams South monitoring well.

Schulte

Monitored willows and cottonwoods both began the monitoring season with an ACR of 1.0, and both ended with an ACR of 2.3. The ACR for willows and cottonwoods followed the same trend line at Schulte. Both had a constant ACR of 1.0 until the last week of September when it increased to 1.7, and then continued to climb during the month of October for a final ACR of 2.3 (Fig.6).

May through the first week in October the depth-to-groundwater at Reimers monitoring well dropped a total of 1.63ft from 18.01ft to 19.64 ft below surface (Fig.6). Heavy rainfall in the second week of October brought the depth up to 16.93ft for the end of the monitoring season. The greatest drop in depth was 0.24ft in 7days, and occurred in May.

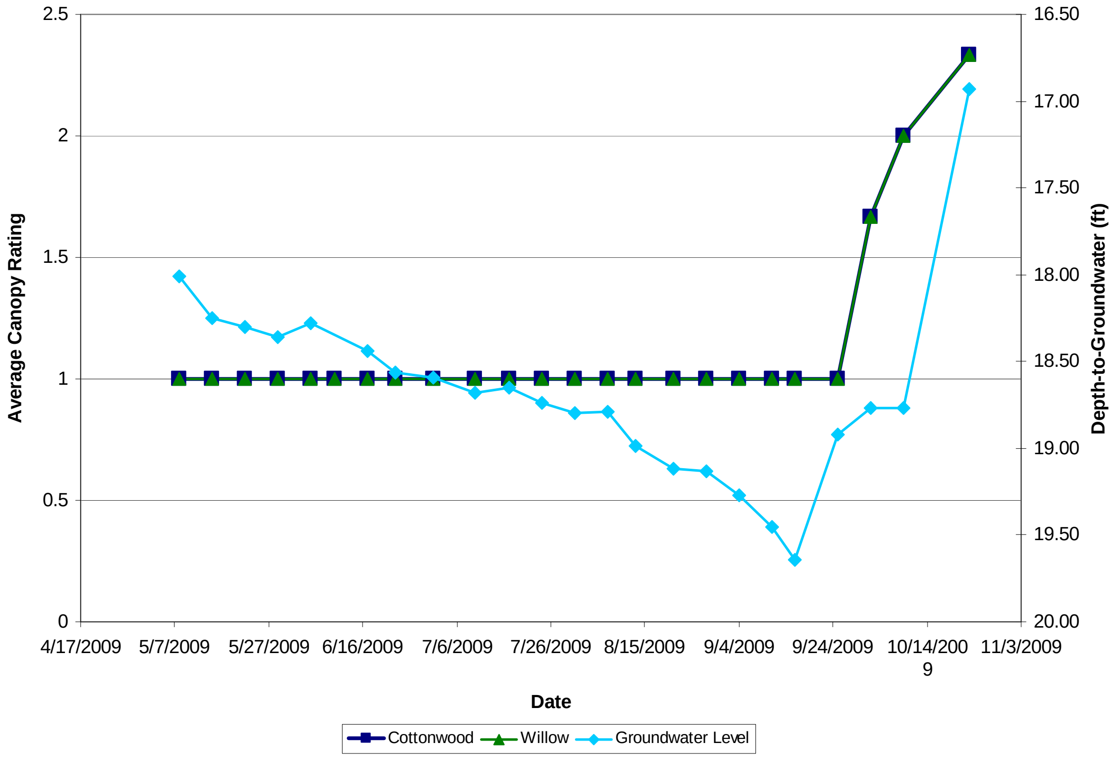

Figure 6: Average Weekly Canopy Rating for cottonwoods and willows at Schulte vs. depth-to- groundwater at the Reimers monitoring well.

Soil Moisture

Rancho Canada

Tensiometer values near the toe (close to river channel bottom) at Rancho Canada began at approximately 0.14 bars (18") and 0.19 bars (36") in early June. The 18" tensiometer peaked at 0.65 bars in the beginning of October, and after heavy rainfall in mid October, ended the season at 0.09 bars. The 36" tensiometer peaked at 0.58 bars the first week of October, and ended the season at 0.11 bars. (Fig. 7).

At Rancho Canada, there is a general relationship between depth-to-groundwater and tensiometer values where as the depth-to-groundwater increases, so does the tension on the tensiometer (which gives a higher reading). The data shows that the depth-to-groundwater increased to 44.32ft below the ground surface during the monitoring season and the tensiometer readings also increased, revealing a drying trend in soil moisture. This trend continued until the mid October storm event that began to moisten the soil profile and reverse the trend.

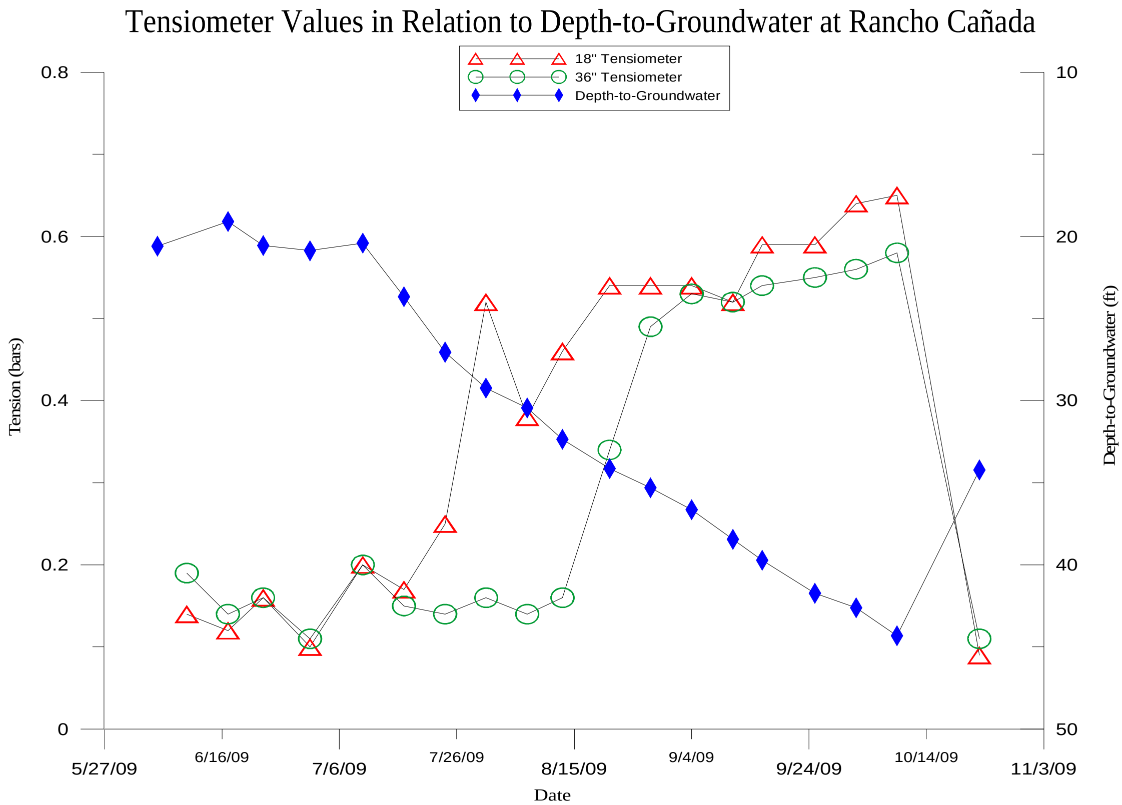

Figure 7: Rancho Canada tensiometer soil moisture values vs. depth-to-groundwater at Canada East monitoring well.

San Carlos

Tensiometer values near the toe at San Carlos began at approximately 0.12 bars (both 18" and 36") in early June. The 18" tensiometer peaked at 0.84 bars in early October and ended the season (post heavy rains) at 0.06 bars. The 36" tensiometer peaked at 0.80 bars and at the end of October read 0.13 bars (Fig. 7).

At San Carlos, the relationship between depth-to-groundwater and tensiometer values is clear. The data shows that from early July to early October the depth-to-groundwater gradually increased and the tensiometer readings did the same, revealing a drying trend in soil moisture.

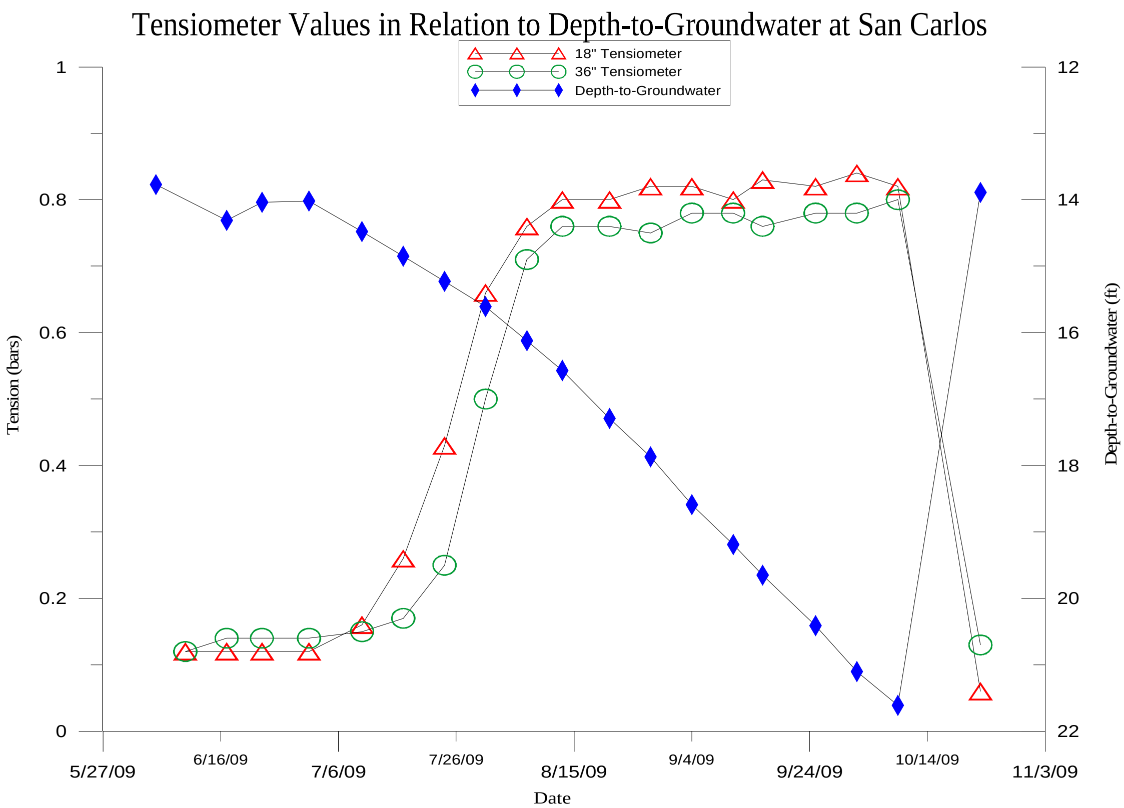

Figure 8: San Carlos tensiometer soil moisture values vs. depth-to-groundwater at San Carlos monitoring well.

Valley Hills

Tensiometer values near the toe (close to river channel bottom) at Valley Hills began at 0.25 bars (18") and 0.49 bars (36") in early June. The 18" tensiometer peaked at 0.33 bars in early October and finished the monitoring season at 0.00 bars. The 36" tensiometer peaked at 0.57 bars and ended the season at 0.06 bars (Fig. 8).

The data collected at Valley Hills shows that from early June to the beginning of October tensiometer values increased slightly while the depth-to-groundwater steadily increased. Consistent with the other sites, both depth-to-groundwater and tensiometer values declined shortly after the large storm event in mid October.

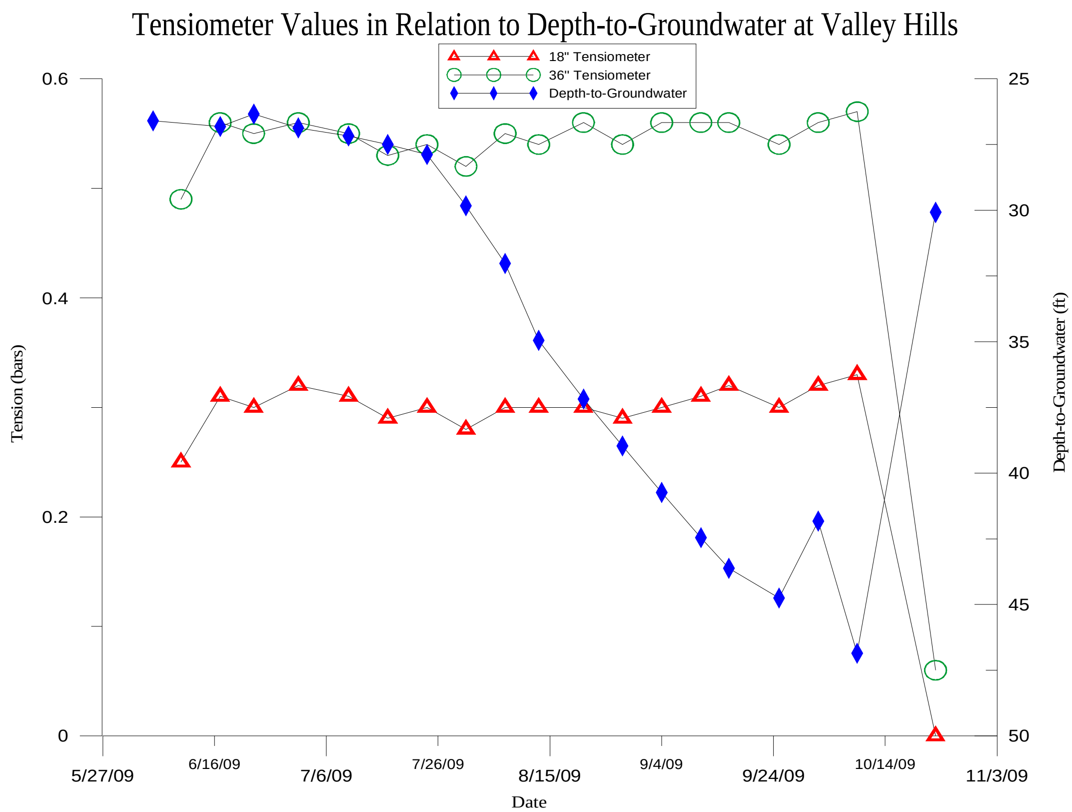

Figure 9: Valley Hills tensiometer soil moisture values vs. depth-to-groundwater at Williams South monitoring well.

Schulte

Tensiometer values near the toe at Schulte began at 0.64 bars (18") and 0.39 bars (36") in early June. The 18" tensiometer peaked at 0.78 bars and after heavy rainfall in October, ended the season at 0.10 bars. The toe 36" tensiometer peaked at 0.70 bars and ended the season at 0.00 bars. (Fig. 9).

At Schulte the depth-to-groundwater increased only slightly this year from early June to mid September. During this time the tensiometer values also increased. In September CAW began releasing 33% more water from the Los Padres Reservoir which may account for the slight decrease in depth-to-groundwater that month. After heavy precipitation in October the depth-to-groundwater decreased again, and the tensiometer values also decreased.

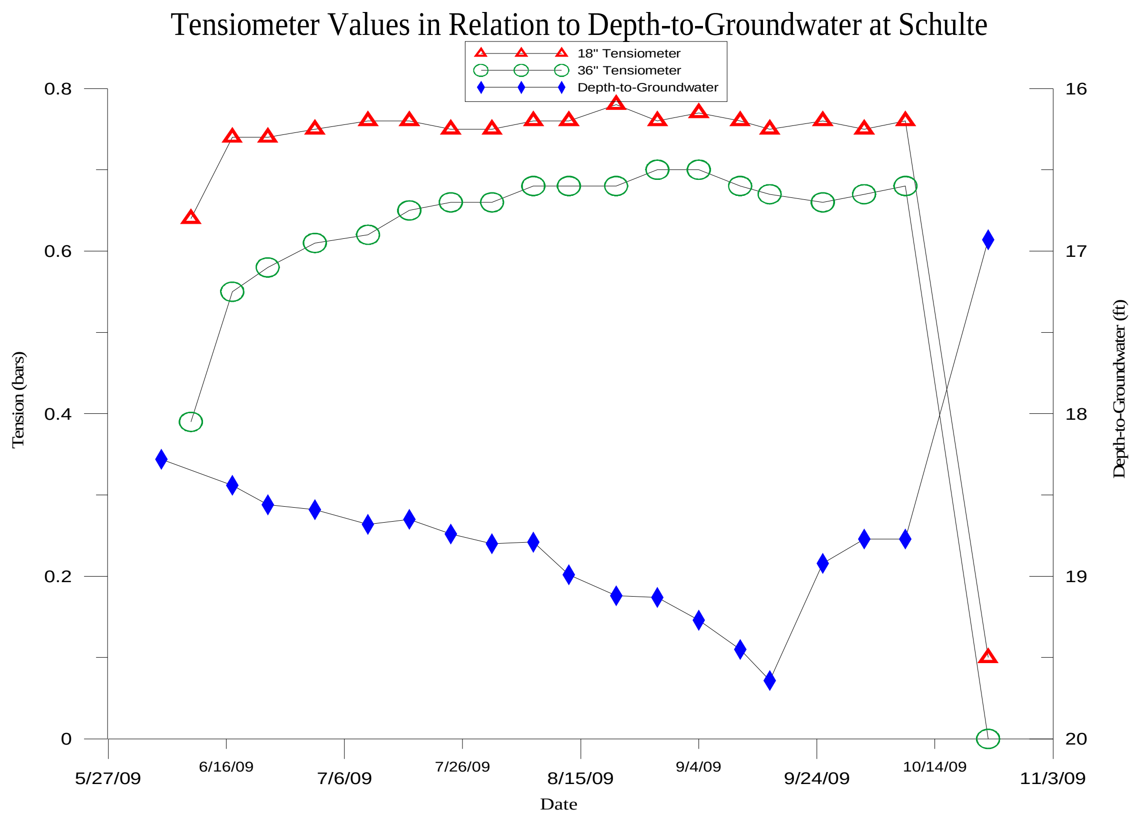

Figure 10: Schulte tensiometer soil moisture values vs. depth-to-groundwater at Reimers monitoring well.

V. DISCUSSION

Many complex interacting factors influence the moisture stress experienced by riparian vegetation. Factors that impact riparian monitoring results include depth to groundwater, which is influenced by weather, precipitation, river flow, and CAW's groundwater pumping. This in turn impacts soil moisture. To complicate things further different soils have different water holding capacities. Finer textured soils (clay) hold more water than coarse textured soils (sand). Therefore, directly measuring plant stress helps integrate the various driving forces. However, it is important to note that there is a lag time associated with a change in depth to groundwater and moisture stress in individual plants. Plant available moisture is a function of matric potential (capillary and surface binding forces), osmotic potential produced by solutes in the soil water, gravitational forces, and external pressure (Kramer and Boyer 1995). As the water table drops residual moisture in the soil still provides water for a limited time to plants.

All of CAW's production wells in Carmel Valley have the potential to impact flow in the Carmel River. However, the most notable impacts to riparian vegetation occur in the vicinity of CAW's four well system (Cañada, San Carlos, Cypress, and Pearce). The results show that riparian vegetation experiences an increase in moisture stress in relation to a reduction in stream flow and a drop in the water table elevation. Initial studies on the Carmel River done by McNeish state that severe water stress is defined by a draw down rate of two or more feet per seven days; mild water stress is defined by a draw down rate of one to two feet per seven days or a total draw down of eight feet below the elevation of the adjacent river channel; and no effect is defined as draw down of less than one foot per week throughout summer and autumn and a total draw down of less than four feet below the adjacent river channel (McNeish, 1986). Draw down on the Carmel River peaked at the Williams South monitoring well at the Valley Hills site with a 5.03 ft draw down in a 7 day period starting September 25th 2009. Other studies show that on coarse substrates in dry regions, early establishment and growth of Populus spp. seedlings may require water tables within 3.3-6.6 feet of the established surface (McBride and Strahan 1984, Mahoney and Rood 1992, Seqelquist and others 1993, Stromberg and others 1996). Mature root structures of established trees allow survival during gradual water table decline. Mature trees are more suited to withstand channel incision and floodplain isolation (Everitt 1968, Hereford 1986). Cottonwoods typically grow where the depth to the water table is 11.5 feet (Busch and others 1992, Scott and others 1997, Stromberg and others 1997), although cottonwoods have been observed to exist in areas where the water table is 23 to 29.5 feet deep (Robinson 1958). Mature black cottonwoods were also found 33.5 feet above the water table on a historic floodplain in the San Carlos area. These values appear to be close to the limit of what black cottonwoods on the Carmel River can withstand. Mortality may have been avoided simply because these are mature black cottonwoods, with extensive root structures, growing in a soil with higher organic content than some of the sandy areas with riparian vegetation. Fine textured soils have a greater holding capacity for moisture and buffer some groundwater-dependent plants against rapid water table declines (Sorenson and others 1991). The higher organic content in the San Carlos soil would enable a greater degree of water retention and capillary rise from the root zone toward the soil surface.

Obtaining an accurate characterization of soil moisture can be difficult in alluvial areas. In the past MPWMD used a neutron probe to test soil moisture in riparian areas. This system was complicated because it depended on radioactive equipment and a special license. Currently MPWMD uses tensiometers which have some limitations. One limitation with tensiometers is that they are difficult to install deeper than 3 feet and are designed for homogenous agricultural soils. Working with tensiometers in gravel and sandy areas give a relative indication of soil drying and wetting. The ideal tensiometer range is 0.0 to 0.5 bars with a peak of 0.8 bars. Highly stressed vegetation exceeds the potential of this tool. Laboratory results indicate that the vegetation wilting point is reached at 15 bars and 0.3 bars indicates field capacity or total soil saturation. This range varies according to soil type (Kramer & Boyer 1995). As a result this equipment can provide a limited set of information concerning riparian vegetation stress. Ideally soil moisture measuring devices would be installed 5 to 8 feet down where the roots would be interacting with more available moisture.

The canopy rating results provide an overall look at how riparian vegetation responds to greater depth-to-groundwater. The results show that riparian vegetation experiences an increased canopy rating (more defoliation) in relation to a reduction in stream flow and a drop in the water table elevation. From the results it can be concluded that both willows and cottonwoods were healthy and vigorous for the first half of the monitoring season, and then experienced steady increases in ACR. The results provide evidence that willows, in general, respond to stress before cottonwoods. Willows at Rancho Cañada responded to stress after cottonwoods, however, the majority of willow monitoring trees are located near the Hacienda Carmel Community Association irrigation system. At Schulte there was adequate water available for the majority of the season, and the willows and cottonwoods responded in unison, with very minor stress. It should be noted that the canopy was rated based on human judgment and therefore small errors may occur. However, the health of the riparian canopy is a viable indicator of the overall health of the streamside vegetation.

Generally, willows and cottonwoods have a similar ACR and follow a similar pattern. In 2009 there was more water in the river than previous monitoring seasons, as “inflow to Los Padres was higher than predicted, resulting in storage being almost 200 acre-feet greater than expected.” As a result, the minimum flow targets for the Carmel River at the Sleepy Hollow Weir were raised by 33% for September, from a target of 6 cfs to 8 cfs. In addition, heavy precipitation in the second week of October improved soil moisture and groundwater levels before the end of the monitoring season. As a result, willows and cottonwoods showed less stress overall in 2009 compared to the previous two years.

VI. CONCLUSION

The health and vigor of riparian vegetation is dependant on the amount of water available. Plant available moisture is dependant on a complex interaction of factors which includes: the total amount of precipitation, CAW pumping regimes and legal/illegal diversions. During the 2009 water year, the total annual rainfall was 18.14 inches at the San Clemente Dam, located mid-watershed. Precipitation for this season was 85 percent of normal (21.34 inches is the average annual rainfall at San Clemente from 1922 to the 2009). Monitoring stream flow, depth to groundwater, soil moisture, and canopy defoliation help determine when supplemental irrigation should be applied to riparian vegetation and provide riparian managers with an effective means to identify vegetation stress. During the 2009 monitoring season an overall trend towards higher stress during the summer was observed. In addition, monitoring results show that pumping does impact depth to groundwater at specific sites thus impacting soil moisture and riparian vegetation.

In 2009 MPWMD irrigated nine project areas (Trail and Saddle Club, Scarlett, Begonia, Schulte South, Schulte Bridge, Schulte, All Saints, Valley Hills, and San Carlos at the Dow property) with a total of 5.66 acre-feet of supplemental water to offset stress associated with water diversions from the Carmel River. Mitigation in the form of irrigation can be used to prevent plant mortality along the riparian corridor thus contributing to stable riverbanks and habitat for wildlife.

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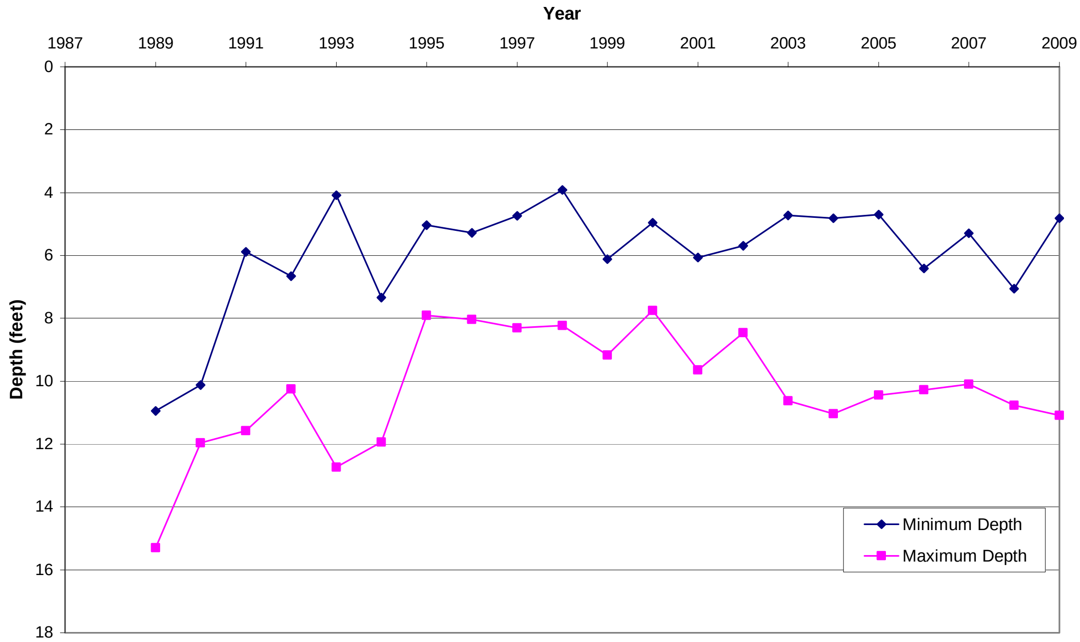
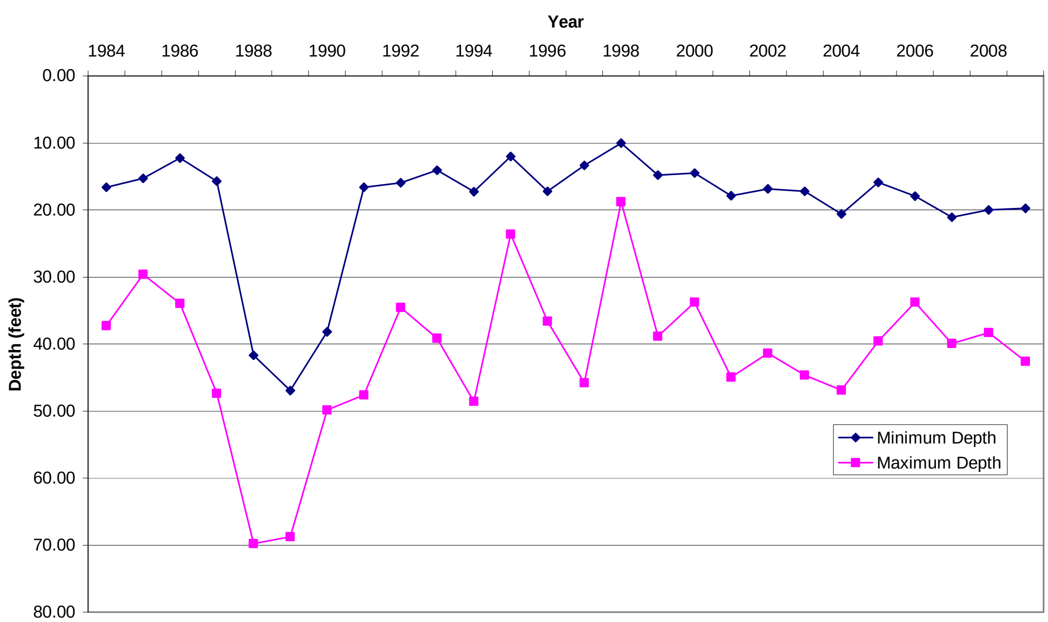
APPENDIX A

Historical Depth to Groundwater for Selected Monitoring Wells

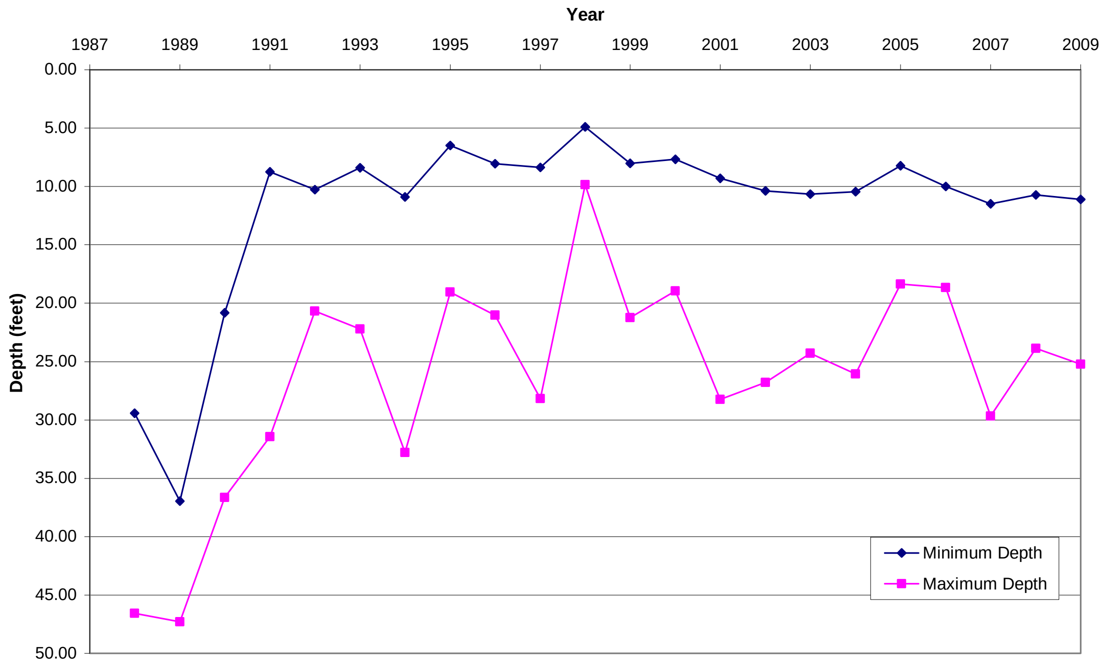
Highway 1 Monitoring Well (T16S/ R1W-13Lc) Annual Minimum and Maximum Depth to Groundwater Values in Feet



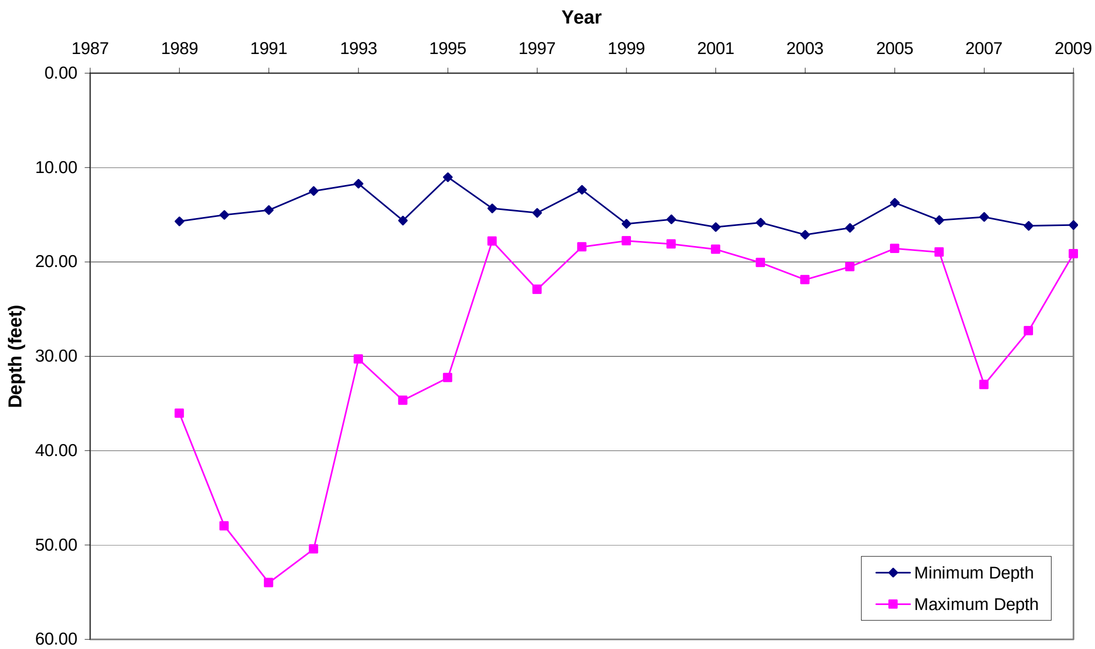
Cañada East Monitoring Well (T16S/R1E-17Lb) Annual Minimum and Maximum Depth to Groundwater Values in Feet



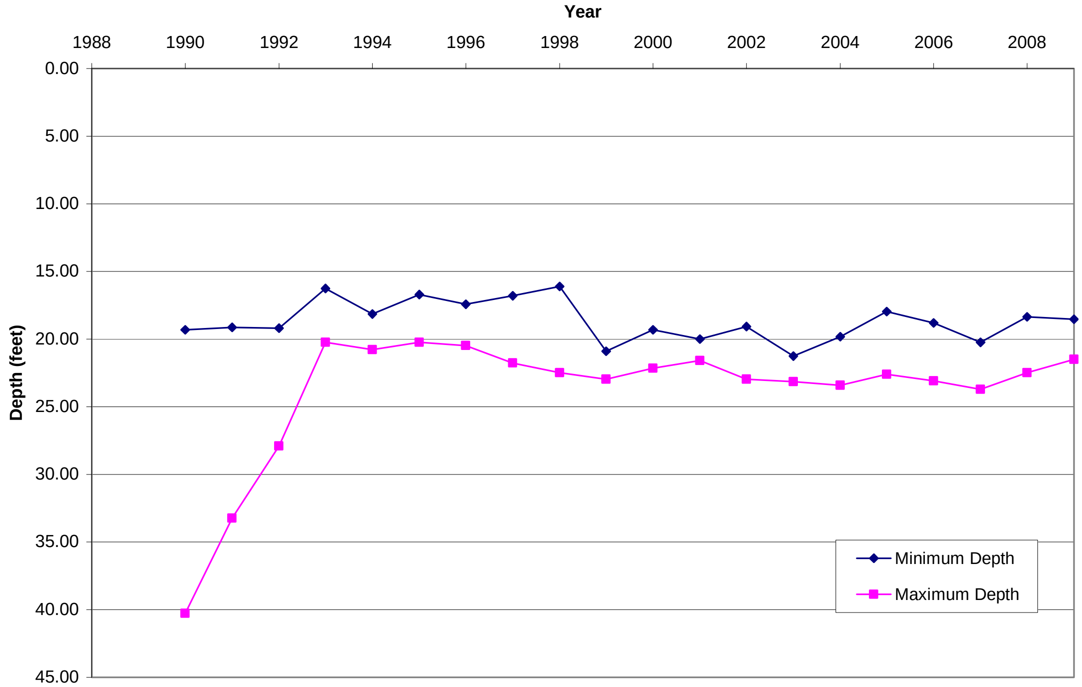
Rubin Monitoring Well (T16S/R1E-17Jd) Annual Minimum and Maximum Depth to Groundwater Values in Feet



Reimers Monitoring Well (T16S/R1E-23La) Annual Minimum and Maximum Depth to Groundwater Values in Feet



Coyote Monitoring Well (T16S/R2E-19Nx) Annual Minimum and Maximum Depth to Groundwater Values in Feet



DeDampierre Monitoring Well (T17S/R2E-03La) Annual Minimum and Maximum Depth to Groundwater Values in Feet