ATTACHMENT A

1943 REPORT OF REFEREE

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

CITY OF PASADENA, a municipal corporation,
Plaintiff,

vs.

CITY OF ALHAMBRA, a municipal corporation, et al.
Defendants,

No. Pasadena C-1323

REPORT OF REFEREE

DIVISION OF WATER RESOURCES

DEPARTMENT OF PUBLIC WORKS

STATE OF CALIFORNIA, REFEREE

TABLE 34

ESTIMATED UNDERFLOW FROM SUBDIVISIONS OF RAYMOND BASIN AREA

UNDER NATURAL CONDITIONS

Mean for Twenty-nine Year Period, 1904-05 to 1932-33, inclusive

Acre Feet

	Monk Hill Basin	Pasadena Sub-area	Santa Anita Sub-area (Eastern Unit)	Entire Area
Water available				
Precipitation (Table 6)	12100	29600	4450	46150
Inflow from mountains (Table 7)	9600	4560	7140	21300
Inflow from hills (Table 8)	291	153	0	444
Storm inflow from Monk Hill Basin	--	4750[a]	--	--
Rising water inflow from Monk Hill Basin	--	2170	--	--
Underflow from Monk Hill Basin	--	5080	--	--
1. Total	21990	46310	11590	67890
Disposal				
Consumptive use (Table 30)	9840	28650	3620	42110
Storm outflow (Table 12)	4900	6670	3960	10780[b]
Rising water flowing out	2170	7730	0	7730
2. Total accounted for	16910	43050	7580	60620
Underflow (Item 1 minus Item 2)	5080[c]	3260[d]	4010	7270[e]

a Storm outflow from Monk Hill Basin excluding Verdugo Drainage (Table 98).
b Includes only Verdugo Drainage from Monk Hill Basin.
c The large variation from the corresponding value in Table 33 may be due in part to error resulting from subtracting one relatively large estimated quantity from another. With the more continuous high water table in Monk Hill Basin, however, considerable underflow may have occurred north of Monk Hill. There is some indication in the graphs of wells 10 and 16, on Plate 31, that the water table south of Monk Hill responds more pronouncedly to changes to the north when the water table in Monk Hill Basin is high. From this it may be deduced that the underflow is materially greater when the water table in Monk Hill Basin is high.
d Underflow from Pasadena Sub-area is the same as from the Western Unit.
e Sum of that from Pasadena and Santa Anita Sub-areas only. Underflow from Monk Hill Basin goes into Pasadena Sub-area.

SAFE YIELD AND OVERDRAFT

43. General Discussion

The safe yield from a body of ground water under any given set of conditions may be defined as the amount of water which can be continuously extracted from it for useful purposes over an unlimited period of time. Under different sets of conditions it may vary widely. Since water cannot come out of storage indefinitely, the safe yield cannot be greater than the difference between the supply which reaches the ground water and the amount of water which flows out from it or is consumed by types of water-loving natural vegetation which extract and use water from below the water table.

The supply reaching the ground water varies considerably from year to year and from period to period, while the outflow and extractions are more uniform. The result is that water alternately goes into and comes out of storage with a corresponding rise and fall of the water

table. The supply which determines the safe yield is not that of any one year or short series of years but is the average for a longer period which includes both wet and dry years. Where usable storage capacity is unlimited, the supply is the long time mean. Where, however, the usable storage capacity is limited either by shallow depth between water table and ground surface or by excessive cost of pumping from a lowered water table the insufficient capacity does not provide complete regulation, and safe yield is limited by this lack of regulating storage.

The supply which reaches the ground water underlying a particular area consists of underflow from adjoining areas and direct deep percolation from precipitation, from mountain streams, from water applied on the surface for irrigation and from cesspools. While the total of precipitation and stream flow remains the same, in Raymond Basin Area the deep percolation from them is different for different stages of cultural development because the amount of water artificially applied and the consequent deep percolation from areas so watered changes and the return from use within buildings depends upon what part enters cesspools and what part is carried away in sewers.

The amount of outflow and wasteful consumption from the ground water depends upon the elevation of the water table. It has been shown that extraction by pumping results in a lowering of the water table and a reduction in the outflow and wasteful consumption. Conversely, the safe yield depends upon the average elevation of the water table chosen as the condition which should be maintained. If it is desired to maintain a high water table, the outflow and waste will be greater and the safe yield will be less. If practical considerations permit that the average elevation of the water table be lower, the safe yield will be greater.

In the following paragraphs, estimates of safe yield for three stages of development, (1) that of the present, (2) that under natural conditions, and (3) that which will ultimately be reached, are made. As is justified by the depth of the ground water above bedrock in Raymond Basin Area and the large expense which can be borne for the urban and other uses of water in the Area, the results of all three estimates are predicated on an underground storage capacity sufficient to regulate the mean supply. The capacity required for this approximates 200,000 acre feet as shown by Table 52 while the storage capacity between bedrock and present water table is about 800,000 acre feet. The estimates are further predicated on the continuance of the present average water table elevation just above the boundaries where outflow underground occurs so that the average underflow will be the same as that which actually occurred during the 11 year period 1927-28 to 1937-38.

44. Safe Yield with Present Development

If it were possible to find a historic period in which development was as at present, in which the supply reaching the ground water was equal to the long time mean under that development, and in which the water table elevation and the resulting outflow and wasteful consumption from the ground water were the average of that for the 11 year period, the decrease in amount in

storage during such a period would directly measure the amount by which the actual extractions during the period exceeded the safe yield. This excess would be the overdraft.

In the absence of such a period it is necessary to estimate the overdraft from the change in storage which occurred in any base period for which the supply reaching the ground water, the outflow and wasteful consumption from it and the useful extractions can be evaluated from observations. Since the overdraft is the amount which must have come from storage under the conditions of the preceding paragraph, the change in storage during the base period must be adjusted for the differences between the long time mean and base period values of these items.

It is necessary that the base period should be one in which the change in storage can be estimated with reasonable accuracy and desirable that it be one in which as many as possible of the elements which make up the recharge and natural extractions may be assumed equal to their long time mean values under present development without significant error. Such elements need not be evaluated in estimating the overdraft since they play no part in the required adjustment.

The 11 year period 1927-28 to 1937-38, inclusive, reasonably satisfies these requirements. During that period, changes in water table elevation upon which the estimate of storage change below the water table is based, are fairly well defined. With two wet years preceding both the beginning and end of the period, the amount of water in transit from the surface to the water table is deemed to be the same at the beginning and the end of the 11 year period and thus only the storage change beneath the water table need be considered. The change in elevation has been recorded and by methods previously discussed the change in storage of water can be evaluated. Since the condition has been imposed that the long time mean and 11 year average water table elevation should be the same, it follows that the natural escapes must also be about equal since these are a function of water table elevation. It may also be assumed without significant error that the 11 year average and long time mean values under present development are the same for consumptive use and for underflow from one part of the Area to another. All of these are difficult to evaluate accurately and the fact that they can here be eliminated from consideration is advantageous.

Other than underflow into the basin and water injected directly through wells, the recharge to the ground water consists solely of percolation from water applied on the surface either naturally or artificially. The simplest way to evaluate this percolation is to subtract the sum of the consumptive use and surface outflow from the total entering the Area on the surface. Since 11 year average and long time mean consumptive use are assumed equal, only the supply reaching the surface of the area overlying the basin and the outflow need be evaluated here.

While the substitution of water pumped locally for imported water would increase the overdraft, and either increased importation or decreased exportation would decrease it, neither would in any way change the safe yield unless development on the Area were changed, so neither importation nor exportation for use need be considered in the adjustment. Sewage outflow, however, reduces the amount of deep percolation and the sewage outflow has been continuously in-

creasing. Because of this, the difference between its 1937-38 value and the average for the 11 year period is considered.

In Table 37, the required adjustment is evaluated, and the safe yield estimated by subtracting the resulting overdraft under present development and with importations and exportations for use equal to their 11 year averages, from the average extractions by pumping during that period.

In the same table, the overdrafts which would have resulted had local pumping been substituted for importations from San Gabriel River, and had pumping been substituted for all importations, are estimated. Water has been imported from San Gabriel River since 1933-34 (Table 114) and while it is probable that very little of it actually entered Monk Hill Basin, it is assumed for reasons given immediately following that more water would have been pumped there for use in Pasadena Sub-area, had there been no importation. Consequently, both Pasadena Sub-area and Monk Hill Basin have been affected by the importation. During the six year period 1927-28 to 1932-33 inclusive, 30 per cent of the total pumped by Pasadena in the two areas (Table 61) came from Monk Hill Basin. During the period 1933-34 to 1937-38 inclusive, the average sum of pumped water and that imported for use was 11,600 acre feet. Had it been necessary to pump all of this and had 30 per cent of it been from Monk Hill Basin, an average of 3480 acre feet would have come from that source. Actually, 2800 acre feet per year was pumped from that Basin, the average annual difference for the five years being 680 acre feet. Thus, during the 11 year period, 1927-28 to 1937-38 inclusive, the average annual increase in extraction from Monk Hill Basin, had no San Gabriel River water been imported, would have been five-elevenths of this value or 310 acre feet. Had pumping been substituted for the 165 acre feet imported from other sources (Table 114), the average increase would have been 475 acre feet. An 11 year average of 27 acre feet was imported to Pasadena Sub-area from other sources and the corresponding increases there would have been 2460 and 2490 acre feet excluding imported water spread down well No. 15. These values are used in Table 37 instead of the actual importations, a larger part of which was to Pasadena Sub-area.

TABLE 35

SUMMARY

PRESENT DEVELOPMENT

(See Table 37)

Acre Feet

	11 year average			OVERDRAFT	
	Extractions	Change in ground water storage	SAFE YIELD	With present importations for use	Without importations from San Gabriel River
Monk Hill Basin	6380	+ 122	6060	321	631
Pasadena Sub-area	17570	-5930	11910	5660	8120
Total Western Unit	23950	-5808	17970	5980	8750
Santa Anita Sub-area (Eastern Unit)	3380	+ 11	3870	- 491[a]	- 491[a]
Total for Area	27330	-5800	21840	5490	8260

a Surplus.

It will be noted that the serious overdraft is in the Pasadena Sub-area and that the average annual decrease in ground water storage in that subdivision during the 11 year period is 5,930 acre feet or practically the same as the overdraft which is 5660 acre feet for the long time period. Thus the other quantity, 271 acre feet, which enters into the calculation of overdraft, is negligible. The overdraft subtracted from the amount pumped gives the safe yield. The reliability of the estimate of overdraft therefore is dependent almost entirely on the accuracy of the estimate of the amount of water stored between two elevations of the water table and this is from well logs, laboratory experiments and judgment. Thus there is no direct check which can be applied.

There is, however, an indirect check by which the reasonebleness of the calculated change in storage and overdraft may be tested. This test rests upon the values of pertinent items during the 11 year period. These are tabulated in Table 36.

TABLE 36

CHANGES IN WATER TABLE ELEVATION, PRODUCTION AND PRECIPITATION INDICES

FOR PASADENA SUB-AREA

11 year period

	Change in water table elevation,* feet (Table C)	Gross production from wells, acre feet (Table 3)	Water spread down wells, acre feet (Table Q)	Net production acre feet	Precipitation index (Table 65)
1927-28	- 9.52	21046	0	21046	68
28-29	- 9.55	22646	0	22646	76
29-30	- 5.51	22880	0	22880	76
30-31	- 8.15	22987	0	22987	79
31-32	- 8.07	19155	0	19155	108
32-33	- 6.97	18725	0	18725	79
33-34	- 0.77	16565	29	16536	102
34-35	+ 1.20	10791	32	10759	122
35-36	- 7.22	17616	63	17553	82
36-37	+ 5.75	10825	100	10725	141
37-38	+ 6.57	9996	1026	8970	153

Period	Inclusive	Average Annual: Change in water table elevation, feet	Average Annual: Net production, acre feet	Average Annual: Precipitation index
A	1932-33 to 1937-38	- 0.24	13900	113
B	1933-34 to 1937-38	+ 1.11	12900	120
C	1933-34 to 1934-35	+ 0.22	13600	111
D	1935-36 to 1936-37	- 0.74	14100	111

* Determined by averaging annual changes at typical wells throughout the Sub-area.

The item in this table on which change in underground storage is based is found in the column headed "Change in water table elevation". The other items are from direct measurements. As it is desired to check the estimate of change in ground water storage the periods of consecutive years in which the change in water table elevation was the least should be selected in approaching the matter in order to as far as possible eliminate this quantity from the equation. All the periods complying with this criterion are shown as groups A, B, etc. In all, precipitation was above average and in all except Period C there probably was an excess of water in transit from the surface to the water table which introduces an element of uncertainty. As heretofore stated, if a period in which surface culture was as at present, had normal rainfall and runoff and if no change in water table elevation occurred in it and if it covered a sufficient period of years, the production from the ground water would be the safe yield of the subdivision. . In all of the periods cited in Table 36 the water table changes were very small but the precipitation was above normal. The general conclusion can be made from this study that the safe yield of Pasadena Sub-area is considerably less than the net average production of 14,000 acre feet in periods A and D during which the water table fell and that it is also less than the net production of 12,900 acre feet and 13,600 acre feet respectively in Periods B and C since in both of these latter periods, although the water table rose slightly, the above average precipitation would appear to be sufficient to more than account for the rise.

It therefore may be concluded that the average annual change in storage in Pasadena Sub-area during the 11 year period which, subtracted from the average annual extraction during the same period and slightly adjusted for long time mean conditions gives the safe yield as 11,910 acre feet in Tables 35 and 37, is as reliably evaluated as is possible with present information. As the safe yield in that evaluation depends primarily on the change in ground water storage and takes into consideration all modifying factors which is impossible under the direct method discussed in the preceding paragraph, it is also concluded that the safe yield and overdraft in Pasadena Sub-area are reliably evaluated.

The values of safe yield derived in Table 37 are based on the assumption that there is sufficient usable storage capacity to regulate the 29 year mean supply. The fluctuation of the water table required to accomplish this is discussed in a later section of the report headed "Fluctuations of Water Table with Extractions from Ground Water Limited to Safe Yield". On the basis of values derived in Table 53, fluctuations in both Monk Hill Basin and Santa Anita Subarea may be materially greater than any which have occurred, but in neither case, nor in the case of Pasadena Sub-area are they great enough to preclude the use of the required storage capacity if the well owner is willing to meet the cost of pumping from the greater depth. As pointed out in that discussion, however, it is possible that the slope of the water table toward the east into Santa Anita Sub-area may at times be steep and this might result in a material flow in that direction from Pasadena Sub-area. At such times the water table in Santa Anita Sub-area would be low and a reduction of the pumping in that subdivision to some value less than the safe yield would not result in a material increase in the outflow across Raymond Fault.

SAFE YIELD AND OVERDRAFT WITH PRESENT DEVELOPMENT*

Acre Feet

TABLE 37

SAFE YIELD AND OVERDRAFT WITH PRESENT DEVELOPMENT*

Acre Feet

Items for which 11 year average and 29 year mean values differ.	Monk Hill Basin			Pasadena Sub-area		
	29 year mean	11 year avg.	Difference equals excess of 29 year mean over 11 year avg.	29 year mean	11 year avg.	Difference equals excess of 29 year mean over 11 year avg.
1. Water entering Subdivision						
a. Precipitation (a)	12100	11640	460	29600	29280	320
b. Inflow from mountains (b)	9600	7680	1920	4560	3570	990
c. Inflow from hills (c)	291	228	63	153	119	34
d. Storm inflow from Monk Hill Basin (d)	--	--	--	5220	2370	2850
e. Sewage inflow from Monk Hill Basin (e)	--	--	--	139*	123	16
f. Imported water sunk in wells	0	0	0	0	114	- 114
	21991	19548	2443	39672	35576	4096
2. Water leaving Subdivision						
a. Storm outflow (f)	5430	2560	2870	10980	7940	3040
b. Sewage outflow (e)	139*	123	16	5915*	5130	785
	5569	2683	2886	16895	13070	3825
3. Water retained in Subdivision (Item 1 minus Item 2) The difference between the two sums is the difference which would occur in increment to ground water storage.	16422	16865	- 443	22777	22506	+ 271

4.	From Item 3	- 443	+ 271
5.	Change in ground water storage (11 year average) (g)	+ 122[h]	- 5930
6.	OVERDRAFT with present importation and use (Item 4 plus Item 5 with sign changed)	321	5660
7.	Average pumped during 11 year period (i)	6380	17570
8.	SAFE YIELD (Item 7 minus Item 6)	6060	11910
9.	Importation for use from San Gabriel River (j)	310	2460[k]
10.	OVERDRAFT with pumping substituted for Item 9 (Item 6 plus Item 9)	631	8120
11.	Importations from other sources (L)	165	27
12.	OVERDRAFT with pumping substituted for Item 11 (Item 10 plus Item 11)	796	8150

* Development as of 1937-38.
a See Table 6.
b See Table 7.
c See Table 8.
d Storm outflow from Monk Hill Basin excluding Verdugo Drainage. See Tables 88 and 91.
e See Tables 21, 23 and 27.
f See Table 10.
g See Table 32.
h Water table rose during 11 year period.
i See Table 133.
j See paragrapns preceding this table.
k Excludes 114 acre feet spread down well No. 15.
L See Table 27.

Western Unit			Eastern Unit Santa Anita Sub-area			Area as a whole		
29 year mean	11 year avg.	Difference equals excess of 29 year mean over 11 year avg.	29 year mean	11 year avg.	Difference equals excess of 29 year mean over 11 year avg.	29 year mean	11 year avg.	Difference equals excess of 29 year mean over 11 year avg.
41700	40920	780	4450	4350	100	46150	45270	880
14160	11250	2910	7140	5860	1280	21300	17110	4190
444	347	97	0	0	0	444	347	97
--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--
0	114	- 114	0	0	0	0	114	- 114
56304	52631	3673	11590	10210	1380	67894	62841	5053
11190	8130	3060	4140	3240	900	15330	11370	3960
5915*	5130	785	0	0	0	5915*	5130	785
17105	13260	3845	4140	3240	900	21245	16500	4745
39199	39371	- 172	7450	6970	+ 480	46649	46341	+ 308

- 172	+ 480	+ 308
-5808	+ 11[h]	-5800
5980	- 491	5490
23950	3380	27330
17970	3870	21840
2770[k]	0	2770
8750	- 491	8260
192	0	192
8940	- 491	8450

45. Safe Yield under Natural Conditions

If all the natural conditions including wasteful consumption from below the water table and underflow out of Raymond Basin Area were maintained, it would not be possible to extract any water for useful purposes; in other words, there would be no safe yield. Assuming, however, the water table to have been lowered so that the underflow is reduced, rising water is eliminated and the only consumptive use on the Area is that by vegetation which derives its supply directly from precipitation or surface water in streams emerging from the mountains, an amount of water equal to the reduction in outflow and water consumed resulting from the lowering, can be extracted for useful purposes without lowering the water table below some particular average elevation. For the purposes of this discussion, this average elevation is taken as that which would result in an outflow underground equal to the average of that which occurred during the 11 year period. Under this condition, there would be no swamp area north of Raymond Fault and no rising water.

Elimination of the original swamp area results in a decrease in consumptive use and in storm outflow. On the assumption that grass and brush consuming an average of 1.58* acre feet per acre would replace the water loving vegetation which consumed 4.00 acre feet per acre, the reduction in wasteful consumption on the 1000 acres of former swamp, would amount to 2420 acre feet per year. Of the approximately 1700 acre feet of precipitation which falls annually on the 1000 acres it may be assumed that 100 per cent and 5 per cent would run off from swamp and from grass and brush respectively. This decrease due to lowering the water table would be about 1600 acre feet.

Table 38 presents an estimate of the safe yield with culture as it was prior to any development but with a lowered water table. Since the assumption is that only natural culture occupies the Area, all water extracted would have to be exported.

46. Safe Yield with Ultimate Development

Assuming again that the water table elevation is such that the outflow from the ground water is the same as during the 11 year period, which it should be if overdraft is eliminated, the safe yield is equal to the deep percolation from all sources plus the inflow underground minus the outflow underground. In Article 48, deep percolation is discussed and in Table 43 its value under ultimate cultural development in each subdivision of Raymond Basin Area is estimated. Using those values and the 11 year average underflow values derived in Table 33, the estimated safe yield is as presented in Table 39.

* Average of unit values for brush and grass and weeds, Table 30.

TABLE 38

SAFE YIELD UNDER NATURAL CONDITIONS OF CULTURE

BUT WITH LOWERED WATER TABLE

Acre Feet

	Monk Hill Basin	Pasadena Sub-area	Total Western Unit	Eastern Unit Santa Anita Sub-area	Area es a whole
Underflow in					
Natural (a)	0	5080	0	0	0
Eleven year period (b)	0	2220	0	0	0
Decrease	0	2860	0	0	0
Decrease in rising water inflow (a)	0	2170	0	0	0
Total decrease	0	5030	0	0	0
Underflow out					
Natural (a)	5080	3260	3260	4010	7270
Eleven year period (b)	2220	2860	2860	620	3480
Decrease	2860	400	400	3390	3790
Decrease in rising water outflow (a)	2170	7730	7730	0	7730
Decrease in storm outflow	0	1600	1600	0	1600
Decrease in consumptive use	0	2420	2420	0	2420
Total decreese	5030	12150	12150	3390	15540
Safe yield	5030	7120	12150	3390	15540

See Table 34.
See Table 33.

TABLE 39

ESTIMATED SAFE YIELD WITH ULTIMATE DEVELOPMENT

Acre Feet

	Monk Hill Basin	Pasadena Sub-area	Total Western Unit	Eastern Unit Santa Anita Sub-area	Entire Raymond Basin Area
1. Deep percolation	7430	11390	18820	4300	23120
2. Inflow underground	0	2220	0	0	0
3. Outflow underground	2220	2860	2860	620	3480
Safe Yield	5210	10750	15960	3680	19640

ATTACHMENT B

1944 RAYMOND BASIN JUDGMENT (PARTIAL)

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

CITY OF PASADENA, a municipal corporation,

Plaintiff,

vs.

CITY OF ALHAMBRA, a municipal corporation, et al.,

Defendants.

No. Pasadena C-1323

JUDGMENT

The above entitled action having been brought by plaintiff, City of Pasadena, a municipal corporation, against City of Alhambra, a municipal corporation, City of Monrovia, a municipal corporation, City of Arcadia, a municipal corporation, City of Sierra Madre, a municipal corporation, City of South Pasadena, a municipal corporation, La Canada Irrigation District, San Gabriel County Water District, Lincoln Avenue Water Company, a corporation, The Las Flores Water Company, a corporation, Rubio Canon Land and Water Association, a corporation, Valley Water Company, a corporation, Flintridge Mutual Water Company, a corporation, California-Michigan Land and Water Company, a corporation, Mira Loma Mutual Water Company, a corporation, El Campo Mutual Water Company, a corporation, Sunnyslope Water Company, a corporation, California Water and Telephone Company, a corporation, Crown

City Ice Company, a corporation, Rancho Santa Anita, Inc., a corporation, Royal Laundry and Dry Cleaning Company, a corporation, Alice H. Graves, A. V. Wagner, Eugene E. Bean, Fred M. Wilcox, and Charles Hueston Hastings, Defendants, for the purpose of quieting the title of said plaintiff as against said defendants to the alleged prior and paramount right of said plaintiff to take, divert and use the waters within the area involved in the issues of the action situate in the County of Los Angeles, State of California, and to enjoin each defendant found to own a right to take or divert water from the Raymond Basin from taking therefrom, in any year, water in such volume as, when added to the amount which the other parties shall be adjudged and decreed to be entitled to take and divert, would result in a total annual diversion from said basin in excess of the average annual supply of water thereto; and on July 13, 1939, the above entitled court having issued its order directing said plaintiff to bring in and make parties to said action Ross M. Lockhard, Pasadena Cemetery Association, a corporation, Altadena Golf Club, a corporation, Henry E. Huntington Library and Art Gallery, a corporation, Bradbury Estate Company, a corporation, and East Pasadena Water Company, Ltd., a corporation, and said court on the 8th day of November, 1939, having made its order declaring void the order to bring in new parties made July 13, 1939, insofar as East Pasadena Water Company, Ltd., is concerned, and said defendant having been dismissed from this action; and

All said parties defendant having been duly served personally with summons and a copy of the complaint, and the issues having been joined; defendant Ross M. Lockhard having answered by his true name Ross M. Lockhart; and Robert A. Millikan, Archer Milton Huntington, Herbert Hoover, William B. Munro and Edwin P. Hubbell, Trustees of the Henry E. Huntington Library and Art Gallery answering for defendant Henry E. Huntington Library and

Art Gallery, a corporation; defendants Bradbury Estate Company, a corporation, and Eugene E. Bean having disclaimed any right, title, interest or estate in and to the properties involved in this action, Charles Hueston Hastings, having answered by his true name Charles Heuston Hastings, and since the commencement of this action said defendant Charles Heuston Hastings having died and Ernest Crawford May as Executor of the Last Will and Testament of Charles Heuston Hastings, deceased, having been substituted for said decedent, and A. V. Wagner having answered and having asserted and claimed a right to water on his own behalf and on behalf of others claiming under and through him, and Canyon Mutual Water Company, a corporation, sued herein as Doe Corporation No. 1, having answered under its true name, and defendant Alice H. Graves having died since the commencement of this action, and Alice Graves Stewart and Katharine Graves Armstrong and Francis P. Graves being the heirs at law of said Alice H. Graves, deceased, and being the residuary legatees under the Last Will and Testament of Alice H. Graves, deceased, and having been substituted by stipulation as parties defendant for said Alice H. Graves, and plaintiff since the commencement of this action having acquired the water rights owned and claimed by Jacob Bean Securities Company, a corporation, Alice Graves Stewart, Katharine Graves Armstrong and Francis P. Graves, exclusive of the rights of the last named individuals which are hereinafter set forth and defined, and plaintiff having duly filed its supplemental complaint with respect thereto, and the defendant City of Arcadia, since the commencement of this action, having acquired all water rights involved herein of the Rancho Santa Anita, Inc., a corporation, and said defendants having duly filed their supplemental answer with respect thereto, and First Trust and Savings Bank of Pasadena, a corporation, answering as successor in interest to defendant Altadena Golf Club,

defendant Sunnyslope Water Company, a corporation, having stipulated that its true name is Sunny Slope Water Company, Chesley E. Osborn and Kathleen M. Osborn having been substituted as parties defendant in the place and stead of defendant Fred M. Wilcox, and Dell A. Schweitzer, executor of the estate of Fred M. Wilcox, deceased; motion of defendant City of South Pasadena for permission to file its amended answer disclaiming any interest or estate in the water and/or water rights in the Raymond Basin as described in plaintiff's complaint, having been granted, and said defendant, City of South Pasadena, having been dismissed from this action, subject to the obligation of said defendant to pay certain costs, plaintiff and certain defendants having jointly filed herein their motion that reference should be made to the Division of Water Resources, Department of Public Works, State of California, as referee; after hearing thereon, following notice duly served on all defendants not parties to said motion, said Division of Water Resources having been appointed referee herein to investigate all of the physical facts involved herein, and seasonably to report to the court thereon, and the said referee having filed its report herein and the objections thereto filed with it, a stipulation in writing having been entered into on the 29th day of September, 1943 by and between the attorneys for certain parties, to wit: City of Alhambra, City of Arcadia, California Water and Telephone Company, Canyon Mutual Water Company, Crown City Ice Company, El Campo Mutual Water Company, First Trust and Savings Bank of Pasadena, Flintridge Mutual Water Company, Francis P. Graves, Alice Graves Stewart and Katharine Graves Armstrong, being the heirs of Alice H. Graves, deceased, and being the residuary legatees under the Last Will and Testament of Alice H. Graves, deceased, Las Flores Water Company, Lincoln Avenue Water Company, Ross M. Lockhart, Ernest Crawford May, as Executor of the Last Will and Testament of Charles Heuston

Hastings, deceased, Robert A. Millikan, Archer Milton Huntington, Herbert Hoover, William B. Munro and Edwin P. Hubbell, Trustees of the Henry E. Huntington Library and Art Gallery, Mira Loma Mutual Water Company, City of Monrovia, Chesley E. Osborn and Kathleen M. Osborn, Pasadena Cemetery Association, City of Pasadena, Royal Laundry and Dry Cleaning Company, Rubio Canon Land and Water Association, San Gabriel County Water District, City of Sierra Madre, Sunny Slope Water Company, Valley Water Company, A. V. Wagner and those claiming under and through him, and said stipulation having been filed herein on the 24th day of November, 1943, requesting that a certain judgment be entered herein as between said parties, and stipulating that the amount of water pumped or otherwise taken by non-parties to this action in the Western Unit of the Raymond Basin Area as described in paragraph I of the proposed judgment attached to said stipulation is 340 acre feet per year and that the amount of water pumped or otherwise taken by non-parties to this action in the Eastern Unit of said Raymond Basin Area is 109 acre feet per year, and the court on November 24, 1943 having made its order making each and all of the terms and provisions of said proposed judgment immediately effective as to said stipulating parties, and on April 5, 1944 the court having made its order appointing and authorizing the Division of Water Resources of the Department of Public Works of the State of California to act and serve herein as Water Master in accordance with the provisions of the order made on November 24, 1943 and the provisions of the proposed judgment attached thereto and made a part thereof, and a stipulation between said stipulating parties and the defendant La Canada Irrigation District making the defendant La Canada Irrigation District a party to said stipulation for said judgment and order having been filed in this court on April 28, 1944, and this court on April 28, 1944 having ordered that during the pendency of this

litigation or until further order of this court the said defendant La Canada Irrigation District be made a party to the stipulation for judgment and order entered into on the 29th day of September, 1943 and filed on the 24th day of November, 1943, and all objections and exceptions to the Report of Referee, except those of defendant California-Michigan Land and Water Company, having been withdrawn, and defendant Flintridge Mutual Water Company having assigned all its water rights involved herein to defendant Valley Water Company,

This cause came on regularly for hearing of the objections and exceptions of defendant California-Michigan Land and Water Company filed to the Report of Referee and the further trial of the cause between said defendant and the other parties on the 18th day of May, 1944 before the Honorable Frank C. Collier, judge presiding in Department Pasadena A of the above entitled court, the court sitting without a jury; said hearing and trial were held on the following dates in the year 1944, to wit: May 18, May 19, May 23, May 24, May 25, May 31, June 1, June 2, June 6, June 7, June 8, July 20, August 7 and August 8. A. E. Chandler, Esq., Special Counsel, and Harold P. Huls, Esq., City Attorney, appearing as attorneys for plaintiff; Messrs. Goodspeed, McGuire, Harris & Pfaff by Richard C. Goodspeed, Esq., J. Donald McGuire, Esq., and Paul Vallee, Esq., appearing as attorneys for defendant California-Michigan Land and Water Company; Emmett A. Tompkins, Esq., City Attorney, and Kenneth K. Wright, Esq., appearing as attorneys for defendant City of Alhambra; Paul F. Garber, Esq., City Attorney, and Kenneth K. Wright, Esq., appearing as attorneys for defendant City of Monrovia; Kenneth K. Wright, Esq., appearing as attorney for defendant Ross M. Lockhart; Kenneth K. Wright, Esq., appearing as attorney for defendant Flintridge Mutual Water Company; Kenneth K. Wright, Esq., appearing as attorney for defendant Valley Water Company; John C. Packard, Esq.,

and Kenneth K. Wright, Esq., appearing as attorneys for defendant El Campo Mutual Water Company; Messrs. Derthick, Cusack and Canahl by W. J. Cusack, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant Crown City Ice Company; Messrs. Dunn & Sturgeon by Walter F. Dunn, Esq., Messrs. Chandler & Wright by Howard W. Wright, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendants Francis Graves, Alice Graves Stewart and Katharine Graves Armstrong; Messrs. Bailie, Turner & Lake by Norman A. Bailie, Messrs. Cruickshank, Brooke & Dunlap by Robert H. Dunlap, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant Ernest Crawford May, as Executor of the Last Will and Testament of Charles Heuston Hastings, deceased; Messrs. Gibson, Dunn & Crutcher by Ira C. Powers, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendants Robert A. Millikan, Archer Milton Huntington, Herbert Hoover, William B. Munro and Edwin P. Hubbell, trustees of the Henry E. Huntington Library and Art Gallery; Messrs. Anderson and Anderson by Trent G. Anderson, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant Rubio Canon Land and Water Association; Frank P. Doherty, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant La Canada Irrigation District; Messrs. Boyle, Holmes & Garrett by John W. Holmes, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant First Trust and Savings Bank of Pasadena; Walter F. Dunn, Esq., City Attorney, and Kenneth K. Wright, Esq., appearing as attorneys for defendant City of Sierra Madre; Wilton W. Webster, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant Royal Laundry and Dry Cleaning Company; Messrs. Bacigalupi, Elkus & Salinger by Claude Rosenberg, Esq., and Kenneth K. Wright, Esq., appearing as attorneys for defendant California Water and Telephone Company; Kenneth K. Wright, Esq., appearing as attorney for defendant San Gabriel Valley Water Company; Messrs. Merriam, Rinehart & Merriam

by Ralph T. Merriam, Esq., appearing as attorneys for defendant Pasadena Cemetery Association; Frederick G. Stoehr, Esq., appearing as attorney for defendant A. V. Wagner; Messrs. Potter and Potter, by Bernard Potter, Esq., appearing as attorneys for defendant Mira Loma Mutual Water Company; Gerald E. Kerrin, Esq. and James C. Bone, Esq., City Attorney, appearing as attorneys for defendant City of Arcadia; Laurence B. Martin, Esq., appearing as attorney for defendant Sunny Slope Water Company; Robert E. Moore, Esq., appearing as attorney for defendant Lincoln Avenue Water Company; Messrs. Hahn and Hahn by Edwin F. Hahn, Esq., appearing as attorneys for defendant The Las Flores Water Company; Messrs. Hahn and Hahn by Edwin F. Hahn, Esq., appearing as attorneys for defendants Chesley E. Osborn and Kathleen M. Osborn; and Messrs. Hahn and Hahn by Edwin F. Hahn, Esq., appearing as attorneys for defendant Canyon Mutual Water Company, and

All objections and exceptions to the Report of Referee filed by defendant California-Michigan Land and Water Company having been overruled by the court with the exception of objection 18 which was withdrawn by said defendant, and

Certain stipulations having been entered into by and between the parties and evidence both oral and documentary having been introduced and the cause having been submitted to the court for its decision upon briefs, and briefs for the respective parties having been filed and considered, the court, being fully advised in the premises, and having made its findings of fact and conclusions of law:

WHEREFORE, by reason of the stipulation aforesaid and the findings of fact and conclusions of law, it is hereby ordered, adjudged and decreed:

I

That there exists in the County of Los Angeles, State of California, a field of ground water, known and hereinafter referred

to as the Raymond Basin Area, and subdivisions thereof herein designated the Eastern Unit and the Western Unit which are shown on the map attached hereto and hereby made a part hereof.

That, under existing conditions, the safe yield of said Eastern Unit is 3,900 acre feet per year, and the safe yield of said Western Unit is 18,000 acre feet per year.

That the amount of water pumped or otherwise taken by non-parties to this action in said Western Unit is 340 acre feet per year, and the amount of water pumped or otherwise taken by non-parties to this action in said Eastern Unit is 109 acre feet per year.

That the parties hereto pumping from wells or otherwise taking water for beneficial use from the ground in said subdivisions of said Raymond Basin Area are as shown in the table in paragraph IV hereof.

II

That, as to those parties hereto who are taking or diverting water for beneficial use from any source contributing to the supply of water in the ground in said Raymond Basin Area, each of said parties has the right as against all parties other than the defendant California-Michigan Land and Water Company, no determination as to the existence of such right being made as against it, to continue to divert from such source for such use an amount of water measured by the maximum capacity of its diversion works and other facilities as the same existed at any time within five (5) years prior to October 1, 1937. That said maximum capacities of the said works and facilities of each of such parties in cubic feet per second are as follows:

La Canada Irrigation District (Snover Canyon)	1.20
Las Flores Water Company	0.50
Lincoln Avenue Water Company	6.59
Lockhart, Ross M.	1.20
May, Ernest Crawford, as Executor of the Last Will and Testament of Charles Heuston Hastings, deceased	0.26
Mira Loma Mutual Water Company	0.81
Pasadena Cemetery Association	0.02
Pasadena, City of	
Arroyo Seco including Millard Canyon	25.00
Eaton Canyon	8.90
Rubio Canon Land and Water Association	2.20
Sierra Madre, City of	6.00

That each of said parties, and each of their agents, employees, attorneys, and any and all persons acting by, through, or under them, or any of them, are and each of them is hereby forever enjoined and restrained from increasing its taking or diversion from such source beyond the amount of such taking or diversion as measured by said maximum capacity of its diversion works and other facilities.

III

That each and all of the rights of the parties hereto to pump water from wells or otherwise take water from the ground in said Raymond Basin Area are of equal priority and of the same legal force and effect.

IV

That, subject to the provisions of paragraphs V, VI and XXI hereof, each party hereto is the owner of the right to pump water from wells or otherwise take water from the ground in each of said units in the amount set forth opposite the name of each party in the following table, which said right, for convenience, is designated the "present unadjusted right";

PRESENT UNADJUSTED RIGHTS TO TAKE WATER IN RAYMOND BASIN AREA

Eastern Unit	Acre Feet Per Year
Arcadia, City of	2,527
Sierra Madre, City of	1,264
Western Unit	
Alhambra, City of	1,042
Arcadia, City of	1,180
California-Michigan Land and Water Company	521
California Water and Telephone Company	2,272
Canyon Mutual Water Company	128
Crown City Ice Company	0
El Campo Mutual Water Company	52
First Trust and Savings Bank of Pasadena	188
Graves, Francis P., Alice Graves Stewart and Katherine Graves Armstrong, being the heirs of Alice H. Graves, deceased, and being the residuary legatees under the Last Will and Testament of Alice H. Graves, deceased	65
La Canada Irrigation District	101

Las Flores Water Company	252
Lincoln Avenue Water Company	573
Lockhart, Ross M.	88
May, Ernest Crawford, as Executor of the Last Will and Testament of Charles Heuston Hastings, deceased	0
Milliken, Robert A., Archer Milton Huntington, Herbert Hoover, William B. Munro and Edwin P. Hubbell, Trustees of the Henry E. Huntington Library and Art Gallery	265
Mira Loma Mutual Water Company	99
Monrovia, City of	961
Osborn, Chesley E. and Kathleen M.	63
Pasadena Cemetery Association	92
Pasadena, City of	12,758
Royal Laundry and Dry Cleaning Company	111
Rubio Canon Land and Water Association	1,234
San Gabriel County Water District	1,103
Sunny Slope Water Company	1,575
Valley Water Company (including that of Flintridge Mutual Water Company)	806
Wagner, A. V. and those claiming under and through him	79

That the total of said rights in the Eastern Unit is 3,791 acre feet per year, and that the total of said rights in the Western Unit is 25,608 acre feet per year.

V

That, in order to maintain and protect the supply of water in the ground in said Raymond Basin Area, it is necessary that the respective parties to this action be limited in the exercise of their respective present unadjusted rights, and the right, so limited, in acre feet per year, of each party to pump water from wells or otherwise take water from the ground, in the Western Unit, is as set forth in the table at the end of this paragraph V, and in the Eastern Unit, is as set forth in paragraph VI hereof. That said right, for convenience, is designated the "decreed right." That in said Western Unit the amount of the decreed right of each party hereby is determined by reducing the present unadjusted right of each party as tabulated in paragraph IV hereof, in the proportion that the safe yield of said unit, less the water taken therein by non-parties hereto, bears to the aggregate of such rights of the parties hereto in said unit. That each of said parties and each of their agents, employees, attorneys, and any and all persons acting by,

them, or under them, are and each of them is, subject to the terms of paragraph XXI hereof, hereby forever enjoined and restrained on and after July 1, 1944, as to all parties other than California-Michigan Land and Water Company, and on and after July 1, 1945 as to said California-Michigan Land and Water Company, from pumping or otherwise taking from the ground in said Western Unit more water than its decreed right in this paragraph determined; provided, however, that any of the parties to this action may take in any twelve month period beginning July 1 for its own beneficial use and for the release of water for use by other parties or persons pursuant to and in accordance with the Raymond Basin Area Water Exchange Agreement of 1943 and amendment thereto, hereinafter referred to, attached hereto and hereby made a part hereof, any amount not exceeding one hundred and twenty per cent (120%) of its decreed right as fixed herein and such greater amount as may become necessary in case of an emergency as determined by the Water Master hereinafter referred to, but in no event shall the aggregate amount pumped or taken by any party during any period of sixty (60) consecutive months exceed the amount of water released to it pursuant to and in accordance with said agreement and amendment thereto, and five (5) times the annual decreed right of said party. That the yearly period from July 1 to June 30 hereby is adopted and shall be used in the administration and enforcement of this judgment.

DECREED RIGHTS TO TAKE WATER FROM THE GROUND IN SAID WESTERN UNIT IN ACRE FEET PER YEAR

Alhambra, City of	719
Arcadia, City of	814
California-Michigan Land and Water Company	359
Canyon Mutual Water Company	88
California Water and Telephone Company	1,567
Crown City Ice Company	0
El Campo Mutual Water Company	36
First Trust and Savings Bank of Pasadena	130
Graves, Francis P., Alice Graves Stewart and Katherine Graves Armstrong, being the heirs of Alice H. Graves, deceased, and being the residuary legatees under the Last Will and Testament of Alice H. Graves, deceased	45
La Canada Irrigation District	70
Las Flores Water Company	174
Lincoln Avenue Water Company	395
Lockhart, Ross M.	61
May, Ernest Crawford, as Executor of the Last Will and Testament of Charles Heuston Hastings, deceased	0

Millikan, Robert A., Archer Milton Huntington, Herbert Hoover, William B. Munro and Edwin P. Hubbell, Trustees of the Henry E. Huntington Library and Art Gallery	183
Mira Loma Mutual Water Company	68
Monrovia, City of	663
Osborn, Chesley E. and Kathleen M.	44
Pasadena Cemetery Association	64
Pasadena, City of	8,794
Royal Laundry and Dry Cleaning Company	77
Rubio Canon Land and Water Association	851
San Gabriel County Water District	761
Sunny Slope Water Company	1,086
Valley Water Company (including that of Flintridge Mutual Water Company)	556
Wagner, A. V. and those claiming under and through him	55

VI

That the decreed right of each party hereto in said Eastern Unit is the present unadjusted right of each party as tabulated in paragraph IV hereof, and is the amount shown opposite the name of each said party as follows:

City of Arcadia, 2,527 acre feet per year

City of Sierra Madre, 1,264 acre feet per year.

That each of said parties, and each of their agents, employees, attorneys and any and all persons acting by, through, or under them, are and each of them is subject to the terms of paragraph XXI hereof, hereby forever enjoined and restrained on and after July 1, 1944, as follows:

(1) from pumping or otherwise taking from the ground in said Eastern Unit more water than its decreed right in this paragraph determined; provided, however, that either of said parties may take in any twelve month period beginning July 1 for its own beneficial use, and for the release of water for use by the other party pursuant to and in accordance with the said Raymond Basin Area Water Exchange Agreement of 1943 and amendment thereto, any amount not exceeding one hundred and twenty per cent (120%) of its decreed right as fixed herein and such greater amount as may become necessary in case of an emergency as determined by the Water Master, but in no event shall the aggregate amount pumped or taken by either of said parties during any period of sixty (60) consecu-

tive months exceed the amount of water released to it pursuant to and in accordance with said agreement and amendment thereto and five (5) times the annual decreed right of said party;

(2) from pumping or otherwise taking water from the ground in said Eastern Unit in any year within one-half mile of its western boundary in an amount which, in addition to other extractions, would be in excess of the average amount pumped or taken in said one-half mile zone during the period 1927-28 to 1937-38, to wit: 88 acre feet per annum, the half mile being measured along a perpendicular erected on the boundary between said unit and said Western Unit as shown on the map attached hereto;

(3) from pumping or otherwise taking water from the ground in said Eastern Unit in any year in excess of the average amount pumped or taken therein during the period 1927-28 to 1937-38, to wit: 3,261 acre feet per annum, during any year in which static ground water level measurements, made at the time of maximum high water table in the spring season of each year, show that the average water table elevation in the area between Foothill Boulevard and Raymond Fault and between a line 300 feet west of Rosemead Boulevard and a line 100 feet east of Michillinda Avenue, is higher than that at the Arcadia group of wells designated as such on said map attached hereto and located west of the intersection of Orange Grove and Santa Anita Avenues in the City of Arcadia, this limitation to apply only when the water table elevation at said group is less than 500 feet above sea level, United States Geological Survey datum.

VII

That there is now and, so long as the requirements in subparagraphs 2 and 3 of paragraph VI hereof are fulfilled and maintained, there will be no material movement of water across the boundary between the Western Unit and the Eastern Unit.

VIII

That nothing in this judgment contained shall be deemed to

ATTACHMENT C

1955 DECREED RIGHTS

APPENDIX A

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IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA

IN AND FOR THE COUNTY OF LOS ANGELES

CITY OF PASADENA, a municipal corporation, Plaintiff, v. CITY OF ALHAMBRA, a municipal corporation, et al., Defendants.	No. Pasadena C-1323 MODIFICATION OF JUDGMENT

The motion of the Plaintiff City of Pasadena for an order that a review of the determination of the safe yield of both units of the Raymond Basin Area be had pursuant to Paragraph XXI of the Judgment entered herein having been granted and on November 17, 1950, the court having ordered that the matter be referred to the Department of Public Works, State of California, acting through the State Engineer, for an investigation and report, and the Report of Referee in said matter having been duly made and filed

with the Clerk of the above entitled court on October 5, 1954 in accordance with law and the motion of the Plaintiff City of Pasadena for an order approving and confirming the Report of Referee and for an adjudication of each party's pumping rights in said area based upon said Report of Referee having come on regularly for hearing on the 22nd day of April , 1955, at the hour of 1:45 P.M. in the courtroom of Department Pasadena "B" of said court, the Honorable Kurtz Kauffman, Judge Presiding; Notice of said motion having been duly served on all defendants and interested parties; and it appearing that no objections to the draft of Report of Referee were filed with said Referee and that no exceptions to the Report of Referee as filed herein were filed with the Clerk of the Court within the time allowed by law; and the court having heard said matter and having read and approved said Report of Referee and the court being fully advised in the premises and good cause appearing therefor,

IT IS HEREBY ORDERED, ADJUDGED AND DECREED:

I

That the Report of Referee filed herein October 5, 1954 be and the same hereby is approved, accepted and confirmed.

II

That under the conditions existing during 1951-52, the safe yield of the Eastern Unit of the Raymond Basin Area is 5,290 acre-feet per year which is an increase of 1,390 acre-feet over that obtained under 1937-38 conditions and the safe yield of the Western Unit of said area is 25,480 acre-feet per year which is

Western Unit in acre-feet is modified and changed to read as follows:

Alhambra, City of	1,031
Arcadia, City of	1,167
California-Michigan Land & Water Assn	515
California Water & Telephone Co.	2,248
Canyon Mutual Water Co.	127
Crown City Ice Co.	--
El Campo Mutual Water Co.	51
Graves, Francis P. et al	64
Huntington Library and Art Gallery	262
Kinneloa Canyon Estates, Inc.	87
La Canada Irrigation District	100
Las Flores Water Co.	249
Lincoln Avenue Water Co.	567
Mira Loma Mutual Water Co.	98
Monrovia, City of	951
Osborn, Chesley E. & Kathleen M.	62
Pasadena Cemetery Assn.	91
Pasadena, City of	12,807
Royal Laundry & Dry Cleaning Co.	110
Rubio Canon Land & Water Assn.	1,221
San Gabriel County Water District	1,091
Sunny Slope Water Co.	1,558
Valley Water Co.	797
Wagner, A. V.	78
Total Western Unit	25,332

That the decreed right to take water from the ground in said Eastern Unit in acre-feet per year is modified and changed as follows:

Arcadia, City of	3,526
Sierra Madre, City of	1,764
Total Eastern Unit	5,290

V

That the Judgment entered herein be and thesame hereby is modified and changed in so far as the same relates to and incorporates Paragraph VII of the Raymond Basin Area Water Exchange Agreement of 1943 to provide that in the event the aggregate amount

an increase of 7,480 acre-feet over that under 1937-38 conditions, which latter conditions were considered and used in determining and adjudicating the decreed rights of the interested parties; and that under the conditions existing during 1951-52 the safe yield of the Monk Hill Basin, a subdivision of the Westesn Unit is 7,490 acre-feet which is an increase of 1,430 acre-feet over that under 1937-38 conditions;

That as of 1951-52 the amount of water pumped or otherwise taken by non-parties to this action in said Western Unit is 148 acre-feet per year of which one acre-foot is pumped from the Monk Hill Basin and that the amount of water pumped or otherwise taken by non-parties to this action in said Eastern Unit is none per year.

III

That the water rights of Flintridge Mutual Water Company have been acquired and are owned by the Valley Water Company; that the water rights of Ross M. Lockhart have been acquired and are owned by Kinneloa Canyon Estates, Inc.; and that the water rights of the First Trust and Savings Bank of Pasadena have been acquired and are owned by the City of Pasadena.

IV

That the decreed right of each party or successor to pump or otherwise take water from the ground in the Raymond Basin Area be and hereby is changed proportionately in the same manner as originally fixed in the Final Judgment entered in the within case. That the decreed right to take water from the ground in said

of released water taken in any such period by said six parties minus the sum of the total amount of water released in the Western Unit by the City of Pasadena in the same period and the total amount of water released by one or more of said parties exceeds 1.47 per cent of the safe yield of the Monk Hill Basin, computed to the nearest acre-foot, the City of Pasadena shall be paid as undue cost Ten Dollars ($10.00) per acre-foot by said six parties for each acre-foot of such excess as provided in Article X thereof.

VI

That this modification of judgment shall take effect and shall become operative on the 1st day of July 1955 on which date the parties may commence to exercise the decreed rights specified in Paragraph IV herein.

The Clerk is ordered to enter this modification of judgment.

DATED: April 29th, 1955.

Kurtz Kauffman
Judge of the Superior Court

CHAPTER II. MODIFICATION OF RIGHTS TO EXTRACT GROUND WATER

The original decree defining the rights to extract ground water in Raymond Basin Area, entered by Judgment of the Trial Court on December 23, 1944, was modified by the Court this past year. In recognition of a considerable rise in ground water levels in a portion of the Area coincident with drought conditions, the Court, on November 17, 1950, granted a motion by City of Pasadena that there be a review of the determination of the safe yield of Raymond Basin Area, and that the matter be referred to the Department of Public Works, State of California, acting through the State Engineer as referee for investigation and report on the physical facts involved. On October 5, 1954, the referee filed its report, and on April 29, 1955, on motion of the City of Pasadena, a "Modification of Judgment" was signed by the court approving the report of the referee and modifying the rights to ground water within the Raymond Basin Area as set forth in the original decree entered on December 23, 1944.

The referee, in its report, found that under conditions prevailing in 1952 the safe yield of Raymond Basin Area had substantially increased over the safe yield under 1938 conditions on which the original decree was based. Set forth in the following tabulation are safe yields in acre-feet for each unit of Raymond Basin Area as determined under 1952 conditions:

	Monk Hill Basin	Pasadena Subarea	Total for Western Unit	Santa Anita Subarea	Total for Raymond Basin Area
Safe yield, 1952 Conditions	7,490	17,990	25,480	5,290	30,770
Safe yield, 1938 Conditions	6,060	11,940	18,000	3,900	21,900
Increase	1,430	6,050	7,480	1,390	8,870
Per cent increase	23.6	50.7	41.6	35.6	40.5

In the "Modification of Judgment", the previously decreed rights of the various parties in the Raymond Basin Area were modified in accordance with the safe yield determined for 1952 conditions. The text of the "Modification of Judgment" is presented in Appendix A. In Table 1, entitled "Rights to Extract Ground Water by Parties in Raymond Basin Area Under Decrees of 1944 and 1955", there are presented the names of the parties entitled to ground water from the Raymond Basin Area, their rights as set forth in the Judgment of the Trail Court entered on December 23, 1944, hereinafter referred to as "Decreed Right 1944", and their rights as set forth in the "Modification of Judgment", signed by the court on April 29, 1955, hereinafter referred to as "Decreed Right 1955". During the period covered by this report, parties in Raymond Basin Area extracted ground water in accordance with the decree of 1944. A provision of the "Modification of Judgment" sets July 1, 1955, as the effective date of the modified rights to extract ground water from the Raymond Basin Area.

TABLE 1

RIGHTS TO EXTRACT GROUND WATER BY PARTIES IN RAYMOND BASIN AREA
UNDER DECREES OF 1944 AND 1955

In Acre-Feet

Party	"Decreed Right 1944"	"Decreed Right 1955"
Western Unit		
Alhambra, City of	719	1,031
Arcadia, City of	814	1,167
California-Michigan Land and Water Assn.	359[a]	515
California Water and Telephone Co.	1,567	2,248
Canyon Mutual Water Co.	88	127
Crown City Ice Co.	0	0
El Campo Mutual Water Co.	36	51
Graves, Francis P. et al.	45	64
Huntington Library and Art Gallery	183	262
Kinneloa Canyon Estates, Inc.	61	87
La Canada Irrigation District	70	100
Las Flores Water Co.	174	249
Lincoln Avenue Water Co.	395	567
Mira Loma Mutual Water Co.	68	98
Monrovia, City of	663	951
Osborn, C. E. and K. M.	44	62
Pasadena Cemetery Assn.	64	91
Pasadena, City of[b]	8,924	12,807
Royal Laundry and Dry Cleaning Co.	77	110
Rubio Canon Land and Water Assn.	851	1,221
San Gabriel County Water District	761	1,091
Sunny Slope Water Co.	1,086	1,558
Valley Water Co.	556	797
Wagner, A. V.	55	78
Subtotals	17,660	25,332
Eastern Unit		
Arcadia, City of	2,527	3,526
Sierra Madre, City of	1,264	1,764
Subtotals	3,791	5,290
TOTALS	21,451	30,622

a. Effective July 1, 1945.
b. Rights of City of Pasadena in Monk Hill Basin under conditions of the 1944 and 1955 decrees are equal to 3929 and 4464 acre-feet respectively, which are computed as the difference between the safe yield of Monk Hill Basin and the sum of the rights of other parties in the basin and the amount of water taken by non party users. Rights of City of Pasadena in Pasadena Subarea are equal to total rights in Western Unit less rights in Monk Hill Basin.

ATTACHMENT D

BASELINE STUDY (2004)

BASELINE GROUND WATER ASSESSMENT OF THE RAYMOND BASIN FINAL REPORT

EXECUTIVE SUMMARY

Prepared For:

RAYMOND BASIN MANAGEMENT BOARD

February 2, 2004

Prepared By:

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EXECUTIVE SUMMARY

BASELINE GROUND WATER ASSESSMENT

OF THE RAYMOND BASIN

CONTENTS

This Executive Summary Report provides a general summary of the Baseline Assessment of the Raymond Basin. A complete document containing the main report is available from the Raymond Basin Management Board. The table of contents of the main report is included at the end of the Executive Summary.

FIGURES

EXECUTIVE SUMMARY

1.0 INTRODUCTION

This executive summary provides an overview of the Baseline Ground Water Assessment of the Raymond Basin that was conducted for the Raymond Basin Management Board (RBMB) by GEOSCIENCE Support Services, Inc. during 2003. This report focuses on data collection and provides an evaluation of current conditions and basin management. A second phase of the project will involve the development of a detailed ground water flow model and basin management practices to assess the effectiveness of future conjunctive use scenarios. The ground water flow model will be developed using the geohydrologic information and understanding obtained in the generation of this report.

Between 1990 and 1992, CH2M Hill was contracted by the Metropolitan Water District of Southern California (MWD) and the City of Pasadena to assess how much ground water can be stored in the Raymond Basin, and to estimate the impacts associated with four different conjunctive use scenarios. A second phase of the study (1992) concluded that there were no major institutional constraints to implementing a conjunctive use program in the Basin. Since the recommendations made in the CH2M Hill reports, seven wells have been completed as aquifer storage and recovery (ASR) wells. The spreading of runoff water at various spreading facilities throughout the Basin has continued in the same manner as before 1990, and no spreading of imported water has been implemented as yet. Another indirect recharge option that currently takes place is through in-lieu deliveries of MWD imported water.

MWD, the RBMB, the City of Pasadena, and Foothill Municipal Water District have entered into an agreement for the Raymond Basin Conjunctive Use Project. This agreement allows MWD a maximum storage capacity of 75,000 acre-ft in the Raymond Basin. At MWD's request, participating agencies will pump MWD's stored water from the Basin, thereby reducing the agencies' demand on MWD's imported water. The City of Pasadena and Foothill Municipal Water District would contractually shift their demands on MWD's deliveries to winter months, resulting in a significant reduction in summer imported deliveries.

2.0 PROJECT OVERVIEW

The Raymond Ground Water Basin is located in the northwest portion of the San Gabriel Valley in Los Angeles County, California (see Figure ES-1). The basin is bounded by the San Gabriel Mountains to the north, the San Rafael Hills to the west, and the Raymond Fault to the south and southeast. The Raymond Basin is mandated by the Raymond Basin Management Board (RBMB) which consists of sixteen member agencies. The RBMB was established in March 1984 to function as the watermaster.

Ground water production within the Raymond Ground Water Basin is currently managed based on the safe yield of the Basin (a volume of 30,770 acre-ft/yr), as stipulated within the Report of Referee regarding the adjudication of the Basin (City of Pasadena v. City of Alhambra et al. Report of Referee, 1943; City of Pasadena v. City of Alhambra et al. Report of Referee, 1954). Safe yield, in this report, is defined as:

> *...the average annual amount of ground water that could be artificially extracted from the basin over an indefinitely long period of years, under a particular set of those physical conditions affecting supply to and disposal from the ground water body, without causing a net lowering of ground water levels during the period.*

The Raymond Basin is divided into three subareas based on differences in ground water elevations and flow directions: the Monk Hill subarea in the northwest, the Pasadena subarea in the central portion of the basin, and the Santa Anita subarea in the east (see Figure ES-2).

The base of the water-bearing strata of the Raymond Ground Water Basin is defined by bedrock material that is not considered to yield significant quantities of water to wells. Overlying the bedrock are more than 1,200 ft of unconsolidated alluvial materials consisting of boulders, gravel, sand, silt, and clay. The alluvial aquifer system in the Raymond Basin consists of many individual interconnected water-bearing zones. Based on a review of driller's reports, ground water level elevations, and ground water quality data, the water-bearing zones within Raymond Basin have been classified as one general aquifer system. For the most part, the aquifer system is unconfined to semi-confined. However, as late as 1938, flowing artesian wells were observed up to 1.5 miles north of Raymond Fault along much of the length of the fault. This suggests that confined conditions do occur in this area as evidenced by ground water levels rising above confining layers and

sometimes above the land surface resulting in flowing wells.

Specific yield values in the Raymond Basin are typical of alluvial sediments and range from approximately 5 to 18 percent. Ground water generally flows southerly from areas of recharge at the base of the San Gabriel Mountains to areas of discharge along Raymond Fault at hydraulic gradients ranging from approximately 209 to 475 ft/mi (0.040 to 0.090 ft/ft) (see Figure ES-3). The Raymond Fault acts as a leaky hydrologic barrier and defines the boundary between the Raymond Ground Water Basin and the main San Gabriel Valley Ground Water Basin to the south.

Natural ground water recharge to the Raymond Basin occurs through infiltration and percolation of rainfall and surface runoff, and subsurface inflow (i.e. mountain front inflow) from the San Gabriel Mountains. Ground water discharge in the Raymond Basin occurs through pumping and subsurface outflow across the Raymond Fault.

Optimum ground water basin management is predicated on a thorough understanding of the hydrogeology of the basin of concern. A greater understanding, enhanced through the collection of ground water levels, production, quality and other data, allows for more informed decisions to be made regarding the optimization of ground water resources. The RBMB recognized that a vast amount of data had been generated since the CH2M Hill study in the early 1990's upon which management decisions needed to made. Additionally, the RBMB needed a baseline evaluation of the Basin before MWD begins to store up to a maximum of 75,000 acre-ft in the Raymond Basin through the Raymond Basin Conjunctive Use Project. Thus, the first part of the study included:

- A Baseline Evaluation including a comprehensive review of past documentation and a review and update of existing water facilities, infrastructure, and or systems;
- Collection and compilation of geohydrologic data, facilities information, and other available background information; and
- Development of a computer database containing all geohydrologic data.

Once background and geohydrologic data had been identified, compiled and presented, key basin management aspects were evaluated and recommendations made to improve the Basin's efficiency and management. The specific tasks included:

- An evaluation of the effects of RBMB's current long-term storage (LTS) program on ground water levels, quality, and storage;

- Development of a basin-wide monitoring program outlining a monitoring network and monitoring protocol for the collection of geohydrologic data within the Raymond Ground Water Basin;

- An investigation of existing conjunctive use operations within the Raymond Ground Water Basin and development of a strategy for future conjunctive use and ground water storage opportunities.

3.0 BASELINE EVALUATION

The first task of this study was to review documentation related to Raymond Ground Water Basin, and update the system and facilities maps. This task provided the basis for later work, including database development.

A comprehensive list of historical documents pertaining to the Raymond Basin and adjacent San Gabriel Basin was developed as part of this task, the most important of these documents being:

- CH2M Hill. Phase 1 (1990) and Phase 2 (1992) Raymond Basin California – First Technical Assessment Devil's Gate Multi-Use Project. Prepared for the City of Pasadena.

- CH2M Hill, 1990. Work Plan for Conjunctive Use Feasibility Study Phase San Gabriel Basin L.A. County, California. May 4, 1990.

- Raymond Basin Watermaster Reports for 1986 to 2002. Raymond Basin Management Board.

- California Department of Water Resources, 2003. California's Ground Water, Bulletin 118. Draft Individual Basin Descriptions. Raymond Groundwater Basin.

Apart from documents describing various projects within the Raymond Basin, data recorded for each of the wells was available from water purveyors and the RBMB. A major source of geohydrologic data was the annual RBMB's Watermaster reports. Additionally, data was requested from the individual water purveyors, and other organizations such as the California Department of Health Services and the Department of Water Resources.

The water system in the Raymond Basin comprises: (1) the collection and distribution of water by the sixteen local purveyors, (2) the importation of Metropolitan Water District of Southern California (MWD) water, and (3) artificial recharge. Extracted ground water is the largest component of the Raymond Basin water system (51%), followed by imported water (45%) and surface water diversions (4%).

The City of Pasadena possesses the largest water rights share at 12,807 acre-ft per year, and the largest four purveyors (Cities of Pasadena, Arcadia and Sierra Madre, and California-America Water Company) hold rights to 74% of the Basin's ground water. Most of the other purveyors control rights of less than 1,600 acre-ft per year.

A total of 35 ground water extraction wells currently operate in the Basin. Since the publication of CH2M Hill's (1990) report, a total of seven extraction wells have been installed and two extraction wells have been destroyed. Even though seven wells have the capability to inject water, only one well, Valley Water Company's Well 2, is currently injecting water. The City of Pasadena injection wells have not injected water since 1999 due to the high total dissolved solids (TDS) concentrations of imported source water. Twelve wells within the Basin have been impacted by perchlorate (> 4 parts per billion (ppb)). Most of these wells are now inactive or are blended with other water to achieve perchlorate concentrations less than 4 ppb.

There are four primary spreading grounds for artificial recharge of runoff (Arroyo Seco, Eaton Wash, Sierra Madre and Santa Anita). Since 1977, approximately 204,430 acre-ft of spreading has taken place at these four spreading basins. To a lesser degree, Pasadena Glen, Sludge Ponds, Rubio Canyon Debris Basin and Millard Canyon are also used for spreading surface water (approximately 27,880 acre-ft).

4.0 DATABASE

Over a number of decades, the RBMB, its member agencies and other organizations (such as the California Department of Health Services and the Department of Water Resources) have measured, recorded and documented a large amount of ground water-related data. Due to the large volume of data (i.e. ground water levels, well production, spreading, injection, and water quality) the most efficient method of data storage, retrieval, management and maintenance is to use a database.

A comprehensive MS Access database and Instructional Manual have been developed as part of this study. A total of 108 wells have been included in the database with over 8,000 ground water level records, 38,000 production records, and 282,000 ground water quality records. These data will be used extensively in the construction of the ground water flow model that is part of Phase II of this study.

The database will be used primarily by the RBMB for management and reporting purposes; however, member agencies can request read-only copies of the database from the RBMB. No one, other than the RBMB can add, delete or modify data in the database.

The maintenance of the database will be the responsibility of the RBMB. The database has been developed such that a person with minimal database skills can maintain the system.

5.0 EFFECTS OF THE CURRENT LONG-TERM STORAGE (LTS) PROGRAM

Comparisons in ground water levels and basin storage were made from before and after the LTS program started in the early 1990's to evaluate its effects on the Basin as a whole. Data used in the evaluation was extracted from the Raymond Basin Geohydrologic Database.

The LTS program alternatives proposed by CH2M Hill involved both in-lieu pumping and artificial recharge (CH2M Hill, 1992). Although some in-lieu pumping has taken place in the Basin since 1992, as part of the LTS program, recharge by spreading of MWD imported water has not taken place. The source of water for surface spreading continues to be from runoff and diversions.

The CH2M Hill model predictions for effects of the proposed LTS programs (Alternatives 2A and 2B) on ground water conditions was concluded to be insignificant (CH2M Hill, 1992), but there would be slight increases in ground water levels (generally less than 20 to 30 ft) in the winter months. Ground water elevations for the Raymond Basin were projected from July 1989 to June 2003 using CH2M Hill's numerical ground water flow model (CH2M Hill, 1992). These projected "base case" ground water elevations were compared to actual measured ground water elevations for selected wells (see Appendix C). This evaluation showed that, despite the LTS program not being completely carried out as recommended by CH2M Hill, the predicted ground water elevations correlate reasonably well with measured elevations within the Monk Hill and Pasadena subareas, and less within the Santa Anita subarea.

Ground water recharge in the Raymond Basin has generally increased in the period 1992 to 2002 as compared to 1980 to 1991 although the magnitude of increase varies across the Basin. In general, ground water production has decreased in the western Pasadena subarea and increased in the southeastern Pasadena subarea. Ground water production in the vicinity of the Arroyo Seco spreading grounds decreased in 1990 but increased again in 2002. Elsewhere across the Basin, ground water production changed little.

Subsurface outflow across the Raymond Fault was estimated to be 6,360 acre-ft per year by the California Department of Water Resources, and as much as 10,564 acre-ft per year by CH2M Hill. The amount of ground water outflow will be confirmed by a detailed ground water flow model in Phase II of this study.

Ground water levels in the western portions of the Raymond Basin appear to be very sensitive to recharge (natural and/or artificial). Ground water levels in wells downgradient of the Arroyo Seco spreading grounds rose by more than 200 ft between 1991 and 2002, corresponding to a period of substantial increases in artificial recharge in the spreading grounds. Although ground water pumping from the wells in the western portion of the Basin declined slightly, this would not fully account for the substantial increase in ground water levels in this area. Approximately 55,000 acre-ft was spread at the Arroyo Seco spreading grounds between 1991 and 2002, which appears to account for the 20,000 to 40,000 acre-ft increase in ground water storage south of the Arroyo Seco. This will be further evaluated in detail using the ground water flow model during Phase II of this study.

Ground water levels in the southern portion of the Raymond Basin along the Raymond Fault, particularly west of Eaton Wash, appear to be influenced by recharge activities in the Arroyo Seco area. Ground water contours indicate that ground water flows south from Arroyo Seco and then east along the Raymond Fault approximately as far as Eaton Wash. These data suggest that the Raymond Fault is significantly less permeable in the western portion than the eastern portion.

Ground water levels in the Santa Anita subarea are also sensitive to available recharge. However, substantially less water was recharged in the Santa Anita and Sierra Madre spreading grounds than the Arroyo Seco spreading grounds between 1991 and 2002, and ground water levels in the Santa Anita subarea did not show the magnitude of ground water level increases observed in the western portion of the Basin.

The following table summarizes estimates of actual and potential ground water storage volumes within the Raymond Ground Water Basin. Potential storage increases as the actual volume of ground water in storage decreases.

Estimates of Actual and Potential Ground Water Storage in the Raymond Basin

Ground Water Storage Scenarios	GEOSCIENCE (2003)	CH2M Hill (1990)	CDWR (1971)
	Volume [thousands of acre-ft]		
Land Surface to Bedrock	1,412	1,470	Not calculated
(Land Surface – 20 ft) to Bedrock	1,367	Not calculated	1,450
Water Levels in 2002 to Bedrock	816	Not calculated	Not calculated
Water Levels in 1991 (Dry Year) to Bedrock	862	Not calculated	Not calculated
Water Levels in 1986 (Dry Year) to Bedrock	Not calculated	994	Not calculated
Water Levels in 1983 (Wet Year) to Bedrock	929	Not calculated	Not calculated

Increases in precipitation and spreading volumes during the period from 1992 to 2002 may have slowed the decline of ground water levels within the Basin. A decrease in precipitation from 1983 to 1990 (dry period) was followed by an increase from 1991 to 1998 (wet period) indicating that natural recharge was greater during the latter period. Spreading volumes were greater during the period from 1992 to 2002 (approximately 136,270 acre-ft) than from 1983 to 1991 (64,860 acre-ft).

While both natural and artificial ground water recharge has increased since 1991, pumping from wells within the Basin has on average decreased. Average production during the period from 1983 to 1991 was approximately 31,900 acre-ft. From 1992 to 2002, average ground water production decreased slightly to approximately 31,300 acre-ft. This may have also assisted in slowing the decline in ground water levels.

Despite increases in spreading, the volume of ground water in storage within the Raymond Ground Water Basin has decreased by 112,600 acre-ft from 1983 to 2002. What is important to note is that while ground water levels have been overall declining in the Basin (accounting for increased storage capacity), the decline since 1992 has been slower than previous, due to increased natural and artificial recharge. Between 1992 and 2002, the volume of ground water in storage decreased by approximately 46,100 acre-ft while it decreased by approximately 66,500 acre-ft from 1983 to 1991.

Ground water in the Raymond Basin is typically a calcium bicarbonate-type water. The chemical characteristics of wells in the Pasadena and Santa Anita subunits are relatively stable; however, ground water in the Monk Hill area has generally shifted toward a sodium chloride-type water between 1987 and the present. The reason for the shift is probably due to injection of imported MWD water that has a higher TDS concentration than local ground water, and the chemical composition of the aquifer in this area (CDWR, 1971).

Point sources of contamination include specific sites where contaminants have been released to the subsurface from an underground storage tank (UST) or a localized surface spill. The primary risk to potential well sites from USTs is from vertical migration of contaminants from shallow zones through less permeable layers and into the deeper aquifer system. Leaks from USTs generally impact the shallow aquifer system, which is often perched and restricted in lateral extent. In areas where no aquitards exist to separate shallow aquifers from deep aquifers, contamination can migrate from point sources into the deeper system. In addition, cross contamination can also occur from vertical flow in existing wells that are perforated in both the shallow and deep zones.

Point source contaminants identified for evaluation in this report included perchloroethene (PCE), trichloroethene (TCE) and perchlorate. These contaminants were evaluated due to their status as priority pollutants and their relative mobility in the subsurface.

In the northwestern portion of the Raymond Basin (Monk Hill), detections of point source contaminants such as PCE, TCE and perchlorate are readily explainable in the context of identified pollution sources in this area. In some cases (Las Flores Company Well 2), concentrations in downgradient wells are increasing. In other cases (Las Flores Well 5 and Pasadena's Sunset Well), concentrations in downgradient wells are decreasing.

In the southern portion of the Raymond Basin, detections of PCE, TCE and perchlorate are not as readily explained by identified point sources. Relatively consistent detections of PCE in Sunny Slope Water Company wells may be explained by as yet unconfirmed contaminant sources north of the wells. Sources for the historical detections of PCE and TCE in the Santa Anita subarea have not been identified. Concentrations of these constituents have generally decreased since the early 1990s. The decreasing concentrations may be a result of several different factors, but increased recharge upgradient of the detections may have the effect of flushing and/or diluting the contaminants.

Perchlorate has been detected in ground water samples from approximately

55 percent of the wells in the Raymond Basin (28 wells out of 51 wells). The highest concentrations have been detected in City of Pasadena Well 52, which is located in the vicinity of the Arroyo Seco spreading grounds directly downgradient of the Jet Propulsion Laboratory. The majority of detected perchlorate concentrations are less than 4 µg/L. Perchlorate has not been detected in the Santa Anita subarea.

Non-point sources of ground water contamination result from regional application of chemicals/compounds to the land surface that eventually leach into the ground water with irrigation water and/or precipitation. The primary non-point source of ground water contamination in the Raymond Basin area is historical agricultural activity. This has resulted in widespread nitrate impacts to the ground water from deep percolation of nitrogen-based fertilizers applied to agricultural orchards and row crops. Because the area has been almost completely urbanized, elevated TDS and residual nitrate concentrations in the ground water are likely a result of historical agricultural practices.

TDS and nitrate concentrations have generally increased in the western and southern portions of the Raymond Basin, decreased in the central portion of the Basin, and remained relatively stable in the eastern portion of the Basin (Santa Anita subarea). The highest concentrations of these constituents generally occur in the southernmost portions of the Basin and in the Arroyo Seco spreading area. The data suggest that TDS and nitrate associated with historical land use practices is migrating from the recharge areas in the north to the southern portions of the Basin where it concentrates behind the Raymond Fault.

6.0 BASIN-WIDE MONITORING PROGRAM

General recommendations for a basin-wide monitoring program have been identified based on a review of the current management environment in the Raymond Basin, the geohydrologic characteristics and ground water level history of the Raymond Basin, and ground water level data gaps. Currently, ground water production within the Raymond Ground Water Basin is managed based on a safe yield of 30,770 acre-ft/yr, as stipulated within the Report of Referee regarding the adjudication of the Basin. The safe yield was determined by comparing the ground water storage of the Basin, as determined from a baseline hydrologic condition (1927-28 through 1937-38), with the ground water storage of the Basin at the time of the adjudication (1951-52).

Although ground water level trends from selected wells within the Raymond Basin are reported in the RBMB annual reports, the trends are not used as criteria for managing

ground water production within the Basin unless it is necessary to reevaluate the safe yield. Likewise, ground water quality is not a factor in current basin management decisions.

Ground water data within the Raymond Basin is collected entirely from pumping and non-pumping wells owned by the member agencies of the RBMB. A subset of these wells includes seven "key" wells that are used for monitoring ground water levels. Only two of these wells are non-pumping wells.

Based on a review of current monitoring and management practices:

- It is recommended that future management of the ground water resources in the Raymond Basin be conducted based on both ground water levels and safe yield. Proper management of the Basin will require an iterative process of monitoring ground water levels consistent with extractions within the Basin's safe yield;

- Ground water levels in non-pumping key wells should be used, along with action criteria, for making management decisions regarding the operation of the ground water basin; and

- Implementation of annual ground water audits can be an effective way of managing the ground water basin, using ground water level data from the key wells.

In regard to ground water level monitoring, it is recommended that ground water levels be measured using an electric well sounder calibrated to the nearest 0.01 ft. In some cases, static ground water levels in production wells are currently measured using an airline. This method has a limited accuracy (usually 0.5 psi or 1.2 ft).

Ground water production data is currently collected from each operating well on a monthly basis. This frequency is suitable.

Ground water quality samples are collected from each municipal production well in accordance with DHS Title 22 requirements. This sample and analysis frequency is relatively comprehensive and no sampling and analysis above and beyond what is currently being conducted is recommended.

For other monitoring wells, initially, Title 22 requirements can be applied, but in order to be more cost effective, selected constituents can be tested for instead of the full range of constituents, based on potential contaminants in the area.

Approximately ten new wells for ground water level and quality monitoring have been recommended (see Figure ES-4).

These are either new wells to fill spatial data gaps in the Basin, or to replace existing key wells that are pumping wells. The following are recommended changes to the monitoring well network in the Raymond Basin, in order of priority (highest priority first):

- At least two additional monitoring wells (non-pumping) should be identified in the Santa Anita subarea.

- One additional monitoring well (non-pumping) should be identified in the eastern Pasadena subarea between the Eaton Wash spreading grounds and the Santa Anita subarea boundary.

- The Kinneloa Irrigation District Wilcox Well, which is a pumping well, should be replaced with a non-pumping well as the key well in the eastern portion of the Pasadena subarea. The monitoring well recommended for the area between Eaton Wash and the Santa Anita subarea may be suitable for this.

- One additional monitoring well should be identified in the southwestern Pasadena subarea, midway between the 210 Freeway and the Raymond Fault.

- Two additional monitoring wells should be identified in the northwestern Pasadena Subarea.

- One additional monitoring well should be identified in the northwestern Monk Hill Subarea.

- The current key wells Pasadena Copelin, California American Water Company Winston, and City of Alhambra No. 2, which are all pumping wells, should be replaced by non-pumping wells in the same general vicinities as the current wells.

In addition to replacing unsuitable key wells, two monitoring wells should be established either side of the Raymond Fault to monitoring outflow across the fault.

For all recommended monitoring wells, existing wells in the vicinity should be identified first and investigated to determine their suitability for ground water monitoring of water levels and quality. If no existing non-pumping wells can be identified for use as monitoring wells, it may be prudent to drill and construct a new monitoring well(s). The estimated engineering cost of investigating existing wells for monitoring suitability and completing ten recommended monitoring wells will be approximately between $160,000 and $210,000. Note that this cost does not include construction costs for 4-inch stainless steel monitoring wells, geophysical logging, well development, or water quality sampling.

To monitor land surface elevations for subsidence in the Raymond Basin, it is recommended that a network of land surface benchmarks be established in the southern part of the Raymond Basin where conditions for subsidence potential may exist. An additional option that may be considered in the evaluation of changing land surface elevations is the use of InSAR satellite data.

An alternative approach to the current Raymond Basin ground water management practice is through an annual ground water audit process. This process involves evaluating ground water level trends, production rates, ground water quality or other aquifer/well/pump considerations from the previous year. This information is used to make recommendations for pumping in the following year. This type of management approach focuses more on maintaining ground water levels within acceptable limits rather than maintaining pumping within a predetermined safe yield although refinement of the safe yield is part of the audit process. The goal of the annual audit approach is to avoid potential undesirable conditions or adverse environmental impacts.

If the results of the water audit indicate that annual ground water pumping in an individual subarea shows both short-term and long-term declining water level trends in key monitoring wells, suggesting exceedance of the safe yield, it may be recommended that pumping in that subarea or a portion thereof be decreased and/or artificial recharge increased in the upcoming water year. In this manner, undesirable trends in ground water levels are regulated so that both short- and long-term trends can be stabilized. Action criteria (e.g. a critical ground water level) for key wells would have to be established by the RBMB to provide a standard against which decisions to increase or decrease pumping would be based.

The estimated cost of implementing an annual basin audit will be between $35,000 and $40,000 per year.

7.0 FUTURE CONJUNCTIVE USE AND GROUND WATER STORAGE OPPORTUNITIES

Conjunctive use is a management technique which allows operation of a ground water basin in coordination with a surface water system to increase the total available water supply, while improving the overall reliability of supplies. It requires coordinated operation and maintenance plans designed to meet demands while ensuring maximum conservation. Current ground water management techniques include artificial recharge (spreading and injection), and indirect recharge through in-lieu pumping. Although these methods are being used, they are not utilized to their full potential, and ground water levels are continuing to drop in the Basin. Future

conjunctive use must focus on improving artificial recharge rates and volumes, and exploiting in-lieu recharge as much as possible.

Criteria for determining the location of potential artificial recharge sites include:

- Overall permeability of sediments;
- Presence or absence of impermeable sedimentary layers;
- Depth to ground water;
- Proximity and relationship to existing or proposed production wells and/or conveyance systems;
- Ability to comply with regulatory requirements; and
- Proximity to imported water distribution systems.

The most important factor in the reduction of percolation rates within spreading basins is the clogging of the basin sides and bottom. Clogging of spreading basins can severely reduce recharge rates to only a fraction of the initial rate. It is therefore necessary to periodically dry the basins so the clogging layer can be removed and any organic material can be allowed to decompose. Another method to prevent clogging is to reduce the volume of suspended material within the water prior to diverting it into the spreading basin. Weir ponds or desilting basins are designed to reduce the sediment load within recharged water prior to diversion into the spreading basins. Flocculation systems can also be used to coagulate suspended solid particles so that they will settle out of the water as it passes through a series of desilting ponds.

The efficiency of a typical injection well is likely to be reduced with time due to four major factors: 1) clogging by sedimentation; 2) air entrainment; 3) water-chemistry problems; and 4) thermal interference. The injection wells currently being operated in the Raymond Basin reportedly have not had any efficiency problems. This may be due to their dual use as extraction wells, which reduces the chances of clogging.

The most suitable areas for large-scale surface spreading are located in the foothills or forebays of alluvial basins. They are favorable to ground water storage because of the unconfined nature of the aquifers coupled with high infiltration rates. For injection wells, a major consideration in their applicability includes the physical properties of the aquifer to be injected.

Other considerations in conjunctive use projects include the source of recharge water which must be available in sufficient quantities and must meet regulatory requirements. Currently, imported MWD water from the Weymouth Treatment Plant has an average TDS of 615 mg/L, which exceeds the Basin water quality objectives set by the Regional Water Control Board (450 mg/L). Another potential source of water could be recycled water. However, no recycled water is available in the Basin,

apart from the La Cañada water reclamation plant operated by the Sanitation Districts of Los Angeles County which uses all its treated, secondary effluent on the golf course.

In-lieu recharge is an effective ground water management practice that makes use of indirect recharge. This is achieved by using imported water when it is readily available (i.e. October through April) in-lieu of pumping ground water from the Basin. In the peak season (i.e. May through September) ground water is extracted from the Basin again.

Certain purveyors in the Basin already practice in-lieu recharge (City of Pasadena, Valley Water Company, Lincoln Avenue Water Company and La Cañada Irrigation District). Provided imported water can be purchased from MWD at a reasonable cost, this option is very attractive. Currently, the limiting factor to increasing in-lieu deliveries is the infrastructure in place that will need to be upgraded and/or modified if in-lieu practices are maximized. It is recommended that the capacity for maximizing the amount of in-lieu pumping that can take place be reviewed by each member agency.

Phase II of this study, which involves a ground water flow model, will take into account in-lieu pumping as part of the Basin's conjunctive use program. The amount of in-lieu pumping will be adjusted in order to achieve optimal basin management, along with artificial recharge.

Based on an evaluation of existing conjunctive use practices, potential for optimizing future conjunctive use and artificial recharge in order of priority are:

1) Maximize in-lieu recharge.

2) Expansion of existing facilities in the Santa Anita area.

3) Expansion of existing facilities in Eaton Canyon and Sierra Madre areas.

4) Utilization of existing debris basins within the foothills of Raymond Basin. These basins are, for the most part, used for flood control purposes and would require considerable coordination with regulatory agencies (e.g. Los Angeles County Flood Control District).

5) Injection wells should be tested as a means to recharge water in areas below impermeable layers such as those areas immediately north of Raymond Fault.

6) Development of additional surface basin-type recharge facilities. This option is limited due to lack of undeveloped land in the Raymond Basin.

In order to evaluate the successful operation of existing and potential artificial recharge facilities, a comprehensive field investigation should be conducted at each site and would include visits to existing artificial recharge facilities and sites identified as potential candidates for future artificial recharge; evaluation of the condition of each recharge facility; and infiltrometer testing and shallow borings to verify the permeability of materials

In particular, controlled pilot-scale tests should be conducted in the Santa Anita Basin area to determine the optimum recharge capability. In addition, it is recommend to conduct pilot-scale recharge testing in one or more of the existing debris basins in order to evaluate their potential as areas of artificial recharge. The estimated preliminary cost of performing an investigation and preparing a work plan pilot testing at the Santa Anita spreading grounds will be between $20,000 and $30,000. To carry out field work and install five shallow monitoring wells will cost approximately $30,000 to $40,000 for engineering and between $50,000 and $75,000 for contractor costs. The implementation of the pilot testing at the Santa Anita spreading grounds and monitoring for four months is expected to cost between $30,000 to $40,000 for engineering costs, and between $10,000 to $15,000 for engineering costs.

The evaluation of an existing debris basin for spreading purposes, including installation of two shallow monitoring wells should cost between $20,000 and $30,000 for engineering costs, and between $20,000 and $30,000 for contractor costs. The pilot basin construction and implementation of the pilot testing, together with field monitoring for four months will cost between $20,000 and $40,000 for engineering costs, and between $10,000 and $15,000 for contractor costs.

Note that all these estimated costs are preliminary budgetary estimates that can be refined once programs have been clarified and confirmed.

8.0 PRELIMINARY ESTIMATED COSTS TO IMPLEMENT PROPOSED PROGRAMS

The table on the following page presents estimated costs for each of the proposed abovementioned programs. The costs are preliminary budget estimates and will be refined further once the programs have been clarified and confirmed.

Preliminary Estimated Costs to Implement Proposed Programs

PROGRAM	ENGINEERING COSTS	CONTRACTOR COSTS
Ground Water Monitoring Plan[1]		
• Identify existing wells as prospective monitoring wells and verify construction details. • Identify locations for 10 new monitoring wells. • Prepare detailed technical specifications. • Provide field inspection during drilling and construction. • Prepare a summary report.	$ 160,000 - $ 210,000	Not Included
Evaluation of Santa Anita Spreading Facilities[2]		
• Perform reconnaissance investigation. • Prepare a detailed pilot test work plan.	$ 20,000 - $ 30,000	None
• Prepare detailed technical specifications for 5 monitoring wells and supervise the bidding process, including one instrumented monitoring well. • Perform infiltrometer testing at five locations. • Prepare a summary report.	$ 30,000 - $ 40,000	$ 50,000 - $ 75,000
• Pilot spreading basin design and construction. • Setup instrumentation and provide field data collection for the 4 month infiltration testing. • Prepare a summary report.	$ 30,000 - $ 40,000	$ 10,000 - $ 15,000
Evaluation of Existing Debris Basins[2]		
• Perform reconnaissance investigation. • Prepare detailed technical specifications for 2 monitoring wells, including one instrumented monitoring well. • Provide inspection services during drilling and installation of monitoring wells. • Perform infiltrometer testing at three locations. • Prepare a summary report.	$ 20,000 - $ 30,000	$ 20,000 - $ 30,000
• Pilot spreading basin design and construction. • Setup instrumentation and provide field data collection for the 4 month infiltration testing. • Prepare a summary report.	$ 20,000 - $ 40,000	$ 10,000 - $15,000
Annual Basin Audit		
• Review historic records of ground water levels and production. • Prepare for and attend one annual workshop. • Provide recommended production using the ground water model. • Prepare Annual Audit summary report.	$ 35,000 - $ 40,000	None

1 Cost does not include construction costs for 4-inch diameter stainless steel monitoring wells, geophysical logging, well development, or water quality sampling.

2 Costs assume all necessary permits have been obtained.

ATTACHMENT E

EVALUATION OF GROUNDWATER PRODUCTION (DECEMBER 2007)

TECHNICAL MEMORANDUM

TO: **TONY ZAMPIELLO**
RAYMOND BASIN MANAGEMENT BOARD

FROM: **STETSON ENGINEERS, INC.**

SUBJECT: **EVALUATION OF GROUNDWATER PRODUCTION IN THE PASADENA SUBAREA OF THE RAYMOND BASIN**

JOB NO.: **1927-05**

DATE: **DECEMBER 12, 2007**

On August 17, 2007, Stetson Engineers Inc. (Stetson) submitted a scope of work and budget to the Raymond Basin Management Board (Board) for development of a groundwater monitoring and management plan for the Raymond Basin (RBGWMP). The RBGWMP was developed in part to support the Raymond Basin Conjunctive Use Project (RBCUP) and the RBGWMP was intentionally developed and implemented in phases. This scope of work, which was prepared for Phase I of the RBGWMP, includes the development of a groundwater elevation monitoring network (Task 1) and an evaluation of groundwater production in the Pasadena Sub-Area, where groundwater levels at selected wells have been declining since 1955 (Task 2). The scope of work was approved by the Board on September 5, 2007.

As part of the scope of work, Stetson is to prepare a short technical report to document the results of the RBGWMP Phase I work. The draft report will include, but is not limited to, data and information collected for Tasks 1.1 and 1.2, such as drillers' logs and geophysical logs, the recommended monitoring network including potential locations and estimated costs for the proposed exploratory boreholes and new monitoring wells. The draft technical report was submitted to the Board on November 30, 2007.

Stetson is also to prepare a separate technical memorandum to document the results of Tasks 2.1 and 2.2 and to review the Board's management actions in the Raymond Basin that that may be affecting the overdraft conditions in the Pasadena Sub-Area. This technical memorandum was prepared to present the evaluation's results and findings and to make recommendations for future activities (Phase II).

I. RESULTS AND FINDINGS

1. Obtain Available Data and Information

Historic data for the evaluation of groundwater production in the Pasadena Sub-Area include groundwater production and injection at production wells located within the subbasin, groundwater level data, surface water spreading data, and precipitation for the Raymond Basin. The data were primarily obtained from the database developed by Geoscience Support Services, Inc. (Geoscience) and then supplemented and/or updated with data obtained from other sources as described below.

- Groundwater production and injection were supplemented and updated with data from the Board's annual reports for watermaster service.
- Surface water spreading by the water producers was supplemented and updated with data from the Board's annual reports for watermaster service and the hydrologic reports (pre-1994) published by the Los Angeles County Department of Public Works (LACDPW), and with spreading data (post-1994) obtained from LACDPW. Surface water spreading data by LACDPW was added because this data was not included in the Geoscience database.
- Historic annual precipitation at several stations within the Raymond Basin was reviewed to select a representative precipitation station for the evaluation. Historic annual precipitation for the selected station, which is the Altadena station, was obtained from the Board's annual reports and supplemented by data obtained from annual summaries for the climatological data in California published by the National Oceanic and Atmospheric Administration (NOAA).
- Groundwater levels were supplemented by hydrographs in the Board's annual reports for watermaster service.

Data used for this evaluation were compiled in tabular format and included in the Attachment.

2. Evaluate Groundwater Production in the Pasadena Sub-Area

a. Review of Available Data and Information

- Annual Groundwater Production

Annual groundwater production from individual wells in the Raymond Basin were compiled from monthly groundwater production data and organized in tabular format, as shown in Table 1. The groundwater production between 1939-40 and 1943-44 could not be found. The annual groundwater production from each water producer and the annual groundwater production for the Raymond Basin were then calculated from these individual well production data. The annual groundwater production for the three subareas and the entire Raymond Basin, published in the Board's annual reports, were also included at the bottom of the table. As can be seen, the calculated annual groundwater production is compatible, but not identical, with the published annual groundwater production for the Raymond Basin.

The annual groundwater production in the Raymond Basin varied from 18,514.00 acre feet in 1913-14 to 34,539.74 acre feet in 2006-07 with an annual average of 29,016.52 acre feet per year, a maximum production of 40,855.80 acre feet in 1998-99, and a minimum production of 16,700.00 acre feet in 1937-38. In the Monk Hill Sub-Area, the annual groundwater production varied from 4,530.00 acre feet in 1913-14 to 6,247.05 acre feet in 2006-07 with an annual average of 7,050.58 acre feet per year, a maximum production of 13,012.40 acre feet in 1995-96, and a minimum production of 3,208.47 acre feet in 1989-90. In the Pasadena Sub-Area, the annual groundwater production varied from 13,851.00 acre feet in 1913-14 to 20,678.35 acre feet in 2006-07 with an average of 17,340.61 acre feet per year, a maximum production of 24,124.10 acre feet in 1998-99, and a minimum production of 8,913.78 acre feet in 1949-50. In the Santa Anita Sub-Area, the annual groundwater production varied from 133.00 acre feet in 1913-14 to 7,614.34 acre feet in 2006-07 with an average of 4,625.33 acre feet per year, a maximum production of 8,104.66 acre feet in 1993-94, and a minimum production of 133.00 acre feet in 1913-14. The fluctuation of the annual groundwater production in the Raymond Basin and its subareas is shown on Plate 1.

The annual groundwater production in the Monk Hill Sub-Area appears to be reasonably stable, but the annual groundwater production in the other two subbasins appears to have increased significantly. The annual groundwater production in the Pasadena and Santa Anita Sub-Areas varied from 13,984.00 acre feet in 1913-14 to 28,292.69 acre feet in 2006-07 with an average of 21,965.94 acre feet per year, a maximum of 31,382.70 in 1998-99, and a minimum of 12,750.05 acre feet in 1949-50. The fluctuation of the annual groundwater production in the Pasadena and Santa Anita Sub-Areas is shown on Plate 2.

❖ Annual Groundwater Injection

Annual groundwater injection from individual wells in the Raymond Basin were compiled from monthly groundwater injection and organized in tabular format, as shown in Table 2. The annual groundwater injection in the Raymond Basin varied from 1,517.32 acre feet in 1992-93 to 945.92 acre feet in 2006-07 with an average of 901.04 acre feet per year, a maximum injection of 2,072.51 acre feet in 1993-94, and a minimum injection of 195.89 acre feet in 1994-95. In the Monk Hill Sub-Area, the annual groundwater injection varied from zero acre feet in 1992-93 to 945.92 acre feet in 2006-07 with an average rate of 659.63 acre feet per year, a maximum injection of 1,478.78 acre feet in 2005-06, and a minimum injection of zero acre feet in 1992-93. In the Pasadena Sub-Area, the annual groundwater injection varied from 1,517.32 acre feet in 1992-93 to zero acre feet in 2006-07 with an average of 241.41 acre feet per year, a maximum injection of 2,072.51 acre feet in 1993-94, and a minimum injection of zero acre feet in 1994-95 and from 1996-97 to 2006-07.

❖ Annual Surface Water Spreading

Annual surface water spreading from individual water producers at each spreading facility in the Raymond Basin were compiled from monthly surface water spreading and organized in tabular format, as shown in Table 3. The annual surface water spreading in the Raymond Basin varied from 337.00 acre feet in 1944-45 to 8,470.8 acre feet in 2005-06 with an average of 6,251.77 acre feet per year, a maximum spreading of 26,754.3 acre feet in 1994-95, and a minimum

spreading of zero acre feet in 1945-46. In the Monk Hill Sub-Area, the annual surface water spreading varied from zero acre feet in 1944-45 to 3,175.9 acre feet in 2005-06 with an average of 1,994.72 acre feet per year, a maximum spreading of 13,122.3 acre feet in 1994-95, and a minimum spreading of zero acre feet in 1944-45. In the Pasadena Sub-Area, the annual surface water spreading varied from zero acre feet in 1944-45 to 4,155.6 acre feet in 2005-06 with an average of 2,388.56 acre feet per year, a maximum injection of 11,527.36 acre feet in 1982-83, and a minimum spreading of zero acre feet in 1944-45. In the Santa Anita Sub-Area, the annual surface water spreading varied from 337.0 acre feet in 1944-45 to 1,139.3 acre feet in 2005-06 with an average of 1,868.49 acre feet per year, a maximum spreading of 5,799.0 acre feet in 1966-67, and a minimum spreading of 337.0 acre feet in 1944-45. The fluctuation of the annual surface water spreading in the Raymond Basin is shown on Plate 3.

❖ Annual Precipitation

Annual precipitation at the selected stations within the Raymond Basin since 1900-01 is shown in Table 4. The precipitation from 1900-01 through 1937-38 at the station No. 4092 and from 1938-39 to 2005-06 at the station No. 144 in Altadena was used as the representative precipitation in the Raymond Basin for this evaluation. The representative precipitation varied from 24.95 inches in 1900-01 to 21.21 inches in 2005-06 with an average precipitation of 21.87 inches per year, a maximum precipitation of 56.43 inches in 2004-05, and a minimum precipitation of 5.38 inches in 1972-73. The fluctuation of the representative precipitation is shown on Plate 4 and the cumulative departure from the average precipitation is shown on Plate 5.

❖ Water Level

Historic water level data for the City of Pasadena's Woodbury Wells (C-52 and C-52a) and Craig Well (C-44) were used for the evaluation. The hydrographs of the water level for these wells are shown on Plate 6. These wells were selected because they are located in the central portion of the Pasadena Sub-Area and because they have long-term record covering periods with different hydrologic and basin management conditions. As can be seen, the water level at Woodbury Wells consistently declined from approximately 142 feet below ground surface (bgs) in 1916 to approximately 260 feet bgs in 1936. The water level at Craig Well also declined from approximately 269 feet bgs in 1925 to approximately 344 feet bgs 1936 then stabilized and slightly recovered to approximately 319 feet bgs in 1956. Since then, the water level in this well declined consistently and reached 435 feet bgs in 1995.

❖ Review Findings

- Groundwater production in the Raymond Basin, especially in the Pasadena-Santa Anita Sub-Areas, has increased significantly since 1910-11. During the last 60 years, the groundwater production in these subareas increased from 14,419.80 acre feet in 1944-45 to 28,292.69 acre feet in 2006-07 (96% increase), as shown on Plate 6.

- The increasing groundwater production in the Pasadena-Santa Anita Sub-Areas appears to be the primary factor for the continuing declination of the water level in these

subareas. During the last 60 years, the water level in the City of Pasadena's Craig Well declined from approximately 320 feet bgs in 1944-45 to approximately 419 feet bgs in 1996-97, a decline of essentially 100 feet.

- Precipitation within the Raymond Basin does not appear to have significant direct impacts on the groundwater level. In fact, the wet period from 1912-13 to 1919-20, as indicated by the cumulative departure curve on Plate 6, did not have any impacts on the groundwater level at Woodbury Well. The very wet period from 1935-36 to 1947-48 appears to stabilize the water level in Craig Well, but the water level did not recover more than 5 feet, as shown on Plate 6.

- Surface water spreading appears to have positive impacts on the water level in the Raymond Basin. During the period from 1914-15 to 1930-31, without surface water spreading, the water level in Woodbury Well declined from approximately 150 feet bgs to approximately 230 feet bgs at an average annual rate of approximately 3.2 feet per year. During the period from 1951-52 to 1979-80, with surface water spreading, the water level in Craig Well declined from approximately 320 feet bgs to approximately 370 feet bgs at an average rate of approximately 0.6 feet per year.

- Impacts of groundwater injection in the Pasadena-Santa Anita Sub-Areas on the water level in these subareas could not be evaluated because of a lack of long term data.

b. Evaluation Methodology

Based on the correlation between the groundwater production and water level in the Raymond Basin and assuming that the Pasadena and Santa Anita Sub-Areas are hydraulically connected (based on the findings during the development of the preliminary groundwater monitoring network), a spreadsheet groundwater balance model was developed to evaluate the relationship between the groundwater production in the Pasadena and Santa Anita Sub-Areas and the water level at the City of Pasadena's Craig Well.

The spreadsheet groundwater balance model, as shown in Table 5, includes components such as net recharge from precipitation, surface water spreading, subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, subsurface outflow to the San Gabriel Basin, and groundwater production and injection. The missing annual groundwater production between 1938-39 and 1943-44 was assumed to be 12,000 acre feet per year (consistent with annual averages).

The groundwater balance model was calibrated for the period from 1913 to 1938 using the water level at the City of Pasadena's Woodbury Wells (C-52 and C-52a). Calibration involved adjusting the net-recharge coefficient from precipitation on the valley floor, the coefficients for the subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, and the coefficient for the subsurface outflow to the San Gabriel Basin until the simulated water level matches with the measured water level at Woodbury Wells. The calibration results indicate that the match between the simulated and measured water levels at Woodbury Wells is excellent, as shown on Plate 7.

The calibrated groundwater balance model was then verified for the period from 1944 to present using the water level at the City of Pasadena's Craig Well (C-44). During the verification process, the net-recharge coefficients from precipitation on the valley floor, the coefficients for the subsurface inflow from the La Canada Flintridge-Altadena subbasin and the Sawpit watershed, and the coefficient for the subsurface outflow to the San Gabriel Basin generated during the calibration process were kept unchanged. Initially, the groundwater balance model was verified without receiving recharge water from surface water spreading as specified in the scope of work, but the simulated results were not consistent with the measured water level in the Craig Well, as shown on Plate 7. The simulated water level in the Craig Well, however, appears to be consistent with the measured water level when the groundwater balance model was verified with recharge water from surface water spreading, as shown on Plate 7.

c. Evaluation Findings

- The Pasadena-Santa Anita Sub-Areas of the Raymond Basin have been overdrafted significantly since probably the beginning of 1900's. According to available historic data since 1910, the groundwater production in these subareas averaged approximately 20,400 acre feet per year, which is almost double the estimated net recharge of approximately 11,400 acre feet per year; including 5,100 acre feet per year from precipitation on the valley floor, 2,200 acre feet per year from surface water spreading, 2,300 acre feet per year from subsurface flow from the Monk Hill Sub-Area, and 1,800 acre feet per year from subsurface flow from the Sawpit watershed.

- The surface water spreading appears to be an important factor in alleviating the declination of the water level in these subareas.

- The impacts of the groundwater injection in the Pasadena-Santa Anita Sub-Areas could not be evaluated due to a lack of long-term data.

- The subsurface flow from the Raymond Basin to the Main San Gabriel Basin is absent in the groundwater balance model.

- Correlation between the groundwater production in the Pasadena-Santa Anita Sub-Areas and the water level in the City of Pasadena's Woodbury and Craig Wells appears to exist.

II. RECOMMENDATIONS

Although the groundwater balance model is considered qualitative, the Board may consider using the model as a guide in managing the groundwater resources in the Raymond Basin, especially the Pasadena-Santa Anita Sub-Areas. It is useful in comparing management scenarios, as demonstrated on Plate 8. In these scenarios, the groundwater balance model was simulated under a 20-year average condition with the average groundwater productions similar to and 50% of the 2005-06 groundwater production for the next 20 years. The results of this simulation show dramatic impacts on the basin water level, as shown on Plate 8.

The Board may also consider using the City of Pasadena's Craig Well as a key well to monitor the water level of the Pasadena-Santa Anita Sub-Areas. Since the water level in this well is very deep (currently exceeding 400 feet), a dedicated sounding tube may be installed to facilitate the water level measurements. If possible, a water level recorder may be installed to obtain adequate water level data to evaluate the response of the water level in this well to the management measures such as surface spreading and ground water injection.

Attachments

Attachment 1: Monthly Groundwater Production in Raymond Basin
Attachment 2: Monthly Groundwater Injection in Raymond Basin
Attachment 3: Monthly Surface Water Spreading in Raymond Basin

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1919-1920	1920-1921	1921-1922	1922-1923	1923-1924	1924-1925	1925-1926	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931	1931-1932	1932-1933	1933-1934	1934-1935	1935-1936	1936-1937	1937-1938	1938-1939	1939-1940	1940-1941	1941-1942	1942-1943	1943-1944	1944-1945
ALHAMBRA, CITY OF																																
NO. 2	1900007																															600.53
NO. 6	1900008																															12.40
	SUBTOTAL																															612.93
ARCADIA, CITY OF																																
ANOAKIA 1	NA																															
CHAPMAN 6	1900424																															623.14
CHAPMAN 7	NA																															
HUGO REID	1940065																															
ORANGE GROVE 1A	1902073																															1,165.07
ORANGE GROVE 2A	1902074																															499.36
ORANGE GROVE 3	1902075																															495.05
ORANGE GROVE 4A	1902076																															747.03
ORANGE GROVE 5	1902810																															
ORANGE GROVE 6	1902909																															
RANCHO 6	1902081																															730.59
RANCHO 8	1902082																															
	SUBTOTAL																															4,260.24
CALIFORNIA AMERICAN WATER COMPANY																																
AOK KNOLL (1921A)	1900927																															236.92
LAMANDA PARK (1928)	1900929																															853.47
LOMBARDY (1917)	1900933																															598.99
LOMBARDY	NA																															
OSWEGO (1921B)	1900930																															
PATTON (1923)	1900928																															43.83
WINSTON (1924)	1900932																															19.10
	SUBTOTAL																															1,752.31
EAST PASADENA WATER COMPANY																																
NO. 1	1940001																															
NO. 4	1940002																															
NO. 7	1901506																															
NO. 8	1901507																															
	SUBTOTAL																															
HUNTINGTON LIBRARY & ART GALLERY																																
CANYON	1900104																															
HILL	NA																															18.08
ORLANDO	1900103																															103.55
ROSCOE MOSS	NA																															
	SUBTOTAL																															121.63
KINNELOA IRRIGATION DISTRICT																																
EATON	1940005																															
GLEN	1940014																															6.02
K-3	1940050																															
WAGNER	1940006																															56.84
WILCOX	1940003																															52.91
	SUBTOTAL																															115.77
LA CANADA IRRIGATION DISTRICT																																
NO. 1	1900372																															74.38
NO. 6	1940103																															
	SUBTOTAL																															74.38
LAS FLORES WATER COMPANY																																
NO. 1	NA																															0.80
NO. 2	1901073																															176.04
	SUBTOTAL																															176.84
LINCOLN AVENUE WATER COMPANY																																
NO. 2	1901062																															14.83
NO. 3	1901063																															223.90
NO. 4	1901064																															359.76
NO. 5	1940012																															
	SUBTOTAL																															598.49
PASADENA, CITY OF																																
ARROYO	1900276																															1,939.63
BANGHAM	NA																															
COPELIN 3	1900278																															1,592.06
CRAIG	1900282																															10.61
EATON 51	1940108																															

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1919-1920	1920-1921	1921-1922	1922-1923	1923-1924	1924-1925	1925-1926	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931	1931-1932	1932-1933	1933-1934	1934-1935	1935-1936	1936-1937	1937-1938	1938-1939	1939-1940	1940-1941	1941-1942	1942-1943	1943-1944	1944-1945
GARFIELD	1900280																															963.35
JOURDAN	1900285																															17.99
MONTE VISTA	1900284																															15.51
NEW CHAPMAN	1940057																															
OHIO	1900281																															147.79
PASADENA 52	1940109																															
SHELDON 1	1940112																															161.64
SUNSET	1900279																															1,640.08
TOWMBLY	NA																															
VENTURA	1900275																															278.04
VILLA	1902795																															392.15
WADSWORTH	NA																															
WINDSOR	1903058																															429.04
WOODBURY	1900283																															
	SUBTOTAL																															7,587.89
PASADENA CEMETERY ASSOCIATION																																
NO. 2-3	1940026																															15.70
NO. 4	1940027																															16.28
	SUBTOTAL																															31.98
ROYAL LAUNDRY																																
ROYAL LAUNDRY	1902843																															111.66
	SUBTOTAL																															111.66
RUBIO CANON LAND AND WATER ASSOCIATION																																
NO. 2	1900993																															141.12
NO. 4	1900994																															123.80
NO. 5	1900995																															630.40
NO. 6	1900996																															
NO. 7	1950010																															
	SUBTOTAL																															895.32
SAN GABRIEL COUNTY WATER DISTRICT																																
NO. 3	1901667																															460.47
NO. 4	1901668																															189.87
	SUBTOTAL																															650.34
SIERRA MADRE, CITY OF																																
NO. 1	NA																															451.97
NO. 2	1900427																															270.29
NO. 3	1900428																															
NO. 4	1900429																															
NO. 5	1902822																															
NO. 6	1902911																															
	SUBTOTAL																															722.26
SUNNY SLOPE WATER COMPANY																																
NO. 1	1900021																															3.05
NO. 2	1900022																															82.25
NO. 3	1900023																															226.50
NO. 6	1900024																															715.37
NO. 11	1950011																															
NO. 12	NA																															
	SUBTOTAL																															1,027.17
VALLEY WATER COMPANY																																
NO. 1	1900662																															0.13
NO. 2	1900663																															0.13
NO. 3	1900664																															918.14
NO. 4	1940091																															
FLINTRIDGE	1900665																															0.00
	SUBTOTAL																															918.40
BASIN PRODUCTION																																19,657.61

ANNUAL GROUNDWATER PRODUCTION FROM ANNUAL REPORTS

SUB-AREA	1913-1914	1914-1915	1915-1916	1916-1917	1917-1918	1918-1919	1919-1920	1920-1921	1921-1922	1922-1923	1923-1924	1924-1925	1925-1926	1926-1927	1927-1928	1928-1929	1929-1930	1930-1931	1931-1932	1932-1933	1933-1934	1934-1935	1935-1936	1936-1937	1937-1938	1938-1939	1939-1940	1940-1941	1941-1942	1942-1943	1943-1944	1944-1945
MONK HILL	4,530.00	5,026.00	5,208.00	5,066.00	5,438.00	5,036.00	4,909.00	5,386.00	7,287.00	7,549.00	5,921.00	5,509.00	7,563.00	7,011.00	7,922.00	6,002.00	6,963.00	7,351.00	7,004.00	7,628.00	7,479.00	3,622.00	7,692.00	4,400.00	4,076.00							5,688.52
PASADENA	13,851.00	12,980.00	13,298.00	14,602.00	17,188.00	17,985.00	16,384.00	17,337.00	15,433.00	16,578.00	21,684.00	20,938.00	18,890.00	19,187.00	21,046.00	22,646.00	22,880.00	22,987.00	19,155.00	18,725.00	16,585.00	10,791.00	17,616.00	10,825.00	9,996.00							10,791.05
SANTA ANITA	133.00	159.00	899.00	1,319.00	1,579.00	1,849.00	1,689.00	2,026.00	2,194.00	2,241.00	3,158.00	3,202.00	2,972.00	3,279.00	3,601.00	3,463.00	3,373.00	3,763.00	3,289.00	3,311.00	3,772.00	2,287.00	3,093.00	3,548.00	3,697.00							3,628.75
RAYMOND BASIN	**18,514.00**	**18,165.00**	**19,405.00**	20,987.00	24,205.00	**24,870.00**	**22,982.00**	**24,749.00**	**24,914.00**	26,368.00	30,763.00	29,649.00	29,425.00	29,477.00	**32,569.00**	32,111.00	33,216.00	34,101.00	29,448.00	**29,664.00**	27,836.00	16,700.00	28,401.00	18,773.00	**17,769.00**							**20,108.32**

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	FISCAL YEAR 1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977
ALHAMBRA, CITY OF																																
NO. 2	1900007	760.28	715.58	628.57	656.61	686.20	632.25	745.09	668.88	668.56	773.61	851.97	861.95	931.68	679.54	646.90	918.50	1,068.60	772.87	976.14	1,012.00	797.47	979.48	230.33	882.21	613.79	855.28	761.47	747.55	884.80	667.49	909.74	779.54
NO. 6	1900008	6.25	8.96	77.05	17.41	1.62	2.07	4.41	43.94	48.87	71.95	57.12	135.56	132.15	156.49	330.30	172.90	93.70	30.64	43.85	59.69	44.97	159.84	61.20	150.46	155.23	284.51	140.66	284.08	190.64	203.99	144.37	24.03
	SUBTOTAL	766.53	724.54	705.62	674.02	687.82	634.32	749.50	712.82	717.43	845.56	909.09	997.51	1,063.83	836.03	977.20	1,091.40	1,162.30	803.51	1,019.99	1,071.69	842.44	1,139.32	291.53	1,032.67	769.02	1,139.79	902.13	1,031.63	1,075.44	871.48	1,054.11	803.57
ARCADIA, CITY OF																																
ANOAKIA 1	NA																															
CHAPMAN 6	1900424	687.21	587.46	662.33	676.14	470.33	645.46	552.18	744.8	461.36	867.02	1310.17	827.16	991.16	753.41	553.7	1167.5	1361.6	791.07	359.04	1185.57	1205.05	1043.61	953.46	990.27	1050.31	1177.16	681.31	1020.88	894.91	905.29	937.81	850.19
CHAPMAN 7	NA																															
HUGO REID	1940065																									551.51	982.41	941.30	1,065.78	1,167.67	1,123.33	1,123.33	857.79
ORANGE GROVE 1A	1902073	1,003.01	908.89	819.02	822.02	976.34	427.67	301.56	951.06	1,108.67	1,378.35	1,471.36	2,020.70	947.92	1,387.06	864.70	906.70	811.20	1,387.22	1,218.78	921.09	837.55	1,145.44	1,760.40	954.44	1,256.18	1,309.65	1,285.46	1,411.76	1,473.90	1,885.09	1,885.09	1,265.08
ORANGE GROVE 2A	1902074	191.36	390.88	227.49	562.61	323.11	202.48	283.90	655.93	584.33	644.34	777.65	1,238.59	755.80	1,906.94	1,239.40	847.60	727.20	1,387.42	1,079.42	894.77	485.71	338.87	1,967.79	861.58	1,169.35	1,113.06	1,226.57	1,788.16	1,283.30	1,412.68	1,412.68	705.40
ORANGE GROVE 3	1902075	940.11	1,043.10	872.88	919.60	889.25	458.84	378.46	1,000.60	801.21	458.05	510.23	592.14	362.29	1,008.11	366.20	144.80	29.80	161.37														
ORANGE GROVE 4A	1902076	694.11	603.95	463.07	324.97	210.85	124.05	208.01	719.12	452.61	518.42	164.20	0.00	7.12	937.88	624.30	355.80	241.10	568.28	398.42													
ORANGE GROVE 5	1902810																			317.29	496.14	420.19	368.86	782.78	879.41	704.09	713.01	527.84	77.06	34.93	198.62	198.62	252.95
ORANGE GROVE 6	1902909																					258.03	121.69	797.68	265.25	729.02	577.08	395.39	687.94	372.69	916.94	916.94	1,117.22
RANCHO 6	1902081	718.37	778.49	852.35	736.85	435.45	486.90	95.77	159.66	100.58	151.22	140.49	229.08	230.84	559.47	795.20	1,003.70	1,230.60	1,036.68	888.95	1,147.83	1,124.42	1,035.77	1,017.18	1,023.44	394.99	438.03	238.26	26.16	46.25	0.00	0.00	293.68
RANCHO 8	1902082			99.91	287.30	311.31	262.39	39.08	0.00	137.51	114.90	43.51	73.27	189.52	473.50	506.30	387.80	39.00	76.87	133.79	78.27	81.12	187.13	180.47	89.67	31.31	1.03	0.27	0.25	0.08	0.04			
	SUBTOTAL	4,234.17	4,312.77	3,997.05	4,329.49	3,616.64	2,607.79	1,858.96	4,231.17	3,646.27	4,132.30	4,417.61	4,980.94	3,484.65	7,026.37	4,949.80	4,813.90	4,440.50	5,408.91	4,395.69	4,723.67	4,412.07	4,241.37	7,459.76	5,064.06	5,886.76	6,311.43	5,296.40	6,077.99	5,273.73	6,441.99	6,474.47	5,342.31
CALIFORNIA AMERICAN WATER COMPANY																																
AOK KNOLL (1921A)	1900927	242.36	322.18	238.38	94.37	61.52	44.17	64.71	87.44	94.59	68.20	76.38	69.26	70.32	40.16	60.19	54.51	65.50	34.47	43.45	47.18	54.15	32.79	129.33	36.54	45.95	105.97	219.21	172.72	128.23	124.46	140.02	65.95
LAMANDA PARK (1928)	1900929	1,126.65	1,043.95	501.84	384.96	517.99	483.39	637.54	707.92	459.59	445.12	393.04	424.94	328.18	413.36	432.30	419.90	398.80	352.07	371.96	388.78	652.58	616.98	448.33	313.13	434.40	290.46	195.85	227.36	234.77	446.48	562.63	701.35
LOMBARDY (1917)	1900933	743.21	657.16	95.87	29.44	179.40	208.19	379.88	558.50	622.08	228.18	385.71	609.86	495.04	741.37	441.70	837.80	871.80	1,116.58	1,115.08	1,075.39	1,259.86	821.21	622.55	457.56	497.30	750.65	1,026.07	508.26	724.84	419.17	436.20	353.72
LOMBARDY	NA																															
OSWEGO (1921B)	1900930						23.50	10.59	0.00	295.70	287.90	251.57	371.69	566.51	709.02	537.40	658.30	525.90	525.90	609.58	555.85	492.98	693.95	612.96	513.19	562.18	401.22	375.40	387.16	510.34	270.87	1,009.28	754.59
PATTON (1923)	1900928	129.48	127.60	59.66	136.25	212.56	223.44	258.29	286.89	340.01	273.81	210.49	198.18	188.67	229.82	181.80	188.28	167.89	152.46	154.44	139.14	104.94	115.70	103.09	189.57	249.60	226.61	191.68	174.57	200.93	258.99	322.32	160.15
WINSTON (1924)	1900932	27.48	71.50	6.89	5.69	21.10	21.41	73.45	110.83	175.69	22.92	42.11	93.13	36.46	459.10	34.90	255.20	105.20	279.25	62.26	291.92	416.58	589.15	569.77	766.04	499.17	493.68	480.97	504.88	562.49	475.33	400.38	465.65
	SUBTOTAL	2,269.18	2,222.39	902.64	650.71	992.57	1,004.10	1,424.46	1,751.58	1,987.66	1,326.13	1,359.30	1,767.06	1,685.18	2,592.83	1,688.29	2,413.99	2,135.09	2,460.73	2,356.77	2,498.26	2,981.09	2,869.78	2,486.03	2,276.03	2,288.60	2,268.59	2,489.18	1,974.95	2,361.60	1,995.30	2,870.83	2,501.41
EAST PASADENA WATER COMPANY																																
NO. 1	1940001	1.84	3.96	12.51	12.84	0.08	0.75	1.73	0.99	0.46	0.71	0.63	0.78	0.90	0.83	0.40	4.80	9.50	2.49	7.69	14.62	17.51	11.84	12.24	5.03	21.21	2.26	7.56	4.45	96.84	157.53	33.59	31.91
NO. 4	1940002	0.60	0.60	0.55	1.73	0.01	0.16	0.30	0.06	0.07	0.07	0.08	0.12	0.08	0.28	0.10	0.20	1.00	0.04													
NO. 7	1901506	525.05	632.57	548.10	569.88	318.86	89.36	115.39	135.74	160.92	143.12	91.55	118.08	148.33	144.09	215.70	195.80	115.80	95.81	149.99	154.43	156.19	144.50	261.62	111.40	93.15	146.54	162.35	162.35	217.86	225.99	123.15	32.28
NO. 8	1901507	357.91	354.05	704.49	537.72	94.95	46.62	50.79	95.36	119.03	129.58	59.92	107.34	109.89	118.99	114.40	238.70	130.60	123.45	207.71	136.27	194.45	192.28	358.84	243.84	324.67	353.53	259.82	248.83	220.30	193.04	466.54	439.76
	SUBTOTAL	885.40	991.20	1,265.65	1,122.17	413.90	136.89	168.21	232.15	280.48	273.48	152.18	226.32	259.20	264.19	330.60	439.50	256.90	221.79	365.39	305.32	368.15	348.62	632.70	360.27	439.03	502.33	429.73	415.63	535.00	576.56	623.28	503.95
HUNTINGTON LIBRARY & ART GALLERY																																
CANYON	1900104									1.36	29.34	52.89	93.29	98.44	94.47	113.80	160.50	135.98	155.22	138.40	93.83	35.40	13.99	10.02	9.17	20.59	22.44	28.34	40.10	74.68	28.72	47.87	96.62
HILL	NA	27.62	38.48	32.16	15.81	26.30	23.99	32.48	57.88	18.60																						
ORLANDO	1900103	192.43	148.87	145.42	165.57	149.86	152.80	155.18	164.25	201.76	134.64	126.20	94.04	98.70	153.36	166.21	154.51	107.32	88.87	111.98	157.10	187.69	184.45	248.95	206.03	261.97	279.75	358.50	298.10	230.02	293.82	361.97	182.74
ROSCOE MOSS	NA																															
	SUBTOTAL	220.05	187.35	177.58	181.38	176.16	176.79	187.66	222.13	221.72	163.98	179.09	187.33	197.14	247.83	280.01	315.01	243.30	244.09	250.38	250.93	223.09	198.44	258.97	215.20	282.56	302.19	386.84	338.20	304.70	322.54	409.84	279.36
KINNELOA IRRIGATION DISTRICT																																
EATON	1940005															7.10	106.80	69.88	66.17													
GLEN	1940014	15.21	24.54	35.11	39.21	39.51	33.87	23.48	19.50	30.96	28.75	32.26	32.78	19.03	37.62	46.80	49.50	48.40	59.34	57.66	55.05	27.61	30.53	30.11	60.20	36.47	33.11	36.96	33.65	32.39	25.60	62.45	31.34
K-3	1940050																				7.18	22.69	77.85	163.66	190.31	82.65	88.18	146.04	145.74	108.33	115.41	245.87	245.35
WAGNER	1940006	0.00	0.00	12.51	17.80	22.64	16.12	13.64	16.09	14.55	15.81	14.90		7.56	12.73	0.00	2.60	0.00	1.25	0.00	0.00	0.93	1.37	2.02	1.14	1.58	1.66	2.00	0.81	0.58	0.63	0.31	0.79
WILCOX	1940003	104.89	126.87	63.26	97.47	71.09	85.11	65.72	76.40	104.55	88.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	162.56	13.28	98.24	59.31	13.99	32.98	31.15	54.34	50.16	37.88	17.76	4.97	22.59	66.16	0.00
	SUBTOTAL	120.10	151.41	110.88	154.48	133.24	135.10	102.84	111.99	150.06	132.87	47.16	32.78	26.59	50.35	53.90	158.90	118.28	289.32	70.94	160.47	110.54	123.74	228.77	282.80	175.04	173.11	222.88	197.96	146.27	184.23	374.79	277.48
LA CANADA IRRIGATION DISTRICT																																
NO. 1	1900372	155.28	193.17	92.06	30.24	1.75	48.48	150.35	87.54	191.64	524.08	215.11	158.10	34.94	123.66	90.60	72.79	39.40	7.44	37.47	37.66	76.04	15.90	194.14	69.96	34.21	10.50	15.24	17.81	0.00	0.00	6.84	1.45
NO. 6	1940103			129.78	345.82	562.59	688.79	459.95	548.47	588.72	448.37	71.83	77.00	1.51	1.51	91.00	97.90	31.90	47.88	63.41	62.37	98.31	74.83	41.15	0.19	9.47	9.47	0.67	45.88	158.29	154.03	161.42	139.03
	SUBTOTAL	155.28	193.17	221.84	376.06	564.34	737.27	610.30	636.01	780.36	972.45	286.94	235.10	36.45	125.17	181.60	170.69	71.30	55.32	100.88	100.03	174.35	90.73	235.29	70.15	43.68	19.97	15.91	63.69	158.29	154.03	168.26	140.48
LAS FLORES WATER COMPANY																																
NO. 1	NA	0.86	2.66	27.27	25.90	58.62	40.34	87.49	5.37	5.66	9.86	0.93	0.00			1.10																
NO. 2	1901073	351.21	422.96	506.13	592.80	618.44	708.84	510.64	393.19	469.97	443.82	360.56	532.43	307.53	203.66	211.30	235.70	259.50	242.67	268.95	247.71	237.03	241.84	254.29	192.26	295.92	231.82	277.19	256.22	258.89	272.45	281.70	265.41
	SUBTOTAL	352.07	425.62	533.40	618.70	677.06	749.18	598.13	398.56	475.63	453.68	361.49	532.43	307.53	203.66	212.40	235.70	259.50	242.67	268.95	247.71	237.03	241.84	254.29	192.26	295.92	231.82	277.19	256.22	258.89	272.45	281.70	265.41
LINCOLN AVENUE WATER COMPANY																																
NO. 2	1901062	115.44	218.88	197.97	0.00	341.55	334.42	274.89	143.13	259.07	300.17	222.87	188.79	145.30	134.02	121.90	12.40	6.10	40.52	56.44	60.30	40.24	31.18	113.55	17.10	34.16	128.23	65.37	38.06	47.23	52.98	43.53	
NO. 3	1901063	250.43	80.59	456.71	0.00	514.59	686.84	502.63	569.16	492.80	576.49	458.76	450.69	336.80	291.93	146.70	244.01	288.21	370.11	211.48	328.17	290.74	212.11	331.95	215.60	278.26	286.89	412.09	313.27	340.53	361.01	477.19	67.98
NO. 4	1901064	517.43	632.17	775.51	0.00	721.96	688.96	539.39	591.38	603.19	700.61	575.42	512.11	345.36	336.11	506.20	246.30	203.60	386.46	279.16	186.36	256.59	204.70	294.80	396.94	251.01	143.39						
NO. 5	1940012																											193.65	375.12	331.60	604.87	664.20	638.28
	SUBTOTAL	883.30	931.64	1,430.19	0.00	1,578.10	1,710.22	1,316.91	1,303.67	1,355.06	1,577.27	1,257.05	1,151.59	827.46	762.06	774.80	502.71	497.91	797.09	547.08	574.83	587.57	447.99	740.30	629.64	563.43	558.51	671.11	726.45	719.36	1,018.86	1,184.92	706.26
PASADENA, CITY OF																																
ARROYO	1900276	2,353.58	1,073.00	917.13	0.00	10.71	13.47	2.78	19.13	0.00	9.39	1,528.86	2,549.94	1,975.29	2,631.32	2,620.00	2,466.90	1,911.40	2,520.11	2,690.86	2,243.53	2,175.32	605.31	209.13	2,976.86	2,350.28	3,070.51	2,809.05	3,084.51	3,236.07	1,834.16	1,656.37	2,837.30
BANGHAM	NA																															
COPELIN 3	1900278	2,193.97	1,396.51	1,730.94	1,053.27	581.27	663.69	848.55	631.33	630.43	750.77	1,637.97	1,850.61	2,303.62	1,927.57	1,890.00	2,408.68	2,273.79	1,214.86	1,209.36	440.60	1,771.50	830.99	1,339.75	635.09	928.20	470.62	469.96	1,019.44	1,263.18	1,600.33	1,271.76	1,041.33
CRAIG	1900282	116.31	177.51	321.84	218.17	20.40	84.02	101.49	139.06	155.57	0.00	0.00	31.14	107.27	40.91	60.50	31.10	7.10	10.42	60.25	48.32	193.83	175.42	481.78	12.29	64.59	64.59	533.04	1,057.76	864.36	720.39	1,433.85	1,030.27
EATON 51	1940108																															

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	FISCAL YEAR 1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977
GARFIELD	1900280	1,088.65	381.10	0.00	303.22	748.46	1,604.86	1,530.73	1,305.82	1,435.58	1,556.19	1,599.94	1,436.90	1,207.07	1,725.13	1,272.20	1,346.30	1,755.71	473.81	787.30	840.74	692.67	442.00	1,318.11	1,023.26	1,325.73	933.33	718.66	1,284.01	1,095.00	887.58	1,642.10	1,609.38
JOURDAN	1900285	0.00	0.00	821.21	1,490.88	882.34	2,820.33	845.51	1,469.93	1,600.80	1,614.60	881.84	2,261.21	1,076.78	994.28	1,429.00	1,536.30	855.30	55.71	7.28	175.42	133.82	0.00	129.32	7.05	2,043.77	1,230.73	1,014.65	232.96	510.62	135.84	1,037.19	61.56
MONTE VISTA	1900284	0.00	55.73	113.81	157.16	56.02	200.17	617.20	151.36	2.21	272.99	281.81	44.57	85.15	117.76	93.69	5.11	7.40	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NEW CHAPMAN	1940057																										47.05	1,886.70	1,520.36	910.29	833.00	1,927.12	1,305.71
OHIO	1900281	201.03	226.46	104.50	183.25	197.67	203.78	211.12	229.49	261.22	227.24	190.83	355.74	138.81	19.43	15.10	9.50	102.80	35.04	32.64	18.61	13.36	362.76	326.97	204.23	12.96	12.96	18.27	0.06			
PASADENA 52	1940109																															
SHELDON 1	1940112	80.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUNSET	1900279	1,383.72	850.51	2,442.63	1,548.64	1,187.53	1,466.32	1,268.22	1,025.83	634.32	885.39	1,438.45	2,497.65	2,528.00	2,429.55	2,248.99	1,687.31	2,046.10	1,971.35	2,055.71	2,154.55	1,598.03	1,454.17	2,116.81	933.32	1,041.68	963.19	736.01	1,071.30	1,317.75	1,520.30	1,142.68	1,645.95
TOWMBLY	NA																															
VENTURA	1900275	348.20	0.00	245.20	0.00	0.00	9.72	2.08	1.69	0.00	9.65	66.63	145.30	1,975.28	2,631.33	2,620.00	1,347.90	1,124.10	1,217.78	681.99	1,291.20	384.13	1,093.12	3,162.29	2,458.32	2,640.66	1,512.98	194.23	2,062.65	1,186.03	1,988.10	2,454.87	1,977.56
VILLA	1902795	272.90	205.03			0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	629.40	2,931.35	2,371.77	2,293.47	2,545.82	1,936.00	2,555.06	1,398.21	2,176.74	1,777.54	2,013.63	1,349.24	1,953.82	2,884.16	603.37	2,072.41
WADSWORTH	NA																															
WINDSOR	1903058	152.44	380.68	0.00	0.00	0.00	7.08	1.92	6.12	6.61	2.68	50.75	59.59	615.30	1,550.41	533.30	236.80	902.60	1,247.51	1,250.56	971.70	967.47	989.39	0.00	23.92	0.00	985.95	1,282.54	943.99	531.27	546.45	398.69	365.28
WOODBURY	1900283			936.94	1,138.32	211.16	1,447.02	722.56	2,023.99	1,162.46	1,543.16	1,693.30	1,654.01	1,764.49	1,872.52	1,055.39	1,412.79	1,969.99	1,267.82	2,179.83	2,135.36	2,475.92	2,198.23	2,774.30	2,088.41	2,218.40	1,735.30	1,338.96	890.79	793.89	340.40	2,063.58	1,883.87
	SUBTOTAL	8,191.14	4,746.53	7,634.20	6,092.91	3,895.56	8,520.46	5,952.16	7,003.75	5,889.20	6,872.06	9,370.38	12,886.66	13,777.06	15,940.21	13,838.17	12,488.69	13,585.69	12,945.76	13,327.57	12,613.50	12,951.87	10,087.39	14,413.52	11,760.96	14,803.01	12,804.75	13,015.70	14,497.07	13,662.28	13,290.71	15,631.58	15,830.62

PASADENA CEMETERY ASSOCIATION

NO. 2-3	1940026	22.61	26.12	0.00	46.59	45.45	36.67	30.45	42.83	44.32	45.92	52.49	49.44	42.65	55.08	51.20	64.21	85.81	92.17	69.73	67.84	74.85	71.34	85.40	78.14	90.37	83.01	80.30	53.23	61.07	58.58	76.27	51.62
NO. 4	1940027	23.50	26.00	0.00	24.24	19.74	19.36	19.17	22.33	24.34	23.08	21.14	18.98	18.34	22.24	23.60	24.70	21.80	14.62	17.38	25.24	9.26	21.53	22.95	20.95	23.69	26.36	24.75	21.49	22.14	18.44	6.73	4.62
	SUBTOTAL	46.11	52.12	0.00	70.83	65.19	56.03	49.62	65.16	68.66	69.00	73.63	68.42	60.99	77.32	74.80	88.91	107.61	106.79	87.11	93.08	84.11	92.87	108.35	99.09	114.06	109.37	105.05	74.72	83.21	77.02	83.00	56.24

ROYAL LAUNDRY

ROYAL LAUNDRY	1902843	95.36	102.13	118.03	125.75	124.68	121.48	120.12	124.11	135.03	132.88	136.22	152.37	136.46	136.73	136.20	135.90	105.60	151.20	145.93	132.72	115.39	134.38	149.95	150.18	150.84	154.82	158.24	160.63	153.48	143.72	131.65	127.42
	SUBTOTAL	95.36	102.13	118.03	125.75	124.68	121.48	120.12	124.11	135.03	132.88	136.22	152.37	136.46	136.73	136.20	135.90	105.60	151.20	145.93	132.72	115.39	134.38	149.95	150.18	150.84	154.82	158.24	160.63	153.48	143.72	131.65	127.42

RUBIO CANON LAND AND WATER ASSOCIAT

NO. 2	1900993	179.03	187.83	202.86	140.83	132.56	129.16	120.59	57.21	155.70	77.64	27.92	82.93	90.32	72.28	41.20	53.60	100.40	111.40	108.00	105.19	114.43	97.70	81.20	88.77	108.31	95.68	118.29	82.88	1.16	0.00	82.25	162.28
NO. 4	1900994	65.87	51.82	172.56	471.04	205.53	165.86	230.61	65.05	54.08	64.19	132.29	105.47	23.97	66.38	153.19	12.20	20.41	0.00	140.32	42.54	185.06	24.47	284.15	296.74	444.21	203.72	113.23	358.60	353.03	182.51	22.65	30.50
NO. 5	1900995	1,023.85	1,044.35	1,320.00	962.41	1,276.50	1,383.71	876.29	1,101.96	1,143.79	999.51	1,164.23	1,007.07	941.39	1,021.35	808.60	917.90	833.80	941.01	907.90	865.97	671.28	577.83	1,019.39	884.54	842.12	738.06	848.10	706.87	751.38	874.14	1,145.20	921.79
NO. 6	1900996			0.00	187.19	171.33	173.16	249.90	260.24	295.61	410.65	170.33	236.11	240.83	208.72	220.90	235.80	220.20	152.99	151.39	144.03	157.49	97.89	123.35	96.19	93.00	97.19	88.44	95.59	174.76	170.10	105.51	3.30
NO. 7	1950010																															
	SUBTOTAL	1,268.75	1,284.00	1,695.42	1,761.47	1,785.94	1,851.89	1,477.39	1,484.46	1,649.18	1,551.99	1,494.77	1,431.58	1,296.51	1,368.73	1,223.89	1,219.50	1,174.81	1,205.40	1,307.61	1,157.73	1,128.26	797.89	1,508.09	1,366.24	1,487.64	1,134.65	1,168.06	1,243.94	1,280.33	1,226.75	1,355.61	1,117.87

SAN GABRIEL COUNTY WATER DISTRICT

NO. 3	1901667	201.43	110.67	231.13	41.49	56.59	149.62	128.38	42.55	15.09	293.86	328.94	538.28	283.99	867.27	599.50	794.80	492.60	594.22	689.68	924.28	725.60	1,080.13	1,103.60	1,059.94	1,104.86	1,104.62	1,070.75	1,095.98	943.33	1,234.71	1,090.99	1,090.98
NO. 4	1901668	213.43	111.42	305.54	79.26	49.90	130.59	86.94	62.86	23.91	292.89	323.78	349.94	83.58	384.46	566.60	674.70	576.30	329.29	508.05	316.92	273.96	40.64	9.04	3.03	0.52	0.41	1.96	0.35	0.00	0.00	0.00	0.00
	SUBTOTAL	414.86	222.09	536.67	120.75	106.49	280.21	215.32	105.41	39.00	586.75	652.72	888.22	367.57	1,251.73	1,166.10	1,469.50	1,068.90	923.51	1,197.73	1,241.20	999.56	1,120.77	1,112.64	1,062.97	1,105.38	1,105.03	1,072.71	1,096.33	943.33	1,234.71	1,090.99	1,090.98

SIERRA MADRE, CITY OF

NO. 1	NA	679.07	583.21	417.19	258.62	308.13	193.48	434.96	447.23	501.79	445.80	300.39	318.64	390.05	318.52	202.90																
NO. 2	1900427	491.53	658.53	737.78	517.45	477.68	730.01	430.74	575.05	598.34	471.20	230.34	99.66	45.19	134.18	85.30	68.10	190.60	14.85	2.94	24.04	0.26	1.87	0.00								
NO. 3	1900428			489.13	692.90	703.16	659.88	476.50	576.66	761.98	604.52	211.94	344.19	380.62	743.23	951.70	1,011.20	1,032.70	564.02	598.78	645.06	472.79	283.60	118.64	119.24	407.57	432.01	760.15	528.30	667.50	512.58	493.02	661.22
NO. 4	1900429											1,164.27	1,062.18	934.52	619.19	732.40	878.20	744.00	567.68	451.88	408.99	174.19	292.66	371.43	368.30	317.77	379.50	467.95	327.21	208.40	139.86	701.66	322.24
NO. 5	1902822																	12.60	871.30	1,161.72	1,042.35	787.28	342.36	670.20	381.50	542.57	482.23	617.34	676.05	571.48	856.84	564.45	340.32
NO. 6	1902911																				3.90	385.61	473.31	562.37	682.05	318.65	318.65	513.40	389.41	381.33	415.70	605.19	363.91
	SUBTOTAL	1,170.60	1,241.74	1,644.10	1,468.97	1,488.97	1,583.37	1,342.20	1,598.94	1,862.11	1,521.52	1,906.94	1,824.67	1,750.38	1,815.12	1,972.30	1,957.50	1,979.90	2,017.85	2,215.32	2,124.34	1,820.13	1,393.80	1,722.64	1,551.09	1,586.56	1,612.39	2,358.84	1,920.97	1,828.71	1,924.98	2,364.32	1,687.69

SUNNY SLOPE WATER COMPANY

NO. 1	1900021	33.14	16.52	29.64	21.17	32.93	88.09	57.32	253.94	188.24	27.88	331.63	701.68	630.84	514.15	371.40	462.60	409.70	564.90	680.22	327.15	753.80	837.71	843.13	523.30	665.56	491.88	374.69	941.37	309.65	278.25	570.21	249.21
NO. 2	1900022	69.25	58.33	35.53	4.27	30.85	9.90	7.78	35.26	21.11	119.00	98.54	47.20	47.75	193.25	0.90	0.10	0.20	0.30	0.50	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. 3	1900023	353.15	371.40	295.61	358.66	431.83	211.17	252.48	328.99	438.81	679.83	720.35	605.92	521.99	527.06	680.50	641.10	625.60	628.60	641.24	512.87	566.32	497.17	406.23	766.84	755.59	524.64	343.17					
NO. 6	1900024	828.96	269.79	670.78	688.61	473.08	556.20	773.32	499.79	980.79	412.67	416.65	363.94	306.01	298.88	566.10	416.70	350.20	443.35	403.14	500.47	467.15	212.47	329.38	263.35	156.25	594.72	310.88	621.97	1,712.98	1,017.63	1,346.98	1,080.41
NO. 11	1950011																															
NO. 12	NA																															
	SUBTOTAL	1,284.50	716.04	1,031.56	1,072.71	968.69	865.36	1,090.90	1,117.98	1,628.95	1,239.38	1,567.17	1,718.74	1,506.59	1,533.34	1,618.90	1,520.50	1,385.70	1,637.15	1,725.10	1,340.68	1,787.27	1,547.35	1,578.74	1,553.29	1,577.40	1,611.24	1,028.74	1,563.34	2,022.63	1,295.88	1,917.19	1,329.62

VALLEY WATER COMPANY

NO. 1	1900662	26.15	116.86	215.23	280.05	388.93	380.18	514.24	436.30	494.21	388.01	692.43	532.04	428.97	454.54	584.61	805.70	609.70	463.68	898.34	611.23	556.06	440.71	628.46	576.85	838.64	655.47	262.81	277.75	297.10	142.97	58.22	94.73
NO. 2	1900663	39.98	0.15	3.28	27.51	31.57	259.78	135.40	139.77	218.90	286.41	19.78	40.56	8.58	1.25	0.00	0.50	2.40	463.68	0.21	0.56	1.19	0.09	9.10	0.00	6.60	15.36	462.64	305.56	278.87	384.65	177.76	236.69
NO. 3	1900664	1,095.37	957.74	1,278.19	1,259.49	1,152.16	980.46	999.35	1,287.70	1,237.51	1,229.12	223.28	96.63	82.89	10.03	5.80	17.29	1.78	2.07	8.44	2.12	31.65	0.27	0.15	0.46	0.00	0.40	0.62	1.16	0.00	0.53	0.16	5.44
NO. 4	1940091																		2.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.26	158.88	196.81	377.43	239.93	579.85	308.00
FLINTRIDGE	1900665	16.36	157.49	135.54	193.70	249.43	342.60	269.02	198.80	177.06	144.73	229.14	236.54	169.28	248.14	212.70	46.90	82.70	195.89	95.06	157.24	255.68	295.36	203.95	3.14	80.93						
	SUBTOTAL	1,177.86	1,232.24	1,632.24	1,760.75	1,822.09	1,963.02	1,918.01	2,062.57	2,127.68	2,048.27	1,164.63	905.77	689.72	713.96	803.11	870.39	696.58	1,127.39	1,002.05	771.15	844.58	736.43	841.66	580.45	926.17	672.49	884.95	781.28	953.40	768.08	815.99	644.86

BASIN PRODUCTION		**23,535.26**	**19,736.98**	**23,637.07**	**20,581.15**	**19,097.44**	**23,133.48**	**19,182.69**	**23,162.46**	**23,014.48**	**23,899.57**	**25,336.37**	**29,987.49**	**27,473.31**	**34,945.63**	**30,282.07**	**29,892.69**	**29,289.87**	**30,638.48**	**30,384.49**	**29,407.31**	**29,667.50**	**25,612.71**	**34,023.23**	**28,247.35**	**32,495.10**	**30,712.48**	**30,483.66**	**32,421.00**	**31,760.65**	**31,779.29**	**36,832.53**	**32,705.53**

ANNUAL GROUNDWATER PRODUCTION FRC

SUB-AREA	FISCAL YEAR 1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976	1976-1977
MONK HILL	6,841.88	5,572.50	6,739.88	6,117.28	6,503.33	7,097.86	5,903.26	5,972.92	6,282.63	6,420.37	6,319.02	7,057.00	5,915.61	8,159.64	7,991.60	7,141.00	6,742.30	8,084.20	7,937.09	7,450.96	6,582.82	5,096.64	7,059.40	8,396.92	8,421.87	8,286.78	7,408.09	9,217.44	8,408.24	7,885.89	8,398.41	8,217.07
PASADENA	12,897.16	10,192.58	13,191.99	12,093.14	8,913.78	13,417.90	10,750.43	12,471.43	11,765.22	12,782.84	14,059.54	17,474.00	16,054.08	18,027.39	16,428.30	18,796.10	18,418.60	16,828.30	17,468.83	17,681.52	19,396.75	17,240.87	19,983.56	15,489.71	18,710.32	17,091.59	17,359.09	17,331.02	18,415.19	17,586.48	21,707.31	19,414.31
SANTA ANITA	3,999.32	4,188.54	4,026.58	4,098.12	3,836.27	2,860.82	2,489.08	4,869.97	3,378.35	4,528.44	4,607.44	5,484.00	1,516.51	7,017.61	4,858.60	3,341.90	3,496.30	5,268.30	4,777.91	3,599.00	3,388.48	3,368.66	7,031.30	4,511.77	5,445.17	5,611.55	5,794.10	5,801.24	4,993.53	6,338.31	6,070.47	5,229.27

RAYMOND BASIN	23,738.36	**19,953.62**	**23,958.45**	**22,308.54**	**19,253.38**	**23,376.58**	19,142.77	23,314.32	21,426.20	23,731.65	24,986.00	**30,015.00**	**23,486.20**	**33,204.64**	**29,278.50**	**29,279.00**	28,657.20	**30,180.80**	30,183.83	28,731.48	**29,368.05**	**25,706.17**	**34,074.26**	28,398.40	32,577.36	30,989.92	30,561.28	**32,349.70**	**31,816.96**	31,810.68	36,176.19	**32,860.65**

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
ALHAMBRA, CITY OF																															
NO. 2	1900007	707.85	889.80	378.49	1,008.63	855.60	799.58	853.36	822.16	821.02	743.53	218.58	0.48	0.00	735.70	766.14	676.97	783.62	643.20	975.10	771.20	899.50	337.90	114.40	76.10	3.70	0.00	0.00	0.00	0.00	0.00
NO. 6	1900008	62.24	205.58	0.66	40.59	288.06	201.69	193.87	157.87	175.62	174.19	5.46																			
	SUBTOTAL	770.09	1,095.38	379.15	1,049.22	1,143.66	1,001.27	1,047.23	980.03	996.64	917.72	224.04	0.48	0.00	735.7	766.14	676.97	783.62	643.20	975.10	771.20	899.50	337.90	114.40	76.10	3.70	0.00	0.00	0.00	0.00	0.00
ARCADIA, CITY OF																															
ANOAKIA 1	NA																									337.47	627.50	712.72	1,313.94	894.89	
CHAPMAN 6	1900424	965.5	1038.57	939	654.6	0	704.91	1147.1	896.64	696.31	997.4	1008.78	806.79	1077.13	981.83	737.51	1175.01	1188.78	1443.2	738.3	485.3	279.6	830.3	918.9	885.2	772.5	378.8				
CHAPMAN 7	NA																										718.00	1,321.53	1,330.77	1,290.13	
HUGO REID	1940065	1,001.10	975.56	1,009.39	1,416.49	1,522.84	1,154.36	948.27	1,258.45	1,427.27	1,372.02	791.53	1,501.93	1,368.56	1,440.64	1,575.79	1,121.65	1,196.80	1,234.58	1,180.99	1,785.85	1,240.98	1,523.50	1,627.50	1,369.90	1,345.80	1,216.80	1,060.00	915.27	246.65	0.00
ORANGE GROVE 1A	1902073	825.40	1,051.38	1,542.02	1,733.37	1,048.30	1,186.58	1,922.52	1,128.82	1,064.13	893.21	807.32	878.60	861.14	535.43	865.11	599.14	767.60	1,404.11	1,035.00	1,455.30	1,155.20	1,407.84	756.30	662.33	610.30	328.00	153.39	1,015.10	1,179.30	1,095.82
ORANGE GROVE 2A	1902074	840.36	2,060.31	1,550.85	1,995.91	990.68	1,254.38	1,946.65	1,919.20	1,919.60	1,641.70	1,022.10	1,088.17	965.43	708.99	1,097.09	841.80	1,814.87	1,040.25	1,021.21	1,229.42	1,181.40	1,566.30	980.00	953.20	889.62	674.30	751.70	388.18	1,239.42	1,074.55
ORANGE GROVE 3	1902075																														
ORANGE GROVE 4A	1902076																														
ORANGE GROVE 5	1902810	442.68	492.39	710.06	803.78	330.76	590.13	677.16	578.29	568.03	557.73	529.11	408.80	586.13	508.14	598.82	500.51	1,026.92	784.00	648.10	850.30	916.83	1,033.97	742.00	831.20	945.40	913.70	968.93	1,118.63	1,219.10	1,117.34
ORANGE GROVE 6	1902909	748.57	1,084.29	1,050.35	813.35	563.04	901.57	1,011.73	1,263.73	1,476.67	1,353.11	1,094.62	1,259.13	1,147.06	1,236.88	1,540.39	962.38	1,712.20	1,532.73	957.16	415.31	976.80	948.39	1,126.54	626.42	0.00	303.70	798.10	704.23	1,079.27	908.79
RANCHO 6	1902081	156.31	244.20	156.58	105.22	225.55	280.57	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	485.43	279.68	5.10	31.40	0.10	0.50	1.20	0.00	0.00	0.00	0.00
RANCHO 8	1902082																														
	SUBTOTAL	4,979.92	6,946.70	6,958.25	7,522.72	4,681.17	6,072.50	7,653.60	7,045.13	7,152.01	6,815.17	5,253.46	5,943.42	6,005.45	5,411.91	6,414.71	5,200.49	7,707.17	7,438.87	5,580.76	6,706.91	6,030.49	7,315.40	6,182.64	5,328.35	4,564.12	4,153.97	5,077.62	6,175.66	7,608.45	6,381.52
CALIFORNIA AMERICAN WATER COMPANY																															
AOK KNOLL (1921A)	1900927	155.45	214.74	0.00	0.00	0.00	68.99	80.70	176.99	144.90	212.82	412.36	478.47	400.12	358.63	987.10	258.36	263.65	297.80	119.90	480.90	350.60	309.90	454.10	280.80	0.00	0.00	0.00	0.00	0.18	0.00
LAMANDA PARK (1928)	1900929	490.55	706.68	777.04	777.55	859.85	687.50	1,027.00	748.67	643.97	871.65	1,310.64	1,527.28	1,082.37	618.63	534.79	774.69	497.58	682.30	999.80	756.10	363.40	584.40	603.00	491.30	568.20	471.10	461.60	229.17	0.00	0.00
LOMBARDY (1917)	1900933	625.01	290.34	705.88	103.50	395.06	349.84	715.69	845.42	645.92	680.80	393.66	68.95	553.17	351.16	4.44	422.00	226.46	255.30	153.56	5.80										
LOMBARDY	NA																				290.40	1,086.50	1,038.30	1,259.90	1,343.10	1,392.80	1,401.40	1,400.40	1,085.58	1,214.79	1,245.70
OSWEGO (1921B)	1900930	139.12	438.36	297.22	552.50	765.68	515.88	342.90	171.83	240.98	446.05	295.98	716.78	307.48	511.52	493.52	571.38	945.45	537.00	629.30	590.70	304.90	416.10	670.40	135.70	0.20	0.00	59.50	165.61	0.00	210.37
PATTON (1923)	1900928	1,060.06	166.22	398.69	342.70	328.98	369.85	269.08	274.92	250.64	297.13	351.01	490.33	390.74	250.33	181.92	364.68	296.40	436.10	441.60	339.60	225.80	432.80	606.00	349.20	0.00	0.00	0.00	0.00	0.00	0.00
WINSTON (1924)	1900932	799.14	558.82	480.51	554.40	250.04	393.69	186.52	301.53	59.48	493.40	0.50	4.59	7.06	78.90	281.25	92.01	74.15	18.10	52.00	57.30	145.20	212.60	408.20	760.70	909.90	544.10	371.80	313.22	548.24	448.75
	SUBTOTAL	3,269.33	2,375.16	2,659.34	2,330.65	2,599.61	2,385.75	2,621.89	2,519.36	1,985.89	3,001.65	2,764.15	3,286.40	2,740.94	2,169.17	2,483.02	2,483.12	2,303.69	2,226.60	2,396.16	2,520.80	2,476.40	2,994.10	4,001.60	3,360.80	2,871.10	2,416.60	2,293.30	1,793.58	1,763.21	1,904.82
EAST PASADENA WATER COMPANY																															
NO. 1	1940001	30.95	3.44	8.61	3.10	4.92																									
NO. 4	1940002																														
NO. 7	1901506	147.88	85.71	40.77	249.26	299.95	279.66	150.42	224.39	299.95	299.95	404.71	359.19	379.05	387.96	335.80	500.20	437.96	254.90	378.00	492.30	577.00	517.40	568.29	450.50	436.70	458.20	196.40	113.47	58.40	6.42
NO. 8	1901507	271.93	273.79	311.04	140.02	44.84	228.68	280.47	104.23	44.84	44.84	404.71	109.54	65.16	110.21	132.24	118.98	63.49	240.80	145.60	10.60	1.10	1.10	1.30	0.80	0.40	98.00	561.12	375.08	379.65	423.46
	SUBTOTAL	450.76	362.94	360.42	392.38	349.71	508.34	430.89	328.62	344.79	344.79	809.42	468.73	444.21	498.17	468.04	619.18	501.45	495.70	523.60	502.90	578.10	518.50	569.59	451.30	437.10	556.20	757.52	488.55	438.05	429.88
HUNTINGTON LIBRARY & ART GALLERY																															
CANYON	1900104	211.46	52.79	165.61	58.16	54.55	60.31	166.44	55.80	112.72	99.82	178.89	221.95	195.41	242.57	237.91	90.88	189.79	123.70	175.40	237.40	99.80	204.80	188.70	176.50	142.60	49.10	198.10	129.00	179.50	286.96
HILL	NA																														
ORLANDO	1900103	84.86	244.20	104.09	276.19	190.06	189.40	102.93	94.91	209.86	170.01	99.77	110.24	53.96	61.04	26.14	245.90	169.10	233.50	264.80	190.00	199.90	119.30	243.20	109.80	110.80	87.70	25.70	20.85	8.54	5.79
ROSCOE MOSS	NA																										47.60	113.90	113.57	76.23	72.94
	SUBTOTAL	296.32	296.99	269.70	334.35	244.61	249.71	269.37	150.71	322.58	269.83	278.66	332.19	249.37	303.61	264.05	336.78	358.89	357.20	440.20	427.40	299.70	324.10	431.90	286.30	253.40	184.40	337.70	263.42	264.27	365.69
KINNELOA IRRIGATION DISTRICT																															
EATON	1940005																														
GLEN	1940014	36.60	3.48	12.78	4.74	4.60																									
K-3	1940050	144.26	141.54	181.75	166.58	133.34	103.87	194.08	183.24	204.42	181.97	220.93	264.43	387.86	298.40	292.30	307.00	411.30	285.30	238.30	263.80	330.90	567.30	562.50	425.20	514.29	457.10	551.00	319.30	423.52	860.08
WAGNER	1940006	0.71	0.00	0.00	0.00	1.21	0.33	0.64	1.05	1.00	1.08	0.59	0.27	0.25	0.92	0.54	0.41	0.27	0.00												
WILCOX	1940003	115.80	82.89	135.56	204.18	277.38	264.30	191.28	183.68	287.94	374.00	360.44	326.28	134.19	383.90	147.60	74.30	59.00	93.20	119.60	170.20	165.40	209.56	272.40	216.90	203.70	213.65	148.90	60.24	37.17	70.17
	SUBTOTAL	297.37	227.91	330.09	375.50	416.53	368.50	386.00	367.97	493.36	557.05	581.96	590.98	522.30	683.22	440.44	381.71	470.57	378.50	357.90	434.00	496.30	776.86	834.90	642.10	717.99	670.75	699.90	379.54	460.69	930.25
LA CANADA IRRIGATION DISTRICT																															
NO. 1	1900372	0.00	0.00	0.00	0.00	0.00	77.60	104.79	172.11	247.88	312.78	139.42	150.66	141.32	84.72	22.29	17.55	0.83	33.60	59.50	66.20	23.40	142.60	28.20	163.90	0.30	0.70	1.00	0.36	0.32	0.03
NO. 6	1940103	93.46	149.03	151.14	105.16	98.72	27.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	0.00	0.00	27.18	7.00	15.10	12.10	130.00	135.80	120.80	149.16	72.85	15.61
	SUBTOTAL	93.46	149.03	151.14	105.16	98.72	104.84	104.79	172.11	247.88	312.78	139.42	150.66	141.32	85.77	22.29	17.55	0.83	33.60	59.50	66.20	50.58	149.60	43.30	176.00	130.30	136.50	121.80	149.52	73.17	15.64
LAS FLORES WATER COMPANY																															
NO. 1	NA																														
NO. 2	1901073	202.18	264.99	444.77	608.02	412.09	403.39	514.38	600.42	539.94	725.24	716.15	655.62	637.15	287.61	268.16	416.48	253.27	481.50	451.60	447.00	325.50	320.50	274.40	181.70	248.90	192.68	418.91	341.50	311.28	358.13
	SUBTOTAL	202.18	264.99	444.77	608.02	412.09	403.39	514.38	600.42	539.94	725.24	716.15	655.62	637.15	287.61	268.16	416.48	253.27	481.50	451.60	447.00	325.50	320.50	274.40	181.70	248.90	192.68	418.91	341.50	311.28	358.13
LINCOLN AVENUE WATER COMPANY																															
NO. 2	1901062																														
NO. 3	1901063	138.21	204.30	125.93	115.67	130.84	193.94	498.67	447.73	408.34	184.00	0.27	0.07	0.15	468.39	0.57	285.81	256.11	781.50	771.20	851.80	1,073.90	449.90	512.60	531.00	301.90	617.70	638.60	1,310.45	1,116.56	1,452.13
NO. 4	1901064																														
NO. 5	1940012	715.55	742.17	601.78	746.14	651.96	357.10	306.97	101.38	46.80	1.61	0.22	0.12	0.00	0.00	125.70	444.41	271.63	0.90	0.20	155.50	0.60	718.30	695.90	528.20	531.10	532.60	676.60	617.03	733.88	1,499.64
	SUBTOTAL	853.76	946.47	727.71	861.81	782.80	551.04	805.64	549.11	455.14	185.61	0.49	0.19	0.15	468.39	126.27	730.22	527.74	782.40	771.40	1,007.30	1,074.50	1,168.20	1,208.50	1,059.20	833.00	1,150.30	1,315.20	1,927.48	1,850.44	2,951.77
PASADENA, CITY OF																															
ARROYO	1900276	1,934.07	2,096.00	2,375.09	496.45	866.14	1,265.90	1,354.52	951.02	121.38	0.00	115.83	18.75	1.13	0.00	0.00	1,059.31	1,484.96	2,467.30	3,266.90	2,954.49	1,790.85	2,167.45	1,995.23		0.00	0.00	0.00	0.00	0.00	0.00
BANGHAM	NA																	0.00		1,079.60	1,423.43	1,969.50	1,944.81	0.00		841.41	181.19	10.16	5.20	5.36	408.56
COPELIN 3	1900278	777.48	778.04	1,667.15	1,018.72	512.90	0.00	0.00	1,178.30	1,870.09	2,121.54	2,030.21	1,287.48	1,104.03	1,382.57	702.87	431.16	47.81	739.30	909.20	854.10	1,120.80	1,138.50	1,097.80	533.10	462.60	33.70	1.50	1.66	0.00	4.19
CRAIG	1900282	362.00	511.85	1,652.01	423.05	0.00	1,295.27	1,682.19	1,363.76	1,532.03	1,475.27	1,107.88	1,663.41	1,401.27	418.17	444.34	473.92	0.00	713.90	860.70	944.00	878.86	1,117.50	993.30	571.60	1,330.90	1,087.33	993.70	567.86	1,126.00	385.28
EATON 51	1940108	308.32	365.83	389.37	452.22	454.29	450.15	436.66	396.36	405.64	383.94	364.92	396.97	322.18	0.00	0.00	238.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

TABLE 1
HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

WELL NAME	RECORDATION NUMBER	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
GARFIELD	1900280	1,028.11	839.50	1,733.19	1,651.57	1,884.52	1,651.26	1,745.53	1,869.85	1,282.28	2,244.12	1,275.66	2,317.44	651.75	1,356.01	547.86	505.59	16.01	1,068.40	1,279.60	1,520.00	1,585.90	1,486.80	391.30	799.50	631.91	180.20	671.96	2,109.67	2,248.59	922.37
JOURDAN	1900285	2.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				1.39	230.80	345.40	312.41	189.37					0.00	0.00	0.00	0.00	0.00
MONTE VISTA	1900284	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.26	470.00	1,138.18	840.42	0.00	1,383.90	1,958.20	1,553.40	2,022.76	2,226.70	2,243.80	1,179.80	2,892.40	2,517.30	968.80	876.97	1,454.26	1,227.47
NEW CHAPMAN	1940057	664.53	979.64	2,000.57	1,739.39	1,883.13	6.41	39.29	19.26	0.04	3.41	0.00	7.12	2,287.83	2,201.41	1,365.08	891.72	90.06	1,181.90	1,815.20	1,641.83	995.70	1,204.31	2,038.70	1,011.20	2,640.00	1,998.43	1,217.52	1,703.71	1,333.76	1,650.06
OHIO	1900281																														
PASADENA 52	1940109			0.91	2,505.15	1,635.06	553.86	1,977.62	1,746.97	1,007.40	35.78	6.53	9.44	2.85	968.82	970.59	1,005.84	1,423.40	2,156.60	2,724.90	1,731.88	2,100.40	1,721.90	2,673.06	1,720.70	1,199.78	0.74	0.00	0.00	0.00	0.00
SHELDON 1	1940112	0.00	0.00	0.00	0.00	57.15	39.22	135.85	27.77	26.33	0.00	0.00	0.08																		
SUNSET	1900279	686.38	1,191.98	1,764.38	1,219.79	1,874.05	1,550.86	1,924.10	1,478.60	604.08	1,581.95	933.94	1,796.98	1,310.94	1,056.90	866.99	497.94	54.45	973.70	596.80	23.44	353.04	1,260.00	458.00	572.30	513.80	44.50	1.70	5.17	3.79	5.75
TOWMBLY	NA																										1,372.70	3,284.73	3,307.11	3,264.23	3,089.48
VENTURA	1900275	599.03	1,310.56	1,847.25	1,492.09	1,290.83	2,150.98	1,994.20	1,109.32	1,644.79	2,304.53	725.56	1,442.59	0.66	1,187.09	896.89	490.20	342.14	1,377.10	1,468.10	1,943.83	2,315.50	2,032.90	2,312.20	936.65	1,163.18	0.75	0.00	0.00	0.00	0.00
VILLA	1902795	1,251.24	1,983.94	3,335.58	502.90	2,391.41	2,671.09	3,288.13	1,808.61	1,383.97	2,561.66	2,236.16	3,037.75	1,902.27	1.24	336.35	595.84	0.00	1,446.60	1,942.90	1,453.30	588.10	1,773.20	372.21	643.80	1,017.53	568.33	2,379.17	349.94	0.00	1,675.24
WADSWORTH	NA																										1,053.80	2,687.58	2,614.30	2,054.48	2,070.16
WINDSOR	1903058	1,040.84	1,323.77	1,231.18	1,100.97	664.26	1,897.75	928.71	1,227.95	1,560.13	1,617.71	1,738.75	1,080.90	0.53	0.00	0.00	459.85	581.42	1,068.70	1,378.00	1,239.05	953.30	1,253.40	1,441.00	1,265.50	757.59	0.41	0.00	0.00	3.49	0.00
WOODBURY	1900283	1,305.69	1,150.13	1,888.74	1,530.56	1,664.25	1,624.17	2,197.81	1,785.17	2,220.10	1,505.01	1,930.08	965.62	3,067.09	1,811.79	1,178.30	845.41	0.00	1,482.10	2,005.60	1,814.44	1,099.82	1,330.63	3,078.60	1,099.00	1,177.70	1,994.50	2,493.27	2,357.42	2,245.00	2,227.74
	SUBTOTAL	9,980.29	12,531.24	19,885.42	14,132.86	15,177.99	15,156.92	17,704.61	14,962.94	13,658.26	15,834.92	12,465.52	14,024.53	12,065.79	13,973.21	10,605.56	8,335.36	4,041.64	16,290.30	21,631.10	19,409.60	17,963.90	20,658.10	19,095.20	10,333.15	14,628.80	11,033.88	14,710.09	13,899.02	13,738.97	13,664.30
PASADENA CEMETERY ASSOCIATION																															
NO. 2-3	1940026	39.45	45.87	45.31	28.63	22.70	24.62	25.16	32.04	39.15	47.09	43.62	58.06	12.36	59.94	43.98	53.49	57.75	62.10	67.50	71.57	49.07	54.63	69.45	68.80	70.56	74.21	83.42	76.29	74.75	125.83
NO. 4	1940027	6.69	8.63	20.09	15.33	20.17	13.99	13.92	13.54	8.03	10.10	9.97	10.97	13.00	10.46	15.15	7.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SUBTOTAL	46.14	54.50	65.40	43.96	42.87	38.61	39.08	45.58	47.18	57.19	53.59	69.03	25.36	70.40	59.13	61.07	57.75	62.10	67.50	71.57	49.07	54.63	69.45	68.80	70.56	74.21	83.42	76.29	74.75	125.83
ROYAL LAUNDRY																															
ROYAL LAUNDRY	1902843	122.35	104.24	119.74	116.54	130.36	109.09	59.11	61.80	70.69	85.19	93.38	66.96																		
	SUBTOTAL	122.35	104.24	119.74	116.54	130.36	109.09	59.11	61.80	70.69	85.19	93.38	66.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUBIO CANON LAND AND WATER ASSOCIA1																															
NO. 2	1900993	183.25	82.90																												
NO. 4	1900994	439.94	201.10	283.70	142.27	675.08	564.92	1,283.99	1,111.20	1,207.39	705.03	293.53	121.06	96.11	114.52	25.33	59.33	111.14	100.60	141.70	428.20	420.70	444.90	431.90	297.70	516.00	379.59	561.90	507.26	474.91	519.78
NO. 5	1900995	552.76	1,096.35	1,126.23	1,353.20																										
NO. 6	1900996	0.00	0.00	0.00	10.25																										
NO. 7	1950010										761.59	1,310.94	1,279.61	1,253.49	1,200.24	910.80	1,191.94	947.44	878.80	1,369.60	935.80	844.30	971.10	942.60	822.50	975.60	711.20	833.90	965.94	920.25	968.54
	SUBTOTAL	1,175.95	1,380.35	1,409.93	1,505.72	675.08	564.92	1,283.99	1,111.20	1,207.39	1,466.62	1,604.47	1,400.67	1,349.60	1,314.76	936.13	1,251.27	1,058.58	979.40	1,511.30	1,364.00	1,265.00	1,416.00	1,374.50	1,120.20	1,491.60	1,090.79	1,395.80	1,473.20	1,395.16	1,488.32
SAN GABRIEL COUNTY WATER DISTRICT																															
NO. 3	1901667	859.15	1,192.56	1,099.97	1,139.19	348.95	904.94	460.19	932.76	492.32	252.29	227.49	708.50	501.19	63.71	4.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. 4	1901668	0.00	0.00	0.00	0.00	624.01	341.00	413.24	875.91	671.39	1,110.87	634.65	892.31	698.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00							
	SUBTOTAL	859.15	1,192.56	1,099.97	1,139.19	972.96	1,245.94	873.43	1,808.67	1,163.71	1,363.16	862.14	1,600.81	1,199.56	63.71	4.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SIERRA MADRE, CITY OF																															
NO. 1	NA																														
NO. 2	1900427																														
NO. 3	1900428	718.36	543.77	518.94	681.93	723.57	623.14	352.35	516.43	737.51	631.46	815.51	424.54	112.89	98.19	68.60	578.60	723.45	747.60	456.20	453.00	413.40	560.40	853.40	627.10	544.40	673.19	776.32	688.88	662.70	882.53
NO. 4	1900429	273.88	359.26	340.06	333.71	68.78	0.00	321.77	318.70	587.71	530.75	435.61	470.53	536.43	466.58	325.96	435.35	811.36	594.70	363.40	395.40	323.20	326.30	591.40	605.10	555.30	308.40	636.49	384.54	390.64	824.85
NO. 5	1902822	298.41	407.77	612.26	676.02	532.07	589.08	694.51	790.66	562.09	390.95	381.48	799.08	999.73	869.56	607.48	849.36	1,248.30	1,121.80	809.70	751.00	710.60	696.30	548.93	614.60	1,066.30	705.90	1,011.28	930.07	726.94	686.31
NO. 6	1902911	329.49	347.89	389.94	376.46	637.49	478.16	381.22	535.90	762.43	938.84	794.17	914.61	1,230.36	1,070.16	747.62	30.03	0.00	0.00	619.50	953.80	797.10	719.10	903.40	908.70	803.30	1,075.30	805.60	39.60	621.54	1,024.15
	SUBTOTAL	1,620.14	1,658.69	1,861.20	2,068.12	1,961.91	1,690.38	1,749.85	2,161.69	2,649.74	2,492.00	2,426.77	2,608.76	2,879.41	2,504.50	2,011.56	1,893.34	2,783.11	2,464.10	2,248.80	2,553.20	2,244.30	2,302.10	2,897.13	2,755.50	2,969.30	2,762.79	3,229.69	2,043.09	2,401.82	3,417.84
SUNNY SLOPE WATER COMPANY																															
NO. 1	1900021	1,007.53	476.66	629.62	271.39	774.83	685.39	1,036.61	974.52	596.85	979.98	948.44	896.45	265.28	196.12	142.48	111.74	54.09	20.13	90.30	0.20	235.00	197.00	1.30							
NO. 2	1900022	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	113.93														
NO. 3	1900023																														
NO. 6	1900024	635.05	816.81	1,081.45	1,249.26	263.88	778.72	310.04	761.52	936.93	583.24	571.63	501.15	1.73	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO. 11	1950011												314.29	1,174.59	1,348.40	341.73	503.90	800.91	549.00	590.60	952.80	598.70	596.80	911.16	977.30	617.00	217.70	216.94	666.22	6.09	0.28
NO. 12	NA														82.97	911.11	1,152.72	1,342.26	877.90	985.30	651.30	692.98	379.30	1,004.50	573.80	524.50	368.20	452.20	243.90	1,564.52	1,197.93
	SUBTOTAL	1,642.58	1,293.47	1,711.07	1,520.65	1,038.71	1,464.11	1,346.65	1,736.04	1,533.78	1,563.22	1,520.07	1,711.89	1,441.60	1,628.26	1,395.32	1,882.29	2,197.26	1,447.03	1,666.20	1,604.30	1,526.68	1,173.10	1,916.96	1,551.10	1,141.50	585.90	669.14	910.12	1,570.61	1,198.21
VALLEY WATER COMPANY																															
NO. 1	1900662	117.90	425.50	28.02	65.43	140.53	0.04	0.25	425.84	105.70	74.63	5.54	0.22	4.36	9.16	181.30	131.98	169.61	2.50	210.70	1.00	117.70	654.20	679.90	659.30	750.80	786.40	845.70	750.44	678.79	670.17
NO. 2	1900663	215.00	0.16	5.17	25.65	1.66	0.08	1.10	3.69	0.08	235.91	0.06	0.12	0.00			1.10	23.47	888.90	891.50	595.30	294.40	2.90	27.50	22.00	1.50	1.10	53.80	13.06	1.17	34.65
NO. 3	1900664	0.67	0.19	1.23	0.74	0.03	0.00	0.14	0.30	0.11	0.12	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.80	1.00	589.20	455.50	3.40	1.50	1.00	1.20	0.90	0.80	1.13	1.28	1.05
NO. 4	1940091	213.95	306.52	1,001.14	687.89	685.67	752.41	860.02	512.13	763.57	754.34	1,194.46	1,133.66	998.80			569.60	431.91	42.00	166.60	141.10	283.20	695.40	600.00	632.06	621.90	635.50	578.30	644.56	653.37	601.49
FLINTRIDGE	1900665																														
	SUBTOTAL	547.52	732.37	1,035.56	779.71	827.89	752.53	861.51	941.96	869.46	1,065.00	1,200.15	1,134.00	1,003.16	9.16	181.30	702.68	624.99	934.20	1,269.80	1,326.60	1,150.80	1,355.90	1,308.90	1,314.36	1,375.40	1,423.90	1,478.60	1,409.19	1,334.61	1,307.36
BASIN PRODUCTION		27,187.31	31,612.99	39,468.86	34,886.56	31,556.67	32,667.84	37,752.02	35,543.34	33,738.44	37,057.14	30,993.84	34,045.32	30,705.37	30,207.55	26,446.28	24,988.51	23,670.56	35,014.70	39,950.92	39,212.98	36,430.82	40,864.99	40,323.37	28,704.96	31,736.77	26,432.87	32,588.68	31,330.16	33,285.48	34,539.56

ANNUAL GROUNDWATER PRODUCTION FRC

SUB-AREA	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
MONK HILL	6,492.95	8,392.57	9,370.01	9,499.05	8,252.50	9,327.90	10,134.37	8,483.27	7,734.13	7,841.89	6,311.40	5,962.14	3,208.47	8,109.12	6,143.02	6,194.87	6,355.06	10,352.70	13,012.40	11,961.90	9,293.90	9,473.10	10,710.90	7,843.30	7,270.30	4,070.40	4,813.90	5,649.28	5,042.90	6,247.05
PASADENA	16,216.47	16,923.60	23,471.44	18,055.94	19,229.24	18,577.21	20,430.72	20,124.26	18,487.89	22,020.48	18,529.81	21,863.04	20,922.96	17,486.15	14,784.04	13,907.46	9,208.18	17,399.20	21,069.00	20,262.50	20,394.50	24,124.10	23,110.20	15,991.30	19,199.30	19,208.50	21,873.00	21,483.92	21,123.66	20,678.35
SANTA ANITA	4,477.15	6,344.99	6,714.48	7,414.53	4,894.69	5,622.98	7,307.91	7,051.73	7,701.37	6,937.75	5,871.57	6,329.51	6,329.71	5,493.94	6,112.74	4,797.18	8,104.66	7,222.80	5,861.70	7,385.10	6,474.60	7,258.60	6,501.90	6,521.90	6,446.40	5,376.00	5,901.80	6,486.61	7,118.91	7,614.34
RAYMOND BASIN	27,186.57	31,661.16	39,555.93	34,969.52	32,376.43	33,528.09	37,873.00	35,659.26	33,923.39	36,800.12	30,712.78	34,154.69	30,461.14	31,089.21	27,039.80	24,899.51	23,667.90	34,974.70	39,943.10	39,609.50	36,163.00	40,855.80	40,323.00	30,356.50	32,916.00	28,654.90	32,588.70	33,619.81	33,285.47	34,539.74

TABLE 2
ANNUAL GROUNDWATER INJECTION IN RAYMOND BASIN IN ACRE-FEET

WELL NAME	RECORDATION NUMBER	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	
PASADENA, CITY OF																	
BANGHAM	NA		9.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
GARFIELD	1900280	1,260.31	929.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
JOURDAN	1900285	257.01	1,133.80	0.00	31.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
TOWMBLY	NA											0.00	0.00	0.00	0.00	0.00	
WADSWORTH	NA											0.00	0.00	0.00	0.00	0.00	
	SUBTOTAL	1,517.32	2,072.51	0.00	31.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
VALLEY WATER COMPANY																	
NO. 2	1900663			195.89	404.20	324.24	409.50	485.90	496.00	503.03	862.07	727.35	1,063.19	906.48	814.10	591.30	
NO. 3	1900664					301.45	215.81	0.00	23.78	0.00	0.00	0.00	0.00	550.85	664.68	354.62	
	SUBTOTAL			195.89	404.20	625.69	625.31	485.90	519.78	503.03	862.07	727.35	1,063.19	1,457.33	1,478.78	945.92	
BASIN INJECTION		**1,517.32**	**2,072.51**	**195.89**	**435.56**	**625.69**	**625.31**	**485.90**	**519.78**	**503.03**	**862.07**	**727.35**	**1,063.19**	**1,457.33**	**1,478.78**	**945.92**	
MONK HILL SUB-AREA		0.00	0.00	195.89	404.20	625.69	625.31	485.90	519.78	503.03	862.07	727.35	1,063.19	1,457.33	1,478.78	945.92	
PASADENA SUB-AREA		1,517.32	2,072.51	0.00	31.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

TABLE 3
SURFACE WATER SPREADING IN RAYMOND BASIN (IN ACRE FEET)

SPREADING BASIN	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	WATER 1972-1973	1973-1974	1974-1975	1975-1976
PASADENA, CITY OF																																
ARROYO																														503.84	215.27	101.33
EATON WASH																													199.79	1,026.58	803.87	1,151.70
MILLARD CANYON																																
SLUDGE PONDS																																
SUBTOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	199.79	1,530.42	1,019.14	1,253.03
KINNELOA IRRIGATION DISTRICT																																
EATON WASH																													0.34	8.27	5.67	15.01
PASADENA GLEN																																
SUBTOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	8.27	5.67	15.01
LAS FLORES WATER COMPANY																																
RUBIO CANYON																														41.38	23.84	24.99
SUBTOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	41.38	23.84	24.99
LINCOLN AVENUE WATER COMPANY																																
RUBIO CANYON																													24.70	611.26	692.95	347.07
SUBTOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.70	611.26	692.95	347.07
LOS ANGELES COUNTY DEPARTMENT OF PUBLIC WORKS																																
ARROYO SECO					108.00	283.00	19.00	986.00	216.00	455.00	197.00	301.00	397.00	2,088.00	352.00	0.00	0.00	1,103.00	249.00	317.00	744.00	1,036.00	1,828.00	855.00	609.00	195.00	644.00	173.00	1,214.00	1,478.00	664.00	344.00
EATON GROUNDS				1.00	0.00	61.00	0.00	1,196.00	0.00	190.00	0.00	181.00	0.00	861.00	130.00	0.00	0.00	1,021.00	7.00	24.00	324.00	2,000.00	1,450.00	305.00	3,249.00	483.00	583.00	0.00	1,689.00	1,581.00	337.00	295.00
SANTA ANITA	337.00	0.00	141.00	0.00	0.00	0.00	0.00	448.00	58.00	265.00	145.00	161.00	2.00	1,576.00	185.00	810.00	304.00	664.00	449.00	327.00	575.00	1,641.00	1,563.00	638.00	494.00	1,415.00	334.00	31.00	738.00	427.00	59.00	36.00
SIERRA MADRE								1,547.00	257.00	470.00	288.00	349.00	295.00	3,897.00	343.00	43.00	41.00	1,313.00	874.00	427.00	905.00	4,075.00	4,236.00	1,723.00	1,871.00	521.00	1,299.00	857.00	3,017.00	2,786.00	2,179.00	1,150.00
SUBTOTAL :	337.00	0.00	141.00	1.00	108.00	344.00	19.00	4,177.00	531.00	1,380.00	630.00	992.00	694.00	8,422.00	1,010.00	853.00	345.00	4,101.00	1,579.00	1,095.00	2,548.00	8,752.00	9,077.00	3,521.00	6,223.00	2,614.00	2,860.00	1,061.00	6,658.00	6,272.00	3,239.00	1,825.00
RUBIO CANON LAND AND WATER ASSOCIATION																																
RUBIO CANYON																													13.34	201.40	142.02	93.77
SUBTOTAL :	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.34	201.40	142.02	93.77
BASIN SPREADING	**337.00**	**0.00**	**141.00**	**1.00**	**108.00**	**344.00**	**19.00**	**4,177.00**	**531.00**	**1,380.00**	**630.00**	**992.00**	**694.00**	**8,422.00**	**1,010.00**	**853.00**	**345.00**	**4,101.00**	**1,579.00**	**1,095.00**	**2,548.00**	**8,752.00**	**9,077.00**	**3,521.00**	**6,223.00**	**2,614.00**	**2,860.00**	**1,061.00**	**6,896.17**	**8,664.73**	**5,122.62**	**3,558.87**
MONK HILL SUB-AREA	0.00	0.00	0.00	0.00	108.00	283.00	19.00	986.00	216.00	455.00	197.00	301.00	397.00	2,088.00	352.00	0.00	0.00	1,103.00	249.00	317.00	744.00	1,036.00	1,828.00	855.00	609.00	195.00	644.00	173.00	1,214.00	1,981.84	879.27	445.33
PASADENA SUB-AREA	0.00	0.00	0.00	1.00	0.00	61.00	0.00	1,196.00	0.00	190.00	0.00	181.00	0.00	861.00	130.00	0.00	0.00	1,021.00	7.00	24.00	324.00	2,000.00	1,450.00	305.00	3,249.00	483.00	583.00	0.00	1,927.17	3,469.89	2,005.35	1,927.54
SANTA ANITA SUB-AREA	337.00	0.00	141.00	0.00	0.00	0.00	0.00	1,995.00	315.00	735.00	433.00	510.00	297.00	5,473.00	528.00	853.00	345.00	1,977.00	1,323.00	754.00	1,480.00	5,716.00	5,799.00	2,361.00	2,365.00	1,936.00	1,633.00	888.00	3,755.00	3,213.00	2,238.00	1,186.00
PASADENA+SANTA ANITA	**337.00**	**0.00**	**141.00**	**1.00**	**0.00**	**61.00**	**0.00**	**3,191.00**	**315.00**	**925.00**	**433.00**	691.00	297.00	6,334.00	658.00	853.00	345.00	2,998.00	1,330.00	778.00	1,804.00	7,716.00	7,249.00	2,666.00	5,614.00	2,419.00	2,216.00	888.00	5,682.17	6,682.89	4,243.35	3,113.54
RAYMOND BASIN	337.00	0.00	141.00	1.00	108.00	344.00	19.00	4,177.00	531.00	1,380.00	630.00	992.00	694.00	8,422.00	1,010.00	853.00	345.00	4,101.00	1,579.00	1,095.00	2,548.00	8,752.00	9,077.00	3,521.00	6,223.00	2,614.00	2,860.00	1,061.00	6,896.17	8,664.73	5,122.62	3,558.87

TABLE 3
SURFACE WATER SPREADING IN RAYMOND BASIN (IN ACRE FEET)

SPREADING BASIN	YEAR																													
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
PASADENA, CITY OF																														
ARROYO	16.67	994.71	1,293.15	379.59	276.86	528.77	1,777.74	507.18	741.65	1,631.84	388.01	485.48	425.57	188.51	369.54	1,367.96	5,014.37	2,146.57	5,732.00	2,722.60	3,046.00	4,272.90	1,169.60	1,027.60	1,213.40	168.90	775.10	15.10	3,263.80	2,842.40
EATON WASH	414.00	1,192.24	906.60	1,573.29	437.29	2,054.75	5,160.12	3,700.39	1,069.60	1,932.88	208.26	2,003.52	1,135.96	646.83	1,620.87	2,816.90	2,385.03	1,221.54	5,534.10	3,360.80	3,272.50	4,272.40	3,380.10	1,066.20	1,068.10	470.60	457.40	294.80	1,923.90	2,137.20
MILLARD CANYON			327.11	352.80	248.91	301.11	677.03	627.43	374.72	613.31	149.38	625.45	287.80	76.19	118.31	779.88	1,975.64	498.66	1,712.30	1,396.20	1,066.70	1,885.30	121.90	137.20	0.00	2.90	0.90	0.00	0.00	0.00
SLUDGE PONDS																							306.10	233.40	448.80	444.20	507.10	250.60	1,362.00	333.50
SUBTOTAL :	430.67	2,186.95	2,526.86	2,305.68	963.06	2,884.63	7,614.89	4,835.00	2,185.97	4,178.03	745.65	3,114.45	1,849.33	911.53	2,108.72	4,964.74	9,375.04	3,866.77	12,978.40	7,479.60	7,385.20	10,430.60	4,977.70	2,464.40	2,730.30	1,086.60	1,740.50	560.50	6,549.70	5,313.10
KINNELOA IRRIGATION DISTF																														
EATON WASH	124.83	61.35	199.10	129.12	188.12	217.08	370.86	391.29	161.63	171.15	190.25	401.85	312.04	199.03	220.97	301.47	555.23	162.57	102.80	43.20	49.20	54.30	47.30	48.20	31.80	24.30	17.80	9.70	1,653.20	39.60
PASADENA GLEN																		257.70	298.90	363.40	278.40	408.80	332.30	210.00	187.90	121.10	97.10	76.60	625.40	169.40
SUBTOTAL :	124.83	61.35	199.10	129.12	188.12	217.08	370.86	391.29	161.63	171.15	190.25	401.85	312.04	199.03	220.97	301.47	555.23	420.27	401.70	406.60	327.60	463.10	379.60	258.20	219.70	145.40	114.90	86.30	2,278.60	209.00
LAS FLORES WATER COMPA																														
RUBIO CANYON	27.58	114.56	194.11	494.72	194.42	199.71	456.67	280.34	213.64	263.97	199.40	190.12	163.36	117.65	164.31	216.67	210.43	229.44	238.80	252.10	320.50	267.00	229.50	100.50	88.60	63.00	52.70	54.40	81.50	63.80
SUBTOTAL :	27.58	114.56	194.11	494.72	194.42	199.71	456.67	280.34	213.64	263.97	199.40	190.12	163.36	117.65	164.31	216.67	210.43	229.44	238.80	252.10	320.50	267.00	229.50	100.50	88.60	63.00	52.70	54.40	81.50	63.80
LINCOLN AVENUE WATER CC																														
RUBIO CANYON	337.22	615.85	627.39	315.32	223.71	334.52	308.23	250.81	135.79	227.27	239.98	224.20	197.87	201.80	209.03	236.64	466.82	265.38	447.60	372.20	315.00	701.40	87.20	151.50	135.90	33.10	65.60	68.00	862.10	429.50
SUBTOTAL :	337.22	615.85	627.39	315.32	223.71	334.52	308.23	250.81	135.79	227.27	239.98	224.20	197.87	201.80	209.03	236.64	466.82	265.38	447.60	372.20	315.00	701.40	87.20	151.50	135.90	33.10	65.60	68.00	862.10	429.50
LOS ANGELES COUNTY DEP/																														
ARROYO SECO	374.00	3,475.00	2,188.00	1,727.00	519.00	1,315.00	6,450.00	665.00	924.00	2,260.00	415.00	0.00	0.00	164.00	942.50	2,714.00	4,197.00	1,562.00	5,678.00	2,152.00	3,241.00	2,008.00	0.00							
EATON GROUNDS	218.00	3,686.00	1,103.00	1,694.00	285.00	1,148.00	4,761.00	683.00	146.00	1,220.00	14.00	0.00	0.00	46.60	1,527.00	1,892.00	3,190.00	493.00	3,459.00	1,197.00	946.00	4,281.00	54.00	701.00	754.00	35.00	413.00	232.00	4,197.00	1,244.00
SANTA ANITA	0.00	724.00	832.00	782.00	63.00	196.00	1,199.00	541.00	457.00	686.00	252.00	523.60	0.00	4.90	404.00	659.50	919.00	580.00	955.00	610.00	734.00	1,103.00	242.00	220.00	366.00	17.00	291.00	114.00	1,603.00	682.00
SIERRA MADRE	919.00	3,544.00	3,735.00	2,777.00	1,736.00	2,227.00	2,699.00	2,365.00	1,310.00	2,890.00	775.00	1,584.90	0.00	634.00	1,369.00	2,315.40	1,354.00	874.00	2,459.00	2,136.00	1,660.00	2,866.00	1,560.00	742.00	1,200.00	198.00	1,106.00	548.00	3,460.00	457.30
SUBTOTAL :	1,511.00	11,429.00	7,858.00	6,980.00	2,603.00	4,886.00	15,109.00	4,254.00	2,837.00	7,056.00	1,456.00	2,108.50	0.00	849.50	4,242.50	7,580.90	9,660.00	3,509.00	12,551.00	6,095.00	6,581.00	10,258.00	1,856.00	1,663.00	2,320.00	250.00	1,810.00	894.00	9,260.00	2,383.30
RUBIO CANON LAND AND WA																														
RUBIO CANYON	86.97	364.59	301.65	268.34	373.63	379.07	470.48	406.99	36.13	55.83	19.81	50.99	76.36	103.90	73.17	114.10	95.10	157.52	136.80	160.20	155.70	247.00	31.90	59.30	48.00	44.40	34.70	38.40	157.30	72.10
SUBTOTAL :	86.97	364.59	301.65	268.34	373.63	379.07	470.48	406.99	36.13	55.83	19.81	50.99	76.36	103.90	73.17	114.10	95.10	157.52	136.80	160.20	155.70	247.00	31.90	59.30	48.00	44.40	34.70	38.40	157.30	72.10
BASIN SPREADING	**2,518.27**	**14,772.30**	**11,707.11**	**10,493.18**	**4,545.94**	**8,901.01**	**24,330.13**	**10,418.43**	**5,570.16**	**11,952.25**	**2,851.09**	**6,090.11**	**2,598.96**	**2,383.41**	**7,018.70**	**13,414.52**	**20,362.62**	**8,448.38**	**26,754.30**	**14,765.70**	**15,085.00**	**22,367.10**	**7,561.90**	**4,696.90**	**5,542.50**	**1,622.50**	**3,818.40**	**1,701.60**	**19,189.20**	**8,470.80**
MONK HILL SUB-AREA	390.67	4,469.71	3,808.26	2,459.39	1,044.77	2,144.88	8,904.77	1,799.61	2,040.37	4,505.15	952.39	1,110.93	713.37	428.70	1,430.35	4,861.84	11,187.01	4,207.23	13,122.30	6,270.80	7,353.70	8,166.20	1,597.60	1,398.20	1,662.20	616.00	1,283.10	265.70	4,625.80	3,175.90
PASADENA SUB-AREA	1,208.60	6,034.59	3,331.85	4,474.79	1,702.17	4,333.13	11,527.36	5,712.82	1,762.79	3,871.10	871.70	2,870.68	1,885.59	1,315.81	3,815.35	5,577.78	6,902.61	2,787.15	10,218.00	5,748.90	5,337.30	10,231.90	4,162.30	2,336.70	2,314.30	791.50	1,138.30	773.90	9,500.40	4,155.60
SANTA ANITA SUB-AREA	919.00	4,268.00	4,567.00	3,559.00	1,799.00	2,423.00	3,898.00	2,906.00	1,767.00	3,576.00	1,027.00	2,108.50	0.00	638.90	1,773.00	2,974.90	2,273.00	1,454.00	3,414.00	2,746.00	2,394.00	3,969.00	1,802.00	962.00	1,566.00	215.00	1,397.00	662.00	5,063.00	1,139.30
PASADENA+SANTA ANITA	2,127.60	10,302.59	7,898.85	8,033.79	3,501.17	6,756.13	15,425.36	8,618.82	3,529.79	7,447.10	1,898.70	4,979.18	1,885.59	1,954.71	5,588.35	8,552.68	9,175.61	4,241.15	13,632.00	8,494.90	7,731.30	14,200.90	5,964.30	3,298.70	3,880.30	1,006.50	2,535.30	1,435.90	14,563.40	5,294.90
RAYMOND BASIN	2,518.27	14,772.30	11,707.11	10,493.18	4,545.94	8,901.01	24,330.13	10,418.43	5,570.16	11,952.25	2,851.09	6,090.11	2,598.96	2,383.41	7,018.70	13,414.52	20,362.62	8,448.38	26,754.30	14,765.70	15,085.00	22,367.10	7,561.90	4,696.90	5,542.50	1,622.50	3,818.40	1,701.60	19,189.20	8,470.80

TABLE 4
HISTORIC PRECIPITATION AT SELECTED STATIONS IN RAYMOND BASIN (IN INCHES)

WATER YEAR	SIERRA MADRE		ALTADENA		LA CANADA	
	4142A	8210	4092	144	5109	175B
1900-1901	30.65		24.95			
1901-1902	16.32		12.54			
1902-1903	28.17		28.19			
1903-1904	13.22		12.28			
1904-1905	32.10		29.35			
1905-1906	32.66		30.56			
1906-1907	37.74		34.25			
1907-1908	20.57		19.81			
1908-1909	38.86		34.07			
1909-1910	22.53		20.73			
1910-1911	32.63		28.83			
1911-1912	23.21		21.22			
1912-1913	18.52		19.99		19.06	
1913-1914	40.16		35.67		39.91	
1914-1915	24.95		25.74		24.05	
1915-1916	29.73		30.24		28.04	
1916-1917	24.94		23.00		22.71	
1917-1918	20.90		21.39		21.42	
1918-1919	15.11		14.20		13.51	
1919-1920	23.67		22.44		21.87	
1920-1921	24.32		22.94		20.95	
1921-1922	36.49		34.85		35.15	
1922-1923	18.87		16.77		16.93	
1923-1924	12.00		9.38		10.43	
1924-1925	16.00		14.01		15.59	
1925-1926	30.36		24.80		25.19	
1926-1927	30.99		27.66		28.96	
1927-1928	16.53		16.05		15.74	
1928-1929	18.79		17.26		17.66	
1929-1930	19.86		18.72		17.26	
1930-1931	18.46		18.89		18.47	
1931-1932	27.11	28.19	24.32	25.55	25.30	
1932-1933	19.00	16.54	17.93	14.33	19.50	
1933-1934	24.84	27.61	21.44	24.25	24.62	
1934-1935	28.97	24.53	28.52	23.65	27.25	
1935-1936	21.64	19.65	18.51	17.24	17.94	
1936-1937	36.96	33.58	35.27	29.20	29.51	
1937-1938	38.44	27.41	36.28	23.86	35.00	
1938-1939		40.94		40.37		
1939-1940		17.45		15.72		
1940-1941		28.93		26.51		
1941-1942		47.53		44.01		
1942-1943		11.89		9.81		
1943-1944		46.04		43.11		
1944-1945		26.23		27.66		
1945-1946		23.53		20.24		
1946-1947		29.60		27.84		
1947-1948		7.13		5.85		
1948-1949		13.78		11.60		
1949-1950		20.77		15.96		
1950-1951		14.58		11.60		
1951-1952		22.37		20.06		
1952-1953		38.17		37.65		
1953-1954				5.62		
1954-1955				18.43		
1955-1956				16.96		
1956-1957	17.00			16.41		17.43
1957-1958	34.15			32.77		33.23

TABLE 4
HISTORIC PRECIPITATION AT SELECTED STATIONS IN RAYMOND BASIN (IN INCHES)

WATER YEAR	SIERRA MADRE		ALTADENA		LA CANADA	
	4142A	8210	4092	144	5109	175B
1958-1959	12.91			10.47		11.05
1959-1960	11.65			10.08		10.55
1960-1961	7.88			7.29		8.22
1961-1962	28.69			24.76		18.74
1962-1963	13.85			12.54		12.84
1963-1964	16.95			13.49		13.91
1964-1965	19.24			17.84		18.95
1965-1966	35.27			33.36		30.35
1966-1967	34.00			28.89		30.96
1967-1968	15.58			16.38		19.17
1968-1969	53.00			43.56		44.04
1969-1970	16.63			14.76		12.16
1970-1971	19.72			17.74		18.76
1971-1972	9.51			5.38		10.75
1972-1973	31.01			27.79		30.18
1973-1974	22.58			20.40		18.56
1974-1975				15.64		17.97
1975-1976				9.30		11.82
1976-1977				15.44		20.01
1977-1978				46.95		46.35
1978-1979				22.69		26.67
1979-1980				40.46		36.45
1980-1981				12.66		13.47
1981-1982				19.40		19.41
1982-1983				49.18		49.63
1983-1984				16.95		16.76
1984-1985				18.93		15.23
1985-1986				21.41		24.24
1986-1987		13.81		10.73		
1987-1988		20.53		18.69		
1988-1989		18.73		13.54		
1989-1990		15.20		14.73		
1990-1991		22.84		20.84		
1991-1992		33.96		34.45		
1992-1993		54.60		42.90		
1993-1994		16.77		13.80		
1994-1995		46.77		38.39		
1995-1996		20.46		16.72		
1996-1997		25.29		17.70		
1997-1998		51.07		43.86		
1998-1999		12.96		10.10		
1999-2000		17.62		9.04		
2000-2001		19.97		18.58		
2001-2002		9.19		7.41		
2002-2003		25.50		20.55		
2003-2004		16.86		15.85		
2004-2005		60.40		56.43		
2005-2006		25.12		21.21		
2006-2007		7.91		5.94		

TABLE 5

RAYMOND BASIN MANAGEMENT BOARD

GROUNDWATER BALANCE MODEL FOR PASADENA-SANTA ANITA SUB-AREAS

YEAR	PRECIP. INCHES	BASIN SURFACE AREA ACRES	RECHARGE COEFFICIENT	NET RECHARGE FROM PRECIP. ACRE-FEET	PRODUCTION ACRE-FEET	SURFACE SPREADING ACRE-FEET	INJECTION ACRE-FEET	INFLOW FROM ALTADENA ACRE-FEET	INFLOW FROM SAWPIT ACRE-FEET	SUBTOTAL STORAGE ACRE-FEET	OUTFLOW TO SAN GABRIEL ACRE-FEET	STORAGE ACRE-FEET
1910-1911	28.83	16,537	0.1	3,973	18,767	0	0	1,788	1,391	1,675,158	0	1,675,158
1911-1912	21.22	16,537	0.008	234	19,834	0	0	105	82	1,655,746	0	1,655,746
1912-1913	19.99	16,537	0.008	220	18,073	0	0	99	77	1,638,069	0	1,638,069
1913-1914	35.67	16,537	0.4	19,662	13,984	0	0	8,848	6,882	1,659,478	0	1,659,478
1914-1915	25.74	16,537	0.1	3,547	13,139	0	0	1,596	1,242	1,652,724	0	1,652,724
1915-1916	30.24	16,537	0.4	16,669	14,197	0	0	7,501	5,834	1,668,531	0	1,668,531
1916-1917	23.00	16,537	0.1	3,170	15,921	0	0	1,426	1,109	1,658,316	0	1,658,316
1917-1918	21.39	16,537	0.008	236	18,767	0	0	106	83	1,639,973	0	1,639,973
1918-1919	14.20	16,537	0.008	157	19,834	0	0	70	55	1,620,421	0	1,620,421
1919-1920	22.44	16,537	0.1	3,092	18,073	0	0	1,392	1,082	1,607,914	0	1,607,914
1920-1921	22.94	16,537	0.1	3,161	19,363	0	0	1,423	1,106	1,594,242	0	1,594,242
1921-1922	34.85	16,537	0.4	19,210	17,627	0	0	8,645	6,724	1,611,193	0	1,611,193
1922-1923	16.77	16,537	0.008	185	18,819	0	0	83	65	1,592,707	0	1,592,707
1923-1924	9.38	16,537	0	0	24,842	0	0	0	0	1,567,865	0	1,567,865
1924-1925	14.01	16,537	0.008	154	24,140	0	0	70	54	1,544,003	0	1,544,003
1925-1926	24.80	16,537	0.1	3,418	21,862	0	0	1,538	1,196	1,528,293	0	1,528,293
1926-1927	27.66	16,537	0.1	3,812	22,466	0	0	1,715	1,334	1,512,688	0	1,512,688
1927-1928	16.05	16,537	0.008	177	24,647	0	0	80	62	1,488,360	0	1,488,360
1928-1929	17.26	16,537	0.008	190	26,109	0	0	86	67	1,462,593	0	1,462,593
1929-1930	18.72	16,537	0.008	206	26,253	0	0	93	72	1,436,712	0	1,436,712
1930-1931	18.89	16,537	0.008	208	26,750	0	0	94	73	1,410,337	0	1,410,337
1931-1932	24.32	16,537	0.1	3,351	22,444	0	0	1,508	1,173	1,393,925	0	1,393,925
1932-1933	17.93	16,537	0.008	198	22,036	0	0	89	69	1,372,245	0	1,372,245
1933-1934	21.44	16,537	0.008	236	20,357	0	0	106	83	1,352,314	0	1,352,314
1934-1935	28.52	16,537	0.1	3,930	13,078	0	0	1,769	1,376	1,346,310	0	1,346,310
1935-1936	18.51	16,537	0.008	204	20,709	0	0	92	71	1,325,968	0	1,325,968
1936-1937	35.27	16,537	0.4	19,442	14,373	0	0	8,749	6,805	1,346,591	0	1,346,591
1937-1938	36.28	16,537	0.4	19,999	13,693	0	0	8,999	7,000	1,368,896	0	1,368,896
1938-1939	40.37	16,537	0.4	22,253	12,000	0	0	10,014	7,789	1,396,952	0	1,396,952
1939-1940	15.72	16,537	0.008	173	12,000	0	0	78	61	1,385,264	0	1,385,264
1940-1941	26.51	16,537	0.1	3,653	12,000	0	0	1,644	1,279	1,379,840	0	1,379,840
1941-1942	44.01	16,537	0.4	24,260	12,000	0	0	10,917	8,491	1,411,507	0	1,411,507
1942-1943	9.81	16,537	0	0	12,000	0	0	0	0	1,399,507	0	1,399,507
1943-1944	43.11	16,537	0.4	23,764	12,000	0	0	10,694	8,317	1,430,282	0	1,430,282
1944-1945	27.66	16,537	0.1	3,812	14,420	337	0	1,715	1,334	1,423,060	0	1,423,060
1945-1946	20.24	16,537	0.008	223	16,896	0	0	100	78	1,406,565	0	1,406,565
1946-1947	27.84	16,537	0.1	3,837	14,381	141	0	1,726	1,343	1,399,231	0	1,399,231
1947-1948	5.85	16,537	0	0	17,219	1	0	0	0	1,382,014	0	1,382,014
1948-1949	11.60	16,537	0.008	128	16,191	0	0	58	45	1,366,052	0	1,366,052
1949-1950	15.96	16,537	0.008	176	12,750	61	0	79	62	1,353,680	0	1,353,680
1950-1951	11.60	16,537	0.008	128	16,279	0	0	58	45	1,337,632	0	1,337,632
1951-1952	20.06	16,537	0.008	221	13,240	3,191	0	100	77	1,327,981	0	1,327,981
1952-1953	37.65	16,537	0.4	20,754	17,341	315	0	9,339	7,264	1,348,312	0	1,348,312

TABLE 5

RAYMOND BASIN MANAGEMENT BOARD
GROUNDWATER BALANCE MODEL FOR PASADENA-SANTA ANITA SUB-AREAS

YEAR	PRECIP. INCHES	BASIN SURFACE AREA ACRES	RECHARGE COEFFICIENT	NET RECHARGE FROM PRECIP. ACRE-FEET	PRODUCTION ACRE-FEET	SURFACE SPREADING ACRE-FEET	INJECTION ACRE-FEET	INFLOW FROM ALTADENA ACRE-FEET	INFLOW FROM SAWPIT ACRE-FEET	SUBTOTAL STORAGE ACRE-FEET	OUTFLOW TO SAN GABRIEL ACRE-FEET	STORAGE ACRE-FEET
1953-1954	5.62	16,537	0	0	15,144	925	0	0	0	1,334,093	0	1,334,093
1954-1955	18.43	16,537	0.008	203	17,311	433	0	91	71	1,317,581	0	1,317,581
1955-1956	16.96	16,537	0.008	187	18,667	691	0	84	65	1,299,941	0	1,299,941
1956-1957	16.41	16,537	0.008	181	22,958	297	0	81	63	1,277,606	0	1,277,606
1957-1958	32.77	16,537	0.4	18,064	17,571	6,334	0	8,129	6,322	1,298,884	0	1,298,884
1958-1959	10.47	16,537	0	0	25,045	658	0	0	0	1,274,497	0	1,274,497
1959-1960	10.08	16,537	0	0	21,287	853	0	0	0	1,254,064	0	1,254,064
1960-1961	7.29	16,537	0	0	22,138	345	0	0	0	1,232,271	0	1,232,271
1961-1962	24.76	16,537	0.1	3,412	21,915	2,998	0	1,535	1,194	1,219,495	0	1,219,495
1962-1963	12.54	16,537	0.008	138	22,097	1,330	0	62	48	1,198,978	0	1,198,978
1963-1964	13.49	16,537	0.008	149	22,247	778	0	67	52	1,177,777	0	1,177,777
1964-1965	17.84	16,537	0.008	197	21,281	1,804	0	89	69	1,158,654	0	1,158,654
1965-1966	33.36	16,537	0.4	18,389	22,785	7,716	0	8,275	6,436	1,176,685	0	1,176,685
1966-1967	28.89	16,537	0.1	3,981	20,610	7,249	0	1,792	1,393	1,170,491	0	1,170,491
1967-1968	16.38	16,537	0.008	181	27,015	2,666	0	81	63	1,146,467	0	1,146,467
1968-1969	43.56	16,537	0.4	24,012	20,001	5,614	0	10,805	8,404	1,175,301	0	1,175,301
1969-1970	14.76	16,537	0.008	163	24,155	2,419	0	73	57	1,153,857	0	1,153,857
1970-1971	17.74	16,537	0.008	196	22,703	2,216	0	88	68	1,133,722	0	1,133,722
1971-1972	5.38	16,537	0	0	23,153	888	0	0	0	1,111,457	0	1,111,457
1972-1973	27.79	16,537	0.1	3,830	23,132	5,682	0	1,723	1,340	1,100,901	0	1,100,901
1973-1974	20.40	16,537	0.008	225	23,409	6,683	0	101	79	1,084,580	0	1,084,580
1974-1975	15.64	16,537	0.008	172	23,925	4,243	0	78	60	1,065,208	0	1,065,208
1975-1976	9.30	16,537	0	0	27,778	3,114	0	0	0	1,040,544	0	1,040,544
1976-1977	15.44	16,537	0.008	170	24,644	2,128	0	77	60	1,018,335	0	1,018,335
1977-1978	46.95	16,537	0.4	25,880	20,694	10,303	0	11,646	9,058	1,054,528	0	1,054,528
1978-1979	22.69	16,537	0.1	3,127	23,269	7,899	0	1,407	1,094	1,044,787	0	1,044,787
1979-1980	40.46	16,537	0.4	22,303	30,186	8,034	0	10,036	7,806	1,062,780	0	1,062,780
1980-1981	12.66	16,537	0.008	140	25,470	3,501	0	63	49	1,041,062	0	1,041,062
1981-1982	19.40	16,537	0.008	214	24,124	6,756	0	96	75	1,024,079	0	1,024,079
1982-1983	49.18	16,537	0.4	27,110	24,200	15,425	0	12,199	9,488	1,064,102	0	1,064,102
1983-1984	16.95	16,537	0.008	187	27,739	8,619	0	84	65	1,045,318	0	1,045,318
1984-1985	18.93	16,537	0.008	209	27,176	3,530	0	94	73	1,022,048	0	1,022,048
1985-1986	21.41	16,537	0.008	236	26,189	7,447	0	106	83	1,003,730	0	1,003,730
1986-1987	10.73	16,537	0	0	28,958	1,899	0	0	0	976,671	0	976,671
1987-1988	18.69	16,537	0.008	206	24,401	4,979	0	93	72	957,620	0	957,620
1988-1989	13.54	16,537	0.008	149	28,193	1,886	0	67	52	931,581	0	931,581
1989-1990	14.73	16,537	0.008	162	27,253	1,955	0	73	57	906,576	0	906,576
1990-1991	20.84	16,537	0.008	230	22,980	5,588	0	103	80	889,597	0	889,597
1991-1992	34.45	16,537	0.4	18,990	20,897	8,553	0	8,545	6,646	911,435	0	911,435
1992-1993	42.90	16,537	0.4	23,648	18,705	9,176	1,517	10,642	8,277	945,990	0	945,990
1993-1994	13.80	16,537	0.008	152	17,313	4,241	2,073	68	53	935,265	0	935,265
1994-1995	38.39	16,537	0.4	21,162	24,622	13,632	0	9,523	7,407	962,366	0	962,366
1995-1996	16.72	16,537	0.008	184	26,931	8,495	31	83	65	944,293	0	944,293

TABLE 5

RAYMOND BASIN MANAGEMENT BOARD

GROUNDWATER BALANCE MODEL FOR PASADENA-SANTA ANITA SUB-AREAS

YEAR	PRECIP. INCHES	BASIN SURFACE AREA ACRES	RECHARGE COEFFICIENT	NET RECHARGE FROM PRECIP. ACRE-FEET	PRODUCTION ACRE-FEET	SURFACE SPREADING ACRE-FEET	INJECTION ACRE-FEET	INFLOW FROM ALTADENA ACRE-FEET	INFLOW FROM SAWPIT ACRE-FEET	SUBTOTAL STORAGE ACRE-FEET	OUTFLOW TO SAN GABRIEL ACRE-FEET	STORAGE ACRE-FEET
1996-1997	17.70	16,537	0.008	195	27,648	7,731	0	88	68	924,728	0	924,728
1997-1998	43.86	16,537	0.4	24,177	26,869	14,201	0	10,880	8,462	955,579	0	955,579
1998-1999	10.10	16,537	0	0	31,383	5,964	0	0	0	930,160	0	930,160
1999-2000	9.04	16,537	0	0	29,612	3,299	0	0	0	903,847	0	903,847
2000-2001	18.58	16,537	0.008	205	22,513	3,880	0	92	72	885,583	0	885,583
2001-2002	7.41	16,537	0	0	25,646	1,007	0	0	0	860,944	0	860,944
2002-2003	20.55	16,537	0.008	227	24,585	2,535	0	102	79	839,302	0	839,302
2003-2004	15.85	16,537	0.008	175	27,775	1,436	0	79	61	813,278	0	813,278
2004-2005	56.43	16,537	0.4	31,106	27,971	14,563	0	13,998	10,887	855,862	0	855,862
2005-2006	21.21	16,537	0.008	234	28,243	5,295	0	105	82	833,335	0	833,335
Average	22.23			5,110	20,352	2,165		2,299	1,788			1,294,262
Last 10 years	22.56			4,398	24,206	4,925		1,979	1,539			948,051
Last 20 years	22.88			6280	25559	6291		2826	2198			957,829

ESTIMATE OF RECHARGE COEFFICIENT

Precipitation Range	Precipitation (inches)	Recharge Coefficient
0	0	
		0
Average/2	11.11	
		0.008
Average	22.23	
		0.1
30 inches	30	
		0.4
Altadena Inflow		0.45
Sawpit Inflow		0.35
Raymond Outflow		0

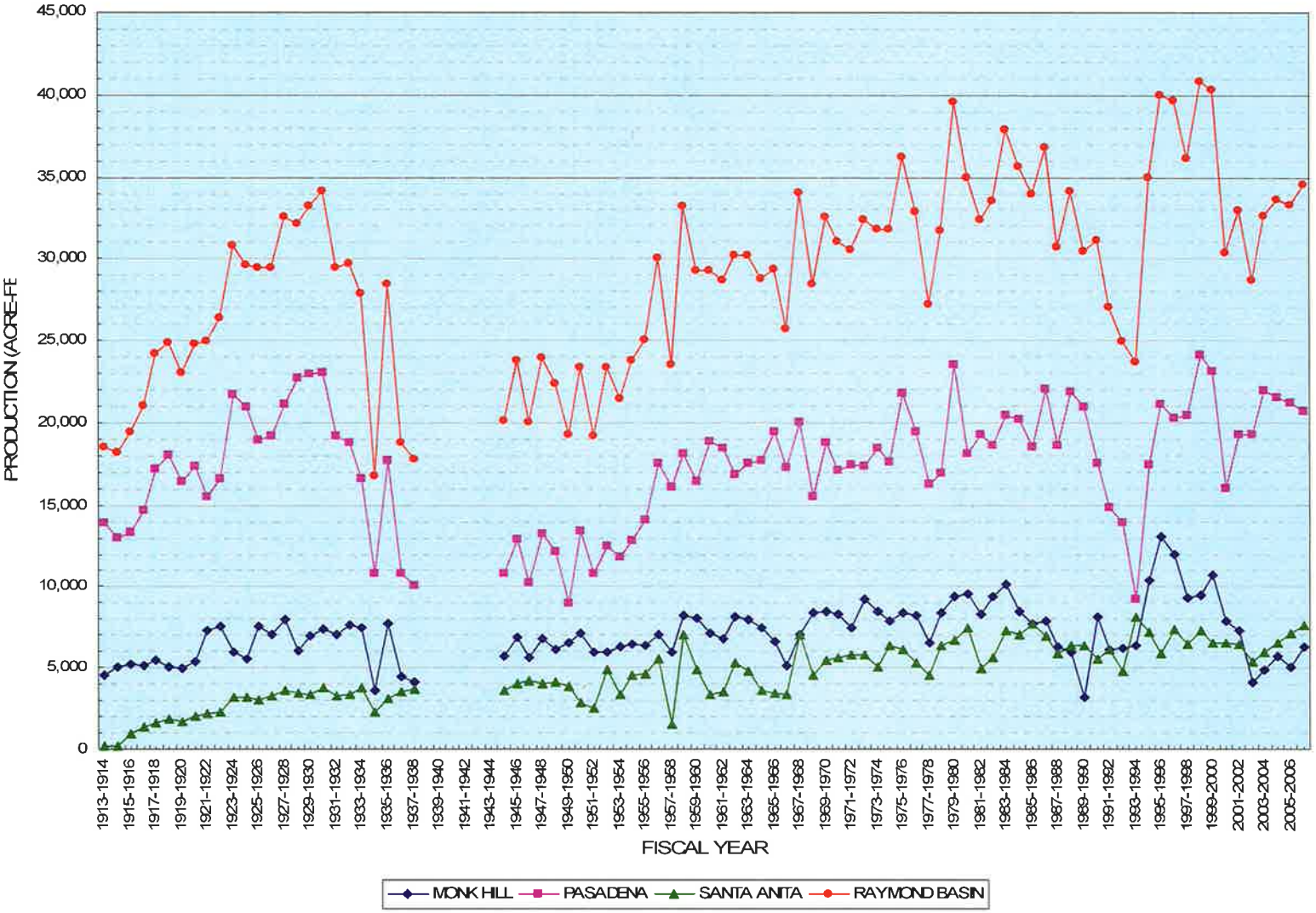


PLATE 1 HISTORIC GROUNDWATER PRODUCTION IN RAYMOND BASIN

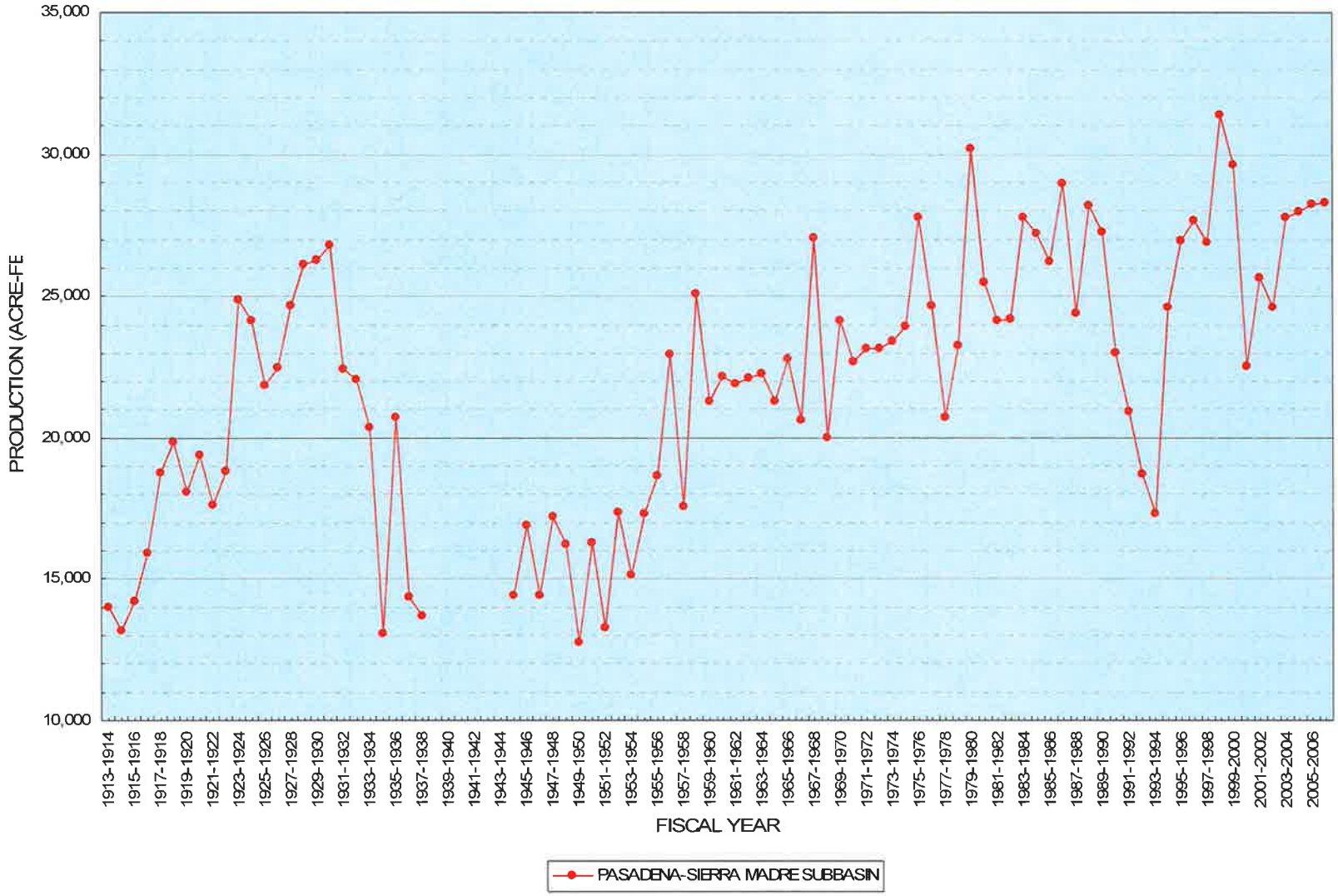


PLATE 2 HISTORIC GROUNDWATER PRODUCTION IN PASADENA AND SANTA ANITA SUB-AREAS

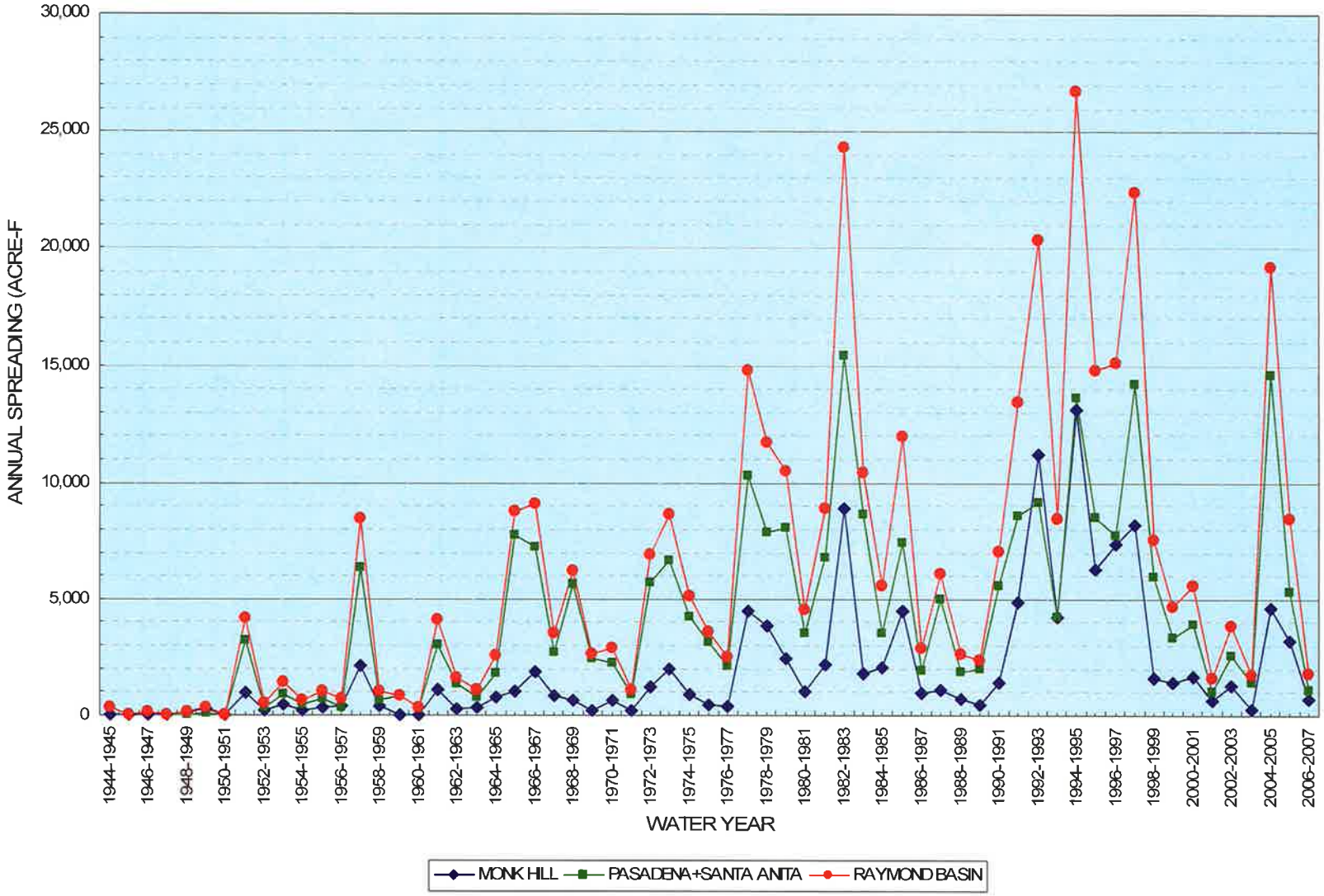


PLATE 3 SURFACE WATER SPREADING IN RAYMOND BASIN

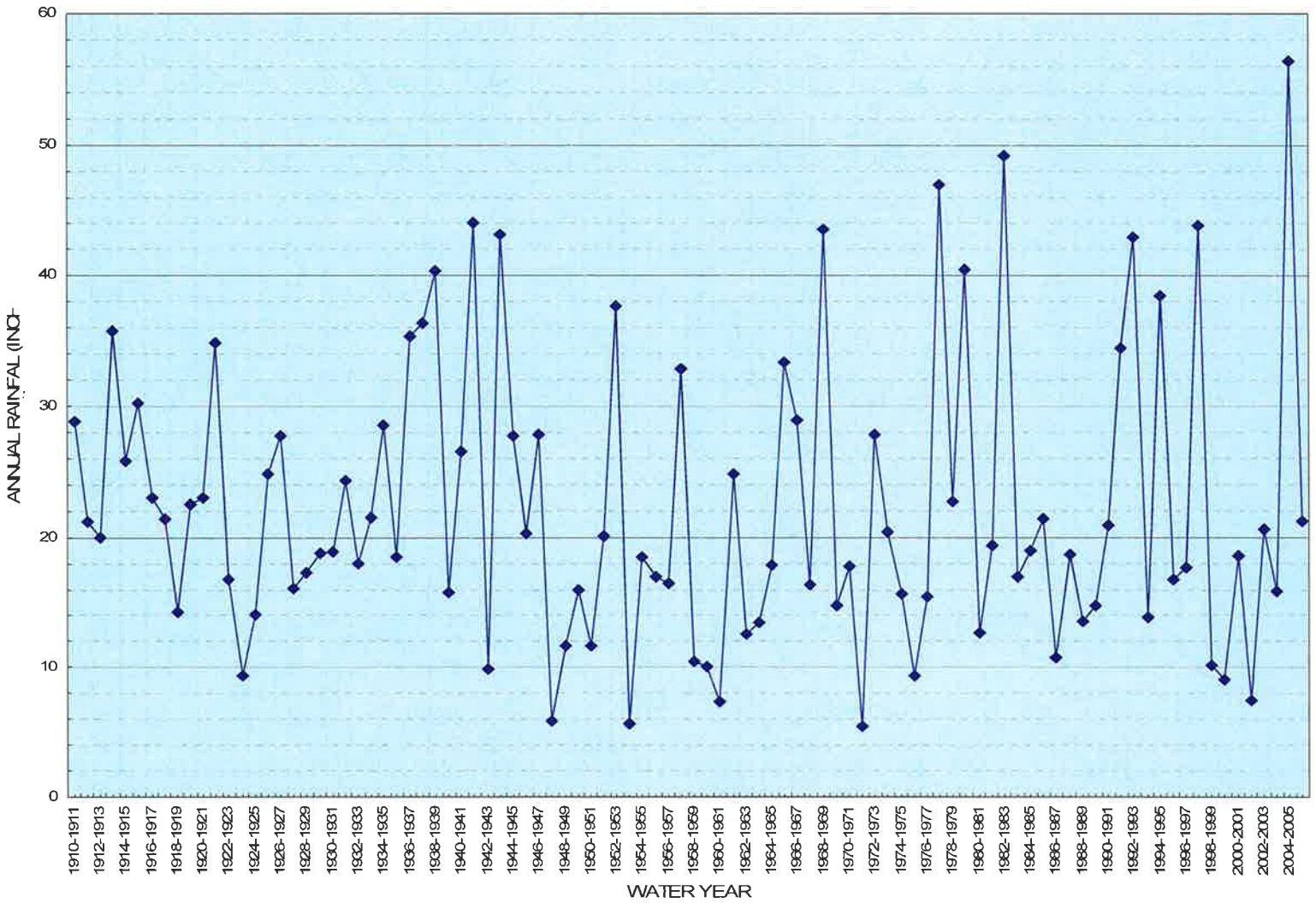


PLATE 4 HISTORIC PRECIPITATION AT ALTADENA STATION

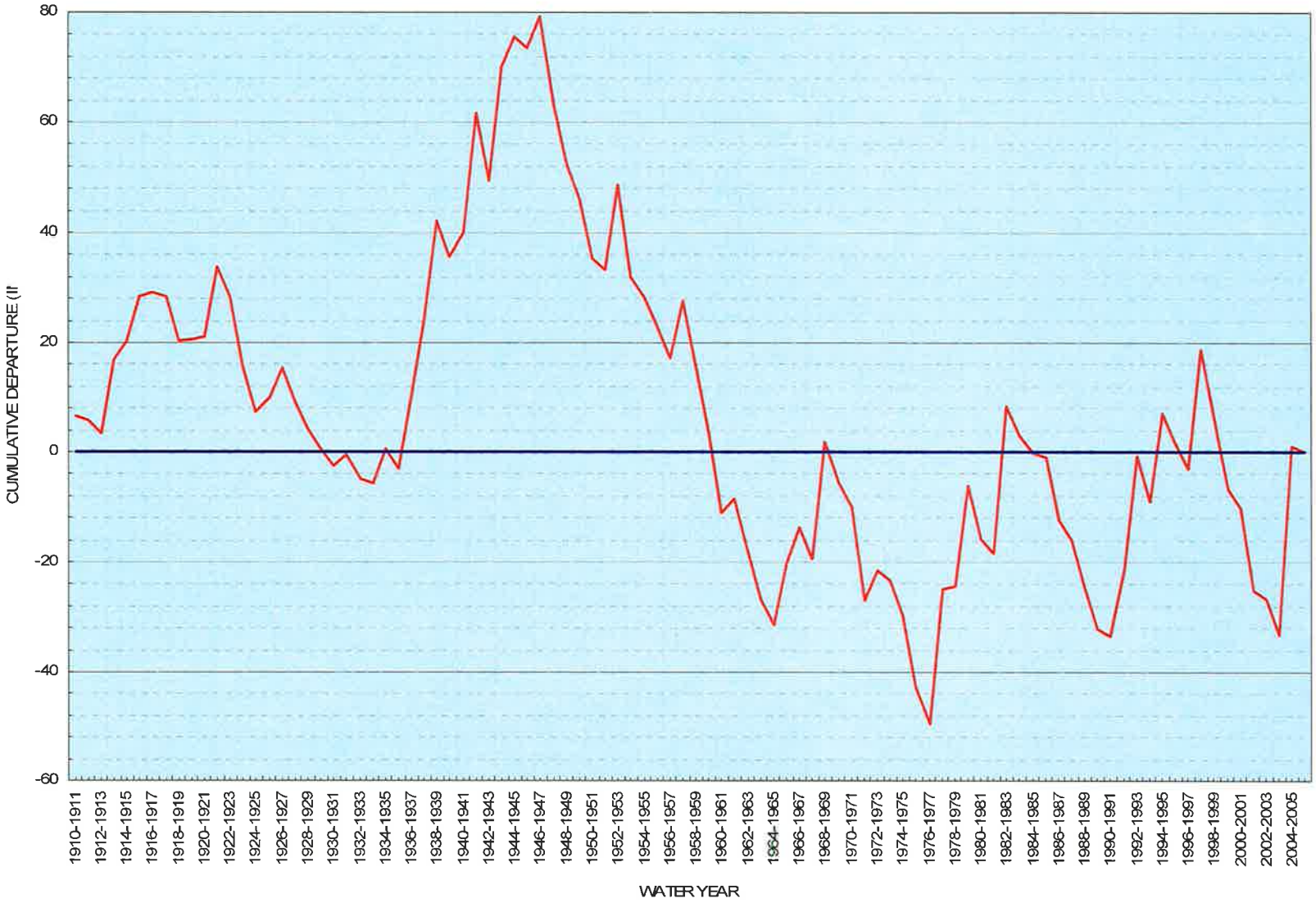
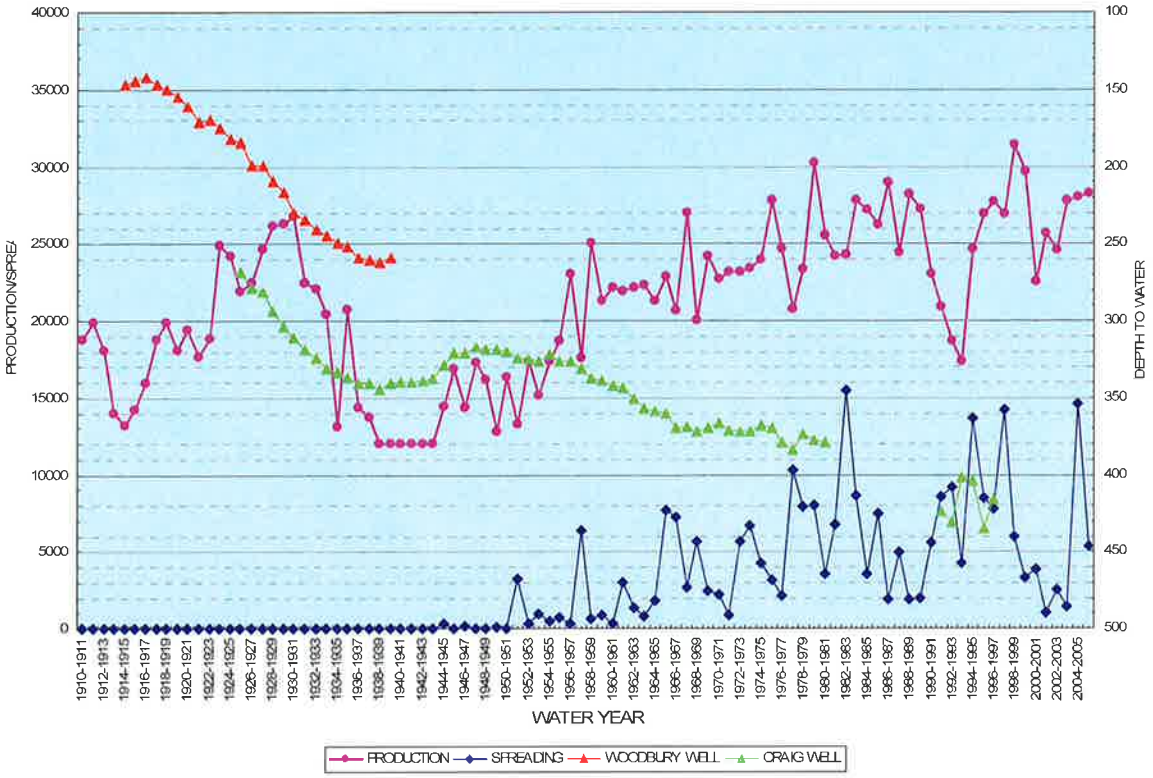


PLATE 5 CUMULATIVE DEPARTURE FROM AVERAGE PRECIPITATION AT ALTADENA STATION



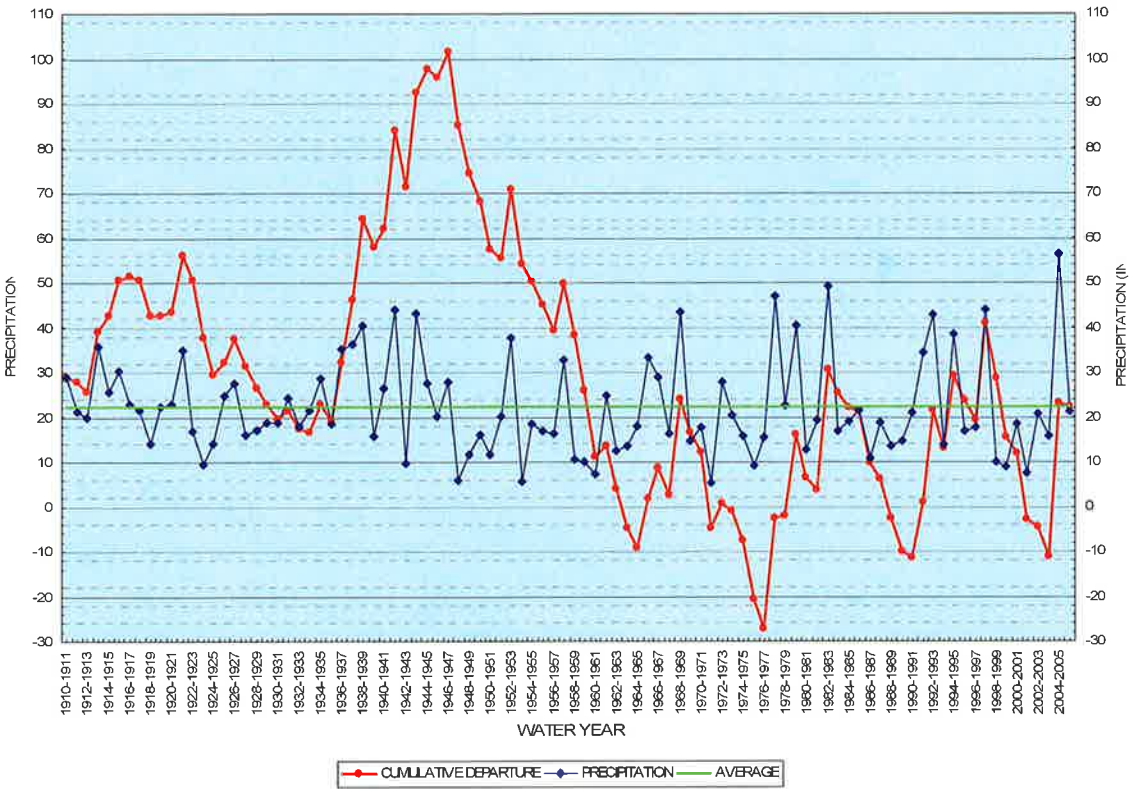


PLATE 6 EVALUATION OF GROUNDWATER PRODUCTION IN RAYMOND BASIN

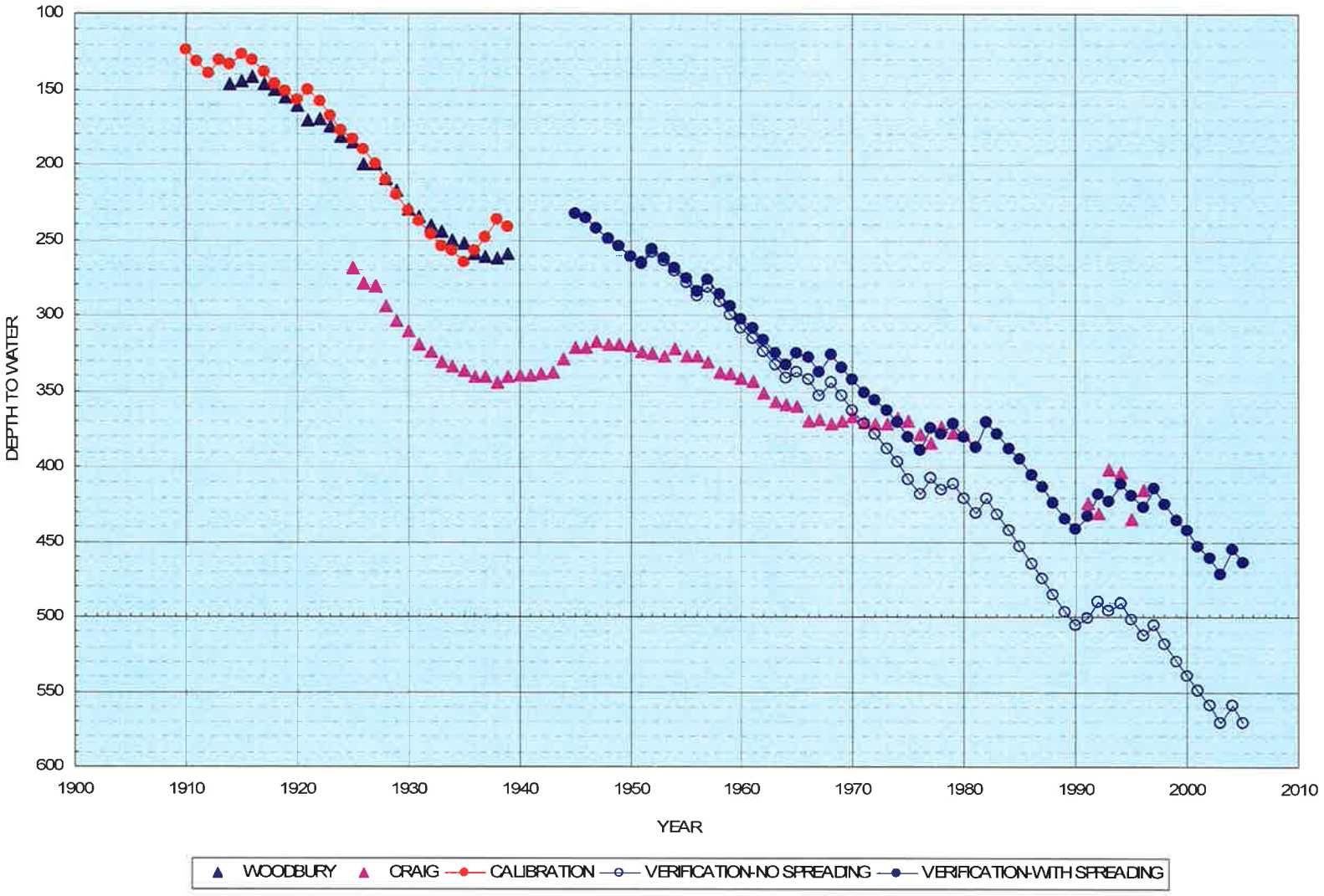


PLATE 7 CALIBRATION AND VERIFICATION OF THE GROUNDWATER BALANCE MODEL

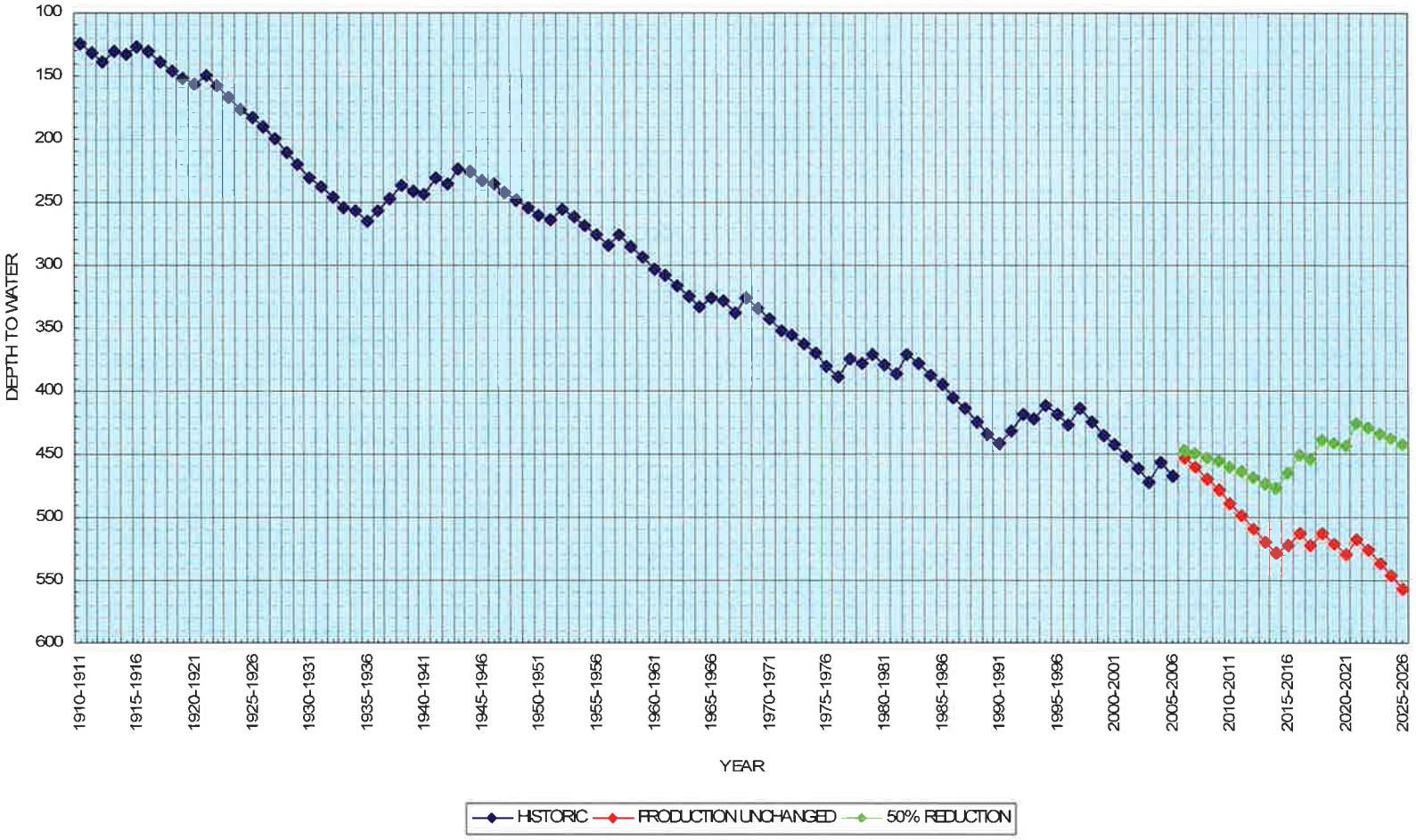


PLATE 8 APPLICATION OF THE GROUNDWATER BALANCE MODEL

ATTACHMENT F

EVALUATION OF GROUNDWATER PRODUCTION IN THE PASADENA SUBAREA (APRIL 14, 2008)

TECHNICAL MEMORANDUM

TO: **TONY ZAMPIELLO**
RAYMOND BASIN MANAGEMENT BOARD

FROM: **STETSON ENGINEERS, INC.**

SUBJECT: **ADDITIONAL EVALUATION OF GROUNDWATER PRODUCTION IN THE PASADENA SUBAREA OF THE RAYMOND BASIN**

JOB NO.: **1927-05**

DATE: **APRIL 14, 2008**

In the meeting held at the office of the Raymond Basin Management Board (Board) on April 7, 2008, Geoscience Support Services, Inc. (Geoscience) presents its comments and recommendations on the spreadsheet groundwater balance model for the Pasadena-Santa Anita subarea of the Raymond Basin (Groundwater Balance Model). The Geoscience's comments and recommendations are described in its draft technical memorandum entitled "Comments on Stetson Groundwater Balance Model" dated April 7, 2008. The Groundwater Balance Model was described in a technical memorandum entitled "Evaluation of Groundwater Production in the Pasadena Subarea of the Raymond Basin" prepared by Stetson Engineers, Inc. (Stetson) dated December 12, 2007. These comments and recommendations were considered and incorporated in the modification of the Groundwater Balance Model to an attempt to improve its reliability and projection confidence. The modified Groundwater Balance Model includes the following:

1. Another component was added to the Groundwater Balance Model to account for the return flow from water use within the modeled area, as shown on Plate 1. The annual water use for the Raymond Basin since 1994-45 was compiled from the Board annual reports, as shown in Table 1. Annual groundwater extractions were assumed to be annual water uses for earlier fiscal year.

2. Because the recent water level data at the City of Pasadena's Woodbury Well is inadequate and inconsistent with the trend at nearby wells, its annual water level since 1940 was reconstructed by offsetting the differences in ground surface elevations from the water level at Craig and Monte Vista Wells. The

reconstructed water level data at Woodbury Well appears to be consistent with some measured data at this well, as shown on Plate 2.

The modified Groundwater Balance Model was re-calibrated (from 1910 to 1940) by adjusting the coefficient for the return flow from water use until a good match was reached, as shown on Plate 2. The calibrated coefficient for the return flow from water use is 0.03 (3 percent). Since the match is relatively good, additional steps for the recharge coefficients as recommended by Geoscience was not explored.

The calibrated was then verified for the period from 1940 to 2005. During the verification process, the coefficient of the return flow from water use was adjusted to 0.04 (4 percent) to match with the overall declination of the water level at Woodbury Well, i.e. at approximately 400 feet in 2003, as shown on Plate 2. Except for the periods from 1940 to 1946 and from 1970 to 1990, the match is relatively good.

The calibrated Groundwater Balance Model was the used to simulate the water level at Woodbury Well for three scenarios. The results, as shown on Plate 3, are summarized as follows:

1. In Scenario 1, the groundwater production and water use in the Pasadena-Santa Anita subarea remain at the 2005-2006 levels (28,243 and 57,737 acre-feet/year, respectively) for the next 20 years under an average hydrologic condition. The simulation result indicates that the water level at Woodbury Well continues to decline from approximately 330 feet to 450 feet, i.e. approximately 120 feet.

2. In Scenario 2, the groundwater production in the Pasadena-Santa Anita was reduced 50% from the 2005-2006 and remains at that level (14,121 acre-feet/year) for the next 20 years, but the water use remains at the 2005-2006 level (57,737 acre-feet/year) under an average hydrologic condition. The simulation result indicates that the water level at Woodbury Well appears to stabilize although it declines approximately 10 feet.

3. In Scenario 3, all conditions in Scenario 2 remain the same, except the groundwater production in the Pasadena-Santa Anita was kept at the 1944 rights since 1954-1955 (15,412 acre-feet/year). The simulation result indicates that the water level at Woodbury Well appears to be stabilized at approximately 250 feet since 1954-1955. This suggests that the long-term safe yield of the Pasadena-Santa Anita subarea is approximately 15,000 acre-feet/year.

PLATE 1 - COMPONENTS OF GROUNDWATER BALANCE MODEL

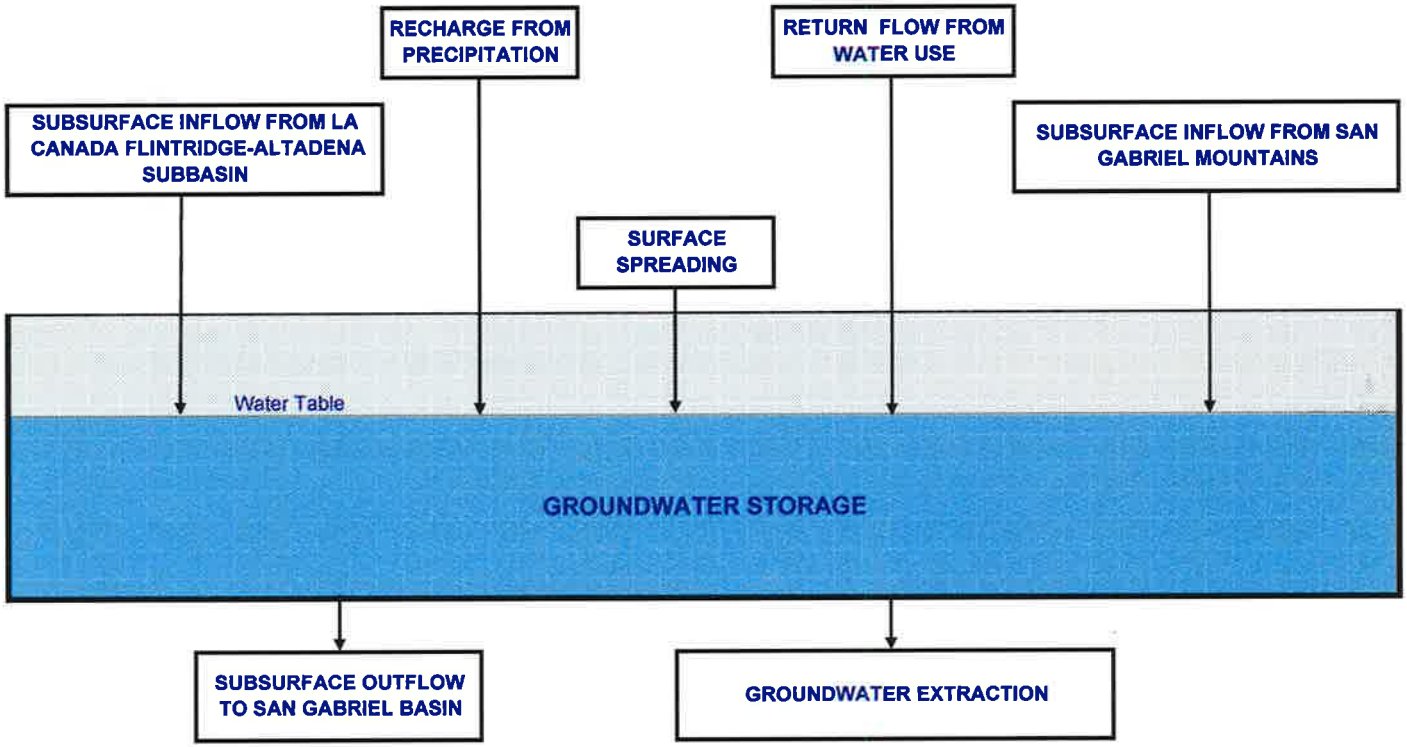


PLATE 2 - MODEL CALIBRATION AND VERIFICATION

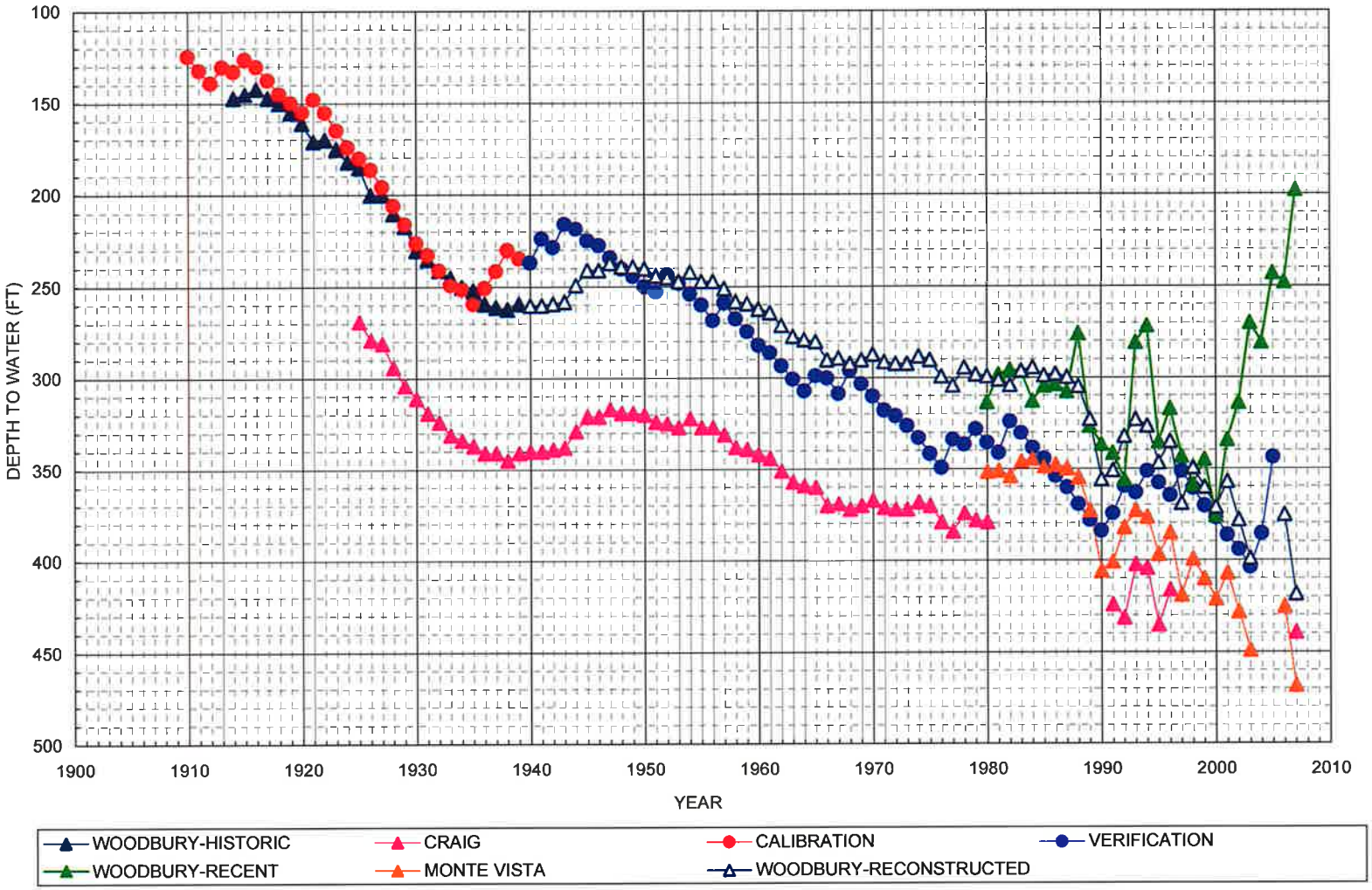


PLATE 3 - SIMULATED WATER LEVEL AT WOODBURY WELL

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

PARTY	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	FISCA 1975-1976
ALHAMBRA, CITY OF																																
Groundwater Extraction	612.93	766.53	724.54	705.62	674.02	687.82	634.32	749.50	712.82	717.43	845.56	909.09	997.51	1,063.83	836.03	977.20	1,091.40	1,162.30	803.51	1,019.99	1,071.69	842.44	1,139.32	291.53	1,032.67	769.02	1,139.79	902.13	1,031.63	1,075.44	871.48	1,054.11
Surface Water Diversion																																
Imported Water						7,065.22	7,148.94	7,085.43	7,916.74	8,370.72	8,238.26	8,322.90		8,048.96	9,136.15	8,794.70	9,165.50	8,639.00	9,209.00	9,121.66	8,968.86	9,478.77	8,900.24	10,607.79	9,407.62	10,694.04	10,182.02	11,072.80	10,066.29	9,927.47	10,007.74	10,966.19
Exported Water														-1,063.83	-836.03	-977.00	-1,091.00	-1,162.00	-804.00	-1,019.99	-1,071.69	-842.44	-1,139.32	-291.53	-1,032.67	-769.02	-1,139.79	-902.13	-1,031.63	-1,075.44	-871.48	0.00
Transferred Water																																
SUBTOTAL	612.93	766.53	724.54	705.62	674.02	7,753.04	7,783.26	7,834.93	8,629.56	9,088.15	9,083.82	9,231.99	997.51	8,048.96	9,136.15	8,794.90	9,165.90	8,639.30	9,208.51	9,121.66	8,968.86	9,478.77	8,900.24	10,607.79	9,407.62	10,694.04	10,182.02	11,072.80	10,066.29	9,927.47	10,007.74	12,020.30
ARCADIA, CITY OF																																
Groundwater Extraction	4,260.24	4,234.17	4,312.77	3,997.05	4,329.49	3,616.64	2,607.79	1,858.96	4,231.17	3,646.27	4,132.30	4,417.61	4,980.94	3,484.65	7,026.37	4,949.80	4,813.90	4,440.50	5,408.91	4,395.69	4,723.67	4,412.07	4,241.37	7,459.76	5,064.06	5,886.76	6,311.43	5,296.40	6,077.99	5,273.73	6,441.99	6,474.47
Surface Water Diversion																																
Imported Water						5,353.74	6,593.63	8,511.43	7,362.76	8,390.14	8,044.61	8,869.86		9,694.98	7,444.95	9,736.90	11,235.50	10,733.00	8,759.00	10,309.74	10,298.28	10,518.96	9,809.76	7,721.78	8,899.18	9,555.65	9,032.79	10,767.15	8,640.17	9,624.94	8,035.92	10,746.89
Exported Water															-741.91									-1,794.03	0.00	-163.36	-1,205.91	-322.67	-1,273.80	-387.57	-1,554.82	-621.14
Transferred Water																																
SUBTOTAL	4,260.24	4,234.17	4,312.77	3,997.05	4,329.49	8,970.38	9,201.42	10,370.39	11,593.93	12,036.41	12,176.91	13,287.47	4,980.94	13,179.63	13,729.41	14,686.70	16,049.40	15,173.50	14,167.91	14,705.43	15,021.95	14,931.03	14,051.13	13,387.51	13,963.24	15,279.05	14,138.31	15,740.88	13,444.36	14,511.10	12,923.09	16,600.22
CALIFORNIA AMERICAN WATER COMPANY																																
Groundwater Extraction	1,752.31	2,269.18	2,222.39	902.64	650.71	992.57	1,004.10	1,424.46	1,751.58	1,987.66	1,326.13	1,359.30	1,767.06	1,685.18	2,592.83	1,688.29	2,413.99	2,135.09	2,460.73	2,356.77	2,498.26	2,981.09	2,869.78	2,486.03	2,276.03	2,288.60	2,268.59	2,489.18	1,974.95	2,361.60	1,995.30	2,870.83
Surface Water Diversion																																
Imported Water						3,677.85	3,671.08	3,467.63	3,378.61	3,480.83	4,010.58	4,083.51		3,800.56	3,855.40	4,661.80	4,249.70	4,025.00	3,587.00	3,932.86	3,630.37	3,367.70	3,036.92	3,917.57	3,618.94	4,555.59	4,820.09	4,915.10	4,857.59	4,416.63	4,804.69	4,579.74
Exported Water															-608.02		-296.00	-219.00	-623.00	-498.71	-579.07	-1,070.01	-873.60	-381.31	-135.75	0.00	0.00	0.00	0.00	-212.09	0.00	-569.83
Transferred Water																																
SUBTOTAL	1,752.31	2,269.18	2,222.39	902.64	650.71	4,670.42	4,675.18	4,892.09	5,130.19	5,468.49	5,336.71	5,442.81	1,767.06	5,485.74	5,840.21	6,350.09	6,367.69	5,941.09	5,424.73	5,790.92	5,549.56	5,278.78	5,033.10	6,022.29	5,759.22	6,844.19	7,088.68	7,404.28	6,832.54	6,566.14	6,799.99	6,880.74
EAST PASADENA WATER COMPANY																																
Groundwater Extraction		885.40	991.20	1,265.65	1,122.17	413.90	136.89	168.21	232.15	280.48	273.48	152.18	226.32	259.20	264.19	330.60	439.50	256.90	221.79	365.39	305.32	368.15	348.62	632.70	360.27	439.03	502.33	429.73	415.63	535.00	576.56	623.28
Surface Water Diversion																																
Imported Water						767.44	1,032.10	1,036.57	1,115.71	1,120.52	1,142.18	1,301.96		1,255.36			1,480.30	1,511.00	1,526.00	1,459.07	1,460.36	1,459.13	1,467.88	1,280.27	1,343.32	1,636.56	1,547.65	1,811.48	1,590.27	1,338.55	1,268.81	1,398.32
Exported Water																	-7.00			-147.08				-195.39	0.00	-1.08	-60.56	0.00	0.00	-148.23	-185.13	-198.61
Transferred Water																																
SUBTOTAL		885.40	991.20	1,265.65	1,122.17	1,181.34	1,168.99	1,204.78	1,347.86	1,401.00	1,415.66	1,454.14	226.32	1,514.56	264.19	330.60	1,912.80	1,767.90	1,747.79	1,677.38	1,765.68	1,827.28	1,816.50	1,717.58	1,703.59	2,074.51	1,989.42	2,241.21	2,005.90	1,725.32	1,660.24	1,822.99

PARTY	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976
HUNTINGTON LIBRARY & ART GALLERY																																
Groundwater Extraction	121.63	220.05	187.35	177.58	181.38	176.16	176.79	187.66	222.13	221.72	163.98	179.09	187.33	197.14	247.83	280.01	315.01	243.30	244.09	250.38	250.93	223.09	198.44	258.97	215.20	282.56	302.19	386.84	338.20	304.70	322.54	409.84
Surface Water Diversion																																
Imported Water																																
Exported Water																																
Transferred Water																																
SUBTOTAL	121.63	220.05	187.35	177.58	181.38	176.16	176.79	187.66	222.13	221.72	163.98	179.09	187.33	197.14	247.83	280.01	315.01	243.30	244.09	250.38	250.93	223.09	198.44	258.97	215.20	282.56	302.19	386.84	338.20	304.70	322.54	409.84
KINNELOA IRRIGATION DISTRICT																																
Groundwater Extraction	115.77	120.10	151.41	110.88	154.48	133.24	135.10	102.84	111.99	150.06	132.87	47.16	32.78	26.59	50.35	53.90	158.90	118.28	289.32	70.94	160.47	110.54	123.74	228.77	282.80	175.04	173.11	222.88	197.96	146.27	164.23	374.79
Surface Water Diversion						17.70	20.87	64.24	37.86	96.39	106.65	75.07		36.75	190.40	134.80	129.30	131.00	133.00	137.68	141.20	249.23	322.22	307.12	81.75	369.74	268.72	227.98	216.98	237.61	244.70	207.13
Imported Water						33.45	29.15		80.24	29.37	28.36	52.42		40.93	35.67	114.50																	
Exported Water																																
Transferred Water																																
SUBTOTAL	115.77	120.10	151.41	110.88	154.48	184.39	185.12	167.08	230.09	275.82	267.88	174.65	32.78	104.27	276.42	303.20	288.20	249.28	422.32	208.62	301.67	359.77	445.96	535.89	364.55	544.78	441.83	450.86	414.94	383.88	408.93	581.92
LA CANADA IRRIGATION DISTRICT																																
Groundwater Extraction	74.38	155.28	193.17	221.84	376.06	564.34	737.27	610.30	636.01	780.36	972.45	286.94	235.10	36.45	125.17	181.60	170.69	71.30	55.32	100.88	100.03	174.35	90.73	235.29	70.15	43.68	19.97	15.91	63.69	158.29	154.03	168.26
Surface Water Diversion						111.22	88.29	144.46	119.03	110.58	96.93	75.19		79.10	128.35	73.30	40.00	64.00	61.00	57.58	51.45	79.19	130.96	189.72	81.30	209.20	264.61	259.02	145.75	148.26	137.09	92.59
Imported Water						425.42	334.29	413.48	724.27	403.75	154.57	1,210.93		1,757.40	2,013.91	1,891.40	2,169.20	2,129.00	2,097.00	1,758.13	1,652.65	1,800.53	1,789.44	1,809.96	1,843.19	2,129.75	2,087.65	2,300.87	1,876.00	2,020.70	1,886.95	2,232.26
Exported Water																															-395.70	-310.41
Transferred Water																																
SUBTOTAL	74.38	155.28	193.17	221.84	376.06	1,100.98	1,159.85	1,168.24	1,479.31	1,294.69	1,223.95	1,573.06	235.10	1,872.95	2,267.43	2,146.30	2,379.89	2,264.30	2,213.32	1,916.59	1,804.13	2,054.07	2,011.13	2,234.97	1,994.64	2,382.63	2,372.23	2,575.80	2,085.44	2,327.25	1,782.37	2,182.70
LAS FLORES WATER COMPANY																																
Groundwater Extraction	176.84	352.07	425.62	533.40	618.70	677.06	749.18	598.13	398.56	475.63	453.68	361.49	532.43	307.53	203.66	212.40	235.70	259.50	242.67	268.95	247.71	237.03	241.84	254.29	192.26	295.92	231.82	277.19	256.22	258.89	272.45	281.70
Surface Water Diversion						63.45	71.74	64.25	82.79	90.88	73.08	83.07		71.48	83.99	68.80	71.60	67.00	52.00	36.49	21.28	58.88	144.14	186.66	221.88	236.40	90.46	91.95	75.01	74.67	58.13	59.68
Imported Water								71.51	349.30	326.08	324.75	361.26		482.24	719.74	647.90	613.30	534.00	626.00	581.64	610.23	540.32	390.68	451.03	345.72	354.06	551.94	588.58	517.90	504.03	429.97	524.11
Exported Water																																
Transferred Water																																
SUBTOTAL	176.84	352.07	425.62	533.40	618.70	740.51	820.92	733.89	830.65	892.59	851.51	805.82	532.43	861.25	1,007.39	929.10	920.60	860.50	920.67	887.08	879.22	836.23	776.66	891.98	759.86	886.38	874.22	957.72	849.13	837.59	760.55	865.49

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

PARTY	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	FISCA 1975-1976
LINCOLN AVENUE WATER COMPANY																																
Groundwater Extraction	598.49	883.30	931.64	1,430.19	0.00	1,578.10	1,710.22	1,316.91	1,303.67	1,355.06	1,577.27	1,257.05	1,151.59	827.46	762.06	774.80	502.71	497.91	797.09	547.08	574.83	587.57	447.99	740.30	629.64	563.43	558.51	671.11	726.45	719.36	1,018.86	1,184.92
Surface Water Diversion						206.42	113.47	529.71	297.21	296.64	187.81	154.93		500.46	253.43	135.20	104.80	244.00	139.00	115.08	140.83	594.08	734.54	485.09	609.07	495.32	633.67	219.60	1,346.26	123.34	0.00	0.00
Imported Water								12.77	410.56	569.75	358.58	716.25		880.45	1,545.05	1,688.10	2,122.90	1,625.00	1,436.00	1,728.45	1,613.09	1,109.17	786.82	961.15	865.74	1,397.06	1,318.24	1,818.68	1,026.61	1,036.92	635.79	940.53
Exported Water																																
Transferred Water																																
SUBTOTAL	598.49	883.30	931.64	1,430.19	0.00	1,784.52	1,823.69	1,859.39	2,011.44	2,221.45	2,123.66	2,128.23	1,151.59	2,208.37	2,560.54	2,598.10	2,730.41	2,366.91	2,372.09	2,390.61	2,328.75	2,290.82	1,969.35	2,186.54	2,104.45	2,455.81	2,510.42	2,709.39	3,099.32	1,879.62	1,654.65	2,125.45
PASADENA, CITY OF																																
Groundwater Extraction	7,587.89	8,191.14	4,746.53	7,634.20	6,092.91	3,895.56	8,520.46	5,952.16	7,003.75	5,889.20	6,872.06	9,370.38	12,886.66	13,777.06	15,940.21	13,838.17	12,488.69	13,585.69	12,945.76	13,327.57	12,613.50	12,951.87	10,087.39	14,413.52	11,760.96	14,803.01	12,804.75	13,015.70	14,497.07	13,662.28	13,290.71	15,631.58
Surface Water Diversion						1,952.81	736.84	6,148.12	2,670.36	2,645.29	1,806.90	1,605.14		4,947.63	1,963.35	499.90	296.30	1,769.00	1,235.00	1,198.58	1,608.40	6,762.15	9,391.09	4,354.03	6,277.73	5,458.59	3,038.44	1,159.65	2,258.95	2,967.27	2,274.61	1,856.43
Imported Water						18,557.62	15,066.35	12,552.41	18,083.54	20,255.04	19,426.54	17,829.73		11,816.13	16,391.41	19,520.90	21,515.90	18,198.00	18,886.00	19,305.88	19,122.30	13,845.09	12,310.05	15,650.53	14,481.85	15,272.59	19,243.00	22,343.51	16,499.34	16,571.05	18,278.25	19,654.21
Exported Water														-2,243.97	-2,780.02	-2,725.00	-2,935.00	-4,411.00	-4,804.00	-5,753.28	-3,530.10	-5,794.29	-3,822.37	-6,080.76	-5,921.82	-5,616.29	-5,089.53	-5,652.69	-4,630.97	-4,569.99	-5,203.65	-6,967.80
Transferred Water																																
SUBTOTAL	7,587.89	8,191.14	4,746.53	7,634.20	6,092.91	24,405.99	24,323.65	24,652.69	27,757.65	28,789.53	28,105.50	28,805.25	12,886.66	28,296.85	31,514.95	31,133.97	31,365.89	29,141.69	28,262.76	28,078.75	29,814.10	27,764.82	27,966.16	28,337.32	26,598.72	29,917.90	29,996.66	30,866.17	28,624.39	28,630.61	28,639.92	30,174.42
PASADENA CEMETERY ASSOCIATION																																
Groundwater Extraction	31.98	46.11	52.12	0.00	70.83	65.19	56.03	49.62	65.16	68.66	69.00	73.63	68.42	60.99	77.32	74.80	88.91	107.61	106.79	87.11	93.08	84.11	92.87	108.35	99.09	114.06	109.37	105.05	74.72	83.21	77.02	83.00
Surface Water Diversion						1.75	1.59																									
Imported Water																																
Exported Water																																
Transferred Water																																
SUBTOTAL	31.98	46.11	52.12	0.00	70.83	66.94	57.62	49.62	65.16	68.66	69.00	73.63	68.42	60.99	77.32	74.80	88.91	107.61	106.79	87.11	93.08	84.11	92.87	108.35	99.09	114.06	109.37	105.05	74.72	83.21	77.02	83.00
ROYAL LAUNDRY																																
Groundwater Extraction	111.66	95.36	102.13	118.03	125.75	124.68	121.48	120.12	124.11	135.03	132.88	136.22	152.37	136.46	136.73	136.20	135.90	105.60	151.20	145.93	132.72	115.39	134.38	149.95	150.18	150.84	154.82	158.24	160.63	153.48	143.72	131.65
Surface Water Diversion																																
Imported Water																																
Exported Water																																
Transferred Water																																
SUBTOTAL	111.66	95.36	102.13	118.03	125.75	124.68	121.48	120.12	124.11	135.03	132.88	136.22	152.37	136.46	136.73	136.20	135.90	105.60	151.20	145.93	132.72	115.39	134.38	149.95	150.18	150.84	154.82	158.24	160.63	153.48	143.72	131.65
RUBIO CANON LAND AND WATER ASSOCIATION																																
Groundwater Extraction	895.32	1,268.75	1,284.00	1,695.42	1,761.47	1,785.94	1,851.89	1,477.39	1,484.46	1,649.18	1,551.99	1,494.77	1,431.58	1,296.51	1,368.73	1,223.89	1,219.50	1,174.81	1,205.40	1,307.61	1,157.73	1,128.26	797.89	1,508.09	1,366.24	1,487.64	1,134.65	1,168.06	1,243.94	1,280.33	1,226.75	1,355.61
Surface Water Diversion						132.63	94.88	340.06	217.51	155.45	122.41	109.74		312.95	209.27	115.30	79.90	152.00	111.00	81.08	92.87	334.95	571.78	425.08	212.36	414.94	307.18	189.41	187.17	108.40	97.16	86.59
Imported Water								59.32	481.89	459.06	458.05	630.83		566.18	948.77	1,167.90	1,380.90	1,142.00	1,067.00	1,040.07	1,140.92	899.77	793.31	403.31	484.06	580.55	990.61	1,339.66	849.87	846.72	801.49	943.89
Exported Water																																
Transferred Water																																
SUBTOTAL	895.32	1,268.75	1,284.00	1,695.42	1,761.47	1,918.57	1,946.77	1,876.77	2,183.86	2,263.69	2,132.45	2,235.34	1,431.58	2,175.64	2,526.77	2,507.09	2,680.30	2,468.81	2,383.40	2,428.76	2,391.52	2,362.98	2,162.98	2,336.48	2,062.66	2,483.13	2,432.44	2,697.13	2,280.98	2,235.45	2,125.40	2,386.09
SAN GABRIEL COUNTY WATER DISTRICT																																
Groundwater Extraction	650.34	414.86	222.09	536.67	120.75	106.49	280.21	215.32	105.41	39.00	586.75	652.72	888.22	367.57	1,251.73	1,166.10	1,469.50	1,068.90	923.51	1,197.73	1,241.20	999.56	1,120.77	1,112.64	1,062.97	1,105.38	1,105.03	1,072.71	1,096.33	943.33	1,234.71	1,090.99
Surface Water Diversion																																
Imported Water						3,631.02	3,729.77	3,803.78	4,365.88	4,534.51	3,892.59	4,020.99		4,525.21	4,414.16	4,424.50	4,358.40	4,410.00	4,389.00	4,306.11	4,187.82	4,583.45	4,215.39	4,722.04	4,660.01	5,297.98	5,307.13	5,924.17	5,360.26	0.00	0.00	5,750.80
Exported Water														-367.57	-1,251.73	-1,176.00	-1,472.00	-1,069.00	-1,038.00	-1,197.73	-1,241.20	-999.56	-1,120.77	-1,112.64	-1,062.61	-1,105.92	-1,105.03	-1,072.71	-1,096.33	-943.33	0.00	0.00
Transferred Water																																
SUBTOTAL	650.34	414.86	222.09	536.67	120.75	3,737.51	4,009.98	4,019.10	4,471.29	4,573.51	4,479.34	4,673.71	888.22	4,525.21	4,414.16	4,414.60	4,355.90	4,409.90	4,274.51	4,306.11	4,187.82	4,583.45	4,215.39	4,722.04	4,660.37	5,297.44	5,307.13	5,924.17	5,360.26	0.00	1,234.71	6,841.79
SIERRA MADRE, CITY OF																																
Groundwater Extraction	722.26	1,170.60	1,241.74	1,644.10	1,468.97	1,488.97	1,583.37	1,342.20	1,598.94	1,862.11	1,521.52	1,906.94	1,824.67	1,750.38	1,815.12	1,972.30	1,957.50	1,979.90	2,017.85	2,215.32	2,124.34	1,820.13	1,393.80	1,722.64	1,551.09	1,586.56	1,612.39	2,358.84	1,920.97	1,828.71	1,924.98	2,364.32
Surface Water Diversion						281.21	204.67	427.84	451.90	222.96	207.06	191.65		333.84	527.38	321.80	213.00	333.00	357.00	207.85	270.45	719.65	999.34	823.87	896.83	1,126.67	688.78	458.56	499.68	715.58	528.63	362.75
Imported Water														31.58																		
Exported Water																																
Transferred Water																																
SUBTOTAL	722.26	1,170.60	1,241.74	1,644.10	1,468.97	1,770.18	1,788.04	1,770.04	2,050.84	2,085.07	1,728.58	2,098.59	1,824.67	2,115.80	2,342.50	2,294.10	2,170.50	2,312.90	2,374.85	2,423.17	2,394.79	2,539.78	2,393.14	2,546.51	2,447.92	2,713.23	2,301.17	2,817.40	2,420.65	2,544.29	2,453.61	2,727.07
SUNNY SLOPE WATER COMPANY																																
Groundwater Extraction	1,027.17	1,284.50	716.04	1,031.56	1,072.71	968.69	865.36	1,090.90	1,117.98	1,628.95	1,239.38	1,567.17	1,718.74	1,506.59	1,533.34	1,618.90	1,520.50	1,385.70	1,637.15	1,725.10	1,340.68	1,787.27	1,547.35	1,578.74	1,553.29	1,577.40	1,611.24	1,028.74	1,563.34	2,022.63	1,295.88	1,917.19
Surface Water Diversion																																
Imported Water																																
Exported Water																			2,274.00	2,429.67	2,706.16	2,458.94	2,446.64	2,741.44	2,346.30	2,818.18	2,574.36	3,438.20	2,634.65	2,097.24	2,748.80	2,696.21
Transferred Water															-1,449.06	-1,523.00	-1,423.00	-1,311.00	-1,538.00	-1,617.70	-1,242.14	-1,686.09	-1,444.45	-1,469.77	-1,451.09	-1,459.73	-1,494.68	-896.57	-1,450.62	0.00	-1,174.37	-1,781.76
SUBTOTAL	1,027.17	1,284.50	716.04	1,031.56	1,072.71	968.69	865.36	1,090.90	1,117.98	1,628.95	1,239.38	1,567.17	1,718.74	1,506.59	84.28	95.90	97.50	74.70	2,373.15	2,537.07	2,804.70	2,560.12	2,549.54	2,850.41	2,448.50	2,935.85	2,690.92	3,570.37	2,747.37	4,119.87	2,870.31	2,831.64

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

PARTY	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	FISCA 1975-1976
VALLEY WATER COMPANY																																
Groundwater Extraction	918.4	1,177.86	1,232.24	1,632.24	1,760.75	1,822.09	1,963.02	1,918.01	2,062.57	2,127.68	2,048.27	1,164.63	905.77	689.72	713.96	803.11	870.39	696.58	1,127.39	1,002.05	771.15	844.58	736.43	841.66	580.45	926.17	672.49	884.95	781.28	953.40	768.08	815.99
Surface Water Diversion																																
Imported Water								134.00	455.08	537.78	455.38	1,465.61		2,103.46	2,560.77	2,534.50	2,479.60	2,324.00	2,266.00	1,981.79	2,202.05	2,157.85	2,032.61	2,196.31	2,061.37	2,112.19	2,280.00	2,419.28	2,061.51	1,821.78	1,912.00	2,319.95
Exported Water																																
Transferred Water																																
SUBTOTAL	918.40	1,177.86	1,232.24	1,632.24	1,760.75	1,822.09	1,963.02	2,052.01	2,517.65	2,665.46	2,503.65	2,630.24	905.77	2,793.18	3,274.73	3,337.61	3,349.99	3,020.58	3,393.39	2,983.84	2,973.20	3,002.43	2,769.04	3,037.97	2,641.82	3,038.36	2,952.49	3,304.23	2,842.79	2,775.18	2,680.08	3,135.94
RAYMOND BASIN	**19,657.61**	**23,535.26**	**19,736.98**	**23,637.07**	**20,581.15**	**61,376.39**	**62,071.14**	**64,049.70**	**71,763.70**	**75,110.22**	**73,034.86**	**76,497.40**	**29,987.49**	**75,083.59**	**79,701.01**	**80,413.27**	**84,374.79**	**79,147.87**	**80,041.48**	**79,939.41**	**81,662.68**	**80,292.92**	**77,486.01**	**81,932.55**	**77,381.63**	**88,094.76**	**85,844.32**	**92,982.54**	**83,647.91**	**79,005.16**	**76,544.87**	**91,801.25**

ANNUAL BASIN WATER USE

SUB-AREA	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	FISCA 1975-1976
MONK HILL																																
Groundwater Extraction	1,800.09	2,614.62	2,834.79	3,817.67	2,826.34	4,706.78	5,215.72	4,492.97	4,465.97	4,807.39	5,120.67	3,143.74	2,893.31	1,922.15	1,882.17	2,046.71	1,868.40	1,632.90	2,329.26	2,006.07	1,786.80	1,927.64	1,609.86	2,179.89	1,571.59	1,943.26	1,592.16	1,954.21	1,902.36	2,173.15	2,290.44	2,533.87
Surface Water Diversion	0.00	0.00	0.00	0.00	0.00	382.84	275.09	738.42	499.03	498.10	357.82	313.19	0.00	651.04	465.77	277.30	216.40	375.00	252.00	209.15	213.56	732.15	1,009.64	861.47	912.25	940.92	988.74	570.57	1,567.02	346.27	195.22	152.27
Imported Water	0.00	0.00	0.00	0.00	0.00	425.42	334.29	631.76	1,939.21	1,837.36	1,293.28	3,754.05	0.00	5,223.55	6,839.47	6,761.90	7,385.00	6,612.00	6,425.00	6,050.01	6,078.02	5,607.87	4,999.55	5,418.45	5,116.02	5,993.06	6,237.83	7,127.41	5,482.02	5,383.43	4,864.71	6,016.85
Exported Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-395.70	-310.41
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	1,800.09	2,614.62	2,834.79	3,817.67	2,826.34	5,515.04	5,825.10	5,863.15	6,904.21	7,142.85	6,771.77	7,210.97	2,893.31	7,796.74	9,187.41	9,085.91	9,469.80	8,619.90	9,006.26	8,265.23	8,078.38	8,267.66	7,619.05	8,459.81	7,599.86	8,877.24	8,818.73	9,652.19	8,951.40	7,902.85	6,954.67	8,392.58
PASADENA																																
Groundwater Extraction	12,875.02	15,515.87	11,347.68	14,178.25	11,956.35	9,285.05	13,726.60	11,488.56	12,866.38	12,698.71	13,125.08	15,868.08	20,288.57	20,316.13	24,221.97	21,313.26	21,252.89	21,236.57	20,882.46	21,767.41	20,772.50	21,507.66	18,367.68	22,660.94	20,060.61	23,078.52	21,196.50	20,874.21	22,519.68	22,485.06	21,121.86	25,459.87
Surface Water Diversion	0.00	0.00	0.00	0.00	0.00	2,103.14	852.59	6,552.42	2,925.73	2,897.13	2,035.96	1,789.95	0.00	5,297.33	2,363.02	750.00	505.50	2,052.00	1,479.00	1,417.34	1,842.47	7,346.33	10,285.09	5,086.23	6,571.84	6,243.27	3,614.34	1,577.04	2,663.10	3,313.28	2,616.47	2,150.15
Imported Water	0.00	0.00	0.00	0.00	0.00	33,732.60	30,677.39	28,005.14	35,422.61	38,250.05	37,196.56	36,242.34	0.00	30,053.33	34,781.56	38,684.30	42,150.70	37,925.00	40,938.00	41,595.32	41,216.79	36,092.85	33,170.43	39,322.95	36,342.10	40,855.49	44,664.86	50,844.92	41,858.27	35,197.66	37,909.78	45,989.36
Exported Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-3,675.37	-6,924.86	-6,401.00	-7,224.00	-8,172.00	-8,807.00	-10,234.49	-7,664.20	-10,392.39	-8,400.51	-9,531.40	-9,603.94	-8,952.04	-8,889.59	-8,524.10	-8,209.55	-6,949.08	-7,434.63	-9,518.00
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	12,875.02	15,515.87	11,347.68	14,178.25	11,956.35	45,120.79	45,256.58	46,046.12	51,214.72	53,845.89	52,357.60	53,900.37	20,288.57	51,991.42	54,441.69	54,346.56	56,685.09	53,041.57	54,492.46	54,545.58	56,167.56	54,554.45	53,422.69	57,538.72	53,370.61	61,225.24	60,586.11	64,772.07	58,831.50	54,046.92	54,213.50	64,081.38
SANTA ANITA																																
Groundwater Extraction	4,982.50	5,404.77	5,554.51	5,641.15	5,798.46	5,105.61	4,191.16	3,201.16	5,830.11	5,508.38	5,653.82	6,324.55	6,805.61	5,235.03	8,841.49	6,922.10	6,771.40	6,420.40	7,426.76	6,611.01	6,848.01	6,232.20	5,635.17	9,182.40	6,615.15	7,473.32	7,923.82	7,655.24	7,998.96	7,102.44	8,366.97	8,838.79
Surface Water Diversion	0.00	0.00	0.00	0.00	0.00	281.21	204.67	427.84	451.90	222.96	207.06	191.65	0.00	333.84	527.38	321.80	213.00	333.00	357.00	207.85	270.45	719.65	999.34	823.87	896.83	1,126.67	688.78	458.56	499.68	715.58	528.63	362.75
Imported Water	0.00	0.00	0.00	0.00	0.00	5,353.74	6,593.63	8,511.43	7,362.76	8,390.14	8,044.61	8,869.86	0.00	9,726.56	7,444.95	9,736.90	11,235.50	10,733.00	8,759.00	10,309.74	10,298.28	10,518.96	9,809.76	7,721.78	8,899.18	9,555.65	9,032.79	10,767.15	8,640.17	9,624.94	8,035.92	10,746.89
Exported Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-741.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1,794.03	0.00	-163.36	-1,205.91	-322.67	-1,273.80	-387.57	-1,554.82	-621.14
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	4,982.50	5,404.77	5,554.51	5,641.15	5,798.46	10,740.56	10,989.46	12,140.43	13,644.77	14,121.48	13,905.49	15,386.06	6,805.61	15,295.43	16,071.91	16,980.80	18,219.90	17,486.40	16,542.76	17,128.60	17,416.74	17,470.81	16,444.27	15,934.02	16,411.16	17,992.28	16,439.48	18,558.28	15,865.01	17,055.39	15,376.70	19,327.29
RAYMOND BASIN	**19,657.61**	**23,535.26**	**19,736.98**	**23,637.07**	**20,581.15**	**61,376.39**	**62,071.14**	**64,049.70**	**71,763.70**	**75,110.22**	**73,034.86**	**76,497.40**	**29,987.49**	**75,083.59**	**79,701.01**	**80,413.27**	**84,374.79**	**79,147.87**	**80,041.48**	**79,939.41**	**81,662.68**	**80,292.92**	**77,486.01**	**81,932.55**	**77,381.63**	**88,094.76**	**85,844.32**	**92,982.54**	**83,647.91**	**79,005.16**	**76,544.87**	**91,801.25**

ANNUAL GROUNDWATER PRODUCTION FROM ANNUAL REPORTS

SUB-AREA	1944-1945	1945-1946	1946-1947	1947-1948	1948-1949	1949-1950	1950-1951	1951-1952	1952-1953	1953-1954	1954-1955	1955-1956	1956-1957	1957-1958	1958-1959	1959-1960	1960-1961	1961-1962	1962-1963	1963-1964	1964-1965	1965-1966	1966-1967	1967-1968	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	FISCA 1975-1976
MONK HILL	5,688.52	6,841.88	5,572.50	6,739.88	6,117.28	6,503.33	7,097.86	5,903.26	5,972.92	6,282.63	6,420.37	6,319.02	7,057.00	5,915.61	8,159.64	7,991.60	7,141.00	6,742.30	8,084.20	7,937.09	7,450.96	6,582.82	5,096.64	7,059.40	8,396.92	8,421.87	8,286.78	7,408.09	9,217.44	8,408.24	7,885.89	8,398.41
PASADENA	10,791.05	12,897.16	10,192.58	13,191.99	12,093.14	8,913.78	13,417.90	10,750.43	12,471.43	11,765.22	12,782.84	14,059.54	17,474.00	16,054.08	18,027.39	16,428.30	18,796.10	18,418.60	16,828.30	17,468.83	17,681.52	19,396.75	17,240.87	19,983.56	15,489.71	18,710.32	17,091.59	17,359.09	17,331.02	18,415.19	17,586.48	21,707.31
SANTA ANITA	3,628.75	3,999.32	4,188.54	4,026.58	4,098.12	3,836.27	2,860.82	2,489.08	4,869.97	3,378.35	4,528.44	4,607.44	5,484.00	1,516.51	7,017.61	4,858.60	3,341.90	3,496.30	5,268.30	4,777.91	3,599.00	3,388.48	3,368.66	7,031.30	4,511.77	5,445.17	5,611.55	5,794.10	5,801.24	4,993.53	6,338.31	6,070.47
RAYMOND BASIN	**20,108.32**	**23,738.36**	**19,953.62**	**23,958.45**	**22,308.54**	**19,253.38**	**23,376.58**	**19,142.77**	**23,314.32**	**21,426.20**	**23,731.65**	**24,986.00**	**30,015.00**	**23,486.20**	**33,204.64**	**29,278.50**	**29,279.00**	**28,657.20**	**30,180.80**	**30,183.83**	**28,731.48**	**29,368.05**	**25,706.17**	**34,074.26**	**28,398.40**	**32,677.36**	**30,989.92**	**30,561.28**	**32,349.70**	**31,816.96**	**31,810.68**	**36,176.19**

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

PARTY	YEAR																													
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
ALHAMBRA, CITY OF																														
Groundwater Extraction	803.57	770.09	1,095.38	379.15	1,049.22	1,143.66	1,001.27	1,047.23	980.03	996.64	917.72	224.04	0.48	0.00	735.70	766.14	676.97	783.62	643.20	975.10	771.20	899.50	337.90	114.40	76.10	3.70	0.00	0.00	0.00	0.00	0.00
Surface Water Diversion																														0.00	0.00
Imported Water	6,717.80	5,882.37	6,022.51	7,418.73	7,792.20	7,797.82	8,388.06	9,899.46	10,035.99	9,800.07	10,322.33	9,493.21	9,798.06	12,099.99	2,751.60	2,214.08	3,213.24	3,226.91	3,178.50	3,149.80	3,300.40	3,383.70	3,353.40	3,467.30	3,429.00		2,992.40	3,063.80	1,997.70	2,816.40	3,019.90
Exported Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	7,521.37	6,652.46	7,117.89	7,797.88	8,841.42	8,941.48	9,389.33	10,946.69	11,016.02	10,796.71	11,240.05	9,717.25	9,798.54	12,099.99	3,487.30	2,980.22	3,890.21	4,010.53	3,821.70	4,124.90	4,071.60	4,283.20	3,691.30	3,581.70	3,505.10	3.70	2,992.40	3,063.80	1,997.70	2,816.40	3,019.90
ARCADIA, CITY OF																														
Groundwater Extraction	5,342.31	4,979.92	6,946.70	6,958.25	7,522.72	4,681.17	6,072.50	7,653.60	7,045.13	7,152.01	6,815.17	5,253.46	5,943.42	6,005.45	5,411.91	6,414.71	5,200.49	7,707.17	7,438.87	5,580.76	6,706.91	6,030.49	7,315.40	6,182.64	5,328.35	4,564.12	4,153.97	5,077.62	6,175.66	7,608.45	6,381.52
Surface Water Diversion																														0.00	0.00
Imported Water	8,436.84	8,138.17	7,843.67	8,263.52	9,160.02	9,845.80	7,918.76	8,219.44	9,760.03	10,066.90	10,319.82	11,807.17	11,015.08	11,184.27	606.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	1,302.20	0.00	0.00	0.00
Exported Water	-354.37	-926.61	-2,010.16	-1,915.70	-2,473.03	-75.93	-2,217.09	-3,342.64	-2,100.25	-2,379.61	-2,028.86	-497.46	-1,228.60	-980.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	13,424.78	12,191.48	12,780.21	13,306.07	14,209.71	14,451.04	11,774.17	12,530.40	14,704.91	14,839.30	15,106.13	16,563.17	15,729.90	16,209.21	6,018.15	6,414.71	5,200.49	7,707.17	7,438.87	5,580.76	6,706.91	6,030.49	7,315.40	6,182.64	5,328.35	4,564.12	4,153.97	6,379.82	6,175.66	7,608.45	6,381.52
CALIFORNIA AMERICAN W																														
Groundwater Extraction	2,501.41	3,269.33	2,375.16	2,659.34	2,330.65	2,599.61	2,385.75	2,621.89	2,519.36	1,985.89	3,001.65	2,764.15	3,286.40	2,740.94	2,169.17	2,483.02	2,483.12	2,303.69	2,226.60	2,396.16	2,520.80	2,476.40	2,994.10	4,001.60	3,360.80	2,871.10	2,416.60	2,293.30	1,793.58	1,763.21	1,904.82
Surface Water Diversion																														0.00	0.00
Imported Water	3,871.33	2,724.60	4,734.93	4,487.58	5,286.42	4,214.63	3,950.48	4,743.61	4,993.52	5,387.58	3,776.99	4,147.07	3,504.91	3,397.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	948.10	601.60	602.70		385.70	1,592.80	1,445.30	1,212.50	1,294.50
Exported Water	-416.33	-1,503.65	-282.65	-419.07	-5.80	-344.75	-366.27	-249.81	-458.68	0.00	-348.30	-375.59	-811.46	-289.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-153.50	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	5,956.41	4,490.28	6,827.44	6,727.85	7,611.27	6,469.49	5,969.96	7,115.69	7,054.20	7,373.47	6,430.34	6,535.63	5,979.85	5,848.50	2,169.17	2,483.02	2,483.12	2,303.69	2,226.60	2,396.16	2,520.80	2,476.40	3,942.20	4,449.70	3,963.50	2,871.10	2,802.30	3,886.10	3,238.88	2,975.71	3,199.32
EAST PASADENA WATER																														
Groundwater Extraction	503.95	450.76	362.94	360.42	392.38	349.71	508.34	430.89	328.62	344.79	344.79	809.42	468.73	444.21	498.17	468.04	619.18	501.45	495.70	523.60	502.90	578.10	518.50	569.59	451.30	437.10	556.20	757.52	488.55	438.05	429.88
Surface Water Diversion																														0.00	0.00
Imported Water	1,511.30	1,049.60	1,515.09	1,386.73	1,428.63	1,657.25	1,328.49	1,472.66	1,108.88	1,483.80	1,380.77	1,411.00	1,550.85	1,584.16	0.00	0.00	0.00	0.00	394.80	382.20	339.00	347.70	363.50	318.70	480.60		577.00	260.80	370.10	357.40	441.10
Exported Water	0.00	-147.84	0.00	-3.97	-86.32	0.00	-20.99	-13.20	0.00	0.00	-111.60	-132.56	-20.18	-8.47	-91.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		-49.10	0.00	-1.40	-1.90	-26.30
Transferred Water																														0.00	0.00
SUBTOTAL	2,015.25	1,352.52	1,878.03	1,743.18	1,734.69	2,006.96	1,815.84	1,890.35	1,437.50	1,828.59	1,613.96	2,087.86	1,999.40	2,019.90	406.37	468.04	619.18	501.45	890.50	905.80	841.90	925.80	882.00	888.29	931.90	437.10	1,084.10	1,018.32	857.25	793.55	844.68
HUNTINGTON LIBRARY &																														
Groundwater Extraction	279.36	296.32	296.99	269.70	334.35	244.61	249.71	269.37	150.71	322.58	269.83	278.66	332.19	249.37	303.61	264.05	336.78	358.89	357.20	440.20	427.40	299.70	324.10	431.90	286.30	253.40	184.40	337.70	263.42	264.27	365.69
Surface Water Diversion																														0.00	0.00
Imported Water																														0.00	0.00
Exported Water																														0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	279.36	296.32	296.99	269.70	334.35	244.61	249.71	269.37	150.71	322.58	269.83	278.66	332.19	249.37	303.61	264.05	336.78	358.89	357.20	440.20	427.40	299.70	324.10	431.90	286.30	253.40	184.40	337.70	263.42	264.27	365.69
KINNELOA IRRIGATION DI																														
Groundwater Extraction	277.48	297.37	227.91	330.09	375.50	416.53	368.50	386.00	367.97	493.36	557.05	581.96	590.98	522.30	683.22	440.44	381.71	470.57	378.50	357.90	434.00	496.30	776.86	834.90	642.10	717.99	670.75	699.90	379.54	460.69	930.25
Surface Water Diversion	0.00	199.10	152.77	53.94	157.99	197.83	184.40	238.55	272.06	210.45	192.30	123.14	0.00	0.00	0.00	149.01	167.35	205.42	239.20	394.90	342.90	306.70	325.50	292.20	198.10		151.50	162.00	382.90	530.10	298.80
Imported Water																														0.00	0.00
Exported Water																						-139.50	-325.80	-222.90	-87.30		-30.20	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	277.48	496.47	380.68	384.03	533.49	614.36	552.90	624.55	640.03	703.81	749.35	705.10	590.98	522.30	683.22	589.45	549.06	675.99	617.70	752.80	776.90	663.50	776.56	904.20	752.90	717.99	792.05	861.90	762.44	990.79	1,229.05
LA CANADA IRRIGATION I																														
Groundwater Extraction	140.48	93.46	149.03	151.14	105.16	98.72	104.84	104.79	172.11	247.88	312.78	139.42	150.66	141.32	85.77	22.29	17.55	0.83	33.60	59.50	66.20	50.58	149.60	43.30	176.00	130.30	136.50	121.80	149.52	73.17	15.64
Surface Water Diversion	75.79	50.54	225.56	254.55	237.48	141.95	186.22	237.08	153.68	117.06	95.35	89.70	71.97	60.98	0.00	93.76	235.81	249.62	241.30	214.70	151.60	173.40	212.10	129.00	73.00		65.20	57.40	124.40	128.80	95.90
Imported Water	1,868.12	1,757.20	1,732.00	1,735.39	2,074.16	1,859.93	1,599.43	1,968.64	2,016.64	2,047.94	2,066.48	2,174.04	2,243.29	2,292.50	2,102.60	1,794.60	1,863.10	2,038.70	2,005.00	2,387.30	2,797.40	2,261.50	2,346.20	2,996.40	2,873.50		2,743.80	3,200.00	2,610.30	2,679.70	3,033.70
Exported Water	-197.85	-302.38	-71.73	-79.34	-115.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	1,886.54	1,598.82	2,034.86	2,061.74	2,301.33	2,100.60	1,890.49	2,310.51	2,342.43	2,412.88	2,474.61	2,403.16	2,465.92	2,494.80	2,188.37	1,910.65	2,116.46	2,289.15	2,279.90	2,661.50	3,015.20	2,485.48	2,707.90	3,168.70	3,122.50	130.30	2,945.50	3,379.20	2,884.22	2,881.67	3,145.24
LAS FLORES WATER COM																														
Groundwater Extraction	265.41	202.18	264.99	444.77	608.02	412.09	403.39	514.38	600.42	539.94	725.24	716.15	655.62	637.15	287.61	268.16	416.48	253.27	481.50	451.60	447.00	325.50	320.50	274.40	181.70	248.90	192.68	418.91	341.50	311.28	358.13
Surface Water Diversion	43.19	78.94	135.01	139.89	153.80	59.07	132.82	191.81	110.59	57.49	80.38	38.99	50.18	40.99	177.96	21.97	98.39	150.83	20.80	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Imported Water	444.70	422.93	358.60	199.96	70.77	308.39	196.71	160.20	174.57	282.87	88.74	133.24	199.96	262.20	533.30	457.40	269.80	500.70	315.00	460.00	514.10	481.10	567.80	738.10	774.80		809.40	679.90	629.60	685.30	741.20
Exported Water					-77.14	-59.80	-89.45	-66.41	-96.19	-88.02	-89.11	-69.57	-60.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	753.30	704.05	758.60	784.62	755.45	719.75	643.47	799.98	789.39	792.28	805.25	818.81	844.94	940.34	998.87	747.53	784.67	904.80	817.30	911.60	961.10	806.60	888.30	1,012.50	956.50	248.90	1,002.08	1,098.81	971.10	996.58	1,099.33

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

LINCOLN AVENUE WATER

PARTY	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Groundwater Extraction	706.26	853.76	946.47	727.71	861.81	782.80	551.04	805.64	549.11	455.14	185.61	0.49	0.19	0.15	468.39	126.27	730.22	527.74	782.40	771.40	1,007.30	1,074.50	1,168.20	1,208.50	1,059.20	833.00	1,150.30	1,315.20	1,927.48	1,850.44	2,951.77
Surface Water Diversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	320.70	408.30	165.70	32.20		225.40	59.50	457.10	425.50	64.50
Imported Water	1,190.83	847.94	925.50	1,218.83	1,406.43	1,353.39	1,530.71	1,386.19	1,706.87	1,785.45	2,025.37	2,206.95	2,243.36	2,225.00	1,624.20	1,239.10	1,211.10	1,512.40	1,265.50	1,322.20	1,297.40	609.50	564.50	1,146.70	1,978.40		1,455.90	2,013.20	1,055.40	1,205.90	878.40
Exported Water																														0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	1,897.09	1,701.70	1,871.97	1,946.54	2,268.24	2,136.19	2,081.75	2,191.83	2,255.98	2,240.59	2,210.98	2,207.44	2,243.55	2,225.15	2,092.59	1,365.37	1,941.32	2,040.14	2,047.90	2,093.60	2,304.70	2,004.70	2,141.00	2,520.90	3,069.80	833.00	2,831.60	3,387.90	3,439.98	3,481.84	3,894.67

PASADENA, CITY OF

Groundwater Extraction	15,830.62	9,960.29	12,531.24	19,885.42	14,132.86	15,177.99	15,156.92	17,704.61	14,962.94	13,658.26	15,834.92	12,465.52	14,024.53	12,065.79	13,973.21	10,605.56	8,335.36	4,041.64	16,290.30	21,631.10	19,409.60	17,963.90	20,658.10	19,095.20	10,333.15	14,628.80	11,033.88	14,710.09	13,899.02	13,738.97	13,664.30
Surface Water Diversion	1,422.42	2,810.93	3,579.99	3,025.22	2,924.47	2,421.04	3,787.89	4,293.63	1,532.62	1,350.43	1,307.76	806.63	780.97	193.26	2,226.74	1,287.58	1,769.64	84.71	31.20	154.70	35.90	45.60	8.90	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Imported Water	16,041.40	18,192.63	17,666.92	10,104.83	18,994.09	16,515.15	14,505.72	15,876.76	22,865.17	24,238.47	22,917.16	25,166.34	23,917.67	27,704.12	22,717.72	20,548.62	23,069.00	29,811.00	14,980.00	14,747.40	17,608.50	15,053.40	15,980.90	21,319.60	23,119.70		24,728.60	25,063.40	22,555.40	21,584.80	25,265.50
Exported Water	-3,972.22	-4,968.45	-4,324.71	-4,280.59	-8,519.36	-5,080.24	-5,033.89	-6,146.00	-11,169.97	-4,182.08	-5,700.63	-7,593.68	-6,885.09	0.00	-2,405.36	-1,775.91	-505.00	-229.00	-1,035.00	-1,340.80	-1,307.70	-1,304.20	0.00	-9.00	-168.70		-871.50	-794.60	-493.90	-469.20	-698.20
Transferred Water																														-1,070.30	1,099.20
SUBTOTAL	29,322.22	25,995.40	29,453.44	28,734.88	27,532.06	29,033.94	28,416.64	31,729.00	28,190.76	35,065.08	34,359.21	30,844.81	31,838.08	39,963.17	13,973.21	10,605.56	32,669.00	33,708.35	30,266.50	35,192.40	35,746.30	31,758.70	36,647.90	40,405.80	33,284.15	14,628.80	34,890.98	38,978.89	35,960.52	33,784.27	39,330.80

PASADENA CEMETERY AS

Groundwater Extraction	56.24	46.14	54.50	65.40	43.96	42.87	38.61	39.08	45.58	47.18	57.19	53.59	69.03	25.36	70.40	59.13	61.07	57.75	62.10	67.50	71.57	49.07	54.63	69.45	68.80	70.56	74.21	83.42	76.29	74.75	125.83
Surface Water Diversion																														0.00	0.00
Imported Water																														0.00	0.00
Exported Water																														0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	56.24	46.14	54.50	65.40	43.96	42.87	38.61	39.08	45.58	47.18	57.19	53.59	69.03	25.36	70.40	59.13	61.07	57.75	62.10	67.50	71.57	49.07	54.63	69.45	68.80	70.56	74.21	83.42	76.29	74.75	125.83

ROYAL LAUNDRY

Groundwater Extraction	127.42	122.35	104.24	119.74	116.54	130.36	109.09	59.11	61.80	70.69	85.19	93.38	66.96																	0.00	0.00
Surface Water Diversion																														0.00	0.00
Imported Water																														0.00	0.00
Exported Water																														0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	127.42	122.35	104.24	119.74	116.54	130.36	109.09	59.11	61.80	70.69	85.19	93.38	66.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RUBIO CANON LAND AND

Groundwater Extraction	1,117.87	1,175.95	1,380.35	1,409.93	1,505.72	675.08	564.92	1,283.99	1,111.20	1,207.39	1,466.62	1,604.47	1,400.67	1,349.60	1,314.76	936.13	1,251.27	1,058.58	979.40	1,511.30	1,364.00	1,265.00	1,416.00	1,374.50	1,120.20	1,491.60	1,090.79	1,395.80	1,473.20	1,395.16	1,488.32
Surface Water Diversion	75.73	105.21	152.93	136.25	134.69	150.46	90.52	94.60	313.24	354.95	207.91	79.48	89.87	89.27	157.62	149.22	197.44	111.92	173.10	222.50	186.10	160.50	276.60	234.30	17.40		34.00	19.20	57.30	217.80	220.60
Imported Water	735.43	504.16	407.10	378.33	556.44	348.67	274.54	732.58	989.00	872.68	743.04	534.06	749.23	893.70	735.00	820.50	556.30	916.40	985.90	650.10	923.80	707.60	622.70	994.70	1,136.00		1,362.10	1,350.10	720.30	702.20	992.50
Exported Water											-232.99	-77.43	-91.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-147.40	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	1,929.03	1,785.32	1,940.38	1,924.51	2,196.85	1,174.21	929.98	2,111.17	2,413.44	2,435.02	2,184.58	2,140.58	2,148.59	2,332.57	2,207.38	1,905.85	2,005.01	2,086.90	2,138.40	2,383.90	2,473.90	2,133.10	2,167.90	2,603.50	2,273.60	1,491.60	2,486.89	2,765.10	2,250.80	2,315.16	2,701.42

SAN GABRIEL COUNTY W.

Groundwater Extraction	1,090.98	859.15	1,192.56	1,099.97	1,139.19	972.96	1,245.94	873.43	1,808.67	1,163.71	1,363.16	862.14	1,600.81	1,199.56	63.71	4.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Surface Water Diversion																														0.00	0.00
Imported Water	4,921.12	4,649.61	5,181.48	5,395.61	5,217.14	5,455.87	4,783.40	6,047.33	4,998.21	5,771.13	5,493.53	5,935.86	7,465.23	5,838.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-63.69	-4.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	6,012.10	5,508.76	6,374.04	6,495.58	6,356.33	6,428.83	6,029.34	6,920.76	6,806.88	6,934.84	6,856.69	6,798.00	9,066.04	7,038.16	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

SIERRA MADRE, CITY OF

Groundwater Extraction	1,687.69	1,620.14	1,658.69	1,861.20	2,068.12	1,961.91	1,690.38	1,749.85	2,161.69	2,649.74	2,492.00	2,426.77	2,608.76	2,879.41	2,504.50	2,011.56	1,893.34	2,783.11	2,464.10	2,248.80	2,553.20	2,244.30	2,302.10	2,897.13	2,755.50	2,969.30	2,762.79	3,229.69	2,043.09	2,401.82	3,417.84
Surface Water Diversion	445.67	493.35	995.72	1,092.52	1,194.50	869.88	765.49	1,242.49	796.10	6.46	389.10	591.42	457.85	80.88	695.62	320.81	793.91	0.00	0.00	511.60	459.80	376.70	599.20	328.80	191.60		203.50	84.10	612.40	666.20	298.60
Imported Water																													247.10	53.80	0.00
Exported Water																													0.00	0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	2,133.36	2,113.49	2,654.41	2,953.72	3,262.62	2,831.79	2,455.87	2,992.34	2,957.79	2,656.20	2,881.10	3,018.19	3,066.61	2,960.29	2,504.50	2,011.56	2,687.25	2,783.11	2,464.10	2,760.40	3,013.00	2,621.00	2,901.30	3,225.93	2,947.10	2,969.30	2,966.29	3,313.79	2,902.59	3,121.82	3,716.44

SUNNY SLOPE WATER CO

Groundwater Extraction	1,329.62	1,642.58	1,293.47	1,711.07	1,520.65	1,038.71	1,464.11	1,346.65	1,736.04	1,533.78	1,563.22	1,520.07	1,711.89	1,441.60	1,628.26	1,395.32	1,882.29	2,197.26	1,447.03	1,666.20	1,604.30	1,526.68	1,173.10	1,916.96	1,551.10	1,141.50	585.90	669.14	910.12	1,570.61	1,198.21
Surface Water Diversion																														0.00	0.00
Imported Water	2,681.21	2,355.05	3,032.18	2,707.22	3,096.05	2,907.31	2,008.01	2,869.38	2,537.54	3,029.18	2,903.24	2,815.62	2,815.77	3,135.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00					0.00	0.00
Exported Water	-1,213.90	-1,538.84	-1,178.32	-1,592.04	-1,396.28	-913.01	-1,353.96	-1,222.56	-1,607.19	-1,398.61	-1,441.78	-1,385.17	-1,542.21	-1,265.72	-1,514.41	-1,294.10	-1,693.08	-2,100.93	-1,350.90	-1,552.70	-1,496.50	-1,439.50	-1,095.60	-1,831.00	-1,025.60		-470.00	-552.80	-787.40	-1,464.40	-1,109.90
Transferred Water																														0.00	0.00
SUBTOTAL	2,796.93	2,458.79	3,147.33	2,826.25	3,220.42	3,033.01	2,118.16	2,993.47	2,666.39	3,164.35	3,024.68	2,950.52	2,985.45	3,311.08	113.85	101.22	189.21	96.33	96.13	113.50	107.80	87.18	77.50	85.96	525.50	1,141.50	115.90	116.34	122.72	3,066.91	3,705.61

TABLE 1
HISTORIC WATER USE IN RAYMOND BASIN

PARTY	YEAR																														
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
VALLEY WATER COMPAN																															
Groundwater Extraction	644.86	547.52	732.37	1,035.56	779.71	827.89	752.53	861.51	941.96	869.46	1,065.00	1,200.15	1,134.00	1,003.16	9.16	181.30	702.68	624.99	934.20	1,269.80	1,326.60	1,150.80	1,355.90	1,308.90	1,314.36	1,375.40	1,423.90	1,478.60	1,409.19	1,334.61	1,307.36
Surface Water Diversion																															
Imported Water	2,681.21	1,878.13	1,874.70	1,753.81	2,456.22	2,103.83	1,954.47	2,301.14	2,518.64	2,481.70	2,420.20	2,170.15	2,228.79	2,523.40	2,571.30	2,187.00	2,310.20	2,535.60	2,453.70	2,707.60	2,903.20	**2,505.60**	2,744.10	3,327.40	3,263.90		3,013.50	3,560.30	2,300.00	2,201.00	3,042.00
Exported Water																														0.00	0.00
Transferred Water																														0.00	0.00
SUBTOTAL	3,326.07	2,425.65	2,607.07	2,789.37	3,235.93	2,931.72	2,707.00	3,162.65	3,460.60	3,351.16	3,485.20	3,370.30	3,362.79	3,526.56	2,580.46	2,368.30	3,012.88	3,160.59	3,387.90	3,977.40	4,229.80	3,656.40	4,100.00	4,636.30	4,578.26	1,375.40	4,437.40	5,038.90	3,709.19	3,535.61	4,349.36
RAYMOND BASIN	**79,714.95**	**69,940.00**	**80,282.08**	**80,931.06**	**84,564.66**	**83,291.21**	**77,172.31**	**88,686.95**	**86,994.41**	**95,034.73**	**93,834.34**	**90,586.45**	**92,588.82**	**101,766.75**	**39,797.47**	**34,274.66**	**58,645.71**	**62,684.84**	**58,912.80**	**64,362.42**	**67,268.88**	**60,281.32**	**68,617.99**	**74,167.47**	**65,594.26**	**31,736.77**	**63,760.07**	**73,709.98**	**65,612.76**	**68,707.78**	**77,108.86**

ANNUAL BASIN WATER U

SUB-AREA	YEAR																														
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
MONK HILL																															
Groundwater Extraction	1,813.25	1,743.06	2,147.36	2,424.58	2,398.66	2,164.37	1,850.41	2,325.40	2,309.18	2,159.60	2,345.82	2,109.80	2,009.50	1,807.14	921.33	657.15	1,928.00	1,464.58	2,293.80	2,619.80	2,918.67	2,650.45	3,048.83	2,904.55	2,800.06	2,658.16	2,977.59	3,417.93	3,903.98	3,644.25	4,758.73
Surface Water Diversion	118.98	129.48	360.57	394.44	391.28	201.02	319.04	428.89	264.27	174.55	175.73	128.69	122.15	101.97	177.96	115.73	334.20	400.45	262.10	214.70	151.60	494.10	620.40	294.70	105.20	0.00	290.60	116.90	581.50	554.30	160.40
Imported Water	6,184.86	4,906.20	4,890.80	4,907.99	6,007.58	5,625.54	5,281.32	5,816.17	6,416.72	6,597.96	6,600.79	6,684.38	6,915.40	7,303.10	6,831.40	5,678.10	5,654.20	6,587.40	6,039.20	6,877.10	7,512.10	5,857.70	6,222.60	8,208.60	8,890.60	0.00	8,022.60	9,453.40	6,595.30	6,771.90	7,695.30
Exported Water	-197.85	-302.38	-71.73	-79.34	-192.61	-59.80	-89.45	-66.41	-96.19	-88.02	-89.11	-69.57	-60.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	7,919.24	6,476.36	7,327.00	7,647.67	8,604.91	7,931.13	7,361.32	8,504.05	8,893.98	8,844.09	9,033.23	8,853.30	8,986.23	9,212.21	7,930.69	6,450.98	7,916.40	8,452.43	8,595.10	9,711.60	10,582.37	9,002.25	9,891.83	11,407.85	11,795.86	2,658.16	11,290.79	12,988.23	11,080.78	10,970.45	12,614.43
PASADENA																															
Groundwater Extraction	23,862.28	18,844.19	20,860.24	28,224.83	22,897.06	22,749.22	23,054.55	26,023.17	24,027.34	21,777.09	25,404.15	21,203.81	23,483.64	20,013.37	21,369.81	17,362.86	15,966.68	11,715.70	22,817.93	29,501.56	27,034.20	25,505.58	28,198.66	28,339.05	17,821.05	21,545.19	16,538.52	20,863.45	19,207.43	19,630.96	19,981.47
Surface Water Diversion	1,498.15	3,115.24	3,885.69	3,215.41	3,217.15	2,769.33	4,062.81	4,626.78	2,117.92	1,915.83	1,707.97	1,009.25	870.84	282.53	2,384.36	1,585.81	2,134.43	402.05	443.50	772.10	564.90	512.80	611.00	526.50	215.50	0.00	185.50	181.20	440.20	747.90	519.40
Imported Water	36,479.59	35,358.02	38,560.21	31,879.03	42,370.97	38,896.70	35,238.70	41,641.78	47,528.31	50,582.91	47,537.06	49,503.16	49,801.72	54,652.89	26,204.32	23,583.20	26,838.54	33,954.31	19,539.20	18,929.50	22,171.70	19,492.40	21,268.60	26,701.90	28,768.00	0.00	30,045.80	31,330.90	27,088.80	29,634.00	34,630.80
Exported Water	-5,602.45	-8,158.78	-5,785.68	-6,295.67	-10,007.76	-6,338.00	-6,775.11	-7,631.57	-13,235.84	-5,580.69	-7,835.30	-9,564.43	-9,350.12	-1,563.75	-4,075.26	-3,074.17	-2,198.08	-2,329.93	-2,385.90	-2,893.50	-2,804.20	-2,883.20	-1,568.80	-2,216.40	-1,281.60	0.00	-1,420.80	-1,347.40	-1,282.70	-1,935.50	-1,834.40
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-1,070.30	1,099.20
SUBTOTAL	56,237.57	49,158.67	57,520.46	57,023.60	58,477.42	58,077.25	55,580.95	64,660.16	60,437.73	68,695.14	66,813.88	62,151.79	64,806.08	73,385.04	45,883.23	39,457.70	42,741.57	43,742.13	40,414.73	46,309.66	46,966.60	42,627.58	48,509.46	53,351.05	45,522.95	21,545.19	45,349.02	51,028.15	45,453.73	47,007.06	54,396.47
SANTA ANITA																															
Groundwater Extraction	7,030.00	6,600.06	8,605.39	8,819.45	9,590.84	6,643.08	7,762.88	9,403.45	9,206.82	9,801.75	9,307.17	7,680.23	8,552.18	8,884.66	7,916.41	8,426.27	7,093.83	10,490.28	9,902.97	7,829.56	9,260.11	8,274.79	9,617.50	9,079.77	8,083.85	7,533.42	6,916.76	8,307.31	8,218.75	10,010.27	9,799.36
Surface Water Diversion	445.67	493.35	995.72	1,092.52	1,194.50	869.88	765.49	1,242.49	796.10	6.46	389.10	591.42	457.85	80.88	695.62	320.81	793.91	0.00	0.00	511.60	459.80	376.70	599.20	328.80	191.60	0.00	203.50	84.10	612.40	666.20	298.60
Imported Water	8,436.84	8,138.17	7,843.67	8,263.52	9,160.02	9,845.80	7,918.76	8,219.44	9,760.03	10,066.90	10,319.82	11,807.17	11,015.08	11,184.27	606.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Exported Water	-354.37	-926.61	-2,010.16	-1,915.70	-2,473.03	-75.93	-2,217.09	-3,342.64	-2,100.25	-2,379.61	-2,028.86	-497.46	-1,228.60	-980.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,302.20	247.10	53.80	0.00
Transferred Water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SUBTOTAL	15,558.14	14,304.97	15,434.62	16,259.79	17,472.33	17,282.83	14,230.04	15,522.74	17,662.70	17,495.50	17,987.23	19,581.36	18,796.51	19,169.50	9,218.27	8,747.08	7,887.74	10,490.28	9,902.97	8,341.16	9,719.91	8,651.49	10,216.70	9,408.57	8,275.45	7,533.42	7,120.26	9,693.61	9,078.25	10,730.27	10,097.96
RAYMOND BASIN	**79,714.95**	**69,940.00**	**80,282.08**	**80,931.06**	**84,564.66**	**83,291.21**	**77,172.31**	**88,686.95**	**86,994.41**	**95,034.73**	**93,834.34**	**90,586.45**	**92,588.82**	**101,766.75**	**63,032.19**	**54,655.76**	**58,645.71**	**62,684.84**	**58,912.80**	**64,362.42**	**67,268.88**	**60,281.32**	**68,617.99**	**74,167.47**	**65,594.26**	**31,736.77**	**63,760.07**	**73,709.98**	**66,612.76**	**68,707.78**	**77,108.86**

ANNUAL GROUNDWATER

SUB-AREA	YEAR																														
	1976-1977	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
MONK HILL	8,217.07	6,492.95	8,392.57	9,370.01	9,499.05	8,252.50	9,327.90	10,134.37	8,483.27	7,734.13	7,841.89	6,311.40	5,962.14	3,208.47	8,109.12	6,143.02	6,194.87	6,355.06	10,352.70	13,012.40	11,961.90	9,293.90	9,473.10	10,710.90	7,843.30	7,270.30	4,070.40	4,813.90	5,649.28	5,042.90	6,247.05
PASADENA	19,414.31	16,216.47	16,923.60	23,471.44	18,055.94	19,229.24	18,577.21	20,430.72	20,124.26	18,487.89	22,020.48	18,529.81	21,863.04	20,922.96	17,486.15	14,784.04	13,907.46	9,208.18	17,399.20	21,069.00	20,262.50	20,394.50	24,124.10	23,110.20	15,991.30	19,199.30	19,208.50	21,873.00	21,483.92	21,123.66	20,678.35
SANTA ANITA	5,229.27	4,477.15	6,344.99	6,714.48	7,414.53	4,894.69	5,622.98	7,307.91	7,051.73	7,701.37	6,937.75	5,871.57	6,329.51	6,329.71	5,493.94	6,112.74	4,797.18	8,104.66	7,222.80	5,861.70	7,385.10	6,474.60	7,258.60	6,501.90	6,521.90	6,446.40	5,376.00	5,901.80	6,486.61	7,118.91	7,614.34
RAYMOND BASIN	**32,860.65**	**27,186.57**	**31,661.16**	**39,555.93**	**34,969.52**	**32,376.43**	**33,528.09**	**37,873.00**	**35,659.26**	**33,923.39**	**36,800.12**	**30,712.78**	**34,154.69**	**30,461.14**	**31,089.21**	**27,039.80**	**24,899.51**	**23,667.90**	**34,974.70**	**39,943.10**	**39,609.50**	**36,163.00**	**40,855.80**	**40,323.00**	**30,356.50**	**32,916.00**	**28,654.90**	**32,588.70**	**33,619.81**	**33,285.47**	**34,539.74**

ATTACHMENT G

RESOLUTION NO. 42-0109

RESOLUTION NO. 42-0109

RESOLUTION OF THE BOARD OF DIRECTORS OF THE RAYMOND BASIN MANAGEMENT BOARD ADOPTING A COOPERATIVE PUMPING REDUCTION PLAN FOR THE PARTIES WITH WATER RIGHTS IN THE PASADENA SUBAREA

BE IT RESOLVED BY THE RAYMOND BASIN MANAGEMENT BOARD OF DIRECTORS as follows:

Section 1. Purpose.

The Raymond Basin Management Board ("Board") desires to implement an interim solution to slow declining water levels in the area of the Raymond Basin, Western Unit, known as the Pasadena Subarea with the goal of a reduction of water produced below 1955 Decreed Rights from 17,843 Acre Feet to 12,493 Acre Feet, dissolution of remaining Long-Term Storage accounts and increased groundwater levels. In order to meet this goal, water production reductions will be implemented incrementally at a rate of 1,070 Acre Feet per year for five years until a 30% reduction is achieved. Implementation will begin July 1, 2009. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. The reduction plan implemented by this resolution is not intended to supersede any provisions of the judgment but is intended as a means to improve water supply conditions and avoid disputes between impacted parties. This reduction plan has been developed cooperatively by the water rights holders in the Pasadena Subarea and is included as Exhibit "A" of this resolution.

Section 2. Findings.

(a) The Judgment of the Los Angeles Superior Court in *City of Pasadena v. City of Alhambra* (LASC No. C1323) ("Judgment") governs management of the Basin. The Board was appointed Watermaster to the Basin in 1984 when the Judgment was modified. As Watermaster, the Board has determined that the adjustment in Decreed Rights in 1955 was based on a snapshot of conditions during the first ten years the

judgment was in place and represented roughly a 30% increase in allowable production rights. The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long-Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today.

(b) The Raymond Basin and the Los Angeles area have experienced below-normal rainfall for eight of the past ten years, resulting in decreased storm water capture and runoff available for groundwater recharge.

(c) Producers within the Pasadena Subarea have been struggling to meet current demands and manage declining water levels.

(d) The Water Rights Holders within the Pasadena Subarea seek to find a cooperative solution to over drafting of the Pasadena Subarea.

(e) The Board, as Watermaster, seeks to establish a cooperative solution to over drafting of the Pasadena Subarea.

(f) The general consensus of the Board that the most effective method of managing the supply under current conditions is to look at each Subarea within the Basin independently or semi-independently when developing short-term or interim solutions.

(g) State of California, Department of Water Resources Bulletin 104-6, (June of 1971) indicated that maintaining the 1955 Decreed Rights as the Safe Yield benchmark without supplementing local supplies with imported recharge would eventually result in reduced overall storage in the Basin and the Pasadena Subarea.

(h) The Board authorized the Raymond Basin Baseline Study which was completed on February 2, 2004.

(i) The Baseline Study confirmed that groundwater levels have generally declined in the Pasadena Subarea since the Judgment was entered into and have not recovered proportionate to production, even during sustained wet periods.

(j) Stetson Engineers were retained to work with the Board in developing overall monitoring and management strategies for the Basin and the Pasadena Subarea based on the findings in the Baseline Study

(k) A mass balance analysis was done as part of Stetson's work which indicated that water levels have been impacted by certain modifications to Basin operations since the initial Judgment was entered into in 1944.

(l) Although more specific groundwater level data is required in the Pasadena Subarea to identify acute impact areas or pumping holes, enough data does currently exist to warrant immediate action to slow and eventually reverse the overall decline in water levels.

Section 3. Resolution.

NOW, THEREFORE, BE IT RESOLVED that the Raymond Basin Management Board will implement the Pasadena Subarea Reduction Plan (Reduction Plan) as described in Exhibit "A", attached hereto, effective July 1, 2009. The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012. The Board further resolves to review the findings and consider any appropriate modifications or adjustments to the Reduction Plan at its first regular meeting thereafter. The Board reserves the right to review the Reduction Plan and consider appropriate action prior to July 1, 2012, should conditions require such action.

PASSED, APPROVED, AND ADOPTED on JANUARY 22, 2009.

_____
Shan Kwan
Chairman

ATTEST:

_____
Robert Hayward
Secretary

[SEAL]

EXHIBIT "A"
Pumping Reductions
Pasadena Subarea

The long term goal is a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea from 17,843 Acre Feet* to 12,493 Acre Feet and to ultimately dissolve remaining Long-Term Storage accounts. In order to meet this objective reductions will be implemented each year for five years until the 30% reduction is reached. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. This means spreading credits must be produced within the same fiscal year they accrue or the following fiscal year and cannot be further carried over. Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right** until such time as all of their water in Long Term Storage is exhausted. Water in Long Term Storage accounts will continue to be subject to Basin losses and those losses will be applied at the end of each fiscal year***.

Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment. Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage.

Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason. Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf on the City of Pasadena will be discontinued at the same time. Spreading credits aside, total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 Acre Feet or 17,843 minus 1,070 in the first year and will be

reduced by an additional 1,070 Acre Feet each subsequent year for five consecutive years to a total allowable amount of 12,493 Acre Feet in any single fiscal year, until the Basin sufficiently recovers.

The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal. The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping. Initially, it will take at least three years to have any valuable comparative data.

**The City of Pasadena has 12,807 Acre Feet of total 1955 Decreed Right in the Western Unit. 4,464 Acre Feet are in the Monk Hill portion of the Western Unit and 8,343 Acre Feet are in the Pasadena Subarea portion of the Western Unit. As adopted, this reduction plan applies to the 8,343 Acre Feet designated as Pasadena Subarea 1955 Decreed Right and any portion of the 4,464 Acre Feet of Monk Hill 1955 Decreed Right produced from the Pasadena Subarea.*

***Allowable Carryover will remain at 10% of each Party's original 1955 Decreed Right and will not be impacted by the agreed upon reductions.*

****Any Party having water stored in existing Long-Term Storage under Metropolitan Water District's (MWD) Cooperative Storage Program (CSP) can produce this water beyond reduction limits, if called upon by MWD to do so, with the concurrence of the Raymond Basin Management Board (Board). This CSP water will be accounted for separate from Long Term Storage and will still be subject to basin losses as determined each year by the Board.*

ATTACHMENT H

MAY 31, 2012

EVALUATION OF PASADENA SUBAREA

STETSON ENGINEERS INC.

861 Village Oaks Drive, Suite 100 • Covina, California 91724
Phone: (626) 967-6202 • FAX: (626) 331-7065 • Web site: www.stetsonengineers.com
Northern California • Southern California • New Mexico • Arizona • Nevada • Colorado

Reply to: Covina

STAFF REPORT

TO: **Raymond Basin Management Board**

FROM: **Stetson Engineers Inc.**

SUBJECT: **A Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea**

JOB NO.: **1927-13**

DATE: **May 31, 2012**

BACKGROUND

The Raymond Basin Management Board (RBMB) identified the Pasadena Subarea as an area of concern due to apparent significant reductions in Subarea stored water. The Pasadena Subarea groundwater elevation experienced approximately a 100-foot decrease between calendar 1980 and 2008 and had not shown signs of recovery. Due to the decreasing groundwater levels, a Baseline Study on the Raymond Basin was prepared as of February 2, 2004. The Baseline Study indicated groundwater levels had generally declined in the Pasadena Subarea since the Judgment was entered and had not recovered, even during sustained wet periods.

In a cooperative effort to manage the water supplies in the Pasadena Subarea, the RBMB formed a Pasadena Subarea subcommittee and ultimately adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" (Reduction Plan) on January 27, 2009, as shown on Attachment A. Section 2(a) of Resolution No. 42-0109 states in part "...The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long Term Storage Policy by the Board in 1993

played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today." Exhibit A of the Reduction Plan notes the long-term goal of the Reduction Plan is "...a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea, from 17,843 Acre Feet to 12,493 Acre Feet and to ultimately dissolve remaining Long Term Storage accounts."

Exhibit A of the Reduction Plan states, "The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century (approximately 1910 to 1955) without importation of supplemental replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." The Woodbury Well, owned by the City of Pasadena, was designated as the key well for determining the groundwater level of the Pasadena Subarea. The water level in the Woodbury Well will be measured by Raymond Basin staff. Exhibit A of the Reduction Plan further states "...initially, it will take at least three years to have any valuable comparative data."

Section 3 of the Reduction Plan notes, "The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Resolution Plan on July 1, 2012." The purpose of this Staff Report is to review the data collected from 2009 through 2011 and to evaluate the basin response to the Reduction Plan.

PLANNED OPERATION OF PASADENA SUBAREA

The Reduction Plan's long-term goal of a 30 percent reduction of all 1955 Decreed Rights is to 1) to dissolve remaining Long Term Storage accounts, and 2) increase the Raymond Basin groundwater level, as measured at the Woodbury Well, 50 feet above "current levels," which is defined in the Reduction Plan as the water level on July 1, 2009. The Reduction Plan specified the following accounting procedures regarding use of water rights within the Pasadena Subarea commencing July 1, 2009.

1. Reductions of Pasadena Subarea Decreed Rights "...will be implemented each year for five years until the 30% reduction is reached."
2. "Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment."
3. "Producers having water in Long Term Storage can use these accounts to make up the difference between the total required reduction and plus or minus 10

percent of their 1955 Decreed Right until such time all of their water in Long Term Storage is exhausted."

4. "Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over…"
5. "Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage."
6. "Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason."
7. "Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf of the City of Pasadena will be discontinued…"
8. "…total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 acre-feet or 17,843 acre-feet – 1,070 acre-feet in the first year (fiscal year 2009-10) and will be reduced by an additional 1,070 acre-feet each subsequent year for five consecutive years to a total allowable amount of 12,493 acre-feet in any single fiscal year, until the Basin sufficiently recovers."
9. "The Woodbury Well, owned by the City of Pasadena, will be used as the Key Well for the Pasadena Subarea."

BASELINE CONDITIONS AS OF JULY 1, 2009 (INITIAL YEAR OF REDUCTION)

Static Water Elevation at the Key Well

The Reduction Plan states, "The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping." The static groundwater elevation in the Woodbury Well for the period May 1, 1980 to October 13, 2011 is shown on Figure 1. According to City of Pasadena the water elevation in the Woodbury Well could not be measured between October 2007 and April 2011. Consequently, the Monte Vista Well, located about 2,200 feet northerly from the Woodbury Well, was used to analyze the static water elevation for the Pasadena Subarea. The static groundwater elevation in the Monte Vista Well for the period May 1, 1980 to April 14, 2011 is shown on Figure 2. Figure 2 shows the water elevation at the Monte Vista Well as of July 1, 2009, at 409.7 feet above mean sea level (msl) and for the purpose of this analysis, is considered to represent "current" groundwater levels, as noted in Item 8 under "Planned Operation of Pasadena Subarea".

Precipitation

Precipitation in the Pasadena Subarea impacts surface water runoff, local water replenishment and groundwater elevations measured by the Raymond Basin staff at the Woodbury Well and the Monte Vista Well. The RBMB Annual Report uses Station 610B

to represent precipitation within the Pasadena Subarea. Station 610B is located at the City of Pasadena's City Hall. The baseline condition for precipitation is based on the 50-year average annual rainfall prior to July 1, 2009 and the five-year average annual rainfall prior to July 1, 2009. As shown on Figure 3, the 50-year average annual rainfall (fiscal years 1958-59 to 2008-09) is about 20.1 inches and the five-year average annual rainfall (fiscal years 2004-05 to 2008-09) is about 23.8 inches.

Local Water Replenishment

Local surface water replenishment within the Pasadena Subarea occurs in the Los Angeles County Department of Public Works Eaton Spreading Grounds using local runoff; and from local water diverted and replenished by Kinneloa Irrigation District and by the City of Pasadena in the Eaton Canyon area. The baseline condition for local water replenishment is based on the five-year average annual replenishment prior to July 1, 2009. As shown in Figure 4, the five-year average annual replenishment (fiscal years 2004-05 to 2008-09) is about 2,700 acre-feet.

Groundwater Production

The Pasadena Subarea groundwater producers include the City of Alhambra, City of Arcadia, California-American Water Company, East Pasadena Water Company, H.E. Huntington Library and Art Gallery, Kinneloa Irrigation District, City of Pasadena, San Gabriel County Water District and Sunny Slope Water Company. The baseline condition for groundwater production is based on the five-year average annual production prior to July 1, 2009. As shown in Figure 5, the five-year average annual production (fiscal years 2004-05 to 2008-09) is about 18,610 acre-feet.

PASADENA SUBAREA OPERATIONS DURING REDUCTION PERIOD

Precipitation

During fiscal year 2009-10, precipitation at Station 610B was 25.1 inches, which is above both the 50-year average annual rainfall of 20.1 inches and the five-year average annual rainfall of 23.8 inches. During fiscal year 2010-11, precipitation was 28.1 inches, which is above both the 50-year average annual rainfall of 20.1 inches and above the five-year average annual rainfall of 23.8 inches. Above average precipitation often is indicative of increased local water runoff, which contributes to increased local water replenishment and rising groundwater levels. Above average precipitation also contributes to reduced groundwater demands due to reduced irrigation requirements.

Local Water Replenishment

During fiscal year 2009-10, local water replenishment was about 1,900 acre-feet, which is 800 acre-feet below the baseline condition of 2,700 acre-feet. During fiscal year 2010-11, local water replenishment was about 4,200 acre-feet, which is 1,500 acre-feet above the baseline condition of 2,700 acre-feet.

Groundwater Production

During fiscal year 2009-10, groundwater production throughout the Pasadena Subarea was about 15,900 acre-feet, which is 2,700 acre-feet less than the baseline condition of 18,600 acre-feet and about 2,100 acre-feet less than fiscal year 2008-09 annual production. During fiscal year 2010-11, groundwater production was about 15,600 acre-feet, which is 3,000 acre-feet less than the baseline condition of 18,600 acre-feet.

Changes in Long Term Storage Accounts

As previously discussed, the RBMB adopted the Long Term Storage Policy in 1993 which allowed groundwater producers to store water in the Raymond Basin. Exhibit A of the Reduction Plan's Long-Term goal is "a 30% reduction in production of all 1955 Decreed Rights..." and "...to ultimately dissolve remaining Long-Term Storage accounts." In addition, Exhibit A of the Reduction Plan describes conditions for use of the Long-Term Storage accounts. "Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right until such time as all of their water in Long Term Storage is exhausted...Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added for any reason." As shown in Table 1, the Long-Term Storage account was capped at the June 30, 2008 amount of 27,148.6 acre-feet.

One of the goals during the first two years after implementation of the Reduction Plan was to evaluate the effectiveness of capping the Long Term Storage accounts. The Long Term Storage had a beginning balance as of July 1, 2009 of 27,021.1 acre-feet. During fiscal year 2009-10, there was a reduction of 115.6 acre-feet, due to the accounting of a one percent loss in the City of Pasadena's Long Term Storage. The ending balance is 26,905.5 acre-feet as of June 30, 2010, as shown in Table 1. The Long Term Storage had a beginning balance as of July 1, 2010 of 26,905.5 acre-feet. During fiscal year 2010-11, there was a reduction of 119.1 acre-feet, due to the accounting of a one percent loss in the City of Pasadena's and Huntington Library's Long Term Storage accounts. The ending balance is 26,786.4 acre-feet as of June 30, 2011, as shown in Table 1. In summary, the beginning balance of the Long Term Storage as of July 1, 2009 was 27,021.1 acre-feet and the ending balance as of June 30, 2011 was 26,786.4 acre-feet. After two years of implementation of the Reduction Plan, the Long Term Storage decreased by 234.7 acre-feet. The long-term goal of the Reduction Plan is to eliminate all 27,021.1 acre-feet in Long Term Storage as of July 1, 2009.

Impacts to Groundwater Levels

Exhibit A of the Reduction Plan indicated the overall intended benefit from the 30 percent reduction "...will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of

the twentieth-century without importation of replenishment water...For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." As shown in Figure 2, the "current" groundwater level at the Monte Vista Well was at 409.7 feet, as of July 1, 2009.

During fiscal year 2009-10 (the initial year of the Reduction Plan), precipitation was above the baseline condition, as shown on Figure 3. In addition, local water replenishment increased from fiscal year 2008-09, but was still below the baseline condition, as shown in Figure 4. Water rights were reduced by 6 percent to 16,773 acre-feet. However, groundwater production was reduced by about 12 percent, to about 15,900 acre-feet, a reduction of about 2,700 acre-feet from the baseline condition (18,600 – 15,900) and about 2,100 acre-feet from fiscal year 2008-09. These conditions resulted in an increase of the groundwater level at the Monte Vista Well to 413.7 feet as of April 22, 2010, which represents an increase of 4.0 feet above the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

During fiscal year 2010-11 (the second year of the Reduction Plan), precipitation was above the baseline condition, as shown on Figure 3. Local water replenishment was above the baseline condition, as shown in Figure 4. Water rights were reduced by a cumulative amount of 12 percent. Groundwater production was approximately 15,600 acre-feet (which is also about a 12 percent reduction) effectively matching the water right reduction, and is similar to fiscal year 2009-10 production (15,900 acre-feet). These conditions resulted in an increase of the groundwater level at Monte Vista Well to 414.7 feet as of April 14, 2011, an increase of 1.0 foot from fiscal year 2009-10 and an increase of 5.0 feet above the "current" (July 1, 2009) groundwater level of 409.7 feet, as shown in Figure 2, after two years of operation under the Reduction Plan.

The change in groundwater levels appears to be most influenced by the change in groundwater production. The reduced production of about 2,100 acre-feet (about 12 percent) between fiscal year 2008-09 and fiscal year 2009-10 was greater than the reduction in water rights (about six percent) and resulted in about a four foot increase in water levels. In fiscal year 2010-11, groundwater production was essentially unchanged from fiscal year 2009-10 (still about a 12 percent reduction) and matched the reduction in water rights (12 percent). Groundwater levels increased by only one foot despite above-average precipitation and local water replenishment. Based upon the limited data, it appears the Reduction Plan is having a beneficial affect on water levels. The average annual increase in groundwater levels has been about two feet for every 6 percent reduction in water rights.

CONCLUSIONS

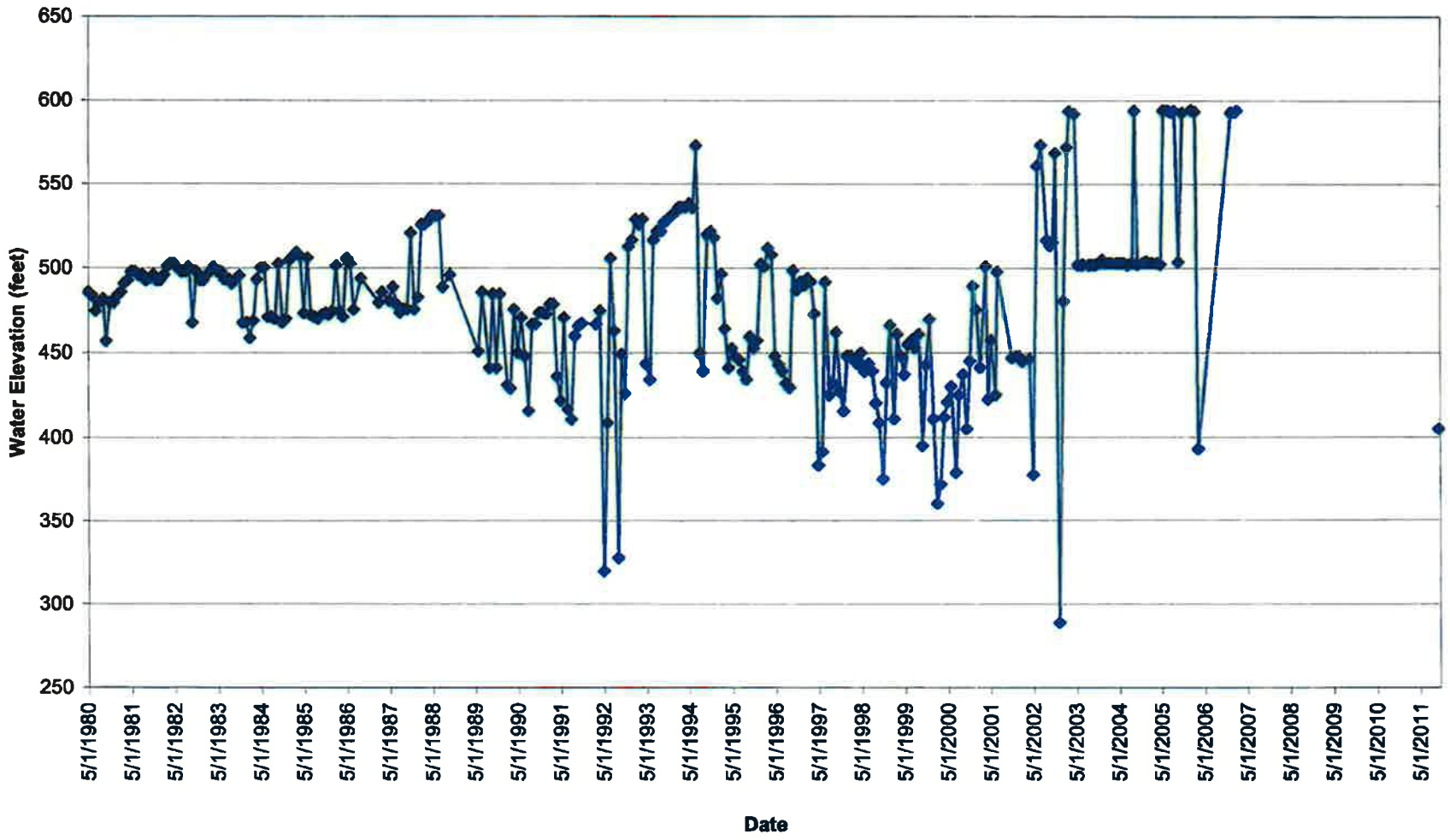
The goal for the first two years after implementation of the Reduction Plan was to evaluate the effectiveness of capping the Long Term Storage accounts and reducing

groundwater produced by a rate of about 1,070 acre-feet per year for five years. The following is a discussion of how the groundwater level was affected by the Reduction Plan for the first two years (fiscal years 2009-10 and 2010-11).

1. The Raymond Basin Management Board adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" on January 27, 2009. The long-term goal of the Reduction Plan is a 30 percent reduction in production of all Decreed Rights in the Pasadena Subarea. Reductions will be implemented each year for five years until the 30 percent reduction is reached. In addition, the Reduction Plan had a long-term goal of 1) ultimately dissolving the remaining Long Term Storage accounts, and 2) to increase groundwater levels to 50 feet above the "current" conditions as of July 1, 2009.
2. Following two year of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 26,786.4 acre feet as of June 30, 2011, a net reduction of 234.7 acre-feet.
3. The "current" groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well increased by about four feet to 413.7 feet as of April 22, 2010, which appears to be primarily influenced by reduced groundwater production. During fiscal year 2010-11 groundwater levels increased by about one foot, while the groundwater production remained essentially unchanged from the prior year. It appears groundwater levels have increased about two feet for every 6 percent reduction in groundwater rights.
4. Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after two years of water rights reductions (a total of 12% reduction), the groundwater level has increased only five feet as compared to the 12 percent goal of about a 20-foot increase.
5. After two years of implementation of the Reduction Plan, the producers have successfully reduced their pumping and have not needed to utilize the Long Term Storage. Implementation of remaining 18 percent (3,210 acre-feet) of the Reduction Plan may require the producers to use Long Term Storage (about 27,000 acre-feet) to provide the necessary water rights to make up the difference between production and water rights. Therefore, the long-term goal of dissolving the remaining Long Term Storage accounts may not be achieved for some time.

Table 1
Pasadena Subarea
Long-term Storage Accounts
(acre-feet)

Fiscal Year	Beginning Balance (4)	Loss (5)	Ending Balance (6)
2008-09	27,148.6	132.1	27,016.5
2009-10	27,021.1	115.6	26,905.5
2010-11	26,905.5	119.1	26,786.4



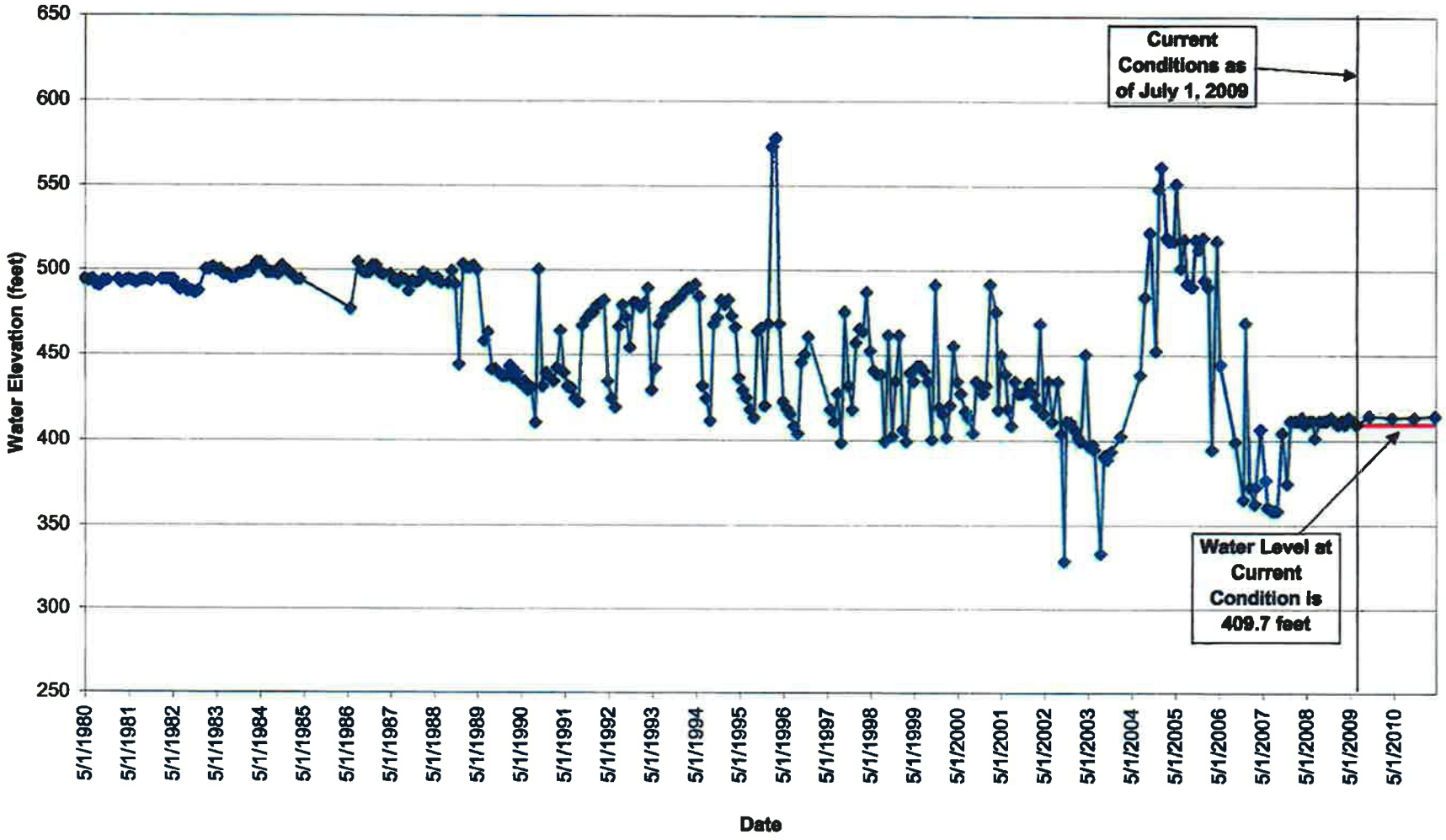
STETSON ENGINEERS INC.
Covina San Rafael Mesa, Arizona
WATER RESOURCE ENGINEERS

RAYMOND BASIN MANAGEMENT BOARD

STATIC WATER ELEVATION AT WOODBURY WELL

FIGURE 1

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Figure 1 - Woodbury Well



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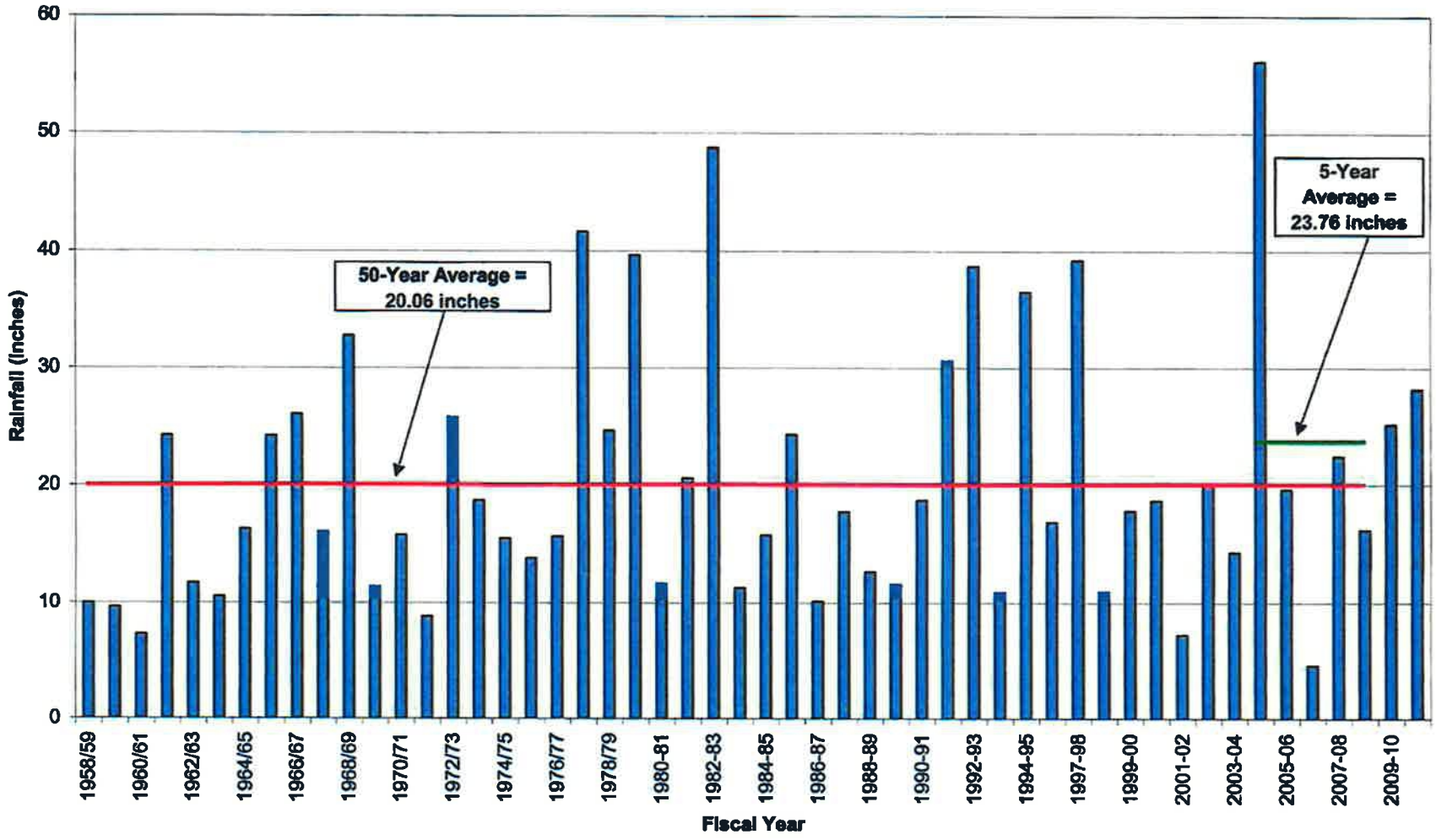
RAYMOND BASIN MANAGEMENT BOARD

STATIC WATER ELEVATION AT MONTE VISTA WELL

FIGURE 2

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Figure 2 - Monte Vista Well



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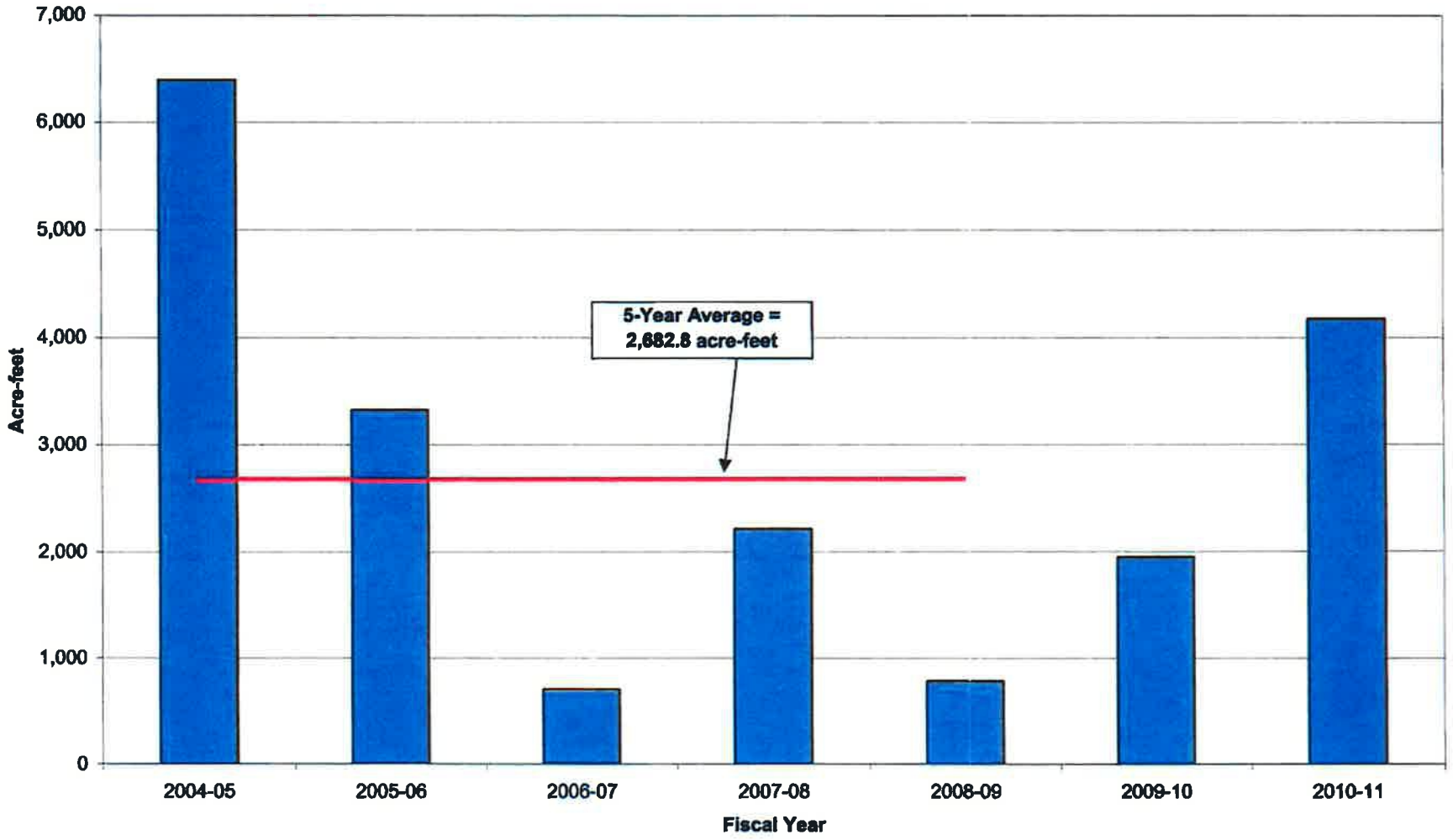
RAINFALL AT STATION 610B IN PASADENA SUBAREA

FIGURE 3

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Figure 3 - Rainfall 610 B



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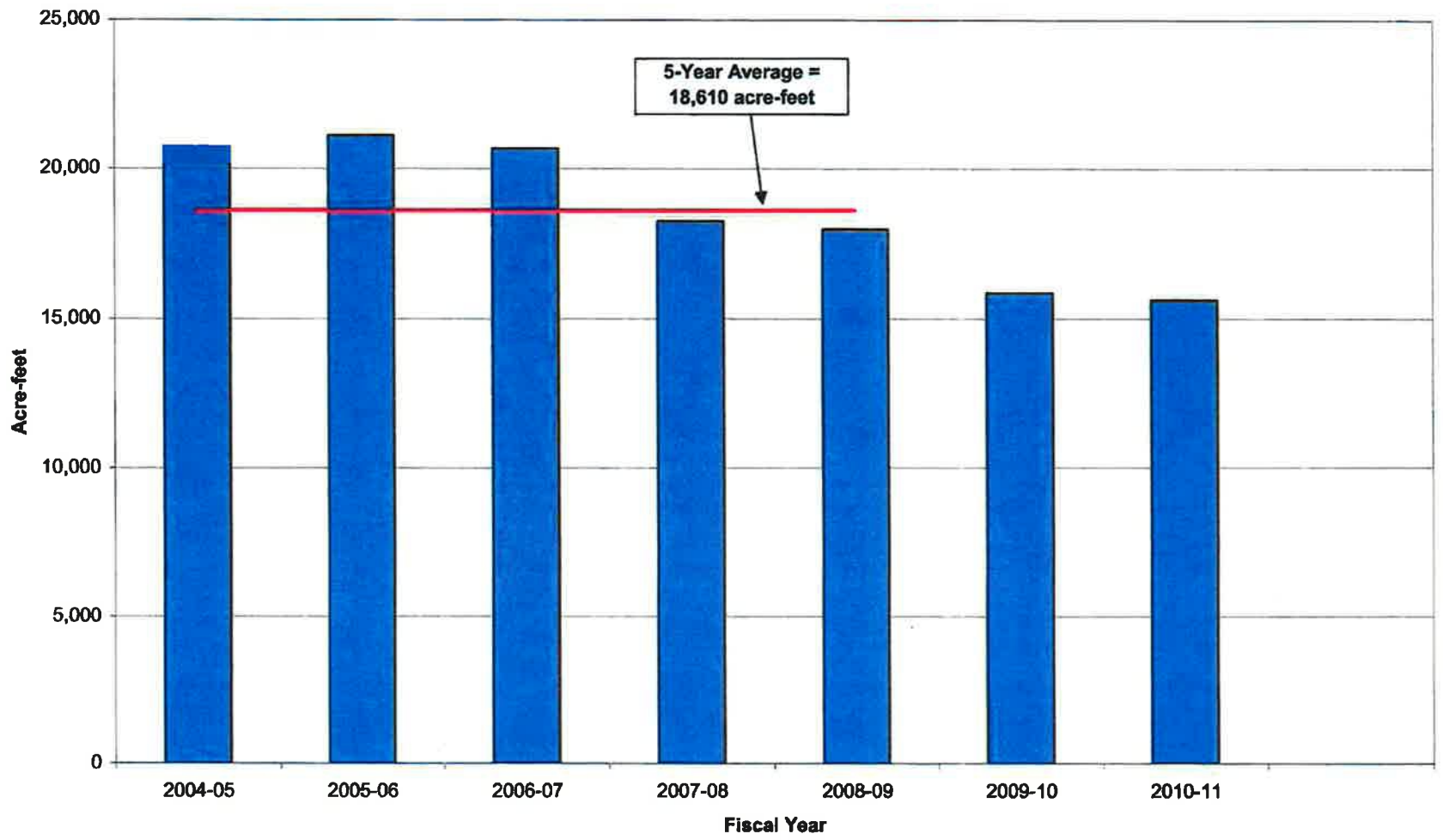
REPLENISHMENT AT PASADENA SUBAREA

FIGURE 4

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Figure 4 - Replenishment



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RAYMOND BASIN MANAGEMENT BOARD

GROUNDWATER EXTRACTIONS AT PASADENA SUBAREA

FIGURE 5

Z:\Jobs\1927\13-Pasadena Subarea evaluation\Figure 5 - Extractions

ATTACHMENT A

RESOLUTION NO. 42-0109

RESOLUTION OF THE BOARD OF DIRECTORS OF THE RAYMOND BASIN MANAGEMENT BOARD ADOPTING A COOPERATIVE PUMPING REDUCTION PLAN FOR THE PARTIES WITH WATER RIGHTS IN THE PASADENA SUBAREA

BE IT RESOLVED BY THE RAYMOND BASIN MANAGEMENT BOARD OF DIRECTORS as follows:

Section 1. Purpose.

The Raymond Basin Management Board ("Board") desires to implement an interim solution to slow declining water levels in the area of the Raymond Basin, Western Unit, known as the Pasadena Subarea with the goal of a reduction of water produced below 1955 Decreed Rights from 17,843 Acre Feet to 12,493 Acre Feet, dissolution of remaining Long-Term Storage accounts and increased groundwater levels. In order to meet this goal, water production reductions will be implemented incrementally at a rate of 1,070 Acre Feet per year for five years until a 30% reduction is achieved. Implementation will begin July 1, 2009. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. The reduction plan implemented by this resolution is not intended to supersede any provisions of the judgment but is intended as a means to improve water supply conditions and avoid disputes between impacted parties. This reduction plan has been developed cooperatively by the water rights holders in the Pasadena Subarea and is included as Exhibit "A" of this resolution.

Section 2. Findings.

(a) The Judgment of the Los Angeles Superior Court in *City of Pasadena v. City of Alhambra* (LASC No. C1323) ("Judgment") governs management of the Basin. The Board was appointed Watermaster to the Basin in 1984 when the Judgment was modified. As Watermaster, the Board has determined that the adjustment in Decreed Rights in 1955 was based on a snapshot of conditions during the first ten years the

judgment was in place and represented roughly a 30% increase in allowable production rights. The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long-Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today.

(b) The Raymond Basin and the Los Angeles area have experienced below-normal rainfall for eight of the past ten years, resulting in decreased storm water capture and runoff available for groundwater recharge.

(c) Producers within the Pasadena Subarea have been struggling to meet current demands and manage declining water levels.

(d) The Water Rights Holders within the Pasadena Subarea seek to find a cooperative solution to over drafting of the Pasadena Subarea.

(e) The Board, as Watermaster, seeks to establish a cooperative solution to over drafting of the Pasadena Subarea.

(f) The general consensus of the Board that the most effective method of managing the supply under current conditions is to look at each Subarea within the Basin independently or semi-independently when developing short-term or interim solutions.

(g) State of California, Department of Water Resources Bulletin 104-6, (June of 1971) indicated that maintaining the 1955 Decreed Rights as the Safe Yield benchmark without supplementing local supplies with imported recharge would eventually result in reduced overall storage in the Basin and the Pasadena Subarea.

(h) The Board authorized the Raymond Basin Baseline Study which was completed on February 2, 2004.

(i) The Baseline Study confirmed that groundwater levels have generally declined in the Pasadena Subarea since the Judgment was entered into and have not recovered proportionate to production, even during sustained wet periods.

(j) Stetson Engineers were retained to work with the Board in developing overall monitoring and management strategies for the Basin and the Pasadena Subarea based on the findings in the Baseline Study

(k) A mass balance analysis was done as part of Stetson's work which indicated that water levels have been impacted by certain modifications to Basin operations since the initial Judgment was entered into in 1944.

(l) Although more specific groundwater level data is required in the Pasadena Subarea to identify acute impact areas or pumping holes, enough data does currently exist to warrant immediate action to slow and eventually reverse the overall decline in water levels.

Section 3. Resolution.

NOW, THEREFORE, BE IT RESOLVED that the Raymond Basin Management Board will implement the Pasadena Subarea Reduction Plan (Reduction Plan) as described in Exhibit "A", attached hereto, effective July 1, 2009. The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012. The Board further resolves to review the findings and consider any appropriate modifications or adjustments to the Reduction Plan at its first regular meeting thereafter. The Board reserves the right to review the Reduction Plan and consider appropriate action prior to July 1, 2012, should conditions require such action.

PASSED, APPROVED, AND ADOPTED on JANUARY 22, 2009.

Shan Kwan
Chairman

ATTEST:

Robert Hayward
Secretary

[SEAL]

EXHIBIT "A"
Pumping Reductions
Pasadena Subarea

The long term goal is a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea from 17,843 Acre Feet* to 12,493 Acre Feet and to ultimately dissolve remaining Long-Term Storage accounts. In order to meet this objective reductions will be implemented each year for five years until the 30% reduction is reached. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. This means spreading credits must be produced within the same fiscal year they accrue or the following fiscal year and cannot be further carried over. Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right** until such time as all of their water in Long Term Storage is exhausted. Water in Long Term Storage accounts will continue to be subject to Basin losses and those losses will be applied at the end of each fiscal year***.

Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment. Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage.

Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason. Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf on the City of Pasadena will be discontinued at the same time. Spreading credits aside, total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 Acre Feet or 17,843 minus 1,070 in the first year and will be

reduced by an additional 1,070 Acre Feet each subsequent year for five consecutive years to a total allowable amount of 12,493 Acre Feet in any single fiscal year, until the Basin sufficiently recovers.

The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal. The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping. Initially, it will take at least three years to have any valuable comparative data.

**The City of Pasadena has 12,807 Acre Feet of total 1955 Decreed Right in the Western Unit. 4,464 Acre Feet are in the Monk Hill portion of the Western Unit and 8,343 Acre Feet are in the Pasadena Subarea portion of the Western Unit. As adopted, this reduction plan applies to the 8,343 Acre Feet designated as Pasadena Subarea 1955 Decreed Right and any portion of the 4,464 Acre Feet of Monk Hill 1955 Decreed Right produced from the Pasadena Subarea.*

***Allowable Carryover will remain at 10% of each Party's original 1955 Decreed Right and will not be impacted by the agreed upon reductions.*

****Any Party having water stored in existing Long-Term Storage under Metropolitan Water District's (MWD) Cooperative Storage Program (CSP) can produce this water beyond reduction limits, if called upon by MWD to do so, with the concurrence of the Raymond Basin Management Board (Board). This CSP water will be accounted for separate from Long Term Storage and will still be subject to basin losses as determined each year by the Board.*

ATTACHMENT I

MARCH 23, 2015
EVALUATION OF PASADENA SUBAREA

STETSON
ENGINEERS INC.

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Phone: (626) 967-6202 • FAX: (626) 331-7065 • Web site: www.stetsonengineers.com

Northern California • Southern California • Arizona • Colorado

Reply to: Covina

STAFF REPORT

TO: **Raymond Basin Management Board**

FROM: **Stetson Engineers Inc.**

SUBJECT: **A Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea**
Performance Evaluation – 2009 through 2014

JOB NO.: **1927-13**

DATE: **March 23, 2015**

BACKGROUND

The Raymond Basin Management Board (RBMB) identified the Pasadena Subarea as an area of concern due to apparent significant reductions in Subarea stored water. The Pasadena Subarea groundwater elevation experienced approximately a 100-foot decrease between calendar 1980 and 2008 and had not shown signs of recovery. Due to the decreasing groundwater levels, a Baseline Study on the Raymond Basin was prepared as of February 2, 2004. The Baseline Study indicated groundwater levels had generally declined in the Pasadena Subarea since the Judgment was entered and had not recovered, even during sustained wet periods.

In a cooperative effort to manage the water supplies in the Pasadena Subarea, the RBMB formed a Pasadena Subarea subcommittee and ultimately adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" (Reduction Plan) on January 27, 2009, as shown on Attachment A. Section 2(a) of Resolution No. 42-0109 states in part "...The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today." Exhibit A of the Reduction Plan notes the long-term goal of the

Reduction Plan is "...a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea, from 17,843 Acre Feet to 12,493 Acre Feet and to ultimately dissolve remaining Long Term Storage accounts."

Exhibit A of the Reduction Plan states, "The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century (approximately 1910 to 1955) without importation of supplemental replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." The Woodbury Well, owned by the City of Pasadena, was designated as the key well for determining the groundwater level of the Pasadena Subarea. The water level in the Woodbury Well will be measured by Raymond Basin staff. Exhibit A of the Reduction Plan further states "...initially, it will take at least three years to have any valuable comparative data."

Section 3 of the Reduction Plan notes, "The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012."

Fiscal year 2013-14 represented the initial year of the full 30 percent reduction of the 1955 Decreed Rights in the Pasadena Subarea. The purpose of this Staff Report is to review the data collected from 2009 through 2014 and to evaluate the Subarea response to the Reduction Plan.

PLANNED OPERATION OF PASADENA SUBAREA

The Reduction Plan's long-term goal of a 30 percent reduction of all 1955 Decreed Rights is to 1) dissolve remaining Long Term Storage accounts, and 2) increase the Raymond Basin groundwater level, as measured at the Woodbury Well, 50 feet above "current levels," which is defined in the Reduction Plan as the water level on July 1, 2009. The Reduction Plan specified the following accounting procedures regarding use of water rights within the Pasadena Subarea commencing July 1, 2009.

1. Reductions of Pasadena Subarea Decreed Rights "...will be implemented each year for five years until the 30% reduction is reached."
2. "Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment."

3. "Producers having water in Long Term Storage can use these accounts to make up the difference between the total required reduction and plus or minus 10 percent of their 1955 Decreed Right until such time all of their water in Long Term Storage is exhausted."
4. "Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment."
5. "Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage."
6. "Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason."
7. "Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf of the City of Pasadena will be discontinued..."
8. "...total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 acre-feet or 17,843 acre-feet – 1,070 acre-feet in the first year (fiscal year 2009-10) and will be reduced by an additional 1,070 acre-feet each subsequent year for five consecutive years to a total allowable amount of 12,493 acre-feet in any single fiscal year, until the Basin sufficiently recovers."
9. "The Woodbury Well, owned by the City of Pasadena, will be used as the Key Well for the Pasadena Subarea."

BASELINE CONDITIONS AS OF JULY 1, 2009 (INITIAL YEAR OF REDUCTION)

Static Water Elevation at the Key Well

The Reduction Plan states, "The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping." The static groundwater elevation in the Woodbury Well for the period May 1, 1980 to April 2014 is shown on Figure 1. According to City of Pasadena the water elevation in the Woodbury Well could not be measured between October 2007 and April 2011 and only four measurements were collected between April 2011 and April 2014. Consequently, the Monte Vista Well, located about 2,200 feet northerly from the Woodbury Well, was used to analyze the static water elevation for the Pasadena Subarea. The static groundwater elevation in the Monte Vista Well for the period May 1, 1980 to April 2014 is shown on Figure 2. Figure 2 shows the water elevation at the Monte Vista Well as of July 1, 2009, at 409.7 feet above mean sea level (msl) and for the purpose of this analysis, is considered to represent "current" groundwater levels, as noted in Item 8 under "Planned Operation of Pasadena Subarea".

Precipitation

Precipitation in the Pasadena Subarea impacts surface water runoff, local water replenishment and groundwater elevations measured by the Raymond Basin staff at the Woodbury Well and the Monte Vista Well. The RBMB Annual Report uses Station 610B to represent precipitation within the Pasadena Subarea. Station 610B is located at the City of Pasadena's City Hall. The baseline condition for precipitation is based on the 50-year average annual rainfall prior to July 1, 2009 and the five-year average annual rainfall prior to July 1, 2009. As shown on Figure 3, the 50-year average annual rainfall (fiscal years 1958-59 to 2008-09) is about 20.1 inches and the five-year average annual rainfall (fiscal years 2004-05 to 2008-09) is about 23.8 inches.

Local Water Replenishment

Surface water replenishment within the Pasadena Subarea occurs in the Los Angeles County Department of Public Works Eaton Spreading Grounds using local runoff; and from local water diverted and replenished by Kinneloa Irrigation District and by the City of Pasadena in the Eaton Canyon area. The baseline condition for local water replenishment is based on the five-year average annual replenishment prior to July 1, 2009. As shown in Figure 4, the five-year average annual replenishment (fiscal years 2004-05 to 2008-09) is about 3,000 acre-feet per year.

Groundwater Production

The Pasadena Subarea groundwater producers include the City of Alhambra, City of Arcadia, California-American Water Company, East Pasadena Water Company, H.E. Huntington Library and Art Gallery, Kinneloa Irrigation District, City of Pasadena, San Gabriel County Water District and Sunny Slope Water Company. The baseline condition for groundwater production is based on the five-year average annual production prior to July 1, 2009. As shown in Figure 5, the five-year average annual production (fiscal years 2004-05 to 2008-09) is about 19,800 acre-feet. (Note: 1955 Decreed Rights on the Pasadena Subarea total 17,843 acre-feet per year.)

Overview of Prior Staff Report

Pursuant to the terms of the Reduction Plan RBMB staff prepared a Staff Report dated May 31, 2012. Key findings from that Staff Report are summarized below.

- Following two years of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 26,786.4 acre feet as of June 30, 2011, a net reduction of 234.7 acre-feet.

- The "current" groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well increased by about four feet to 413.7 feet as of April 22, 2010, which appears to be primarily influenced by reduced groundwater production. During fiscal year 2010-11 groundwater levels increased by about one foot, while the groundwater production remained essentially unchanged from the prior year. It appears groundwater levels have increased about two feet for every 6 percent reduction in groundwater rights.
- Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after two years of water rights reductions (a total of 12% reduction), the groundwater level has increased only five feet as compared to the 12 percent goal of about a 20-foot increase.
- After two years of implementation of the Reduction Plan, the producers have successfully reduced their pumping, but have not needed to utilize the Long Term Storage. Implementation of the remaining 18 percent (3,210 acre-feet) of the Reduction Plan may require the producers to use Long Term Storage (about 27,000 acre-feet) to provide the necessary water rights to make up the difference between production and water rights. Therefore, the goal of dissolving the remaining Long Term Storage accounts may require several years of operation under reduced Decreed Rights.

PASADENA SUBAREA PERFORMANCE EVALUATION DURING REDUCTION PERIOD (2009-10 THROUGH 2013-14)

Precipitation

During the five years of the Reduction Period between fiscal years 2009-10 and 2013-14, precipitation at Station 610B (see Figure 3) averaged 16.8 inches and ranged from 8 inches to 27.8 inches. The average annual rainfall during the Reduction Period was 84 percent of the 50-year average annual rainfall of 20.1 inches, and 65 percent of the recent 5-year average annual rainfall of 25.9 inches. Below average precipitation often results in reduced local water runoff, reduced local water replenishment and may result in decreasing groundwater levels assuming groundwater production remains constant. Below average precipitation may also contribute to increased groundwater demands due to increased irrigation requirements.

Local Water Replenishment

During the five years of the Reduction Plan between fiscal years 2009-10 and 2013-14, local water replenishment averaged about 1,680 acre-feet, which is 1,320 acre-feet below the prior 5-year baseline condition of 3,000 acre-feet, as shown on Figure 4. During the Reduction Plan period about 770 acre-feet, of the average annual amount of 1,680 acre-feet, was by the City of Pasadena and Kinneloa Irrigation District as a Spreading Credit and subsequently pumped in the following year by the City of Pasadena and Kinneloa Irrigation District. Consequently, an average of only about 910 acre-feet was replenished in the Pasadena Subarea for general benefit.

Groundwater Production

During the five years of the Reduction Period between fiscal years 2009-10 and 2013-14, groundwater production throughout the Pasadena Subarea averaged about 15,330 acre-feet, which is 4,470 acre-feet less than the prior 5-year baseline condition of 19,800 acre-feet and about 2,650 acre-feet less than fiscal year 2008-09 annual production. As shown on Figure 5, total groundwater production (including production of Spreading Credits and Long Term Storage) was equal to or less than the reduced Decreed Rights during the initial three years of the Reduction Plan. However, production during fiscal years 2012-13 and 2013-14 exceeded the Reduction Plan goal (through the use of Spreading Credits and Long Term Storage), but was less than the collective 1955 Decreed Rights.

Changes in Long Term Storage Accounts

As previously discussed, the RBMB adopted the Long Term Storage Policy in 1993 which allowed groundwater producers to store water in the Raymond Basin. Exhibit A of the Reduction Plan's Long-Term goal is "a 30% reduction in production of all 1955 Decreed Rights..." and "...to ultimately dissolve remaining Long-Term Storage accounts." In addition, Exhibit A of the Reduction Plan describes conditions for use of the Long-Term Storage accounts. "Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right until such time as all of their water in Long Term Storage is exhausted...Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added for any reason." As shown in Table 1, the Long-Term Storage account was capped at the June 30, 2008 amount of 27,148.6 acre-feet.

One of the goals of the Reduction Plan was to evaluate the effectiveness of capping the Long Term Storage accounts. The Long Term Storage had a beginning balance as of July 1, 2009 of 27,021.1 acre-feet. As shown on Table 1, fiscal years 2009-10 through 2011-12 had reductions of about 120 acre-feet per year, primarily as a result of the

accounting of an annual one percent storage deduction from Long Term Storage accounts. However, commencing fiscal year 2012-13 and continuing into fiscal year 2013-14, Producers have begun using water rights held in Long Term Storage accounts as a result of production in excess of the reduced Decreed Rights. In summary, the beginning balance of the Long Term Storage as of July 1, 2009 was 27,021.1 acre-feet and the ending balance as of June 30, 2014 was 24,784.7 acre-feet, as shown on Table 1. After five years of implementation of the Reduction Plan, the Long Term Storage decreased by 2,236.4 acre-feet, of which about 1,400 acre-feet occurred in fiscal year 2013-14. With the 30 percent reduction phase now in place, further reductions to the Long Term Storage accounts are expected going forward. The long-term goal of the Reduction Plan is to eliminate all 27,021.1 acre-feet, which had been in Long Term Storage as of July 1, 2009.

Table 2 provides a summary of Pasadena Subarea water rights (including Decreed Rights, Spreading Credits, Long Term Storage and carryover of Decreed Rights) and annual production. Table 2 indicates that during fiscal year 2013-14 annual production used all available Decreed Rights (under the Reduction Plan), all carryover and results in Producers actively using water rights in their Long Term Storage Accounts to balance with production.

Impacts to Groundwater Levels

Exhibit A of the Reduction Plan indicated the overall intended benefit from the 30 percent reduction "...will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water...For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal." As shown in Figure 2, the "current" groundwater level at the Monte Vista Well was at 409.7 feet, as of July 1, 2009.

During fiscal year 2009-10 (the initial year of the Reduction Plan), precipitation was above the baseline condition, as shown on Figure 3. In addition, local water replenishment increased from fiscal year 2008-09, but was still below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 6 percent to 16,773 acre-feet. However, groundwater production was reduced by about 12 percent, to about 15,900 acre-feet, a reduction of about 3,900 acre-feet from the baseline condition (19,800 – 15,900) and about 2,100 acre-feet from fiscal year 2008-09. These conditions resulted in an increase of the groundwater level at the Monte Vista Well to 413.7 feet as of April 22, 2010, which represents an increase of 4.0 feet above the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

During fiscal year 2010-11 (the second year of the Reduction Plan), precipitation was above the baseline condition, as shown on Figure 3. Local water replenishment was above the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by a cumulative amount of 12 percent to 15,702 acre-feet. Groundwater production was approximately 15,600 acre-feet (which is also about a 12 percent reduction) effectively matching the water right reduction, and is similar to fiscal year 2009-10 production (15,900 acre-feet). These conditions resulted in an increase of the groundwater level at Monte Vista Well to 414.7 feet as of April 14, 2011, an increase of 1.0 foot from fiscal year 2009-10 and an increase of 5.0 feet above the "current" (July 1, 2009) groundwater level of 409.7 feet, as shown in Figure 2, after two years of operation under the Reduction Plan.

During fiscal year 2011-12 (the third year of the Reduction Plan), precipitation was below the baseline condition, as shown on Figure 3. In addition, local water replenishment was below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 18 percent to 14,631 acre-feet. However, groundwater production was reduced by about 24 percent, to about 14,100 acre-feet, a reduction of about 5,700 acre-feet from the baseline condition (19,800 – 14,100) and about 3,900 acre-feet from fiscal year 2008-09. Despite reduced groundwater production, water supply conditions resulted in a decrease of the groundwater level at the Monte Vista Well by 21 feet from the April 14, 2011 elevation of 414.7 feet to 393.7 feet as of April 24, 2012. This also represents a decrease of 16 feet below the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

During fiscal year 2012-13 (the fourth year of the Reduction Plan), precipitation was below the baseline condition, as shown on Figure 3. In addition, local water replenishment was below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 24 percent to 13,561 acre-feet. However, groundwater production was reduced by about 11 percent, to about 16,500 acre-feet, a reduction of about 3,300 acre-feet from the baseline condition (19,800 – 16,500) and about 1,500 acre-feet from fiscal year 2008-09. These conditions resulted in an increase of the groundwater level at the Monte Vista Well by about 4 feet to 397.7 feet as of April 26, 2013, compared to the prior year when the groundwater level was 393.7 feet. However, the April 2013 elevation represents a decrease of 12 feet below the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

During fiscal year 2013-14 (the fifth year of the Reduction Plan and initial year of full implementation), precipitation was below the baseline condition, as shown on Figure 3. In addition, local water replenishment was below the baseline condition, as shown in Figure 4. Decreed Rights of 17,843 acre-feet were reduced by 30 percent to 12,493 acre-feet. However, groundwater production was reduced by about 22 percent, to about 14,600 acre-feet, a reduction of about 5,200 acre-feet from the baseline condition (19,800 – 14,600) and about 3,400 acre-feet from fiscal year 2008-09. These

conditions resulted in a decrease of the groundwater level at the Monte Vista Well by about three feet from 397.7 feet as of April 26, 2013 to 395.7 feet as of April 21, 2014. The April 2014 elevation represents a decrease of 14 feet below the "current" groundwater level of 409.7 feet (July 1, 2009), as shown in Figure 2.

The change in groundwater levels appears to be most influenced by the change in groundwater production and replenishment of the Pasadena Subarea. During the Reduction Plan period groundwater extractions have averaged about 15,300 acre-feet, including Spreading Credit and use of Long Term Storage credits. Total groundwater extractions were reduced by about 14 percent from the 1955 Decreed Rights. The average annual replenishment was about 1,700 acre-feet, which is about 57 percent of the baseline average of 3,000 acre-feet. During the Reduction Plan period (2009-10 through 2013-14) groundwater levels decreased by about 14 feet (409.7 – 395.7) from the "current" groundwater condition that existed as of July 1, 2009. The three consecutive years (2011-12 through 2013-14) have had below average rainfall and groundwater levels in the Pasadena Subarea have not increased. However, without the Reduction Plan in place, groundwater levels could have decreased even more.

CONCLUSIONS

The goal of this Staff Report is to evaluate the impacts to the static water levels in the five years of the Reduction Plan, evaluate the effectiveness of capping the Long Term Storage accounts and reducing groundwater production. The following is a discussion of how the groundwater level was affected by the Reduction Plan for the initial five years (fiscal years 2009-10 through 2013-14).

1. The Raymond Basin Management Board adopted Resolution No. 42-0109 entitled, "Resolution of the Board of Directors of the Raymond Basin Management Board Adopting a Cooperative Pumping Reduction Plan for the Parties with Water Rights in the Pasadena Subarea" on January 27, 2009. The long-term goal of the Reduction Plan is a 30 percent reduction in production of all Decreed Rights in the Pasadena Subarea. In addition, the Reduction Plan had a long-term goal of 1) ultimately dissolving the remaining Long Term Storage accounts, and 2) to increase groundwater levels to 50 feet above the "current" conditions as of July 1, 2009.

2. During the five years of operation under the Reduction Plan, groundwater production has averaged 15,300 acre-feet compared to the prior 5-year baseline average of about 19,800 acre-feet.

3. During the five years of operation under the Reduction Plan, replenishment has averaged about 1,700 acre-feet compared to the prior 5-year baseline average of about 3,000 acre-feet.

4. Following five years of operation under the Reduction Plan, the Long Term Storage accounts collectively decreased from 27,021.1 acre-feet as of July 1, 2009, to 24,784.7 acre feet as of June 30, 2014, a net reduction of 2,236.4 acre-feet.

5. The "current" groundwater level (as of July 1, 2009) at the Monte Vista Well was 409.7 feet. The groundwater elevation at the Monte Vista Well decreased by about 14 feet to 395.7 feet as of April 21, 2014, which appears to be primarily influenced by below average rainfall and reduced replenishment.

6. Based upon the Reduction Plan, long-term goals of reducing the Pasadena Subarea water rights by 30 percent to increase the basin groundwater levels by about 50 feet, each step of the Reduction Plan (6 percent water rights reduction) should increase the groundwater level by about 10 feet, assuming all other conditions remain relatively constant. As noted above, after five years of water rights reductions (a total of 30% reduction), the groundwater level has decreased about 14 feet as compared to the 30 percent goal of about a 50-foot increase.

7. After five years of implementation of the Reduction Plan, the Producers have successfully reduced their pumping and have used the Long Term Storage. At the end of fiscal year 2013-14 Producers had no carryover rights and had used about 1,400 acre-feet from Long Term Storage and the year-end balance was about 24,800 acre-feet. With the 30 percent reduction of Decreed Rights in-place, continued reductions of the Long Term Storage accounts are expected to continue going forward.

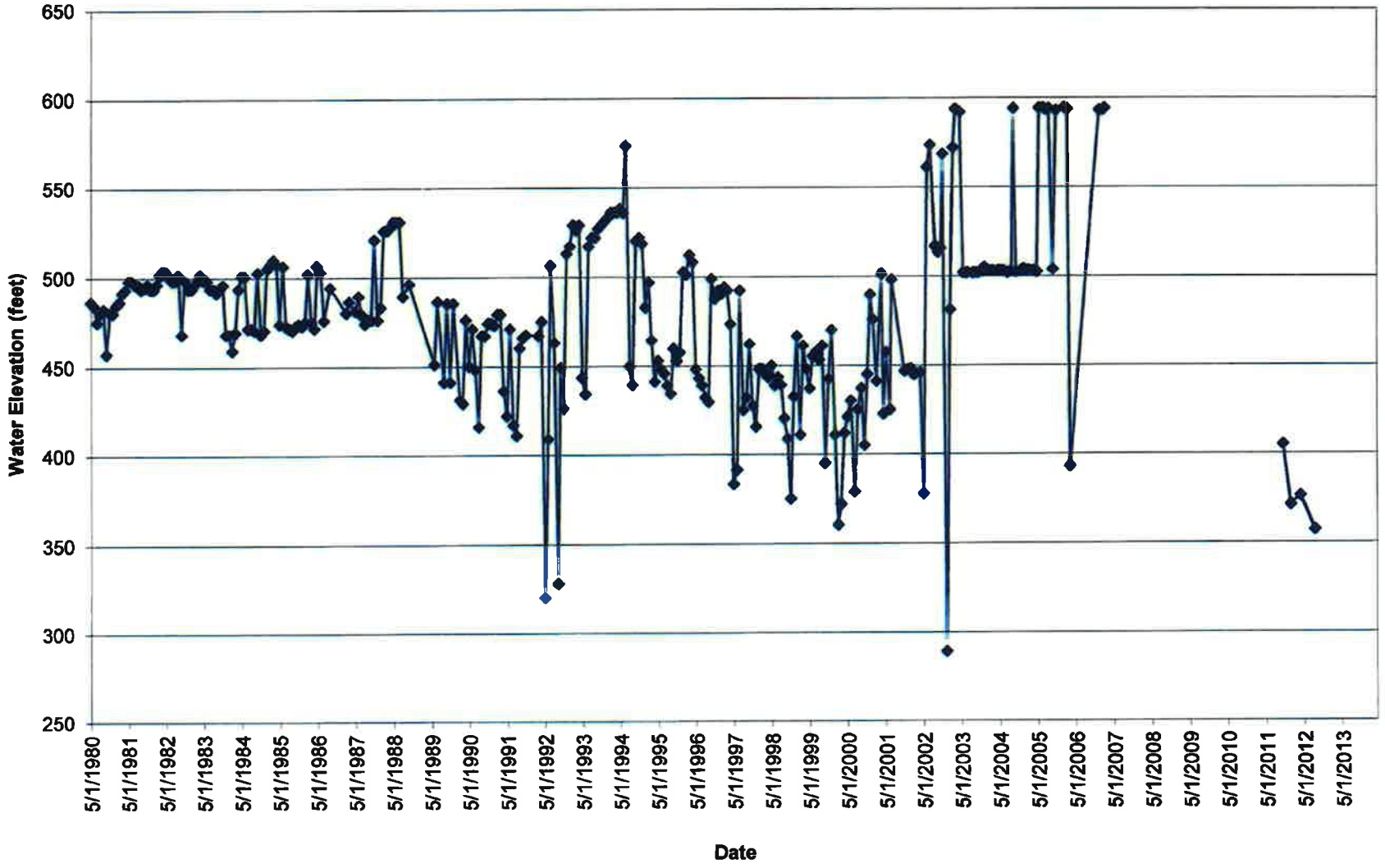
Table 1
Pasadena Subarea
Long-term Storage Accounts
(acre-feet)

Fiscal Year	Beginning Balance (4)	Reduction (5)	Ending Balance (6)
2008-09	27,148.6	127.5	27,021.1
2009-10	27,021.1	115.6	26,905.5
2010-11	26,905.5	119.1	26,786.4
2011-12	26,786.4	121.2	26,665.2
2012-13	26,665.2	436.1	26,229.1
2013-14	26,229.1	1,444.4	24,784.7

Table 2
Pasadena Subarea Operations During Fiscal Years 2009-10 and 2013-14
(acre-feet)

Fiscal Year	Carry Over from Previous Year (1)	Decreed Rights, 1955 (2)	Surface Water Spread Credit (3)	Long-term Storage			Total Water Rights 1/ (7)	Groundwater Extraction (8)	Balance at End of Year (9)=(7)-(8)	Carry Over to Next Year (10)
				Beginning Balance (4)	Loss (5)	Ending Balance (6)				
2008-09	928.1	17,843.0	990.7	27,148.6	132.1	27,016.5	22,252.0	17,979.5	4,272.5	945.0
2009-10	945.0	16,772.4	484.4	27,021.1	115.6	26,905.5	20,393.7	15,860.2	4,533.5	950.0
2010-11	950.0	15,701.8	915.7	26,905.5	119.1	26,786.4	19,318.1	15,622.7	3,695.4	930.1
2011-12	930.1	14,631.3	1,711.1	26,786.4	121.2	26,665.2	17,447.8	14,085.9	3,361.9	819.0
2012-13	819.0	13,560.7	548.8	26,665.2	436.1	26,229.1	18,164.0	16,498.4	1,665.6	480.1
2013-14	480.1	12,490.1	342.1	26,229.1	1,444.4	24,784.7	14,549.0	14,597.9	-48.9	-48.9

Note:
1/ Includes adjustments made between City of Pasadena in Pasadena Subarea and in Monk Hill Subarea.



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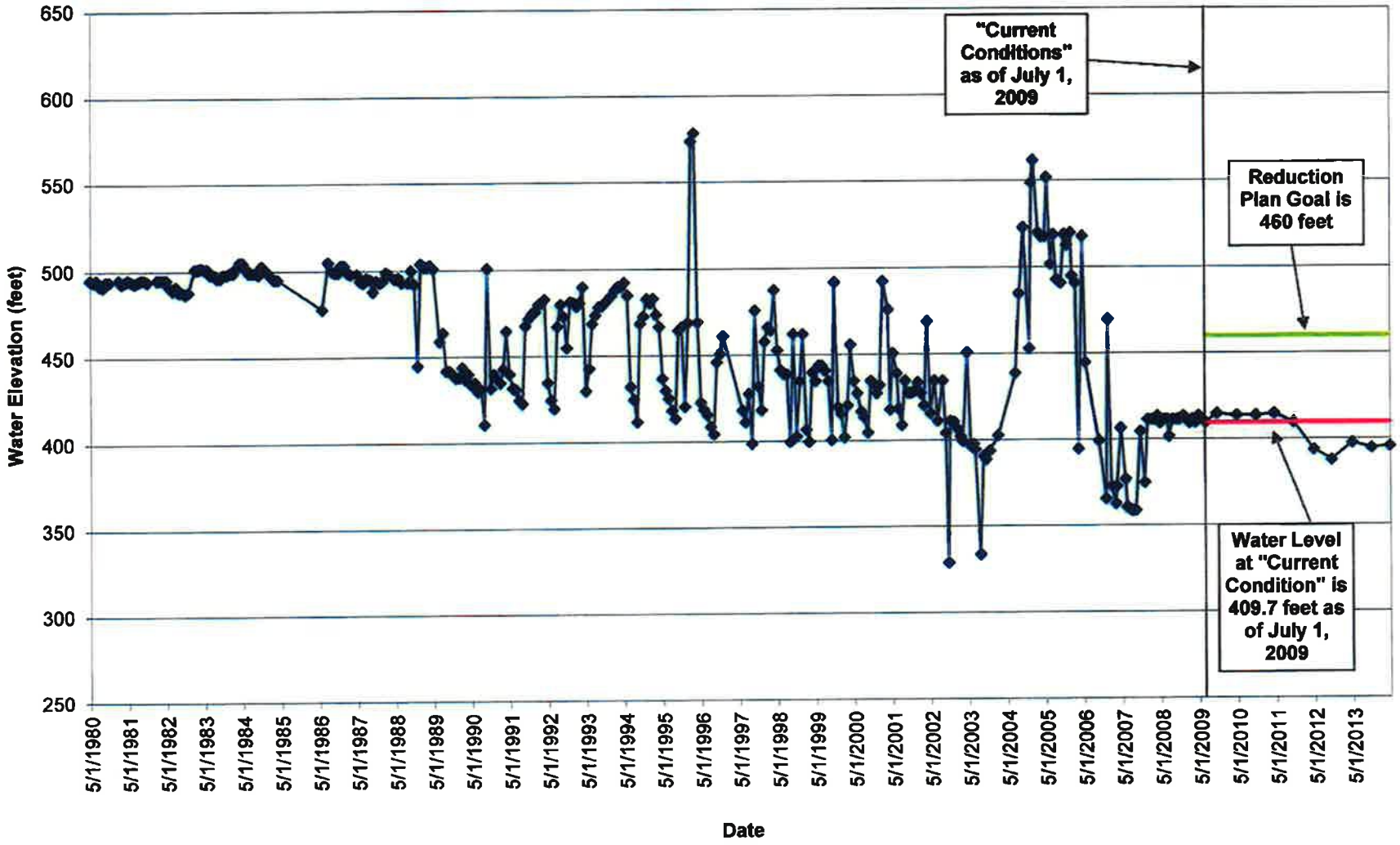
RAYMOND BASIN MANAGEMENT BOARD

STATIC WATER ELEVATION AT WOODBURY WELL

FIGURE 1

J:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2015\Figure 1 - Woodbury Well.xls



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STATIC WATER ELEVATION AT MONTE VISTA WELL

FIGURE 2

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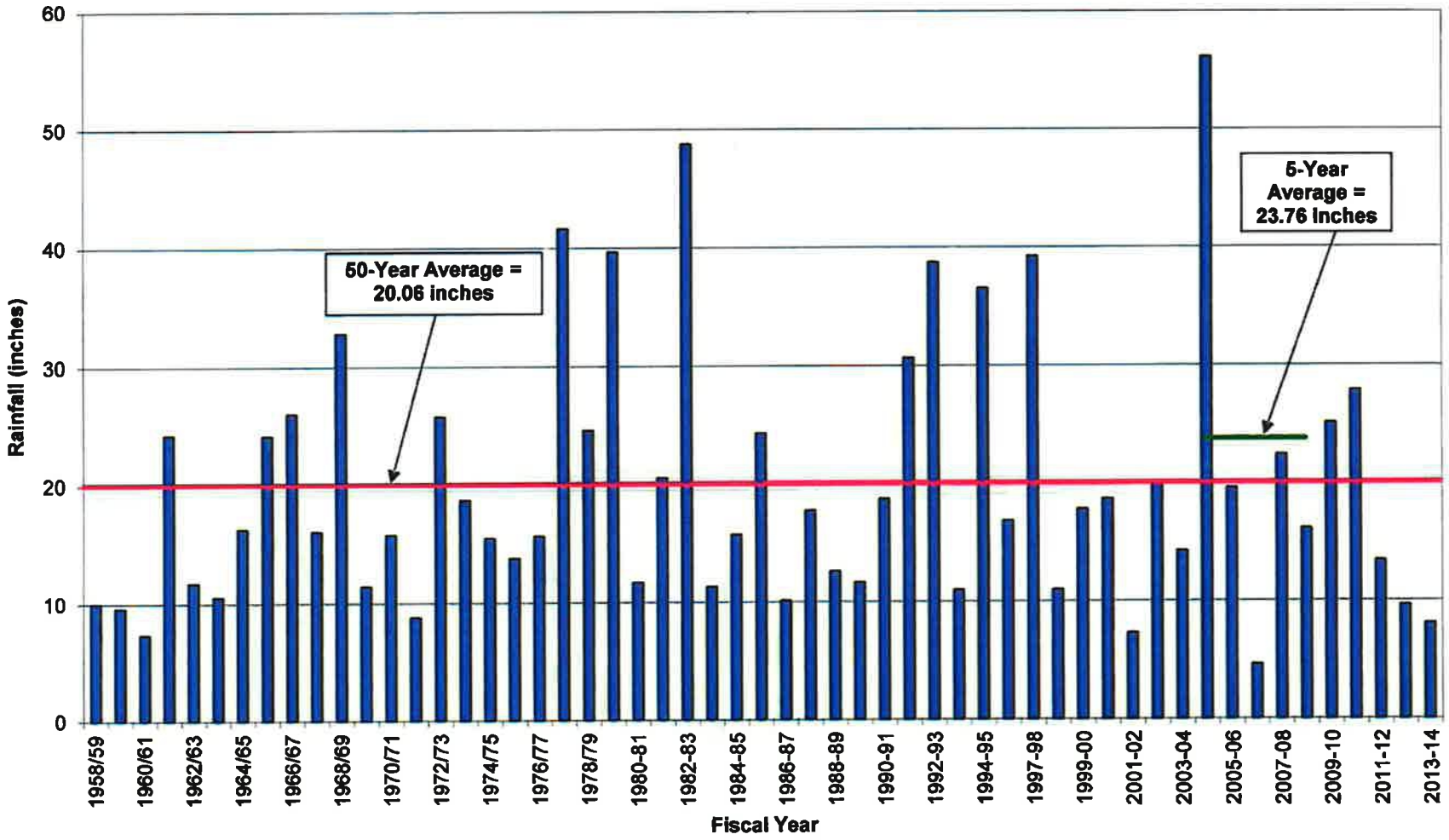

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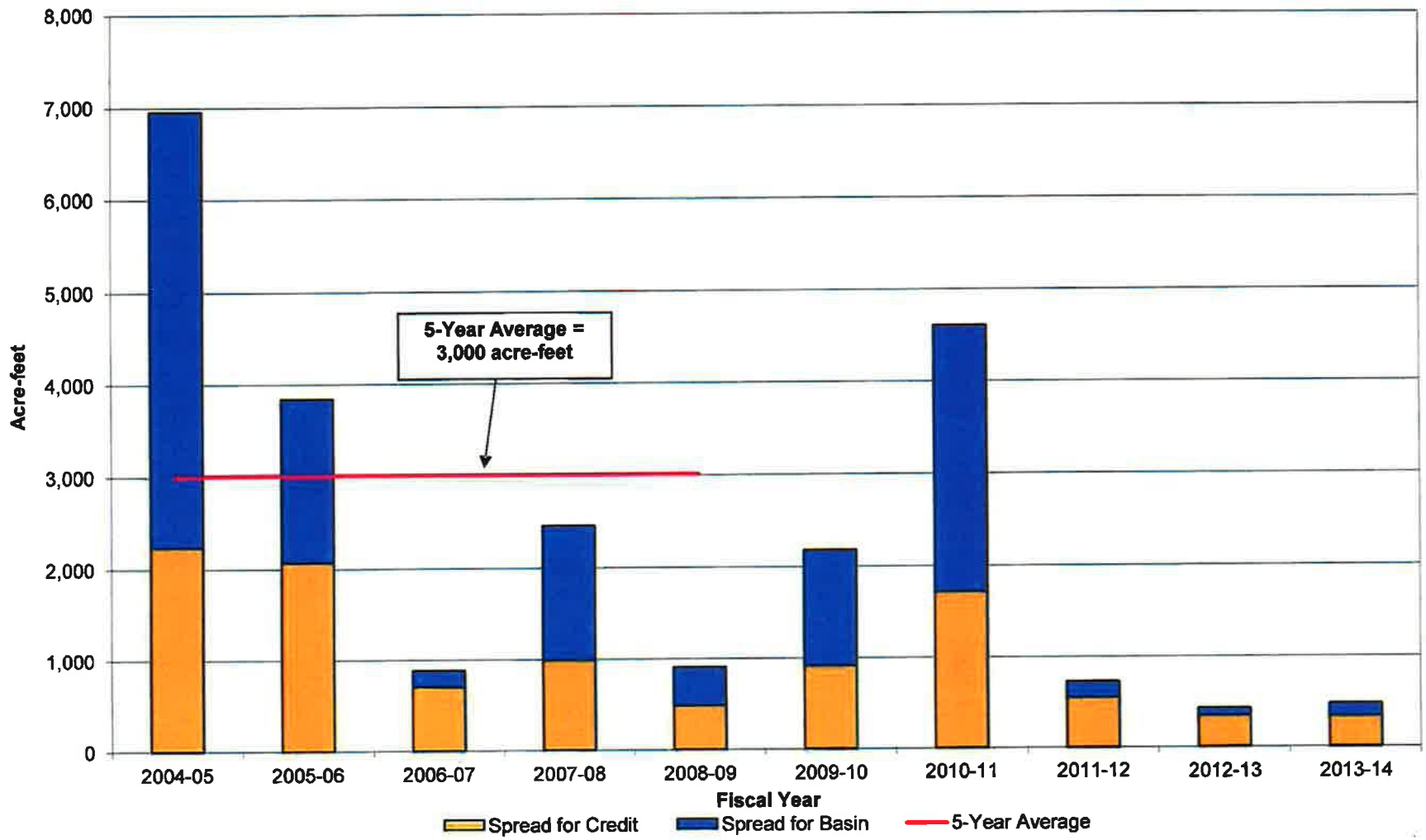
RAINFALL AT STATION 610B IN PASADENA SUBAREA

FIGURE 3

J:\Jobs\1927\13-Pasadena Subarea evaluation\Reduction Plan review 2015\Figure 3 - Rainfall 610 B.xls



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REPLENISHMENT IN PASADENA SUBAREA

FIGURE 4

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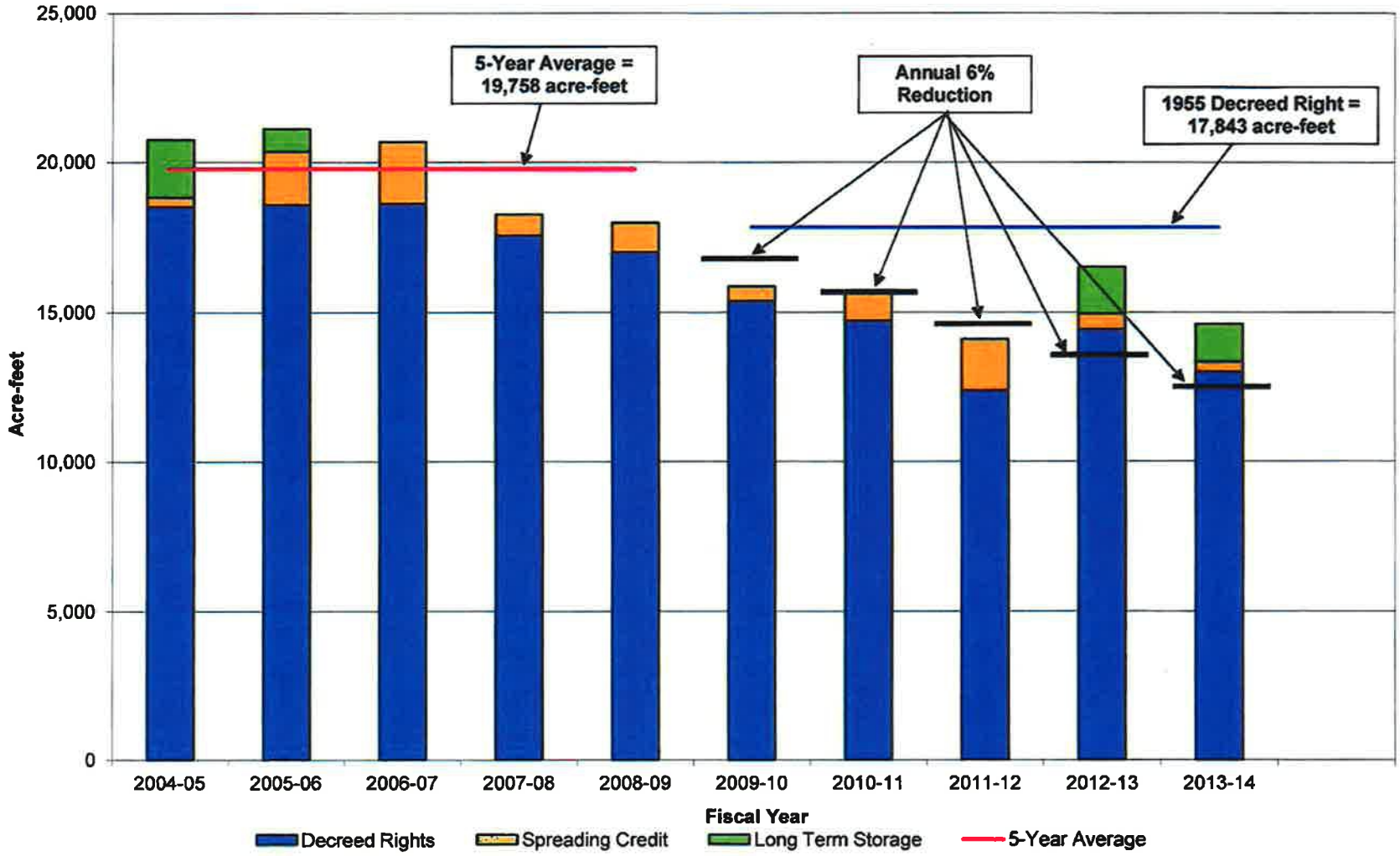

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GROUNDWATER EXTRACTIONS AT PASADENA SUBAREA

FIGURE 5

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ATTACHMENT A

RESOLUTION NO. 42-0109

RESOLUTION OF THE BOARD OF DIRECTORS OF THE RAYMOND BASIN MANAGEMENT BOARD ADOPTING A COOPERATIVE PUMPING REDUCTION PLAN FOR THE PARTIES WITH WATER RIGHTS IN THE PASADENA SUBAREA

BE IT RESOLVED BY THE RAYMOND BASIN MANAGEMENT BOARD OF DIRECTORS as follows:

Section 1. Purpose.

The Raymond Basin Management Board ("Board") desires to implement an interim solution to slow declining water levels in the area of the Raymond Basin, Western Unit, known as the Pasadena Subarea with the goal of a reduction of water produced below 1955 Decreed Rights from 17,843 Acre Feet to 12,493 Acre Feet, dissolution of remaining Long-Term Storage accounts and increased groundwater levels. In order to meet this goal, water production reductions will be implemented incrementally at a rate of 1,070 Acre Feet per year for five years until a 30% reduction is achieved. Implementation will begin July 1, 2009. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. The reduction plan implemented by this resolution is not intended to supersede any provisions of the judgment but is intended as a means to improve water supply conditions and avoid disputes between impacted parties. This reduction plan has been developed cooperatively by the water rights holders in the Pasadena Subarea and is included as Exhibit "A" of this resolution.

Section 2. Findings.

(a) The Judgment of the Los Angeles Superior Court in *City of Pasadena v. City of Alhambra* (LASC No. C1323) ("Judgment") governs management of the Basin. The Board was appointed Watermaster to the Basin in 1984 when the Judgment was modified. As Watermaster, the Board has determined that the adjustment in Decreed Rights in 1955 was based on a snapshot of conditions during the first ten years the

judgment was in place and represented roughly a 30% increase in allowable production rights. The re-determination of the Safe Yield in 1955, which resulted in an increase in production rights along with the adoption of the Long-Term Storage Policy by the Board in 1993 played a major role in lower overall groundwater levels the Pasadena Subarea is experiencing today.

(b) The Raymond Basin and the Los Angeles area have experienced below-normal rainfall for eight of the past ten years, resulting in decreased storm water capture and runoff available for groundwater recharge.

(c) Producers within the Pasadena Subarea have been struggling to meet current demands and manage declining water levels.

(d) The Water Rights Holders within the Pasadena Subarea seek to find a cooperative solution to over drafting of the Pasadena Subarea.

(e) The Board, as Watermaster, seeks to establish a cooperative solution to over drafting of the Pasadena Subarea.

(f) The general consensus of the Board that the most effective method of managing the supply under current conditions is to look at each Subarea within the Basin independently or semi-independently when developing short-term or interim solutions.

(g) State of California, Department of Water Resources Bulletin 104-6, (June of 1971) indicated that maintaining the 1955 Decreed Rights as the Safe Yield benchmark without supplementing local supplies with imported recharge would eventually result in reduced overall storage in the Basin and the Pasadena Subarea.

(h) The Board authorized the Raymond Basin Baseline Study which was completed on February 2, 2004.

(i) The Baseline Study confirmed that groundwater levels have generally declined in the Pasadena Subarea since the Judgment was entered into and have not recovered proportionate to production, even during sustained wet periods.

(j) Stetson Engineers were retained to work with the Board in developing overall monitoring and management strategies for the Basin and the Pasadena Subarea based on the findings in the Baseline Study

(k) A mass balance analysis was done as part of Stetson's work which indicated that water levels have been impacted by certain modifications to Basin operations since the initial Judgment was entered into in 1944.

(l) Although more specific groundwater level data is required in the Pasadena Subarea to identify acute impact areas or pumping holes, enough data does currently exist to warrant immediate action to slow and eventually reverse the overall decline in water levels.

Section 3. Resolution.

NOW, THEREFORE, BE IT RESOLVED that the Raymond Basin Management Board will implement the Pasadena Subarea Reduction Plan (Reduction Plan) as described in Exhibit "A", attached hereto, effective July 1, 2009. The Board resolves to collect sufficient groundwater level and production data as to evaluate the effectiveness of the Reduction Plan on July 1, 2012. The Board further resolves to review the findings and consider any appropriate modifications or adjustments to the Reduction Plan at its first regular meeting thereafter. The Board reserves the right to review the Reduction Plan and consider appropriate action prior to July 1, 2012, should conditions require such action.

PASSED, APPROVED, AND ADOPTED on JANUARY 22, 2009.

Shan Kwan
Chairman

ATTEST:

Robert Hayward
Secretary

[SEAL]

EXHIBIT "A"
Pumping Reductions
Pasadena Subarea

The long term goal is a 30% reduction in production of all 1955 Decreed Rights (Decreed Rights) in the area of the Raymond Basin Western Unit, known as the Pasadena Subarea from 17,843 Acre Feet* to 12,493 Acre Feet and to ultimately dissolve remaining Long-Term Storage accounts. In order to meet this objective reductions will be implemented each year for five years until the 30% reduction is reached. Spreading credits will continue to be applied as in the past and will follow the exact protocol set forth in the Judgment. This means spreading credits must be produced within the same fiscal year they accrue or the following fiscal year and cannot be further carried over. Producers having water in Long Term Storage can use these accounts to make-up the difference between the total required reduction and plus or minus 10% of their 1955 Decreed Right** until such time as all of their water in Long Term Storage is exhausted. Water in Long Term Storage accounts will continue to be subject to Basin losses and those losses will be applied at the end of each fiscal year***.

Producers who cannot produce all of their Decreed Rights or Reduced Decreed Rights may lease those rights to other parties. These and other Decreed Rights must be produced that same year and cannot be carried over beyond the provisions set forth in the Judgment. Producers will be allowed to lease excess Decreed Rights and water in Long Term Storage to other producers but they will not be allowed to "replenish" or add to their Long Term Storage.

Additions to Long Term Storage will be discontinued and individual accounts will be capped at the June 30, 2008, amount and Long Term Storage accounts cannot be added to for any reason. Transfer of Long Term Storage water from the Monk Hill Subarea to the Pasadena Subarea on behalf on the City of Pasadena will be discontinued at the same time. Spreading credits aside, total aggregate production from the Pasadena Subarea (including leases) shall not exceed 16,773 Acre Feet or 17,843 minus 1,070 in the first year and will be

reduced by an additional 1,070 Acre Feet each subsequent year for five consecutive years to a total allowable amount of 12,493 Acre Feet in any single fiscal year, until the Basin sufficiently recovers.

The overall intended benefit received from the 30% reduction will be the stabilization and eventual increase in groundwater levels throughout the Pasadena Subarea. It is recognized that the Pasadena Subarea will most likely never return to the higher groundwater levels experienced in first half of the twentieth-century without importation of replenishment water. It is also recognized that there may be a reasonable operating range higher than current levels and still lower than early twentieth century levels, which is manageable until replenishment water is available. For this reason the working group has established an increase in the Basin of 50 feet above current levels as its initial goal. The Woodbury Well, owned by the City of Pasadena, will be used as the key well for the Pasadena Subarea. The level in the Woodbury Well will be measured at regular intervals by Raymond Basin staff to track the impacts of the re-adjusted pumping. Initially, it will take at least three years to have any valuable comparative data.

**The City of Pasadena has 12,807 Acre Feet of total 1955 Decreed Right in the Western Unit. 4,464 Acre Feet are in the Monk Hill portion of the Western Unit and 8,343 Acre Feet are in the Pasadena Subarea portion of the Western Unit. As adopted, this reduction plan applies to the 8,343 Acre Feet designated as Pasadena Subarea 1955 Decreed Right and any portion of the 4,464 Acre Feet of Monk Hill 1955 Decreed Right produced from the Pasadena Subarea.*

***Allowable Carryover will remain at 10% of each Party's original 1955 Decreed Right and will not be impacted by the agreed upon reductions.*

****Any Party having water stored in existing Long-Term Storage under Metropolitan Water District's (MWD) Cooperative Storage Program (CSP) can produce this water beyond reduction limits, if called upon by MWD to do so, with the concurrence of the Raymond Basin Management Board (Board). This CSP water will be accounted for separate from Long Term Storage and will still be subject to basin losses as determined each year by the Board.*

ATTACHMENT J

STORMWATER CAPTURE PROGRAM

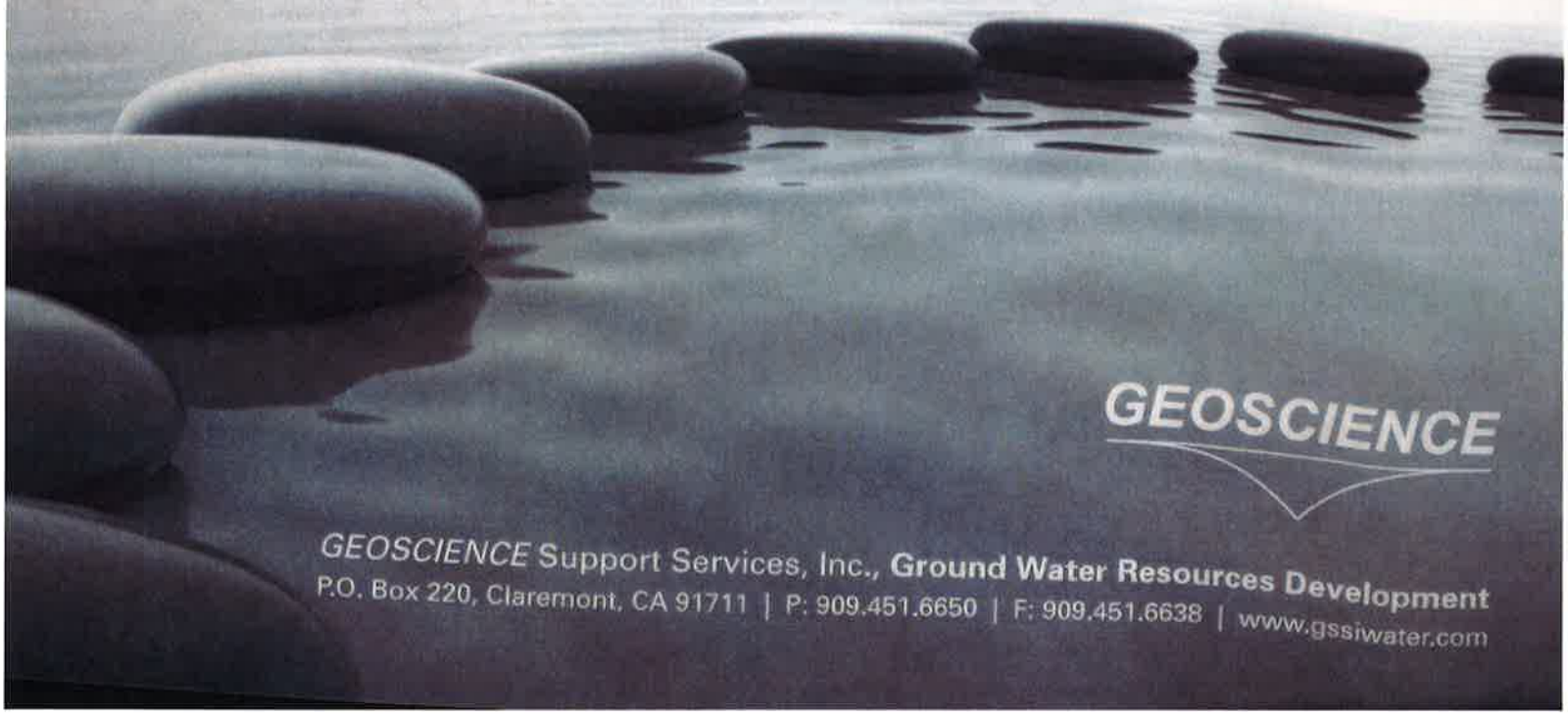
Raymond Basin Groundwater Recharge Technical Analysis – Stormwater Capture Program

DRAFT

PREPARED FOR:

Raymond Basin Management Board

January 26, 2011



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RAYMOND BASIN GROUNDWATER RECHARGE TECHNICAL ANALYSIS STORMWATER CAPTURE PROGRAM

1.0 EXECUTIVE SUMMARY

The purpose of this report is to present the results for a technical analysis of the Raymond Basin Groundwater Recharge Project (Stormwater Capture Program). The purpose of the Stormwater Capture Program is to increase local water supplies and independence from imported water (e.g., State Water Project and Colorado River Water) by using existing debris basins to capture and recharge surface runoff. This project is one of eight individual projects developed by the Foothill Water Coalition (FWC) and the U.S. Army Corps of Engineers for the Foothill Communities Water Supply Reliability Study (FCWSRS). The FWC is a local group of water agencies, which includes the Raymond Basin Management Board (RBMB), which is focused on securing the water resources by addressing issues related to population growth, drought and groundwater contamination within the foothill areas of Southern California.

In order to evaluate the groundwater level and water quality impacts from the proposed Stormwater Capture Program, the existing RBMB groundwater flow model was updated and refined. A summary of the tools and methodology used to update the existing RBMB model and to develop a groundwater solute transport model is included in this report. This report also summarizes the results of basin water level and water quality conditions for 2010 (Baseline), simulated stormwater capture at specific debris basins (Project 1), simulated surface water recharge at Eaton Wash spreading grounds (Project 2), an evaluation for improved surface water recharge at selected spreading grounds (Project 3), and simulated conditions under Project 2 and Project 3 (Project 4).

The scope of work performed during this analysis included the following:

- Evaluating and collecting geohydrologic and groundwater quality data from the RBMB and other water purveyors and agencies within the Raymond Basin;
- Updating and refining the existing RBMB model. The update included refining the model cell size, boundary conditions, location of horizontal-flow barriers, location of pumping / injection wells, and converting model aquifer parameters;
- Extending the flow model calibration period from January 1981 through December 2008 to January 1981 through April 2010;
- Providing characterization of water quality conditions within the Raymond Basin for total dissolved solids (TDS), nitrate (as NO_3), and perchlorate for purposes of developing initial conditions, and for the selection of transport model calibration targets;
- Developing and calibrating a MT3DMS solute transport model for known water TDS and nitrate conditions within the Raymond Basin;
- Simulating various predictive model runs for the Baseline Run and Project Scenarios 1 through 4 using the refined RBMB model and solute transport model;
- Summarizing water budgets for subareas within the Raymond Basin for the Baseline Run and Project Scenarios 1 through 4;
- Providing predictive changes in groundwater levels between 2010 and 2032 for the Baseline Run and Project Scenarios 1 through 4;
- Evaluating movement of perchlorate from wells with elevated concentrations for the Baseline Run and Project Scenarios 1 through 4;
- Attending project progress meetings to discuss the flow model refinement, solute transport model development, calibration processes and results for both models, assumptions for model predictive runs, and results of the Baseline Run and Project

Scenarios 1 through 4; and

- Preparing draft and final technical reports.

A total of five predictive model runs were made using the refined RBMB model and solute transport model to assess the potential impacts of the Project scenarios on groundwater levels and water quality. These model runs include:

- Baseline Run (No Project)
- Project Scenario 1
- Project Scenario 2
- Project Scenario 3
- Project Scenario 4

The following table summarizes the major components of the predictive model runs.

Scenario	Stormwater Capture at Rubio Canyon, Bailey, Sierra Madre Villa and Santa Anita Dam Debris Basins	Recharge at Eaton Wash Spreading Grounds from Diversions through Devils Gate / Eaton Canyon Pipeline	Improved Surface Water Recharge at Sierra Madre, Eaton Wash, Arroyo Seco and Santa Anita Spreading Grounds
Baseline (No Project)			
Project Scenario 1	X		
Project Scenario 2		X	
Project Scenario 3			X
Project Scenario 4		X	X

Based on the results for the Baseline Run and Project Scenarios 1 through 4, the following conclusions are made:

- Based on a water balance model developed for Project Scenario 1, the potential stormwater capture for the Bailey, Rubio Canyon, Sierra Madre Villa, and Santa Anita debris basins is estimated to be 104, 197, 363, and 1,243 acre-ft/yr, respectively, for a total of 1,907 acre-ft/yr.

- Results for Project Scenario 2 indicate that the additional artificial recharge at the Eaton Wash spreading grounds by diversions through the Devils Gate / Eaton Canyon Pipeline is approximately 3,054 acre-ft/yr.

- For Project Scenario 3, the additional artificial recharge by improving surface water recharge in the Arroyo Seco, Sierra Madre, Santa Anita, and Eaton Wash spreading grounds is approximately 427, 887, 419, and 310 acre-ft/yr, respectively, for a total of 2,043 acre-ft/yr.

- Project Scenario 4 assumes both Project 2 and 3 to occur simultaneously during the predictive period (2010-2032). Model results indicate that the additional artificial recharge to be 427, 887, 419, and 3,091 acre-ft/yr for the Arroyo Seco, Sierra Madre, Santa Anita, and Eaton Wash spreading grounds, respectively, for a total of 4,824 acre-ft/yr.

- Under the Baseline Run (i.e., No Project) conditions, water level changes in the Monk Hill Subarea would range from a decline of 10 ft in the central and southeastern areas to an increase of 30 ft in the northeastern area. Change in groundwater levels within the Pasadena Subarea varies from a decline of 40 ft in the southeastern area to an increase of approximately 30 ft in the southwestern area. For the Santa Anita Subarea, water levels would decline by 30 ft to 50 ft.

- The change in groundwater levels by 2032 is predicted to improve (i.e., either increase more or decrease less) under all four Project scenarios within the Monk Hill, Pasadena, and Santa Anita Subareas as compared to the Baseline Run.

- The average annual groundwater storage would decrease 50 acre-ft/yr, increase 150 acre-ft/yr, and decrease 580 acre-ft/yr during the period 2010 through 2032 under Baseline conditions in the Monk Hill, Pasadena, and Santa Anita Subareas, respectively.

- The change in groundwater storage during the period 2010 to 2032 is predicted to improve (i.e., either increase more or decrease less) under all four Project scenarios within the Monk Hill, Pasadena, and Santa Anita Subareas as compared to the Baseline Run.

- Results for model-predicted TDS concentrations in Year 2032 indicates that TDS concentrations in both model layers undergo very little change under Project Scenarios 1 through 4 conditions as compared to the Baseline conditions. Under Project Scenario 1, there are slight improvements in water quality (i.e., decrease in TDS concentration) in the vicinity of the Sierra Madre Villa and Bailey debris basins due to the lower TDS concentrations of stormwater captured under Project conditions. Slight improvements in water quality are also noticeable in the areas of the Eaton Wash, Arroyo Seco, and Sierra Madre spreading grounds under Project Scenarios 2, 3, and 4.

- Results for model-predicted nitrate (as NO_3) concentrations in Year 2032 indicates that nitrate (as NO_3) concentrations in both model layers undergo very little change under Project Scenarios 1 through 4 conditions as compared to the Baseline conditions. Under Project Scenario 1, there are slight improvements in water quality (i.e., decrease in nitrate (as NO_3) concentration) in the vicinity of the Sierra Madre Villa and Bailey debris basins due to the lower nitrate (as NO_3) concentrations of stormwater captured under Project conditions. Slight improvements in water quality are also noticeable in the areas of the Eaton Wash, Arroyo Seco, and Sierra Madre spreading grounds under Project Scenarios 2, 3, and 4.

- Results for model-predicted perchlorate concentrations in Year 2032 indicate that the perchlorate concentrations in both model layers would not change under Project

Scenarios 1 through 4 conditions as compared to the Baseline conditions.

- Forward tracking was simulated using particles released from wells with elevated levels of perchlorate, tetrachloroethylene (PCE), and trichloroethene (TCE). Results of the particle tracking indicate that the groundwater flow paths under Project Scenarios 1 through 4 are the same as conditions under No Project (i.e., Baseline Run).

The refined RBMB groundwater flow and solute transport models are useful tools for evaluating water levels and water quality of the aquifer systems. However, it is a simplified approximation of a complex geohydrologic system. The accuracy of a model prediction is dependent upon the assumptions used. For example, the model assumes that no additional perchlorate would be added to the groundwater systems from the unsaturated zones. For urban areas, the TDS concentration was assumed to be 25 mg/L (precipitation's concentration) plus an urban increment of 250 mg/L and then adjusted by a factor of four for concentrating effects. These mass-loading assumptions may not represent actual conditions due to the lack of field data. The model simulations were not expected to predict the future TDS, nitrate (as NO_3), and perchlorate concentrations with a high degree of accuracy. Rather, they were intended to allow relative comparisons between the Baseline Run (No Project) and Project Scenarios 1 through 4.