

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

**BEFORE THE STATE WATER
RESOURCES CONTROL BOARD**

In the Matter of the State Water Resources)
Control Board (State Water Board))
Hearing to Determine whether to Adopt a)
Draft Cease & Desist Order against)
California American Water Regarding its)
Diversion of Water from the Carmel River)
in Monterey County under Order WR 95-10)
_____)

Hearing Date: July 23 - 25, 2008

Carmel River in Monterey County

EXHIBIT MPWMD-TC12

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

RECEIVED
MAY 30 1986
M.P.W.M.D.

DRAFT

EFFECTS OF PRODUCTION WELL PUMPING ON PLANT WATER STRESS
IN THE RIPARIAN CORRIDOR OF THE LOWER CARMEL VALLEY

VOLUME 1: PRESENTATION OF FINDINGS AND CONCLUSIONS

Prepared for
Monterey Peninsula Water Management District

By
Charles M. McNiesh
Consulting Agronomist

April 4, 1986

EXECUTIVE SUMMARY

Four "new" production wells were drilled in 1981 and 1982 in the lower Carmel Valley where the aquifer system had never been heavily exploited. In light of a longstanding dispute over the environmental impacts of heavy groundwater pumping in the mid valley area, the use permits for the "new" wells mandated the implementation of an irrigation program for the maintenance of the riparian woodlands in the potential area of impact. Subsequently several studies were conducted to develop appropriate irrigation methods and criteria. These studies failed to resolve the questions of when and how much to irrigate, and, in addition, stimulated controversy over the need for any irrigation at all.

The present study was initiated to determine whether normal operation of the "new" wells can and does induce elevated levels of water stress in nearby riparian vegetation. The present study differed from previous ones primarily in its design, emphasizing detail of monitoring, experimental control, and replication of measurements. The study focused on four sites, characterized by distinctly different conditions of groundwater availability. Each site was located within an area of extensive riparian woodland. Plant water stress parameters, soil water availability, and groundwater levels were closely monitored from May through November, 1985.

The water table at Site 1 was not affected by heavy pumping and remained close to the ground surface throughout the year. Site 2 was located adjacent to one of the "new" wells (San Carlos). Pronounced cycles of groundwater drawdown and recovery paralleled the pumping schedule. Site 3 was located 500 feet from the same "new" well. Similar cycles of drawdown and recovery were apparent but considerably moderated. Site 4 was located in the mid valley in an area impacted by heavy regional pumping. The total decline in groundwater elevation was greater than at either Sites 2 or 3, but the rate of decline was gradual and steady over the course of the dry season.

Plant water stress was clearly least severe at Site 1. Water stress levels at Site 2 mirrored the cyclic response of the water table to production well pumping. Periods of major drawdown were followed by rapid increases in water stress, and periods of major water table recovery were followed by appreciable reductions in water stress. This cyclic pattern contrasted strikingly with the gradual, steady increase in water stress measured at Site 4. Results at Site 3 were intermediate between those at Sites 2 and 4.

These findings demonstrated a close, and presumably causal, relation between production well pumping, groundwater drawdown, and elevated levels of plant water stress. Water stress effects

were sufficiently severe to recommend the implementation of a maintenance irrigation program. Soil and weather measurements indicated that up to 20 inches of effective irrigation water should be applied to heavily impacted areas during the summer and early fall months.

CHAPTER 12. RECOMMENDATIONS

Recommendations are presented below (i) for operating an irrigation system in the impact area of the four new Cal-Am wells in the lower valley and (ii) for limited follow-up activities to the present study.

Irrigation Scheduling Recommendations

The annual irrigation program in the lower valley should be started as soon as mild water stress is detected and it may be discontinued if the water table recovers to within a few feet of its winter elevation. The following specific criteria may be used for these determinations.

- I. Irrigations should be started when any of the following conditions occur:
 - A. As soon as ponded surface water disappears from the river bed adjacent to any of the wells, provided that soil water measurements demonstrated that winter rains were insufficient to refill the soil profile above the elevation of the winter water table.

-or-
 - B. If sufficient pumping occurs to cause more than a one-foot drop of the water table in a one-week period as measured in existing nearby monitor wells, provided that no surface water is present in the adjacent river bed.

-or-
 - C. If the mean dawn water potential of at least three cottonwoods or willows in the impact area of a well measures less than -3 bars.

-or-
 - D. If the mean stomatal resistance of unshaded leaves of at least three cottonwoods or willows in the impact area of a well measures greater than 4 sec/cm at some time between 2 and 4 p.m. Pacific Daylight Time (PDT).

-or-

- E. If premature defoliation (defined as the yellowing of greater than 50% of the existing canopy or loss of more than 10% of the original canopy) is observed in at least 20% of a given riparian species (cottonwood or willow) in the impact area of a well.

II. Irrigations may be discontinued in the impact area of a well if all of the following conditions prevail:

- A. Pumping of that well has been discontinued for the remainder of the year.

-and-

- B. The water table, as measured at existing nearby monitor wells, recovers to within four feet of the elevation of the winter water table.

-and-

- C1. The mean dawn water potential of at least three cottonwoods or willows in the impact area of that well measures greater than -3 bars.

-or-

- C2. The mean stomatal resistance of unshaded leaves of at least three cottonwoods or willows in the impact area of a well measures less than 3 sec/cm continuously from 2 p.m. through 4 p.m. PDT.

An irrigation system for the riparian corridor of the lower valley was designed by MPWMD staff and purchased in 1985. Three portable Nelson "Big Gun" sprinklers (Model PC-150D) will be used to distribute irrigation water. To satisfy the water requirement of the riparian vegetation of the full impact area during periods of peak water use, the system will need to be operated approximately 11.5 hours per day, six days a week (Table 28). The projected operation time would need to be increased if only one or two sprinklers are employed simultaneously, if any of the sprinklers are operated at less than maximum capacity, or if the estimated application efficiency proves too high. It could be decreased in proportion with the acreage actually irrigated or if the estimated application efficiency proves too low.

Irrigation sets should last no less than 10 hours and probably no more than 23 hours. There should be virtually no problem with surface runoff, given the permeable soils to be irrigated. At 50% efficiency, a 10-hour set would apply an effective depth of 1.8 inches and cause rewetting of the upper foot or two of a typical, dry soil profile. A 23-hour set would apply an effective depth of 4.0 inches, enough to penetrate about four feet.