II. MONITOR WATER RESOURCES

The Water Allocation Program EIR concluded that Water Supply Option V would have less-than-significant impacts on the water resources in the Monterey Peninsula area, and that no mitigation measures were required. This conclusion was based solely on changes to the hydrologic regime and not on changes to water-dependent resources. Impacts on water-dependent resources (e.g., riparian vegetation and wildlife and steelhead fishery) due to changes in the hydrologic regime were identified as significant in the EIR. Implementation of the mitigation measures proposed for the impacts on these water-dependent resources are described in subsequent sections. It was suggested in the EIR that the District continue and expand its current monitoring programs to establish baseline conditions for assessment of long-term changes (Finding No. 381). The District currently maintains precipitation, streamflow, storage, water level, and water quality monitoring programs. These programs and the activities to implement them for Water Year 2008 (October 1, 2007 through September 30, 2008), are summarized below.

A. Precipitation Monitoring

Description and Purpose

During the period from October 1, 2007 through September 30, 2008, the District continued to process long-term precipitation records at Los Padres and San Clemente Dams provided by California American Water (CAW). District staff also records precipitation at its Monterey office located at Ryan Ranch, and receives daily rainfall reports from the National Weather Service climate station at Monterey (maintained by R.J. Renard). In addition, real-time and historical rainfall data for the Monterey Peninsula area can be accessed via the Internet. These data support a variety of District programs, including erosion control, riparian vegetation management and identifying long-term precipitation trends and conditions.

Implementation and Activities During 2007-2008

Work during this period involved continuing maintenance of the existing precipitation monitoring network. A summary of daily precipitation at San Clemente Dam during Water Year (WY) 2008 is shown in **Figure II-1**. In WY 2008, 19.61 inches of precipitation were recorded at San Clemente Dam. The average annual recorded precipitation at this site for the period from 1922 through 2008 is 21.38 inches, making rainfall in WY 2008 about 92 percent of average. **Figure II-2** shows a comparison of WY 2008 rainfall at San Clemente Dam and the average monthly rainfall at this site. As indicated in this plot, below average rainfall occurred during every month of WY 2008, except for January 2008 which totaled 12.56 inches of rain or 283 percent of the monthly average of 4.44 inches. In addition, approximately 30 percent of the annual rainfall occurred during the major winter storm of January 4-5, 2008 (**Figure II-1**).

B. Streamflow Monitoring

Description and Purpose

Since its inception, the District has collected streamflow measurements at approximately 15 mainstem sites on the Carmel River and on 16 tributaries to the Carmel River. The District's principal streamflow measuring sites within the Carmel River Basin (CRB) are shown on **Figure II-3**. Prior to 1991, the streamflow measurements were instantaneous measurements made by the current meter method. In 1991, a concerted effort was made to upgrade the streamflow monitoring network as staff installed continuous recorders[1] at six selected tributary sites. Since that time, the District has continued to expand its streamflow monitoring network, which currently consists of 18 continuous recording gaging stations.

Data collected at the District streamflow monitoring sites are analyzed for use in water supply planning, fishery, riparian and erosion control programs. More specific uses of streamflow data include, but are not limited, to the items listed below:

- Defining the general hydrologic conditions in the basin
- Setting flow requirements for meeting aquatic life goals
- Monitoring compliance with minimum flow requirements
- Assessing and scheduling fish rescue activities
- Assessing effectiveness of riparian mitigations
- Evaluating surface and ground water interaction
- Developing and calibrating hydrologic models
- Delineating and managing flood plains
- Evaluating and designing water supply projects
- Providing data for forecasting floods and defining flood recurrence intervals
- Assessing hydrologic impacts from water development projects
- Supporting Aquifer Storage and Recovery (ASR) operations

Implementation and Activities During 2007-2008

During the 2007-2008 period, the District operated and maintained (O&M) 15 streamflow gaging stations within the Carmel River Basin/District Boundary. In addition, continuous water level data were collected at both Los Padres and San Clemente Reservoirs, and at the Carmel River Lagoon. The District continuous recording gaging stations are listed below:

Tributary/other	**Mainstem**
Cachagua Creek	Carmel River below Los Padres Reservoir
Pine Creek	Carmel River at Sleepy Hollow Weir
San Clemente Creek	Carmel River at Don Juan Bridge
Tularcitos Creek	Carmel River at Highway 1 Bridge
Hitchcock Creek	
Garzas Creek near Lower Garzas Canyon	

[1] The District utilizes both float gages and data recorders with pressure transducers to monitor stream stage.

Tributary/other	**Continuous Water Level**
Garzas Creek at Garzas Road	Los Padres Reservoir
Potrero Creek	San Clemente Reservoir
Robinson Canyon Creek	Carmel River Lagoon
San Jose Creek	
Arroyo del Rey at Del Rey Oaks	

Streamflow gaging station O&M at each of the above sites involves obtaining monthly discharge measurements, maintaining recording equipment, obtaining staff gage readings and occasional surveying. Subsequently, river/creek stage and discharge data are processed in-house to produce mean daily streamflow records for the sites. **Table II-1** summarizes the computed annual flows for the District sites for the WY 1992-2008 period. In addition, **Table II-1** includes annual flow values for the two USGS operated mainstem sites for the 1992-2008 period.

During the 2007-2008 period, District staff continued to maintain the existing streamflow monitoring network. Streamflow within the Carmel River Basin during WY 2008 was classified as "normal". Work within this period involved collecting numerous, routine streamflow measurements by the current meter method, in order to refine the stage/discharge relation at the gaging stations. In addition, many low flow measurements were obtained at the sites utilizing a three-inch modified Parshall Flume. In between periods of streamflow-related field work, 75 continuous streamflow records covering the WY 2004 – 2008 period were computed and finalized in preparation for completion of the Carmel River Basin Surface Water Data Report – Water Years 2004 – 2008, the fourth volume in a series of four-year reports.

In 2008, staff continued to access seven of the 18 gage sites listed above via telecommunications hardware in order to post current surface water data on the District's website. Current streamflow data are downloaded, processed and posted to the District's web site to improve data dissemination to public and private groups. These streamflow data can be accessed via the Carmel River Flows section of the District's web site and include the following gage locations.

Carmel River below Los Padres Reservoir
Carmel River at Sleepy Hollow Weir
Carmel River at Don Juan Bridge
Carmel River at Highway 1 Bridge

In addition, the Carmel River Lagoon Water Levels section of the District's web site now provides access to continuous Lagoon water level data which are updated daily or weekly.

- **Summary of Streamflow Conditions --** Streamflow during WY 2008 within the Carmel River Basin was classified as "normal". The heaviest storm flow event of the year occurred on January 4, 2008. Peak streamflow along the Upper Carmel River on January 4 reached 3,500 cubic feet per second (cfs) at the Carmel River at Don Juan Bridge gaging station (river mile 10.9). However, the January 4 storm did not produce the highest peak of the year in the Lower Carmel River as this stormflow attenuated greatly as it advanced over a previously dry streambed and alluvial aquifer conditions that were at about 80 percent of capacity prior to the storm event.

The highest peak flow of the year in the Lower Carmel River was 2,480 cfs on January 28, 2008 as measured at the Carmel River at Highway 1 Bridge site (river mile 1.1).

During WY 2008, 49,017 acre-feet (AF) of unimpaired runoff were estimated at San Clemente Dam. This total represents 71% of the average annual runoff (68,800 AF) expected at San Clemente Dam. **Figure II-4** shows a comparison of the actual and average cumulative unimpaired inflows at San Clemente Dam for WY 2008. This runoff provided streamflow to the ocean from January 5, 2008 through April 28, 2008, although numerous lagoon mouth closures occurred during this period.

C. Storage Monitoring

Description and Purpose

Since December 1987, the District has calculated end-of-month (EOM) storage values in the major reservoirs and aquifers within the Monterey Peninsula Water Resources System (MPWRS). The storage values for Los Padres and San Clemente Reservoirs are estimated based on EOM water-level elevations and area-elevation-capacity curves provided for each reservoir by CAW. These reservoir-storage values represent "usable" storage and are adjusted for dead storage and minimum-pool requirements. The storage values for the Upper Carmel Valley (UCV) aquifer subunits, Lower Carmel Valley (LCV) aquifer subunits, and the Coastal Subareas of the Seaside Groundwater Basin are estimated based on groundwater levels observed in selected monitor wells measured by the District and CAW. The aquifer storage values also represent "usable" volumes and are adjusted for water inaccessible to existing wells (i.e., below casing perforations) or held in reserve as a safeguard against seawater intrusion or other adverse environmental impacts. The current total usable storage capacity for the water resources system is 37,550 acre-feet (AF). Of this total, an estimated 1,550 AF are in reservoir storage and 36,000 AF are in aquifer storage. For this report, all storage values are rounded to the nearest 10 AF.

These storage estimates are compiled by the District to provide a quantitative basis for managing the area's water resources. These estimates are used to make decisions regarding water production and water rationing. These estimates are also used to calibrate the District's Carmel Valley Simulation Model (CVSIM).

Implementation and Activities During 2007-2008

At the end of September 2008, system storage totaled 25,700 AF or 68 percent of capacity. This total was approximately 91 percent of the 28,200 AF storage that is expected under normal conditions at this time of the year. **Figure II-5** shows a monthly comparison of usable system storage versus average system storage during the October 2007 – September 2008 period. Of the total storage at the end of September 2008, an estimated 600 AF were in Los Padres and San Clemente Reservoirs, 23,760 AF were in the Carmel Valley Alluvial Aquifer, and 1,340 AF were in the Coastal Subareas of the Seaside Groundwater Basin.

It should be noted that the remaining usable storage capacity in San Clemente Reservoir was constrained in June 2003 when CAW, at the direction of the California Department of Water

Resources (DWR), was required to lower the water level in the reservoir from elevation 525 feet above mean sea level (msl) to elevation 514 feet msl. This "drawdown" project is required by DWR as an interim safety measure at San Clemente Dam and remained in effect in Water Year 2008. As constrained by DWR, usable storage capacity in San Clemente Reservoir during the high-flow season (February - May) is limited to approximately 70 AF and during the low-flow period (June - January) is limited to less than 10 AF.

D. Groundwater-level Monitoring

Description and Purpose

The District maintains a groundwater-level monitoring program in the Carmel Valley aquifer and the Seaside Groundwater Basin. The data collected as part of this program are used to support a variety of programs, including storage monitoring, compilation of annual and long-term well hydrographs, water-table contour mapping, Carmel River Management Program, Seaside Basin Watermaster Program, and other special projects. The monitor-well measurements are stored in a database program developed by the District to facilitate data entry, access and manipulation of the water-level data. In addition, groundwater-level measurements are collected on a regular basis by CAW from each of their production wells, and these measurements are also utilized in the District's program.

Implementation and Activities During 2007-2008

- **Carmel Valley Aquifer --** The District's monitor-well network in the Carmel Valley aquifer consists of dedicated monitor wells and several private production wells, and currently totals approximately 50 water-level monitoring wells. During this period, the wells were measured on a monthly basis, and these measurements were used to compute end-of-month storage-volume estimates for the aquifer. In addition, more frequent monitoring of selected wells was conducted during winter storm events to more closely monitor aquifer recharge.

Figure II-6 is a typical hydrograph from the lower Carmel Valley, showing groundwater-level fluctuations at the Rancho Cañada East monitor well (River Mile 3.13), compared with mean daily streamflow in the Carmel River at Highway 1 (River Mile 1.09). This monitor well is located nearby the most westerly CAW production well in Carmel Valley, the Cañada well. The monitor well is located approximately 375 feet from the river channel, and about 250 feet from the Cañada well. As shown on this figure, the groundwater elevation increased approximately 20 feet between the end of November 2007 and the end of January 2008, due to the reduced groundwater production at this time of the year, combined with the resumption of Carmel River flows in this lower reach of the river. Groundwater levels declined steadily from June through September 2008 in response to receding surface flows and increased groundwater pumping, and at the end of Water Year 2008 (September 30th) the groundwater elevation at this well was about five feet higher than at the start of the water year.

The hydrograph of a monitor well closer to the coast is shown in **Figure II-7**. This monitor well, the CAWD-Rio North well, is located at River Mile 1.65, and approximately 850 feet from the river channel. At this location, the magnitude of seasonal water-level fluctuation, approximately six feet, is significantly less than at the Rancho Cañada East monitor well, due to its location

farther from the river and major production wells in the lower Carmel Valley. Typically, a seasonal rise in water level at the CAWD-Rio North well lags relative to the Rancho Cañada East monitor well, as can be seen in comparing **Figures II-6** and **II-7**. The lag time is a response to the effect of distance from the river channel on the timing of groundwater recharge from river flow events.

During the October 2007-September 2008 period, the monitoring data indicated that groundwater storage in the Carmel Valley aquifer remained relatively full during the water year. In the river reach between San Clemente Dam and the Narrows (i.e., aquifer subunits 1 and 2), the lowest storage capacity estimate was 88% of capacity at the end of October 2007. Similarly, in the river reach from the Narrows to the Carmel River Lagoon (i.e., aquifer subunits 3 and 4), the lowest storage capacity estimate was 75% of capacity at the end of November 2007. The aquifer remained relatively full during the year due to a number of factors, including:

- Availability of adequate base flows during spring and early summer months,
- Timing and magnitude of controlled river releases from the upstream reservoirs,
- Maximized dry-season production from CAW wells in the Seaside Basin,
- Water-supply management practices implemented by the District in coordination with CAW, the California Department of Fish and Game and the National Marine Fisheries Service, as part of the Quarterly Water Supply Strategy and Budget process, and
- State Water Resources Control Board (SWRCB) Order No. WR 95-10 (and subsequent amendments) and the Seaside basin adjudication decision, which constrain CAW production from the Carmel River and Seaside Groundwater Basins, respectively.

● **Seaside Groundwater Basin –** Beginning in 2007, enhanced water-level monitoring in the Seaside Basin is being conducted by the District on behalf of the Seaside Basin Watermaster. The Watermaster significantly enhanced this monitoring to comply with the directives of the Seaside Basin adjudication decisions, as amended in 2007. Currently, the District collects monthly or quarterly water-level measurements from 56 wells in the basin. These wells are a combination of active or inactive production wells, and dedicated monitor wells.

Figure II-8 shows water-level data available from representative wells in the coastal Seaside Basin monitor well network. These graphs show the water-level elevations in the two principal aquifer zones, the shallower Paso Robles Formation and the deeper Santa Margarita Sandstone, at both upgradient (Site FO-07) and downgradient (Site PCA East) locations from the CAW Paralta production well. The graphs illustrate the more dominant effect that production from the Paralta well has had on water levels in the Santa Margarita Sandstone, which is the aquifer zone from which the Paralta well obtains most of its production. The graphs also illustrate the effect of changed water-supply practices resulting from SWRCB Order WR 95-10. Under the Order, CAW has been directed to maximize production from its Seaside Basin sources as a means to reduce production and associated impacts from the Carmel River system. Seasonal recoveries associated with short-term reduced wintertime production and District aquifer storage and recovery (ASR) injection testing have not been sufficient to reverse the observed downward water-level trend. Additional information on the ASR testing program is available at the District office. Discussion of the District's Phase 1 ASR Project is included in Section VI.

E. Groundwater-Quality Monitoring

Description and Purpose

The District maintains an ongoing groundwater-quality monitoring program for the two principal groundwater sources within the District: the Carmel Valley alluvial aquifer, and the Seaside Basin Coastal Subareas. The purpose of the program is threefold:

(1) to characterize the quality of water in the aquifers,
(2) to detect groundwater contamination from septic systems or other sources in the shallow zones of the Carmel Valley aquifer, and
(3) to monitor seawater-intrusion potential in the coastal portions of the Carmel Valley aquifer and Seaside Basin.

The District has maintained a groundwater-quality monitoring program for the Carmel Valley aquifer since 1981, and for the Seaside Basin since 1990. The District's program is in addition to the extensive water-quality monitoring that is conducted by CAW. Beginning is 2007, enhanced water-level monitoring in the Seaside Basin is being conducted by the District on behalf of the Seaside Basin Watermaster. The Watermaster significantly enhanced this monitoring to comply with the directives of the Seaside Basin adjudication decisions, as amended in 2007. The District also manages all well construction, maintenance, and field sampling activities associated with the program. Collection of the water-quality data is intended to detect problems before they can affect the community's water supply.

Implementation and Activities During 2007-2008

Currently, the sampling schedule for Carmel Valley is staggered, with Upper Valley wells (i.e., upgradient of the Narrows) sampled in Spring and Lower Valley wells (i.e., downgradient of the Narrows) in Fall, to coincide with the historically higher nitrate concentrations in these respective areas. Collection of samples from the Seaside Basin monitor wells is conducted once per year in Fall, coinciding with the historically low water levels in the basin at that time of the year. Additionally, beginning in 2007, samples from six of the wells closest to coastline in the Seaside Basin monitoring network are collected by District staff on a quarterly basis, under contract for the Seaside Basin Watermaster.

- **Carmel Valley Aquifer –** Groundwater-quality data were collected from a network of eight monitor wells in the lower Carmel Valley aquifer area in November 2007, and three wells in the upper Carmel Valley aquifer area in April 2008. The results indicated that, in general, there were only minor changes in overall water quality compared to samples collected in the previous year. Staff is particularly interested in tracking indicators of potential seawater intrusion in the coastal portion of the Carmel Valley aquifer. Accordingly, three sets of wells were established west of Highway 1, with each set consisting of three wells completed at different depths. Review of historical data indicated that the shallower and intermediate wells in the coastal area are subject to the mixing of fresh water and saline water as high tides and surf overtop the sand berm between the lagoon and the ocean. This contributes to episodic mixing within the shallower and intermediate zones of the aquifer, but is not necessarily representative

of larger-scale potential seawater intrusion into the aquifer. Currently, only the deeper wells at each of the three coastal locations are sampled.

Well 16S/1W-14Jg is the deepest in the array of three wells located at the Carmel River State Beach parking lot at River Mile (RM) 0.07 (approximately 375 feet from the shoreline). **Figure II-9a** shows that both Specific Electrical Conductance (SEC), a measure of the Total Dissolved Solids concentration, and chloride concentration noticeably increased in this well in 2008 for the fourth consecutive year, but these levels have not approached the levels observed at this location in the early 1990's. These higher values observed early in the period of record at this site are at least partially attributable to the fact that there was no fresh water surface inflow to the lagoon for approximately four years (April 1987 until March 1991). This lack of freshwater inflow for local groundwater recharge, combined with the proximity to the ocean and the permeability of the alluvial sediments, allowed for inland movement of the freshwater / seawater interface past this site near the end of the 1987 – 1991 drought period. It should also be noted that the data from the District's monitor well network indicate that nitrate concentrations in the shallow zone of the aquifer are well below the State drinking water standard of 45 milligrams per liter (mg/L). The highly permeable nature and flushing effect of the aquifer have prevented long-term build-up of contaminants as can occur in more poorly recharged aquifer systems.

Graphs of water-quality data at the two coastal sites located farther from the shoreline show that SEC and chloride concentration was almost unchanged from 2007 to 2008 at well 16S/1W-13Md, located at RM 0.31 from the shoreline (**Figure II-9b**), and decreased from 2007 to 2008 at well 16S/1W-13Lc, located at RM 0.65 (**Figure II-9c**). At both sites, there is a slight trend toward increased levels over the period of record. As noted in prior reports, the anomalously high SEC and chloride concentration in well 16S/1W-13Lc in 2000 are suspicious. Additional background on historical water quality at the coastal monitor well sites can be found in District Technical Memorandum 90-04, *Summary of Carmel Valley Groundwater Quality from Coastal Monitor Wells*, which is available at the District office. Staff will continue to track future results for trends that might indicate significant changes in concentrations of these or other constituents in the coastal area of the aquifer.

For the five wells located farther inland, changes in SEC and chloride concentration did not vary significantly from the previous year's sample results. The graph in **Figure II-9d** shows SEC and chloride concentration in well 16S/1E-23La, located at RM 6.72. The increased levels of SEC and chloride concentration that were observed in this well in 2005 had returned to below 2004 levels by 2007. The high chloride concentration in well number 16S/1E-23La in Spring 1993 is anomalous. Staff will continue to track future results for trends.

● **Seaside Groundwater Basin --** Twelve monitor wells in the Coastal Subareas of the Seaside Basin were sampled in October 2007. The water-quality results from the Seaside Basin indicate that very little water-quality changes have occurred over the period of record since District monitoring began in 1990, and that there is no indication of seawater intrusion in this area of the basin at this time. Part of the function of the District's monitor-well network in the Seaside Basin is to serve as an early warning of potential seawater intrusion into the two principal aquifer zones, the Paso Robles Formation and the Santa Margarita Sandstone. **Figure II-9e** shows SEC and chloride concentrations in two coastal wells for the historical period of

record beginning in April 1991. Results from the District's monitoring program indicate that the SEC averages approximately 350 and 825 micromhos/centimeter, for the Paso Robles and Santa Margarita aquifer zones, respectively.

F. Carmel River Surface Water-Quality Monitoring

Description and Purpose

This monitoring is used to help assess whether or not water-quality criteria for aquatic life are being met in various reaches of the Carmel River, and whether resources such as Carmel River steelhead (*Oncorhynchus mykiss*) and red-legged frogs (*Rana aurora draytonii*) are being sustained or impaired. Monitoring also provides District staff with a way of measuring trends over extended time periods. These data are used for recommending appropriate reservoir release schedules and for determining the timing of fish rescues.

Since 1991, surface-water quality data have been collected at three sampling stations along the Carmel River on a semi-monthly basis. The locations of the sampling stations are as follows: below Los Padres Reservoir at River Mile (RM) 25.4, below San Clemente Reservoir at the Sleepy Hollow Weir (RM 17.1), and at the Carmel River Lagoon (RM 0.1). River miles are measured from the mouth of the Carmel River. Monitoring at these specific stations gives District staff information on the quality of water released from each reservoir and in the surface layer of the lagoon.

District staff also monitors river temperatures continuously at six locations within the Carmel River Basin (**Figure II-10**). The objective is to document the temperature regime in different stream reaches and to determine whether water quality criteria for maximum stream temperatures are exceeded. In addition, these data allow District staff to monitor changes in the thermal regime of the river over time.

Implementation and Activities During 2007-2008

District staff carried out a semi-monthly surface water quality sampling program for the Reporting Year (RY) 2008 (July 1, 2007 to June 30, 2008); data were collected for the following chemical and physical parameters: temperature (°F), dissolved oxygen (mg/L), carbon dioxide (mg/L), pH, specific conductance (uS/cm), salinity (ppt), and turbidity (NTU). The emphasis for this suite of parameters is on the suitability for rearing juvenile steelhead. In addition, continuous recording temperature data loggers (Optic StowAway temperature data loggers from the Onset Computer Corporation) were deployed at six locations on the Carmel River (**Figure II-10**), as follows:

1. ALP	Above Los Padres Reservoir	(RM 27.0)
2. BLP	Below Los Padres Reservoir	(RM 25.4)
3. ASC	Above San Clemente Reservoir	(RM 18.5)
4. SHW	Sleepy Hollow Weir	(RM 17.1)

5. GAR	Garland Park	(RM 10.8)
6. SAL	South Arm Lagoon	(RM 0.1)

The following paragraphs describe the results of the semi-monthly data collection and the continuous temperature recorders at specific sampling stations.

- **Carmel River Lagoon--** Water temperature for the Carmel River Lagoon was sampled in the south arm of the lagoon on the Carmel Area Wastewater District (CAWD) sewer pipe. Water temperature for the South Arm Lagoon (SAL) station is shown in **Figure II-11**. Water temperature was collected in the south arm from July 1, 2007 to August 6, 2007. No data was collected from August 7, 2007 to June 30, 2008 due to a data logger malfunction. Maximum instantaneous water temperature was 76.8 degrees Fahrenheit (°F) occurring on July 21, 2007. Average water temperature at this station during the sampling period was 70.8°F. Water quality data collected at this station is listed in **Table II-2**. The minimum dissolved oxygen measurement recorded was 8.0 mg/L, which is within the suitable criteria recommended by the Environmental Protection Agency (EPA) for steelhead (Chapman, 1986). The pH measurements ranged from 7.5 to 9.0. Carbon dioxide measurements ranged from 5 to 40 mg/L. The conductivity measurements ranged from 302 to 15,570 uS/cm. The surface salinity ranged from 0.3 to 9.2 ppt. The conductivity and salinity are highly variable at the lagoon due to tidal influences and river inflows. The turbidity measurements ranged from 0 to 5.7 NTU. Summertime water temperatures were within stressful ranges and probably decreased growth rates and survival capabilities. Steelhead likely searched for cold water refuges within the lagoon. Carbon dioxide spiked during December, causing increased stress to steelhead. This is usually caused by an increase of marine organic debris entering the lagoon during high surf events. Carbon dioxide is a byproduct of decomposition of this material. Fish in waters with free carbon dioxide concentrations above 20 mg/L show signs of distress (Wedemeyer, 1996)

- **Garland Park--** Water temperature for the Garland Park (GAR) station is shown in **Figure II-12**. The maximum annual water temperature was 69.8°F occurring on June 20, 2008. Average water temperature during the reporting year at this station was 56.5°F. Maximum daily average water temperature was 65.9°F occurring on August 31, 2007. Daily average water temperatures were within adequate range for steelhead rearing during the entire reporting year.

- **Sleepy Hollow Weir--** Water temperature for the Sleepy Hollow Weir (SHW) station is shown in **Figure II-13**. The maximum annual water temperature was 73.4°F occurring on September 1, 2007. Average water temperature during the reporting year at this station was 56.3°F. The maximum daily average water temperature was 70.1°F occurring on August 31, 2007. Average daily water temperatures over 68°F occurred 16 times, nine in July 2007, three in August 2007, two in September 2007 and two in June 2008. This represents 4.4% of the time during the sampling period. Constant temperatures over 68°F are considered stressful for steelhead (Brungs and Jones, 1977). Water quality data collected at this station is listed in **Table II-3**. The minimum dissolved oxygen measurement recorded was 9.0 mg/L, which is within the suitable criteria recommended

by the EPA for steelhead (Chapman, 1986). Carbon dioxide measurements ranged from 5-15 mg/L. The pH measurements ranged from 7.5 to 8.0. The conductivity measurements ranged from 190 to 386 uS/cm. The turbidity measurements recorded were between 0.0 to 4.1 NTU. None of the parameters measured were harmful to steelhead, with the exception of high average water temperatures during the months of July 2007, August 2007, September 2007 and June 2008. The high average water temperatures were in the suboptimal range during these months for steelhead and considered stressful for rearing.

- **Above San Clemente Reservoir--** Water temperature for the Above San Clemente (ASC) station is shown in **Figure II-14**. The maximum annual water temperature was 73.6°F on July 4 and July 5, 2007. Average water temperature during the reporting period at this station was 55.2°F. Maximum daily average water temperature at this station was 69.8°F occurring on August 31, 2007. Average daily water temperatures over 68°F occurred 14 times, ten in July 2007, three in August 2007, and once in September 2007. This represents 3.8% of the time during the sampling period. These maximum daily average water temperatures were within suboptimal range and considered stressful for steelhead rearing. The rest of the reporting year water temperatures were within optimal rearing ranges.

- **Below Los Padres Reservoir--** Water temperature for the Below Los Padres (BLP) station is shown in **Figure II-15**. There was a loss of data from the temperature sensor during July 1, 2007 to August 20, 2007. This loss of data was due to the data logger malfunctioning. Sampling period for this reporting year is August 21, 2007 to June 30, 2008. Maximum thermal regime typically occurs during the June through August months, therefore staff believes that the maximum thermal regime may have not been observed for the reporting year. The maximum annual water temperature observed was 67.4°F occurring on August 21, 2007. Average water temperature observed at this station during the sampling period was 54.8°F. The maximum average water temperature at this station was 65.7°F on June 16, 2008. Water quality data collected at this station is listed in **Table II-4**. Water quality at this station is highly influenced by reservoir water quality and release location. The minimum dissolved oxygen measurement recorded was 4.2 mg/L occurring on November 7, 2007, which is out of the range of suitable criteria recommended by the EPA for steelhead. Fortunately, the dissolved oxygen did not stay low for a long period of time, staff recorded dissolved oxygen of 9.1 mg/L on the next sample at this station. The low dissolved oxygen was likely due to decomposition of organic materials combined with low water levels within the reservoir. Carbon dioxide measurements ranged from 10 to 20 mg/L. The pH and conductivity measurements ranged between 7.0 to 8.0 and 160 to 339 uS/cm, respectively. Turbidity measured at this station ranged from 0.0 to 2.5 NTU. While the instantaneous water temperatures exceeded the optimal levels for steelhead rearing, the average daily temperatures were always adequate. Other water quality parameters measured were within the adequate range for steelhead, with the exception of dissolved oxygen. The low dissolved oxygen measurement recorded likely redistributed steelhead to improved conditions during this short time period.

- **Above Los Padres Reservoir--** Water temperature for the Above Los Padres (ALP) station is shown in **Figure II-16**. The maximum annual water temperature was 66.7°F occurring on July 5 and July 6, 2007. Average water temperature during the reporting period was 53.0°F. Maximum daily average water temperature at this station was 64.8°F occurring on August 31, 2007. Daily average water temperatures were within adequate range for steelhead rearing during the entire reporting year.

G. Carmel River Lagoon Water Level Monitoring

Description and Purpose

Since 1987, the District has monitored the level of surface water in the Carmel River Lagoon. The water level is monitored with a continuous recorder located in the South Arm of the Lagoon that utilizes pressure transducer technology. The water level data have been used, in part, to support technical studies for use by the Carmel River Steelhead Association, California Department of Parks and Recreation, California Coastal Conservancy, Monterey County Water Resources Agency (MCWRA), Monterey County Public Work Department and MPWMD. In addition, the water level data are monitored by the MCWRA via their ALERT system to enhance flood warning for residents located along the northern margin of the Lagoon and wetland.

Implementation and Activities During 2007-2008

During the 2007-2008 period, District staff continued to maintain the continuous water level recorder located in the South Arm of the lagoon, and a complete record of water level readings (i.e., 15 minute intervals) was obtained. Staff continued to utilize the telecommunications capability established at the lagoon gage in September 2007 to post lagoon water level data on to the District's website. These continuous water level data are plotted and posted on the District website under the Carmel River Lagoon Water Levels section approximately weekly. This allows interested parties to access the data to view recent water level trends.

The monthly plot for January 2008 shown in **Figure II-17** illustrates the first lagoon opening of the 2007-2008 rainy season, on January 5, 2008. Prior to this event, the lagoon mouth was closed, and the Carmel River streambed upstream of the lagoon was completely dry. The major winter storm of January 4-5, 2008 generated 5-10 inches of rain in the upper watershed of the Carmel River producing a peak stormflow of about 3,500 cfs that propagated downstream toward the lagoon. This peak flow attenuated to approximately 500-1,000 cfs by the time it reached the lagoon. Precise lagoon inflow data are unavailable as the extremely high lagoon level of 12.66 feet caused significant backwater at the District's Carmel River at Highway 1 Bridge gaging station which precluded accurate computation of discharge values at the site. In addition to the storm runoff entering the lagoon on January 5, unusually high ocean swells of 25-30 feet (NWS buoy reports) accompanied by a high tide of 5.7 feet washed unimpeded into the lagoon. The combined result of the high surf, tide and river flow increased the lagoon water level to a peak of 12.66 feet, or the highest on record. The high lagoon level began to drop naturally once the high tide receded, and the lagoon level dropped to about three feet later that day. Atypically, no bulldozers were used to evacuate the lagoon.

OBSERVED TRENDS, CONCLUSIONS AND/OR RECOMMENDATIONS:

Streamflow and precipitation data continue to provide a scientific basis for management of the water resources within the District. These data continue to be useful in Carmel River Basin planning studies, reservoir management operations, water supply forecast and budgeting, and defining the baseline hydrologic conditions of the Carmel River Basin. The District's streamflow monitoring program continues to produce high quality data in a cost-effective manner. For example, the current annual cost of maintaining a single streamflow gaging station charged by the United States Geological Survey (USGS) is $20,600 per year. If the District's streamflow monitoring program were maintained by the USGS, the annual cost would be $371,000 (based on 18 gage sites). The District is able to maintain its streamflow monitoring network with approximately 75 percent of a full-time District staff position (Hydrography Programs Coordinator), and an annual equipment-operating budget of about $2,000.

There is limited storage of surface water by dams on the Carmel River. Los Padres Dam, completed in 1948, holds 1,478 AF of usable storage, based on an estimate by CAW in 1998. Usable storage in San Clemente Dam, completed in 1921, has been essentially eliminated by order of the DWR due to seismic safety concerns. As an interim safety measure, DWR has required CAW to lower the reservoir water level from 525 feet to 514 feet elevation, which is too low for water supply use. CAW has proposed a dam seismic strengthening program that is currently undergoing state and federal environmental review.

Groundwater levels, and consequently groundwater storage conditions, in the Carmel Valley Alluvial Aquifer have maintained a relatively normal pattern in recent years, in contrast to the dramatic storage declines that were observed during the prolonged 1987-91 drought period. The relatively stable storage in the Carmel Valley alluvial aquifer in recent years is attributable to a combination of more favorable hydrologic conditions and the adoption of improved water management practices that have tended to preserve high storage conditions in the aquifer.

In contrast, storage conditions in the coastal portion of the Seaside Basin have not been stable in recent years, in particular with respect to the deeper Santa Margarita aquifer, from which over 80 percent of the CAW production in the Seaside Basin is derived. This downward trend in water levels reflects the changed production operations in the Seaside Basin stemming from SWRCB Order 95-10. The increased annual reliance on production from CAW's major production wells in Seaside, along with significant increases in non-CAW use, have dramatically lowered water levels in this aquifer, and seasonal recoveries have not been sufficient to reverse this trend.

To address this storage depletion trend, CAW requested a court adjudication of water production and water storage rights in the Seaside Basin in 2003. Hearings were conducted in December 2005 and a final adjudication decision was entered in March 2006. The final decision established a new, lower natural safe yield for the basin, i.e., 3,000 AF per year, and an operating safe yield for the basin, i.e., 5,600 AF per year. Under the decision, pumpers in the basin were allocated a share of the operating safe yield and told that this share would be reduced every four years until the operating safe yield matched the natural safe yield of the basin.

In addition, one of the means to mitigate this observed trend is a program that the District has been actively pursuing since 1996 -- the Seaside Basin groundwater injection program (also known as aquifer storage and recovery, or ASR). Continued testing of the District's full-scale test injection well was carried out during RY 2008 to further confirm the feasibility of this important means to help replenish the basin. Fortunately, groundwater quality conditions in both the Carmel Valley alluvial aquifer and Seaside Basin have remained acceptable in terms of potential indicators of contamination from shallow sources such as septic systems, and there have been no identifiable trends indicative of seawater intrusion in the coastal areas of these two aquifer systems.

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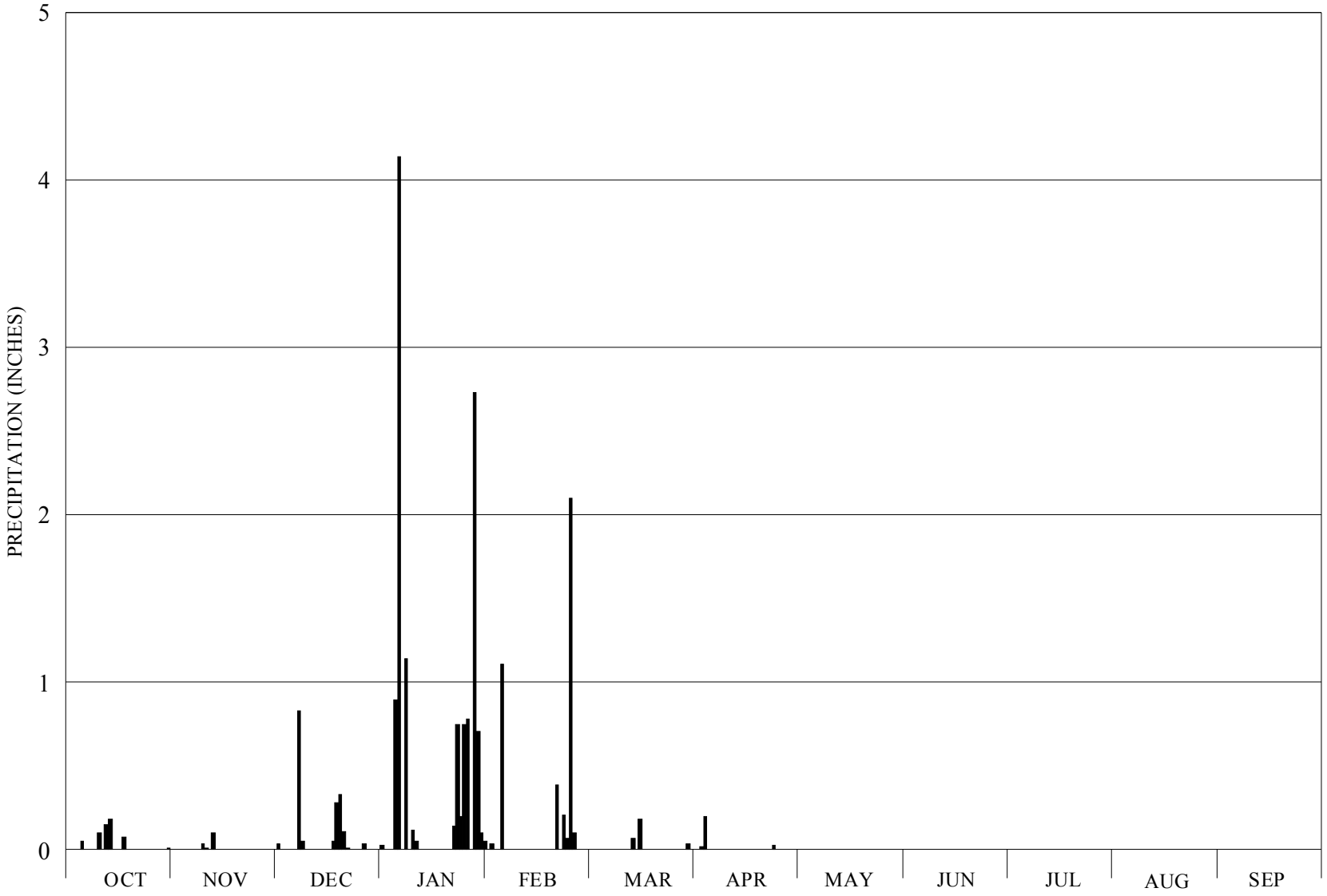
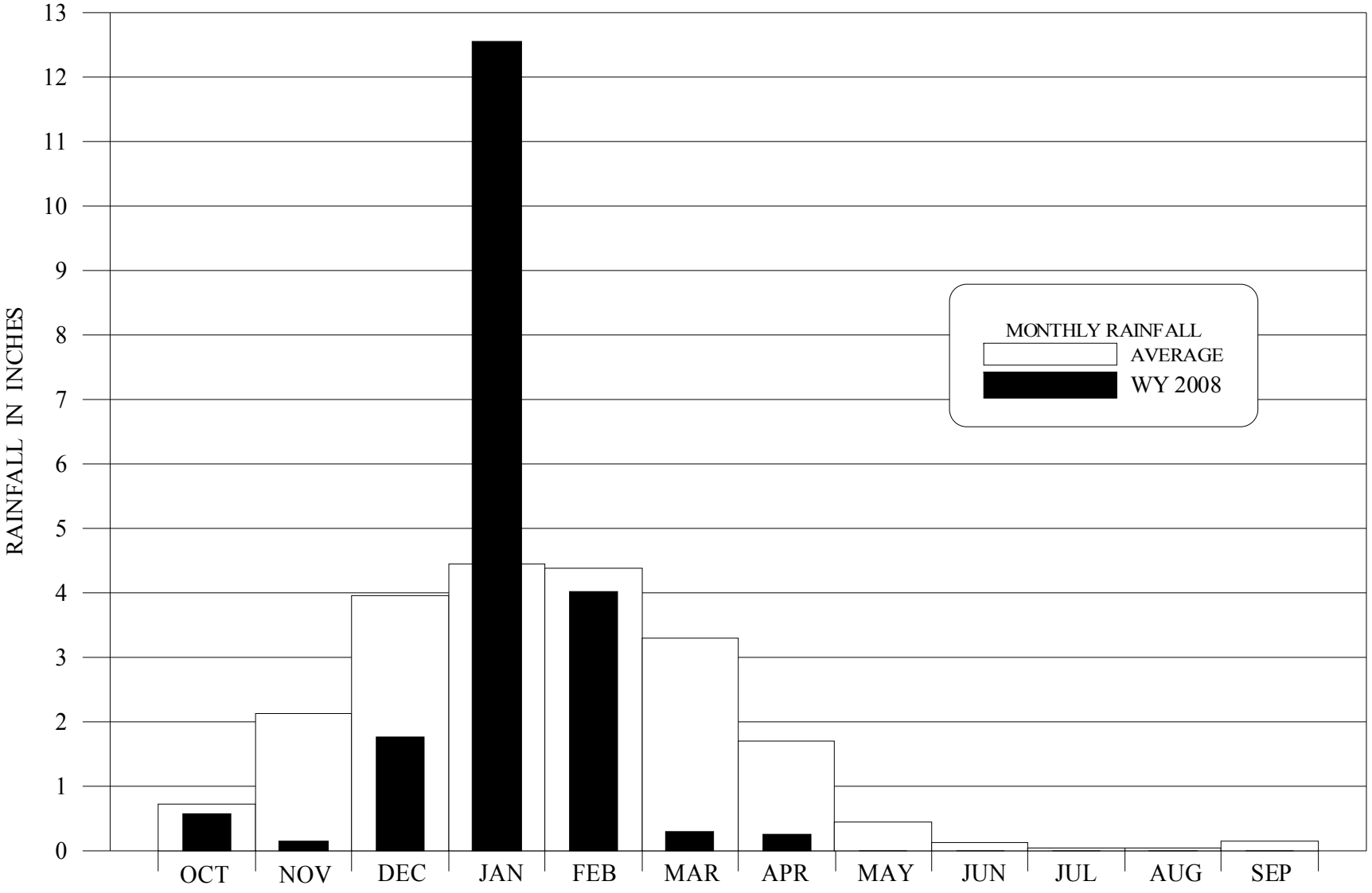
Prepared by Water Resources Division
Finalized: September 26, 2009

Figure II-1
San Clemente Reservoir Daily Rainfall: Water Year 2008



Note: Monthly tick marks are approximate.

Figure II-2
Monthly Distribution of Rainfall at San Clemente Reservoir: Water Year 2008 v. Average Conditions



Note: Averages based on period of record 1922 - 2008

Figure II-3
Carmel River Basin Principal Streamflow Gaging Stations

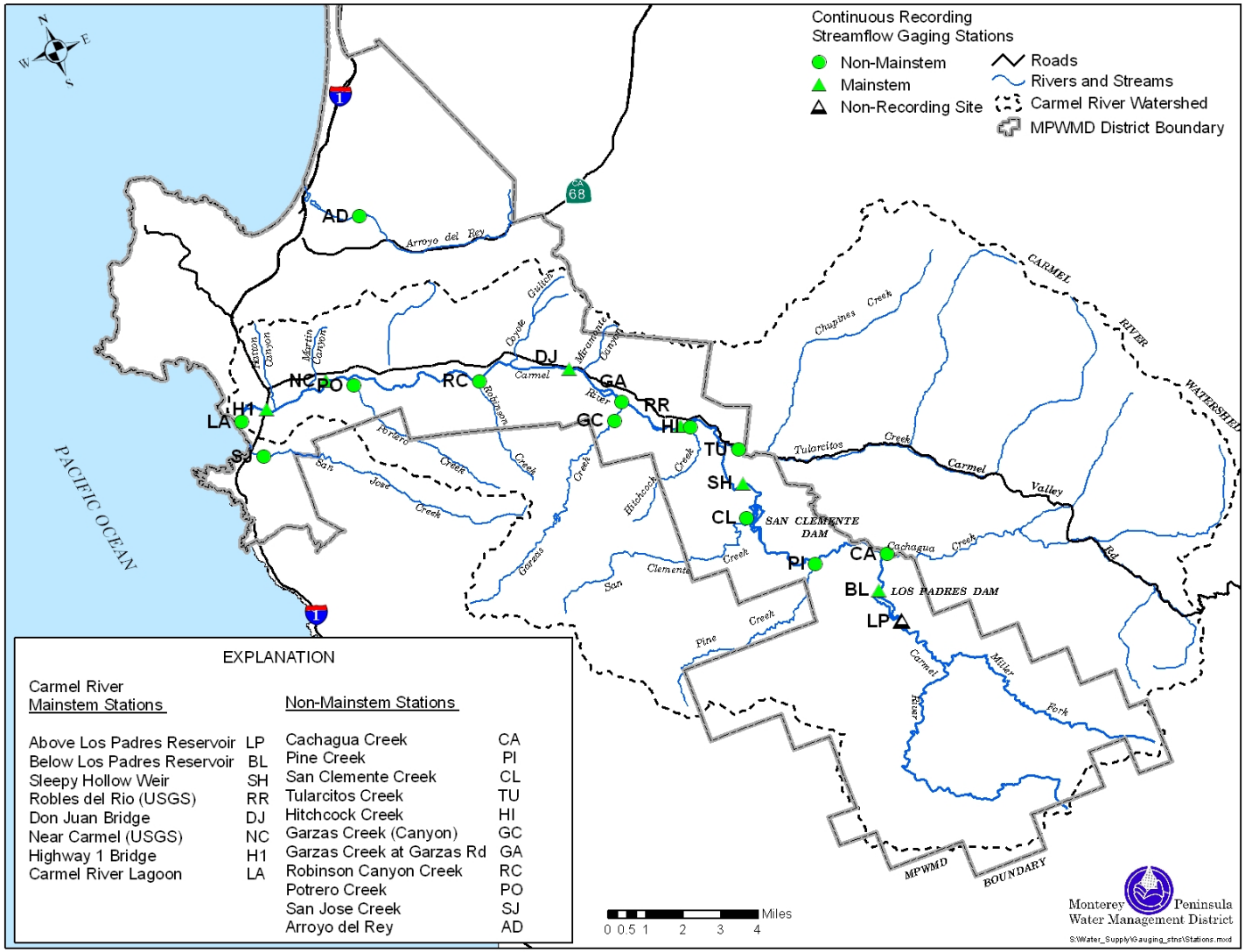


Figure II-4
Cumulative Unimpaired Runnoff: Carmel River at San Clemente Dam

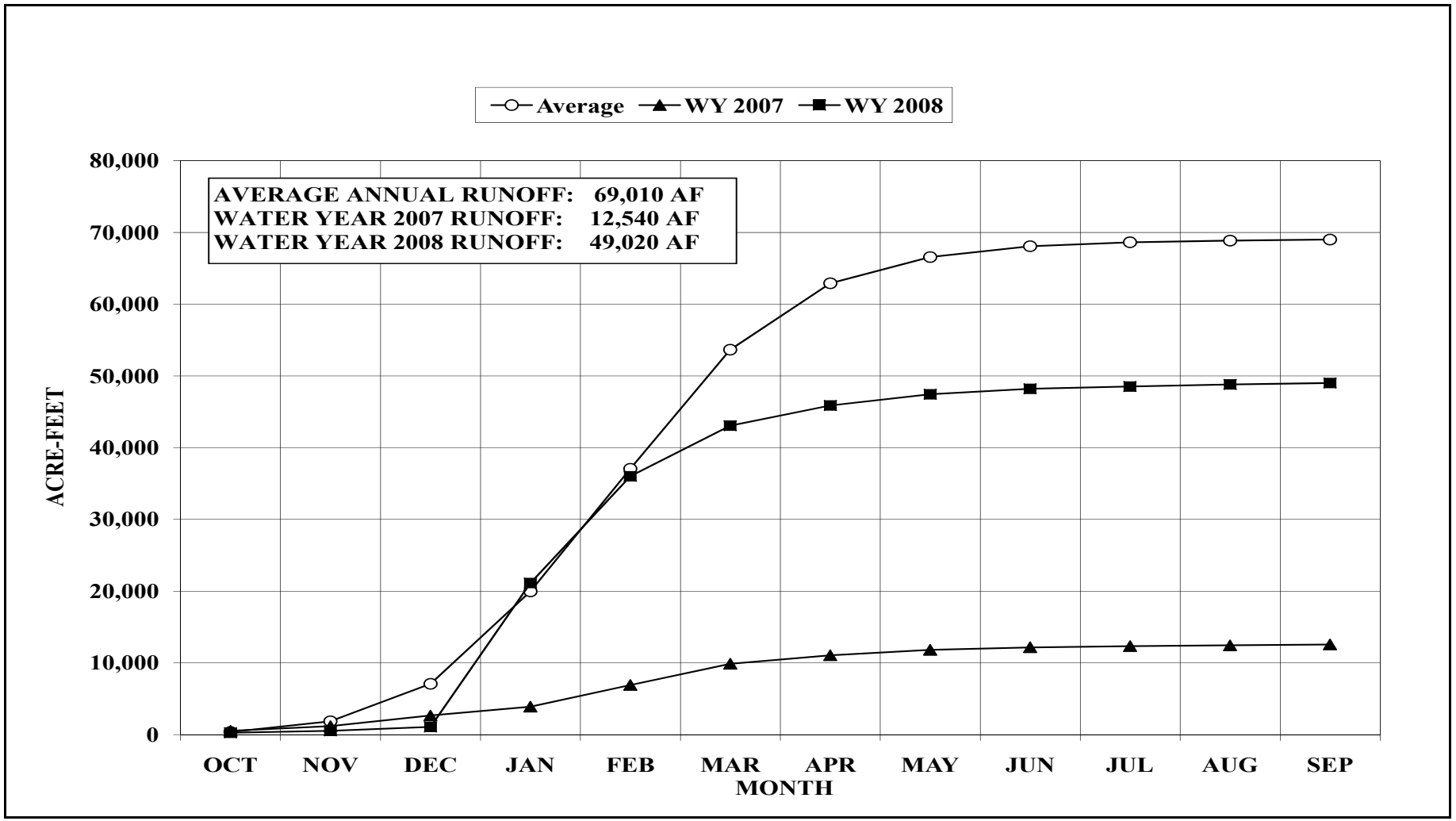


Figure II-5
End-of-Month Usable Storage for the Monterey Peninsula Water Resources System: Water Year 2008

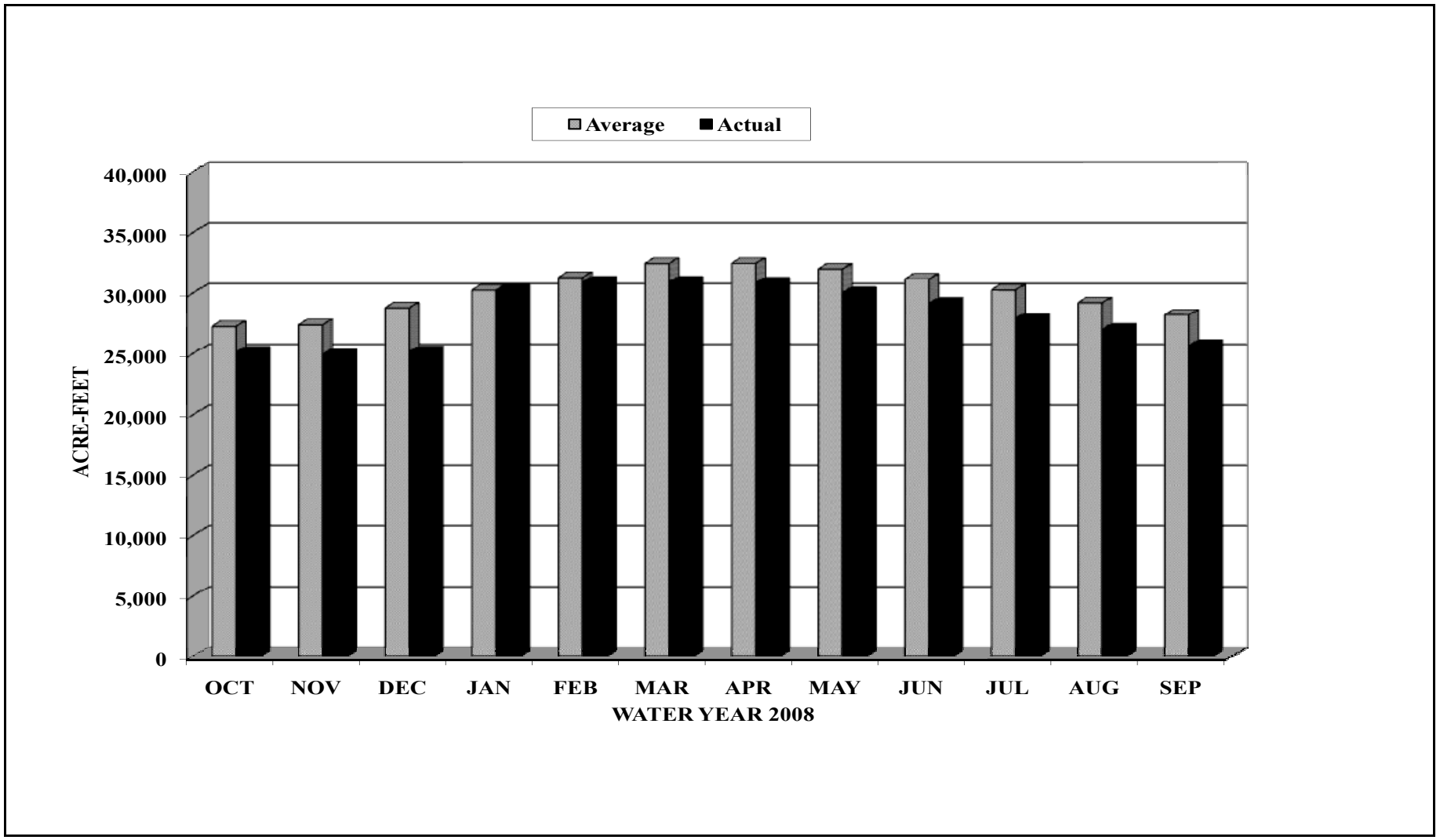


Figure II-6
Mean Daily Streamflow and Groundwater Elevation at the Rancho Canada East Well

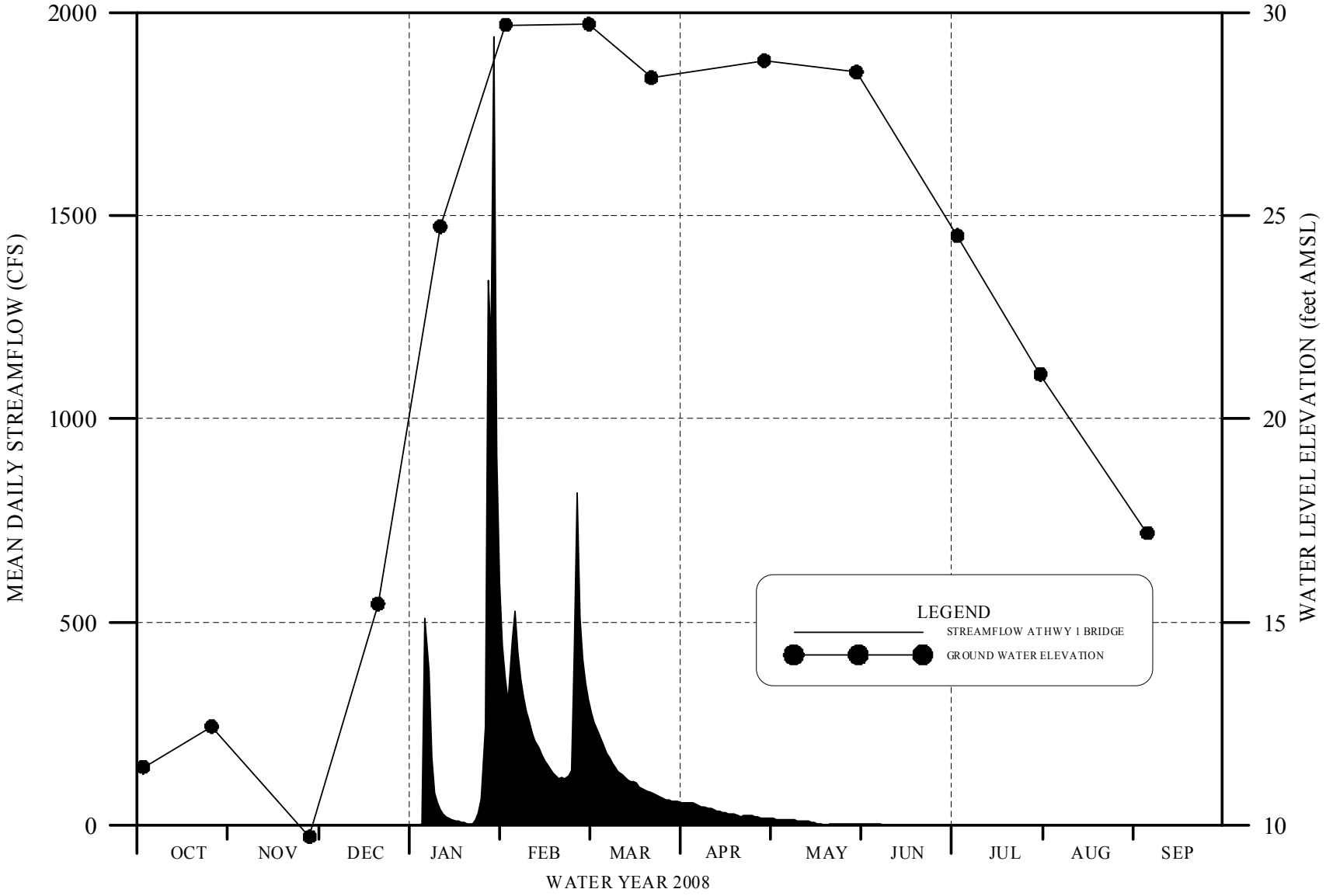


Figure II-7
Mean Daily Streamflow and Groundwater Elevation at the CAWD Rio North Well

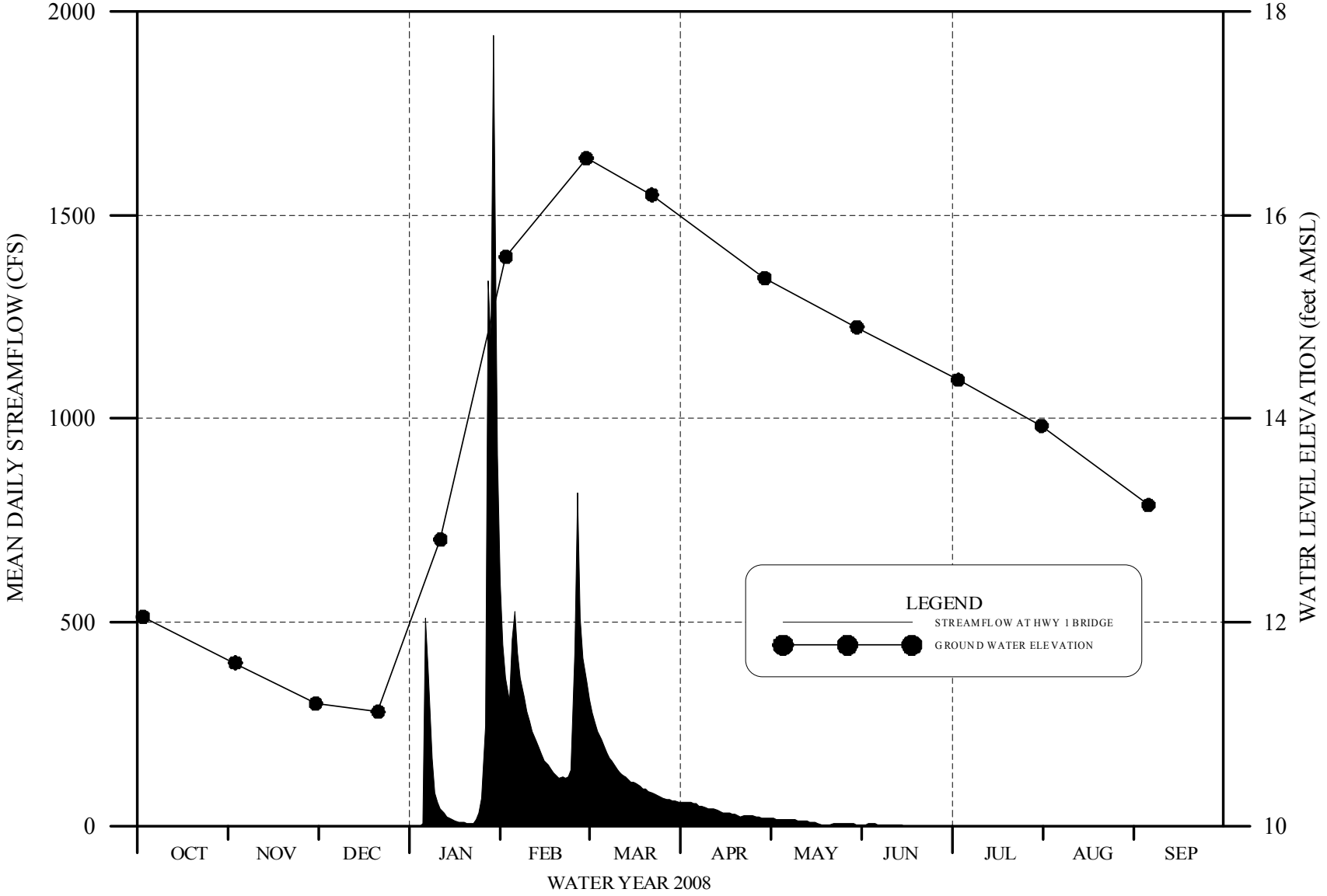
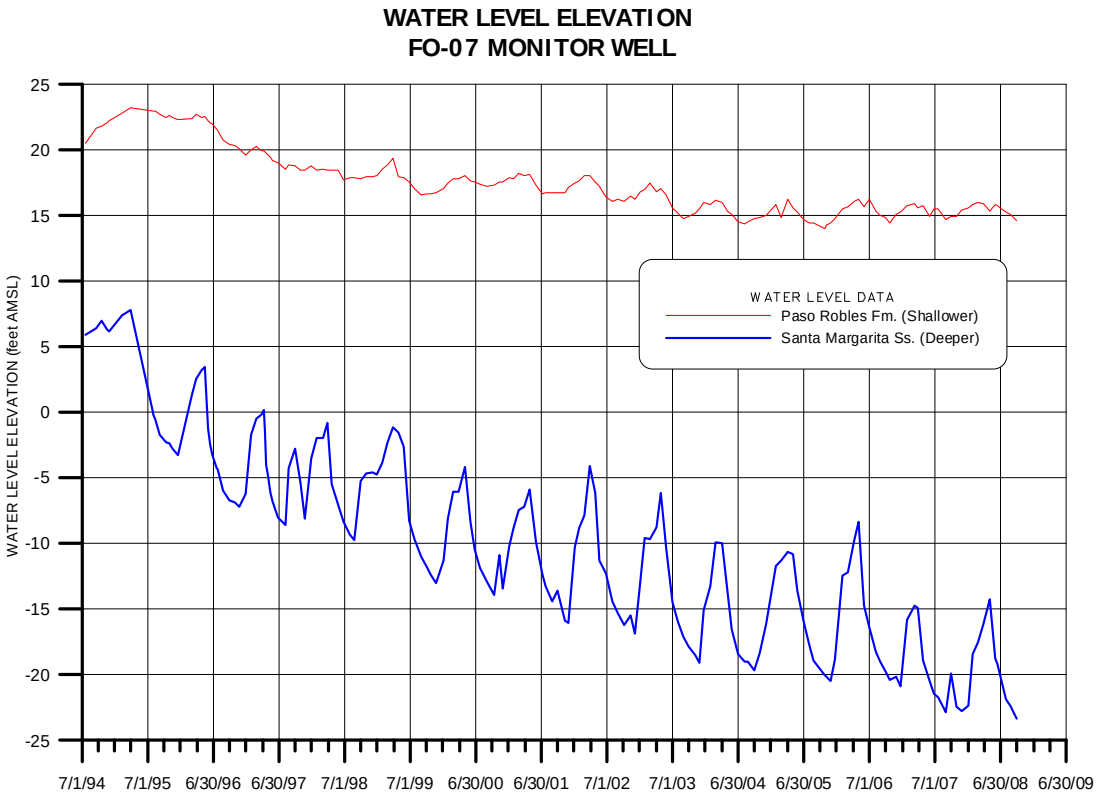


Figure II-8
Seaside Basin Groundwater Monitoring Wells
MONTEREY PENINSULA WATER MANAGEMENT DISTRICT



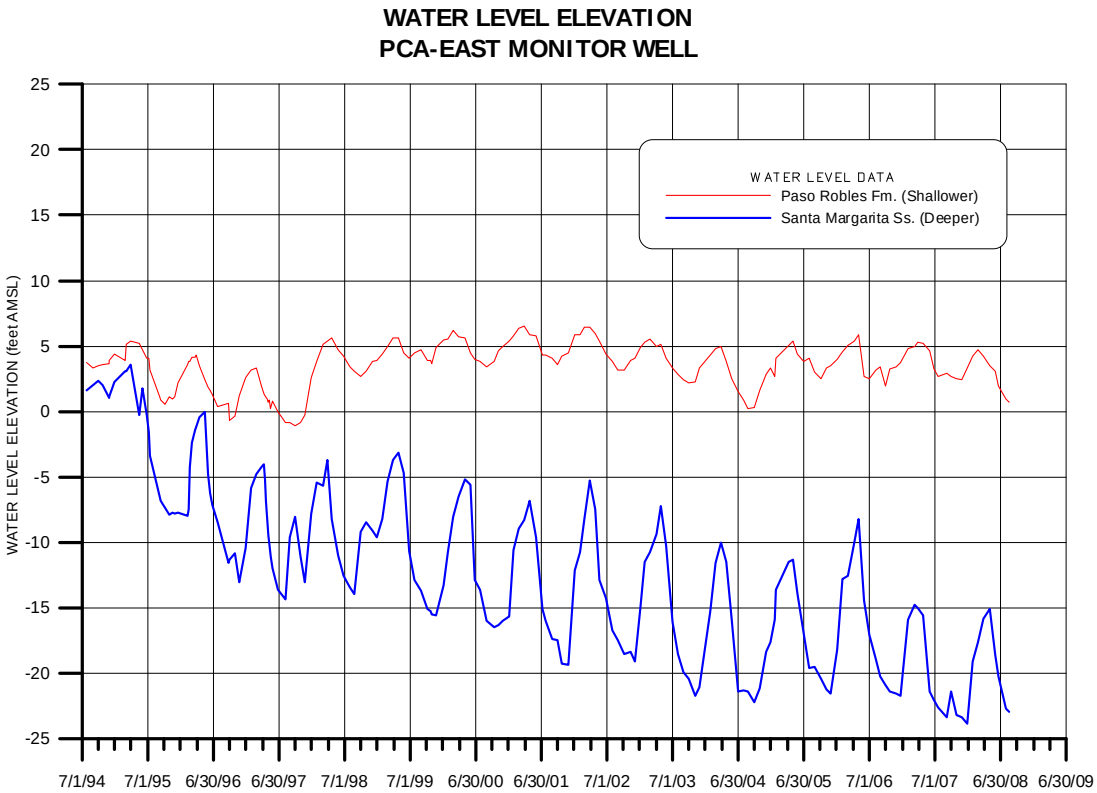


Figure II-9a: Water Quality 0.07 Miles from Coast in Carmel Valley

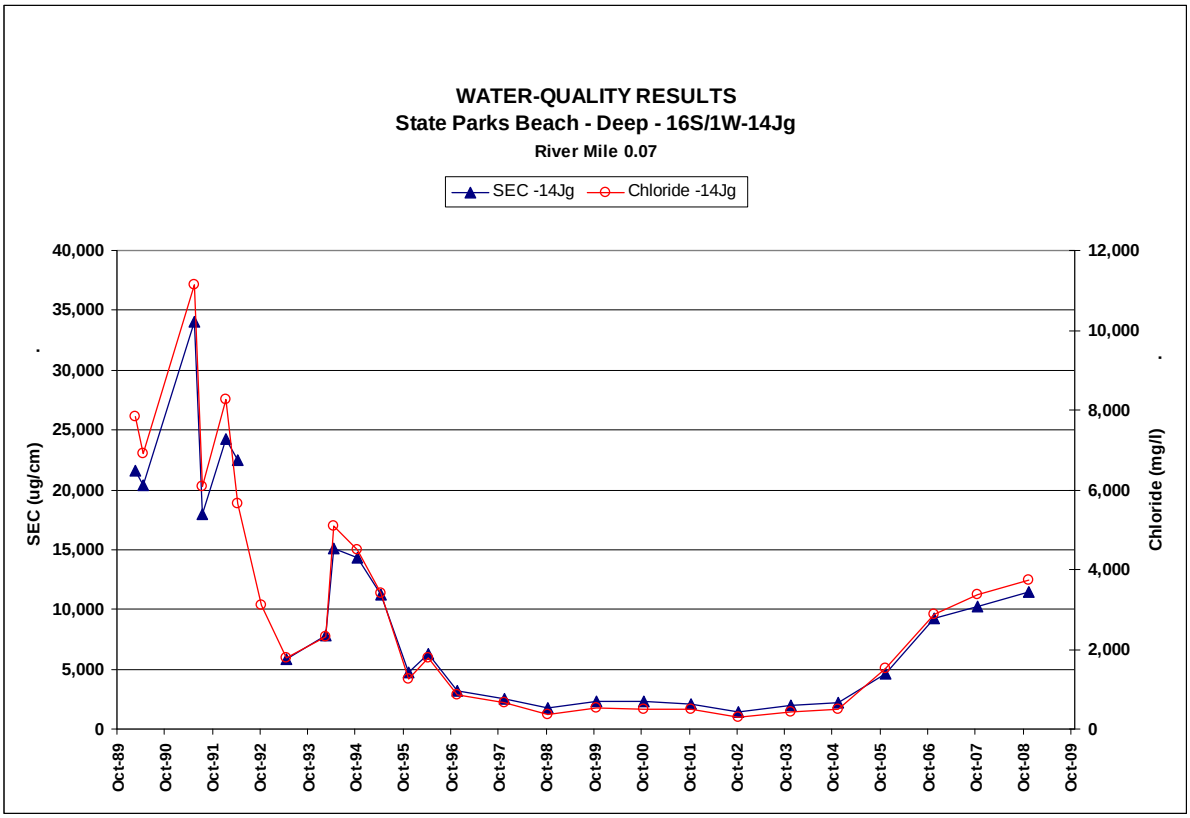


Figure II-9b: Water Quality 0.3 Miles from Coast in Carmel Valley

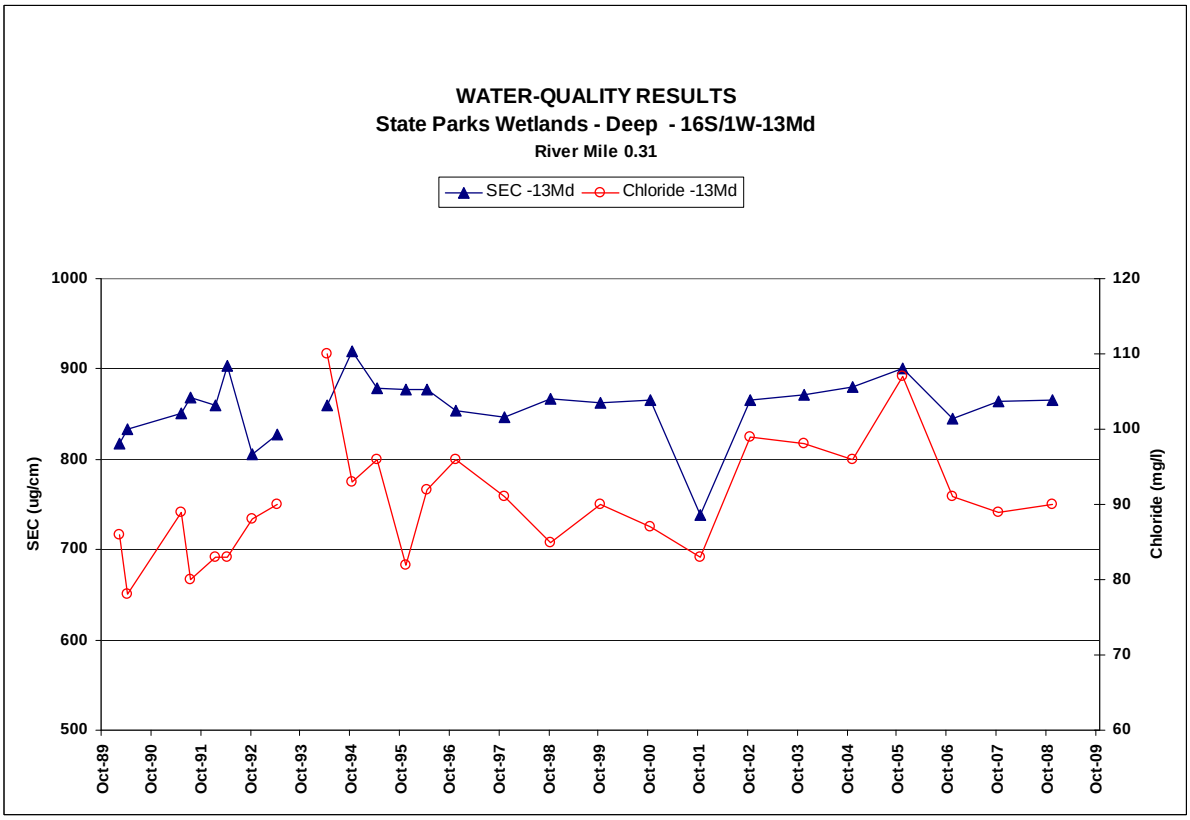


Figure II-9c: Water Quality 0.65 Miles from Coast in Carmel Valley

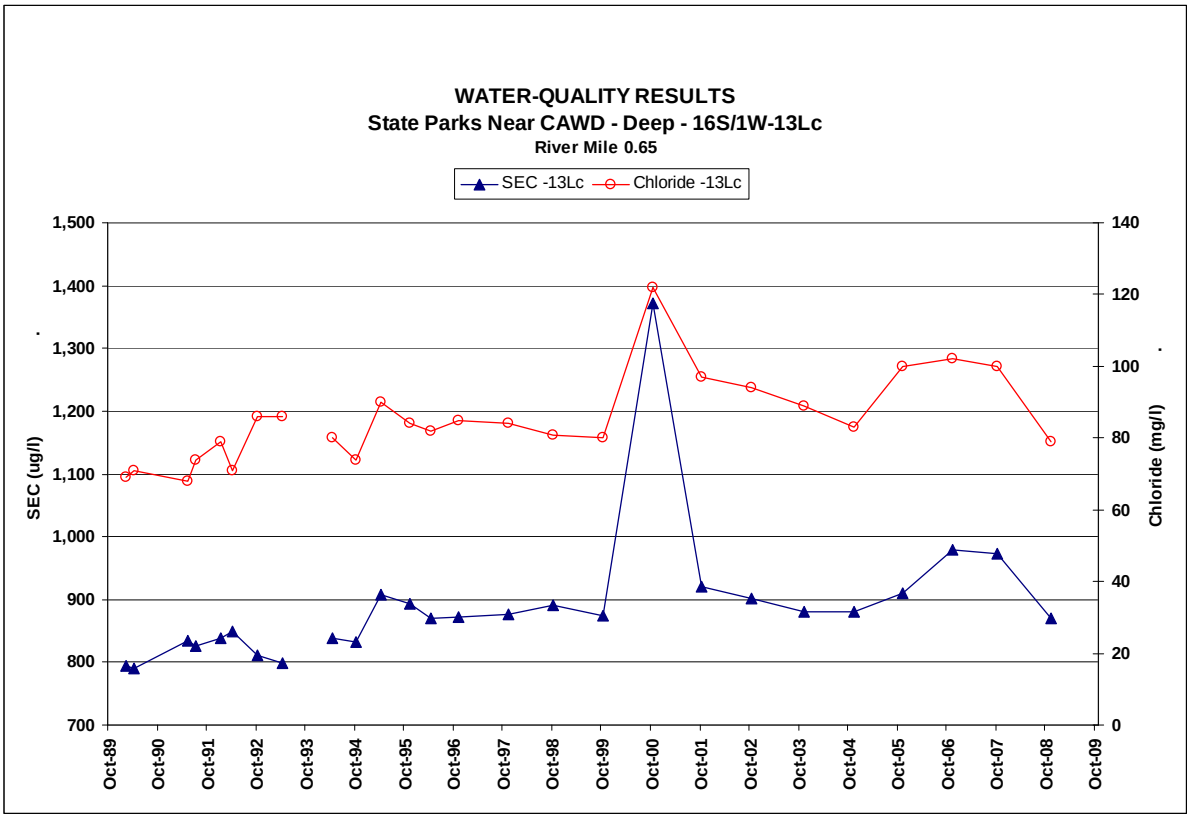


Figure II-9d: Water Quality 6.7 Miles from Coast in Carmel Valley

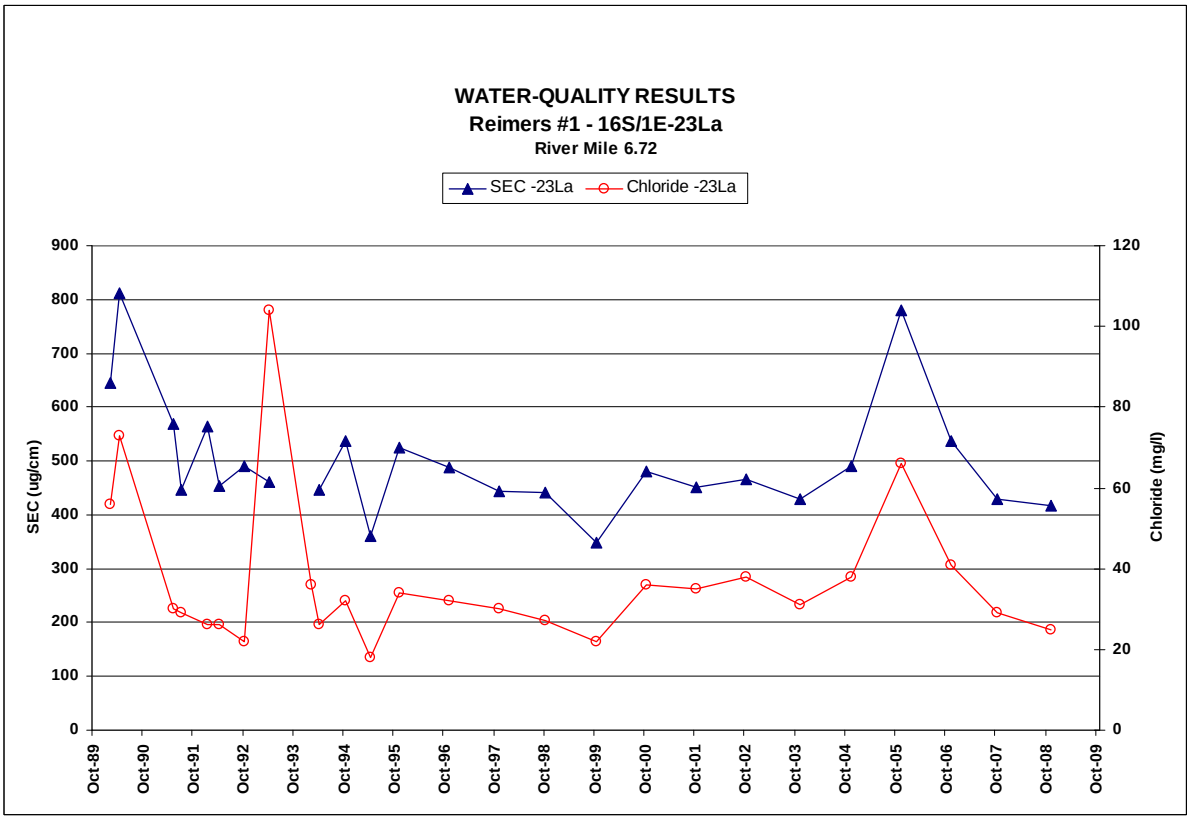


Figure II-9e
Water Quality in Two Coastal Wells in Seaside

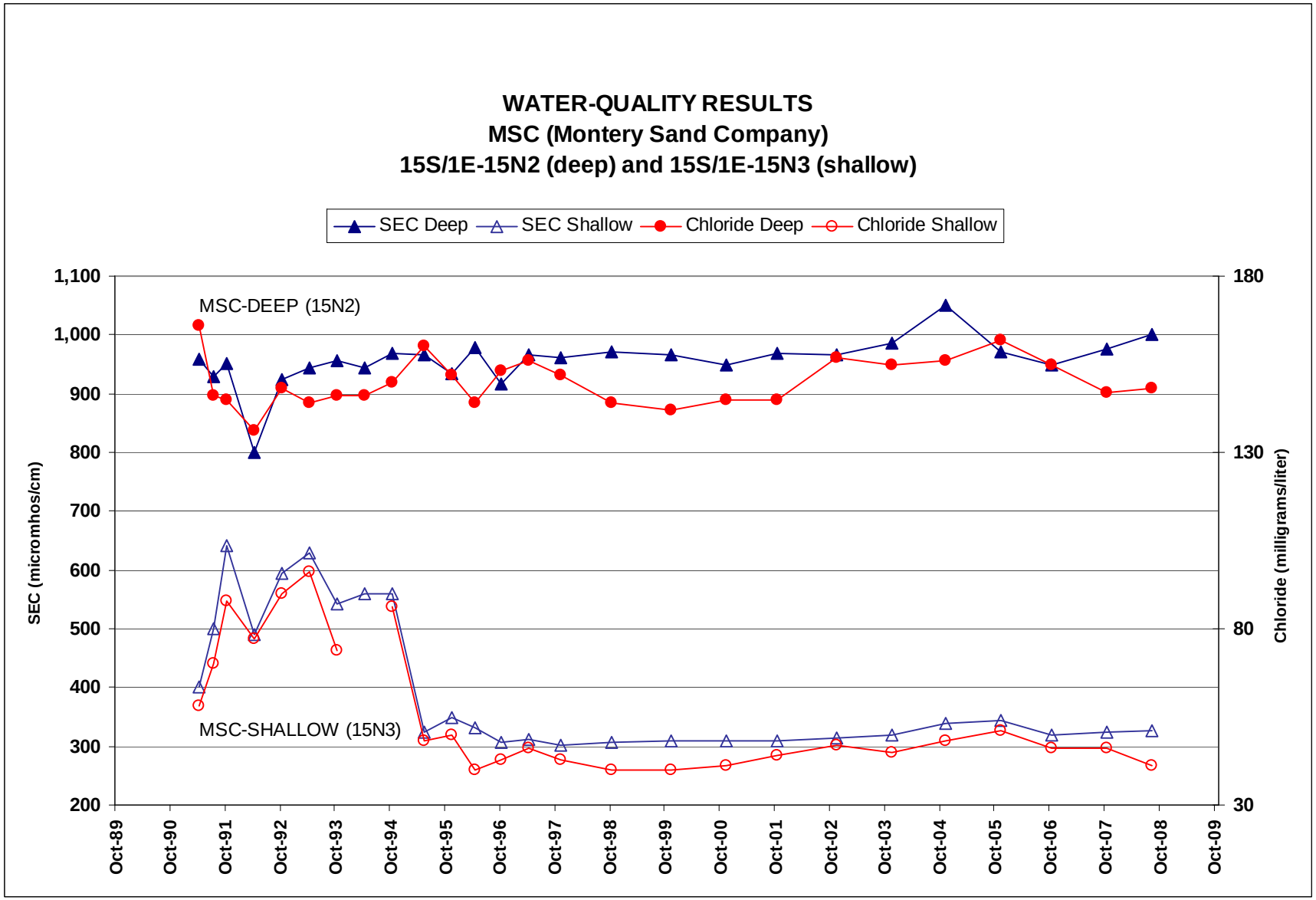


Figure II-10
Temperature and Semi-Monthly Water Quality Monitoring Locations Within the Carmel River Basin During RY 2008

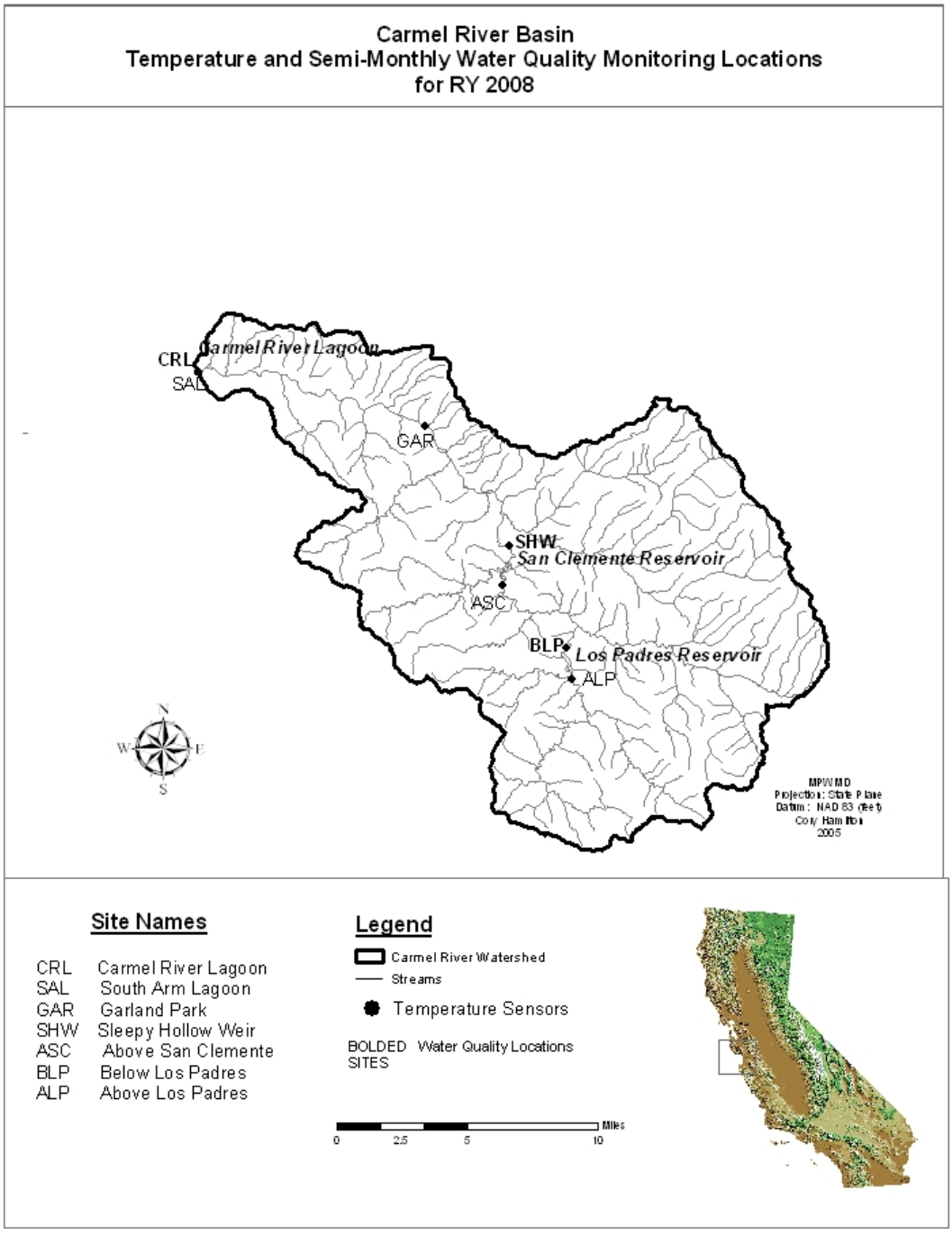
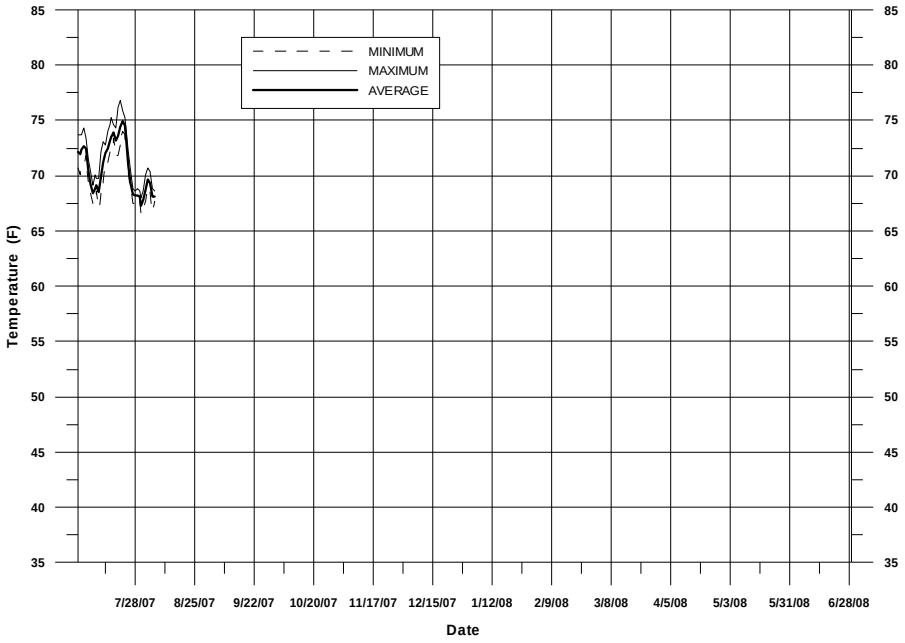


Figure II-11
Daily temperatures recorded from a continuous temperature data logger at the South Arm Lagoon (SAL) station during RY 2008.



Note: data logger error began 08/07/07

Figure II-12
Daily temperatures recorded from a continuous temperature data logger at the Garland Park (GAR) station during RY 2008.

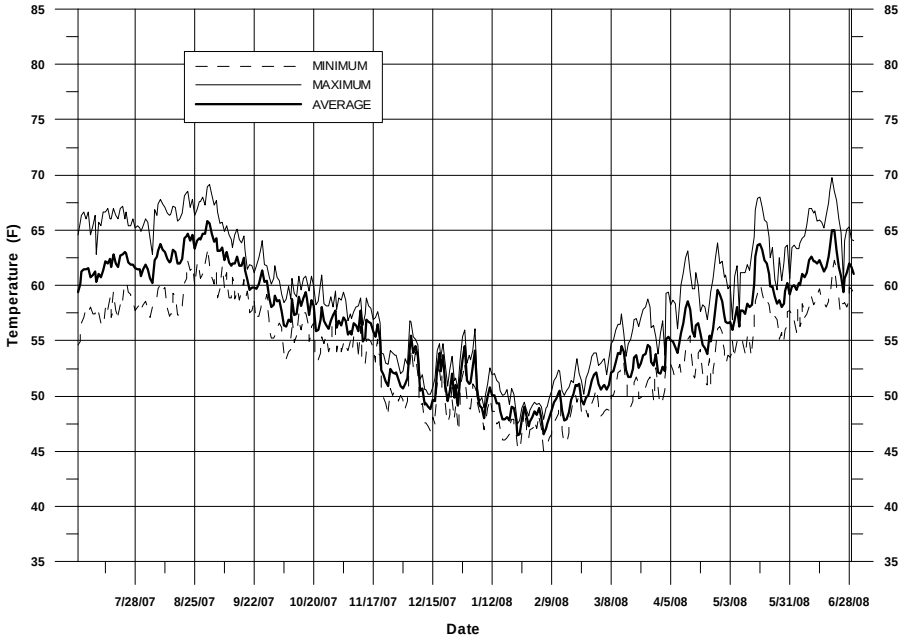


Figure II-13
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Sleepy Hollow Weir (SHW) Station During RY 2008

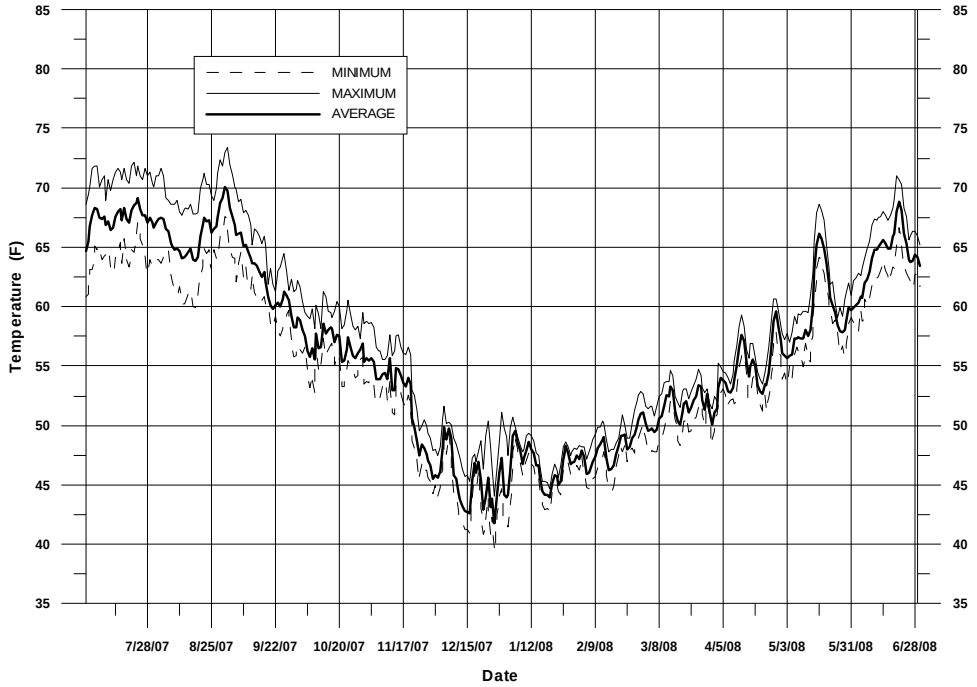


Figure II-14
Daily Temperatures Recorded From a Continuous Temperature Data Logger at the Above San Clemente (ASC) Station During RY 2008

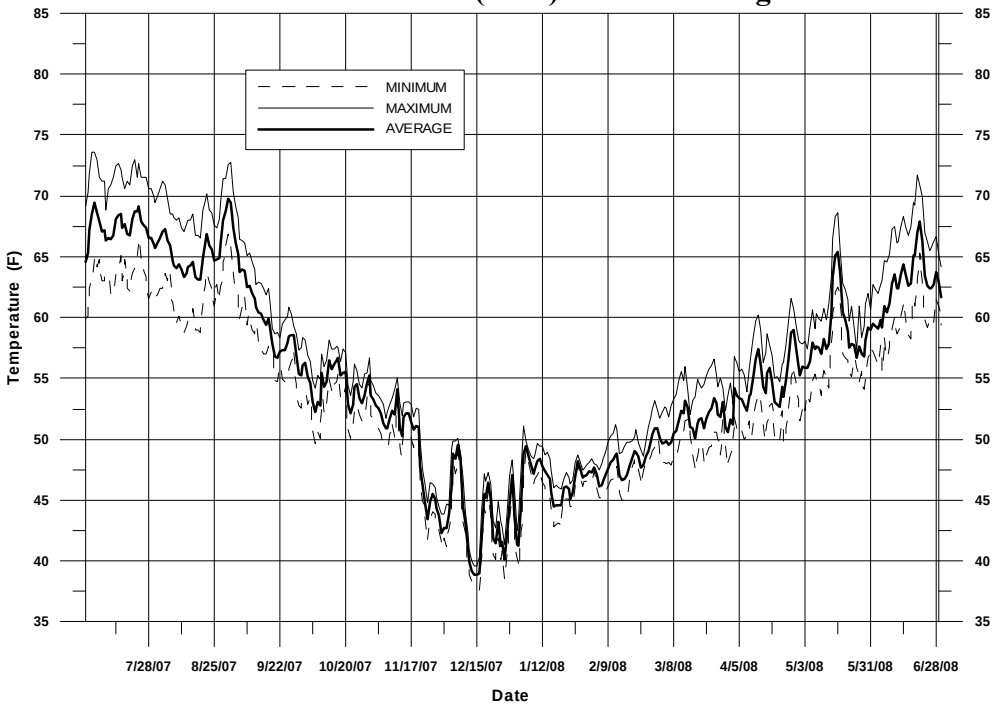


Figure II-15
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Below Los Padres (BLP) Station During RY 2008

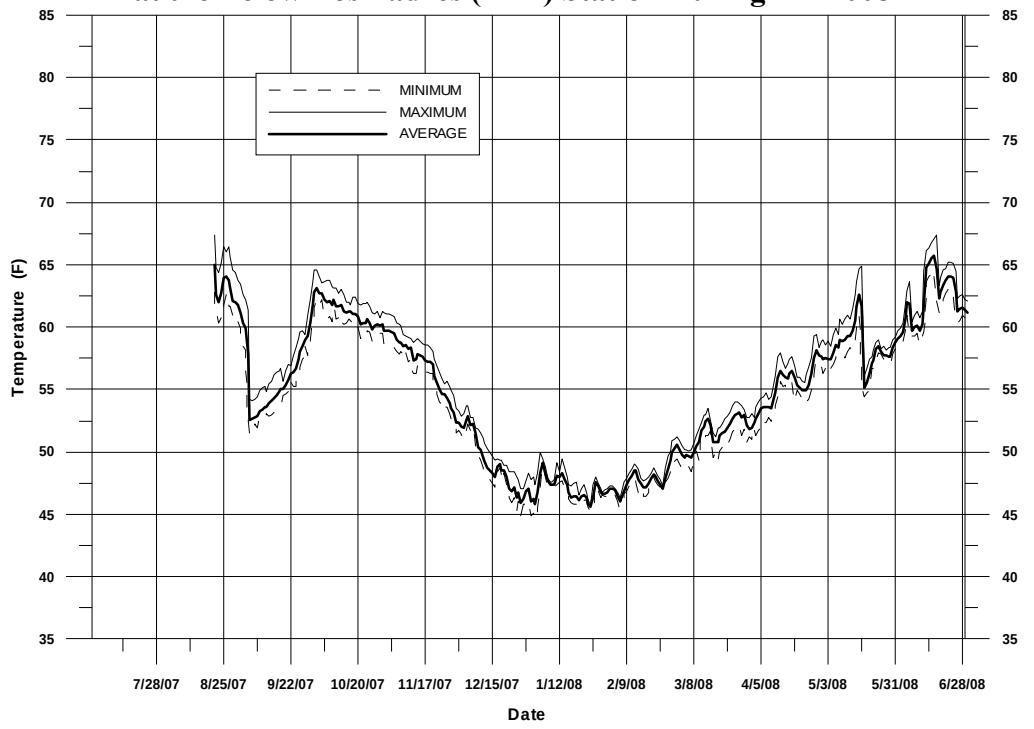


Figure II-16
Daily Temperatures Recorded from a Continuous Temperature Data Logger at the Above Los Padres (ALP) Station During RY 2008

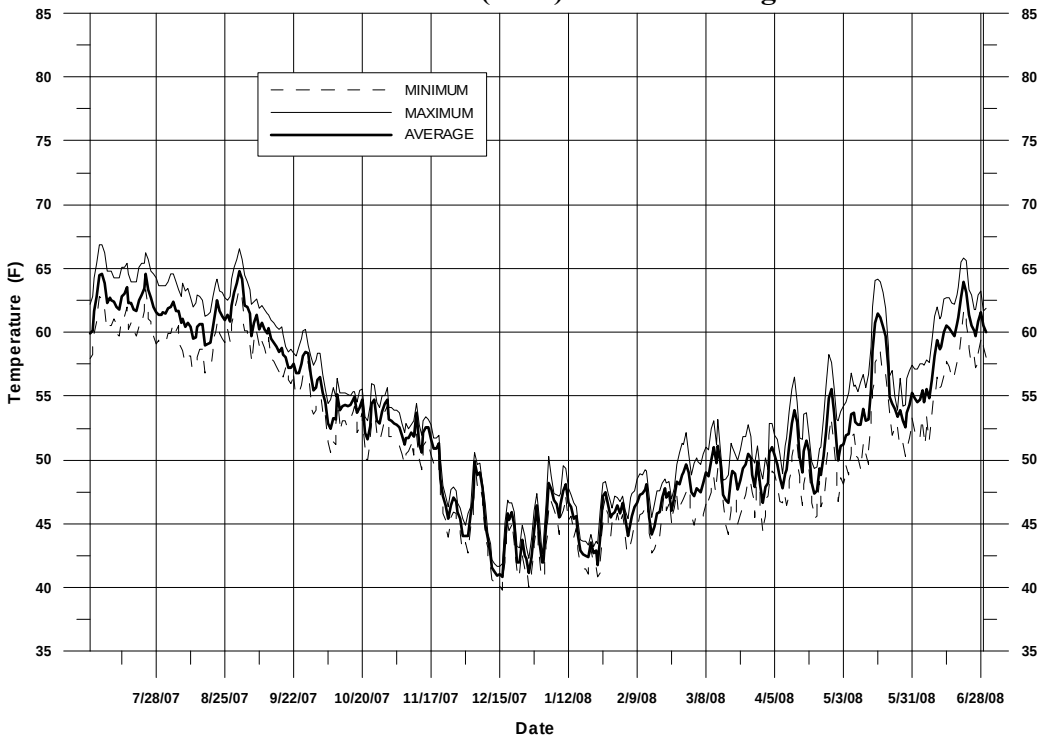


Figure II-17
Carmel River Lagoon Water Level: January 2008

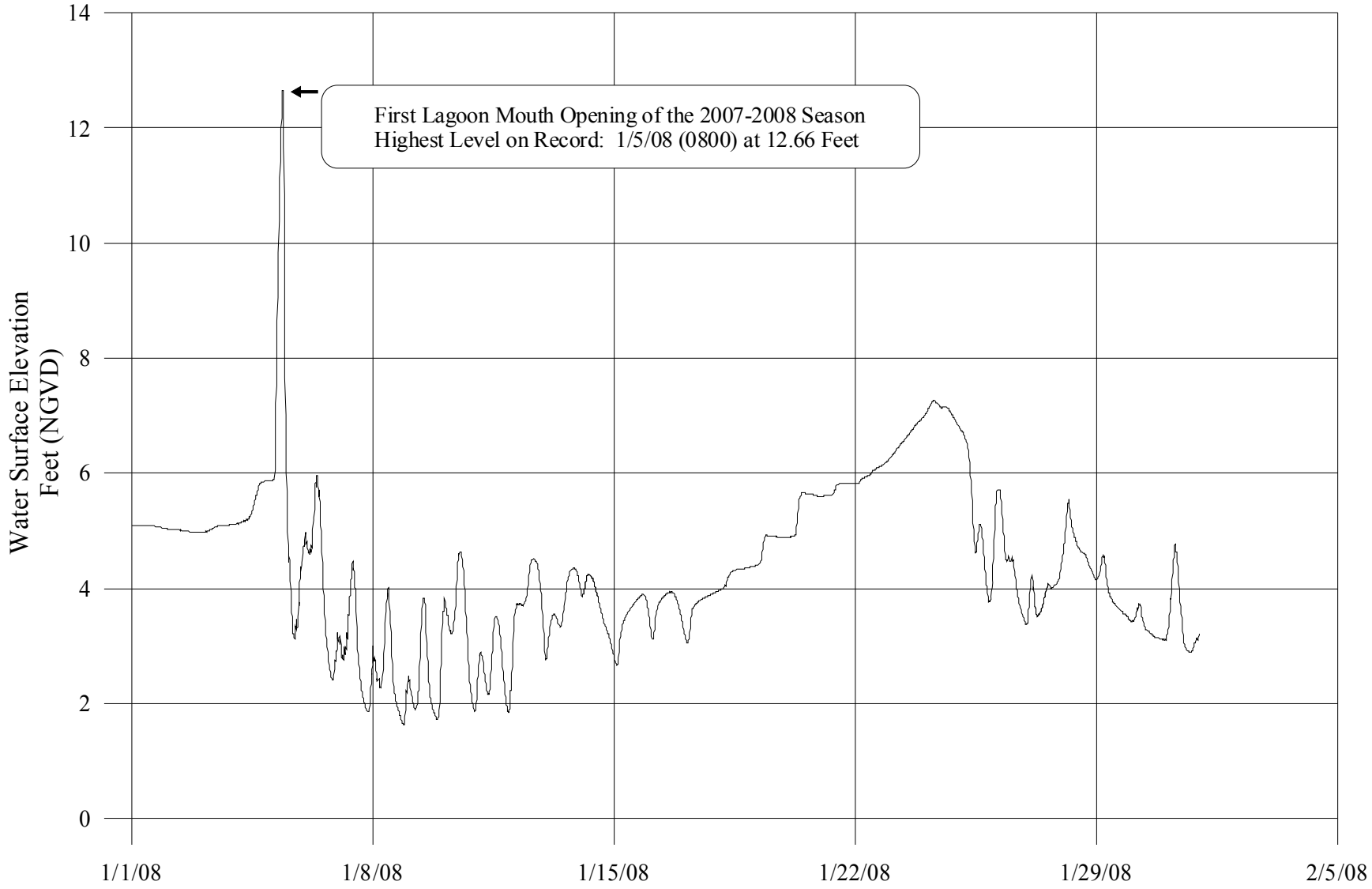


Table II-1
Carmel River Basin Total Annual Streamflow: Water Years 1992 – 2008

TRIBUTARY SITES	Drainage Area (Sq. Miles)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CACHAGUA CREEK	46.3	1,780	7,340	560	16,320	3,840	4,990	23,800	2,590	1,730	1,500	245	1,270	1,250	4,340	5,210	261	2,200
PINE CREEK	7.8	3,750	9,800	1,230	11,110	6,550	8,300	15,610	4,540	5,300	3,270	2,300	4,250	2,350	8,910	8,020	849	3,840
SAN CLEMENTE CREEK	15.6	5,450	17,070	1,820	20,580	9,310	14,100	33,380	7,130	9,830	5,340	3,270	5,850	3,720	16,330	13,720	1,360	5,520
TULARCITOS CREEK	56.3	635	3,220	444	5,100	1,650	2,450	22,610	3,810	2,450	1,490	630	552	503	1,000	2,480	503	917
HITCHCOCK CREEK	4.6	*	*	52	1,820	451	716	2,970	169	482	214	18	274	234	863	691	2	383
GARZAS CREEK	13.2	3,700	11,170	746	12,140	4,890	8,570	24,610	5,050	4,980	3,070	1,200	2,760	1,810	8,590	7,420	381	3,010
ROBINSON CANYON CREEK	5.4	619	2,360	89	2,230	619	1,430	6,890	545	823	433	82	448	354	1,710	1,010	25	455
POTRERO CREEK	5.2	*	*	30	1,790	506	1,210	5,970	855	1,020	310	43	210	164	1,470	1,050	13	308
SAN JOSE CREEK (outside CR	14.2	*	*	*	*	*	*	*	6,400	6,260	2,890	1,100	1,880	1,480	7,640	6,870	862	1,740
MAINSTEM SITES																		
CR AT ROBLES DEL RIO	193	38,240	109,000	11,800	155,000	75,210	99,340	250,300	54,640	76,750	47,180	31,850	60,560	38,060	114,400	110,100	12,220	49,080
CR AT DON JUAN BRIDGE	216	*	122,000	12,760	173,600	83,090	111,800	252,200	53,570	73,960	49,360	31,330	60,420	38,330	121,800	118,300	12,150	52,510
CR NEAR CARMEL	246	35,570	123,400	8,200	177,400	74,500	104,100	261,100	55,000	76,190	47,790	28,340	55,400	35,220	119,200	119,200	7,440	43,960
CR AT HIGHWAY 1 BRIDGE	252	*	123,000	7,410	179,500	83,430	112,000	280,900	50,810	72,660	42,860	24,860	52,000	30,300	115,200	115,000	6,470	42,520

Notes: 1. Carmel River (CR) at Robles del Rio and near Carmel sites are maintained by the USGS.
2. (*) No continuous stage data collected.
3. Streamflow sites listed in downstream order.
4. San Jose Creek is outside the Carmel River Basin, but is shown for comparison.

Table II-2
Water Quality Data Collected by MPWMD During RY 2008 at Carmel River Lagoon (CRL) Site[1].

Date	Time 24 Hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Nacl (ppt)	Turbidity (NTU)	WSE (ft)
13-Jul-07	1315	73.4	8.0	15	8.0	3681	1.9	.25	3.52
20-Jul-07	1300	75.4	9.3	20	8.0	4016	2.1	.40	3.16
09-Aug-07	1250	73.6	9.3	15	8.0	3083	1.6	1.8	3
22-Aug-07	1345	73.9	10.3	10	8.0	4596	2.5	.25	2.7
05-Sep-07	1330	72.8	13.3	5	8.5	3724	2.0	2.2	3.02
21-Sep-07	1315	66.7	10.7	5	8.0	302	1.6	2.1	3.2
05-Oct-07	1315	64.6	10.7	5	9.0	3966	2.1	0	3.64
26-Oct-07	1110	60.4	9.7	5	8.5	6600	3.1	.95	4.46
07-Nov-07	1500	58.6	9.9	15	8.0	5440	3.0	0	4.16
30-Nov-07	1420	50.9	11.6	20	8.0	10160	5.7	.75	4.84
21-Dec-07	1305	52.9	12.3	40	7.5	14460	8.4	1.7	5.24
11-Jan-08	1145	53.1	10.1	15	8.0	10920	6.4	0	3.42
24-Jan-08	1250	47.1	11.2	10	7.5	1232	0.6	.7	7.17
13-Feb-08	1215	52.5	9.6	15	8.0	3166	1.7	0	2.3
29-Feb-08	1245	52.5	10.2	10	7.5	672	0.3	3.7	2.56
14-Mar-08	1145	55.6	10.2	10	7.5	4924	2.6	4.3	2.02
28-Mar-08	1230	55.0	10.8	25	8.0	6490	3.6	5.7	6.32
11-Apr-08	1100	57.9	10.6	15	8.0	1221	0.6	0	5.34
25-Apr-08	1215	61.3	8.0	25	7.5	15570	9.2	.82	1.44
02-May-08	1330	63.1	10.1	15	8.0	1064	0.5	0	6.56
13-May-08	1130	62.8	9.7	15	7.5	800	0.4	0	8.28
30-May-08	1300	65.5	8.8	15	7.5	1014	0.5	0	7.42
20-Jun-08	1115	70.9	10.3	15	8.0	1336	0.7	0	5.66
Minimum		47.1	8.0	5.0	7.5	302	0.3	0.0	
Maximum		75.4	13.3	40.0	9.0	15570	9.2	5.7	
Average		61.8	10.2	14.8	7.9				

[1]The CRL station is located on the southwest end of the main body of the Lagoon, along the rock outcrop at River Mile (RM) 0.1.

Table II-3
Water Quality Data Collected by MPWMD During RY 2008
at Sleepy Hollow Weir (SHW) Site[1]

Date	Time 24 hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Turbidity (NTU)
13-Jul-07	1105	65.5	9.0	15	7.5	356	2.3
20-Jul-07	1052	65.5	9.3	15	8.0	353	3.3
09-Aug-07	1135	64.2	10.1	15	7.5	349	4.1
22-Aug-07	1200	68.2	9.2	15	7.5	350	2.7
05-Sep-07	1150	65.7	9.5	15	7.5	339	1.8
21-Sep-07	1200	60.6	11.8	10	8.0	339	1.2
05-Oct-07	1210	58.5	10.0	10	8.0	342	1.5
26-Oct-07	1010	55.4	9.8	10	8.0	363	1.7
07-Nov-07	1335	55.6	10.7	10	7.5	370	1.1
30-Nov-07	1310	47.1	11.6	15	7.5	N/A	0
21-Dec-07	1130	46.2	11.5	15	7.5	386	0
11-Jan-08	1100	48.4	11.4	10	7.5	195	0
24-Jan-08	1215	46.4	11.6	10	8.0	241	0
13-Feb-08	1125	49.1	11.4	10	8.0	205	0
29-Feb-08	1200	51.3	11.8	5	7.5	190	0
14-Mar-08	1100	51.9	12.4	10	7.5	225	0
28-Mar-08	1130	51.3	11.2	10	7.5	238	0
11-Apr-08	1000	53.6	11.6	10	7.5	257	0
25-Apr-08	1100	53.9	9.4	15	8.0	263	0
02-May-08	1215	57.2	10.5	10	8.0	265	0
13-May-08	1015	56.7	11.5	10	7.5	271	0
30-May-08	1200	60.8	11.6	15	8.0	270	0
20-Jun-08	1030	66.6	10.1	15	7.5	310	0
Minimum		46.2	9.0	5.0	7.5	190	0.0
Maximum		68.2	12.4	15.0	8.0	386	4.1
Average		56.5	10.7	12.0	7.7	294	

[1] The SHW station is located 15 ft downstream of the Sleepy Hollow Weir at RM 17.1.

Table II-4
Water Quality Data Collected by MPWMD During RY 2008
at Below Los Padres (BLP) Site[1]

Date	Time 24 hr	Temperature (F)	Dissolved Oxygen (mg/L)	Carbon Dioxide (mg/L)	pH	Conductivity (uS/cm)	Turbidity (NTU)
13-Jul-07	0935	62.8	7.0	15	7.0	287	.25
20-Jul-07	1000	63.5	6.4	15	7.0	280	1.6
09-Aug-07	1010	63.3	6.0	15	7.5	283	1.2
22-Aug-07	1025	62.2	5.9	15	7.0	282	11
05-Sep-07	1050	52.7	8.6	25	7.0	262	1.1
21-Sep-07	1100	60.1	6.3	15	7.0	268	0
05-Oct-07	1110	63.3	5.8	10	7.5	314	2.5
26-Oct-07	0925	60.8	5.7	20	7.0	327	.55
07-Nov-07	1300	59.9	4.2	20	7.0	337	0
30-Nov-07	1220	54.0	9.1	15	7.5	339	2.2
21-Dec-07	1040	48.9	9.9	15	7.5	326	5
11-Jan-08	1000	49.1	11.3	10	7.5	172	1.3
24-Jan-08	1115	47.3	12.0	10	8.0	222	0
13-Feb-08	1020	49.5	11.1	10	8.0	181	0
29-Feb-08	1100	51.4	12.3	10	7.5	160	0
14-Mar-08	0950	53.4	11.9	10	7.5	203	0
28-Mar-08	1045	53.4	10.3	10	7.5	218	0
11-Apr-08	0915	54.5	11.0	10	7.5	227	0
25-Apr-08	1000	55.4	7.5	10	7.5	244	0
02-May-08	1130	59.0	9.9	15	7.5	243	0
13-May-08	0920	59.2	9.9	10	7.5	295	0
30-May-08	1045	59.4	10.0	15	7.0	249	0
20-Jun-08	0915	63.9	8.4	20	7.0	260	0
Minimum		47.3	4.2	10.0	7.0	160	0.0
Maximum		63.9	12.3	25.0	8.0	339	2.5
Average		56.8	8.7	13.9	7.3	260	

[1]The BLP station is located approximately 200 ft downstream of the Los Padres spillway at RM 25.4.