CHAPTER IV

WATER SUPPLY IMPACTS

A. INTRODUCTION

This chapter assesses the impacts of the five water supply options selected for analysis in this EIR. The five options for the Cal-Am system are:

- Water Supply Option I: 18,400 Acre-Feet (Current Production Level)
- Water Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity Assumption)
- Water Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity Assumption)
- Water Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production Level)
- Water Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production Level)

Chapter II describes in detail these options and the assumptions upon which they are based.

This chapter assesses two broad categories of impacts: impacts related to water production itself, and cumulative impacts of water consumption within the MPWMD boundaries. Sections B through E describe impacts on natural resources; Section F discusses impacts on recreation resources; Section G describes impacts on aesthetic resources; Section H discusses impacts on drought conditions; Sections I through K discuss impacts on public facilities and services; Sections L through Q discuss socioeconomic impacts; and Section R discusses air quality impacts. Section S summarizes all the impacts discussed in the chapter.

Within each section in this chapter, the impact discussion is divided into two parts: 1) a description of the methodology used to determine the impacts and/or an analysis of the impacts; and 2) a summary description of the impacts, including a conclusion as to their levels of significance, along with a discussion of measures that could be implemented to mitigate any negative impacts.

For the assessment of the impacts of water production itself, this EIR assumes that for each Cal-Am water supply option (i.e., production level), an additional 3,137 acre-feet of water will be produced from the Monterey Peninsula Water Resource System (MPWRS) by other distribution systems and private wells. This 3,137 acre-feet reflects current non-Cal-Am consumption and is held constant under all water supply options (see Table III-1). Thus, early sections of this chapter (i.e., Sections B through G) analyze the cumulative impacts of the combined production of the Cal-Am system and other water distribution systems and private wells that draw from the MPWRS. The five water supply options for the total annual production from MPWRS are as follows:

- Water Supply Option I: 21,537 Acre-Feet
- Water Supply Option II: 23,137 Acre-Feet
- Water Supply Option III: 23,367 Acre-Feet
- Water Supply Option IV: 20,637 Acre-Feet
- Water Supply Option V: 19,837 Acre-Feet

For the assessment of the impacts of water consumption (i.e., delivery), this EIR assumes that only about 93 percent of the water produced by the Cal-Am system is actually available to end-users due to system losses and unmetered consumptions such as leakage, fire flows, and meter error. Based on this assumption, the five water supply options for the Cal-Am system would provide the following amounts of water for distribution to the various jurisdictions within the Cal-Am service area.

- Water Supply Option I: 17,112 Acre-Feet
- Water Supply Option II: 18,600 Acre-Feet
- Water Supply Option III: 19,065 Acre-Feet
- Water Supply Option IV: 16,275 Acre-Feet
- Water Supply Option V: 15,572 Acre-Feet

As noted above, non-Cal-Am water production is held constant at its current level for the purposes of this EIR analysis.

While Chapter V focuses on the impacts of how water might be distributed among the eight affected jurisdictions within Cal-Am's service area under five alternative allocation formulas, the later sections of this chapter (i.e., Sections I through R) discuss the cumulative impacts of water distribution to all of the affected jurisdictions within the Cal-Am's service area as well as the growth that could occur outside of the Cal-Am service area.

New Development Potential

As the basis for the assessment of development-related impacts in the later sections of this chapter (i.e., Sections I through R), Table IV-1 summarizes total growth potential for all eight jurisdictions subject to the District's Water Allocation Program for the Cal-Am system and the non-Cal-Am area within the MPWMD boundaries under each water supply option according to Distribution Alternative IV (the "proposed" distribution alternative).

As the discussion in Chapter II indicates, Supply Options II and III would provide water for new development potential within the Cal-Am service area at the current baseline production/consumption level (Baseline Production/Consumption Level A), and Supply Options I, II, III, and IV would provide water for new development potential under a baseline production/consumption level that assumes a nine percent conservation reduction from the current level (Baseline Production/Consumption Level B).

Estimates of development potential within the MPWMD boundaries, but outside of the Cal-Am service area, are based on EIP Associates' *Estimates of Housing and Employment at Buildout Within the Monterey Peninsula Water Management District* (July 1988). This EIR assumes that new development in non-Cal-Am areas will not require an increase in total non-Cal-Am production due to assumed water conservation in existing uses and shifts in water consumption from agricultural and open space uses to urban uses. This EIR assumes that this non-Cal-Am development will occur under all five water supply options and is, therefore, held constant for all combinations of water supply options, baseline production level assumptions, and distribution alternatives. The development potential for the jurisdictions within the Cal-Am service area (Table IV-1) is based on the application of information concerning water use preferences for each jurisdiction (as described in Chapter III) to the water that would be allocated to each jurisdiction under Distribution IV at each supply option/baseline production level combination resulting in additional Cal-Am water. Appendix E summarizes total development potential within the District in two ways. First, it shows development potential according to each of the five distribution alternatives being analyzed. Second, it does the same for each of the water supply option/baseline production level combinations under which new Cal-Am water will be available.

TABLE IV-1
TOTAL DEVELOPMENT POTENTIAL

DISTRIBUTION ALTERNATIVE IV

	Single Family		Multi-Family		Employment		Hotel		Golf Course		Total
	Acre-Feet	Units	Acre-Feet	Units	Acre-Feet	Emp	Acre-Feet	Rooms	Acre-Feet	Emp	Acre-Feet
Supply Option II at Baseline Production of 18,400 Acre-Feet											
Carmel	62.53	274									62.53
Del Rey Oaks	0.33	1	7.01	46							7.34
City of Monterey	-11.41	-50	125.35	814	199.28	1,880	15.32	112			328.53
Pacific Grove	15.94	70	44.02	286	41.25	389	16.64	121			117.85
Sand City			117.76	765	71.68	676	66.56	486			256.01
Seaside	28.87	127	8.45	55	140.87	1,329	51.74	378			229.93
Monterey County	319.01	842	13.31	86	13.07	123	20.80	152	115.47	45	481.65
MPAD					4.58	43					4.58
Non-Cal-Am		741				8,534		150			
TOTAL	415.27	2,005	315.91	2,051	470.73	12,975	171.06	1,399	115.47	45	1,488.43
Supply Option III at Baseline Production of 18,400 Acre-Feet											
Carmel	79.43	348	6.15	40	2.69	25					88.27
Del Rey Oaks	0.58	3	12.21	79							12.79
City of Monterey	-17.48	-77	191.98	1,247	305.20	2,879	23.46	171			503.16
Pacific Grove	21.80	96	69.29	450	56.03	529	21.65	158			168.76
Sand City			148.30	963	90.27	852	83.82	612			322.40
Seaside	28.87	127	8.45	55	173.32	1,635	62.88	459			273.51
Monterey County	395.27	1,043	16.49	107	16.19	153	25.77	188	115.47	45	569.19
MPAD					15.35	145					15.35
Non-Cal-Am		741				8,534		150			
TOTAL	508.46	2,280	452.87	2,941	659.06	14,752	217.57	1,738	115.47	45	1,953.43
Supply Option I at Baseline Production of 16,700 Acre-Feet											
Carmel	65.32	286									65.32
Del Rey Oaks	0.36	2	7.60	49							7.95
City of Monterey	-12.14	-53	133.28	865	211.88	1,999	16.29	119			349.31
Pacific Grove	18.60	82	34.18	222	48.82	461	21.49	157			123.09
Sand City			122.82	798	74.76	705	69.42	507			267.00
Seaside	28.87	127	8.45	55	143.75	1,356	52.73	385			233.79
Monterey County	324.23	855	13.53	88	13.28	125	21.14	154	115.47	45	487.65
MPAD					6.35	60					6.35
Non-Cal-Am		741				8,534		150			
TOTAL	425.23	2,039	319.86	2,077	498.85	13,240	181.06	1,472	115.47	45	1,540.47
Supply Option II at Baseline Production of 16,700 Acre-Feet											
Carmel	85.48	375	43.26	281	18.92	179					147.66
Del Rey Oaks	0.68	3	20.38	132	4.31	41					25.38
City of Monterey	-31.55	-138	346.49	2,250	550.84	5,197	42.34	309			908.12
Pacific Grove	30.03	132	159.39	1,035	74.52	703	22.04	161			285.99
Sand City			220.55	1,432	134.25	1,266	124.66	910			479.45
Seaside	28.87	127	21.99	143	246.90	2,329	75.50	551			373.25
Monterey County	568.26	1,499	23.71	154	23.28	220	37.05	270	115.47	45	767.77
MPAD					40.85	385					40.85
Non-Cal-Am		741				8,534		150			
TOTAL	681.77	2,738	835.77	5,427	1,093.87	18,854	301.59	2,351	115.47	45	3,028.47
Supply Option III at Baseline Production of 16,700 Acre-Feet											
Carmel	86.41	379	55.10	358	31.88	301					173.39
Del Rey Oaks	0.68	3	23.25	151	6.54	62	0.34	2			30.82
City of Monterey	-37.62	-165	413.12	2,683	656.76	6,196	50.48	368			1,082.74
Pacific Grove	33.60	147	198.52	1,289	82.56	779	22.22	162			336.90
Sand City			246.13	1,598	164.13	1,548	135.59	990			545.85
Seaside	28.87	127	33.71	219	278.75	2,630	75.50	551			416.83
Monterey County	644.53	1,701	26.89	175	26.41	249	42.02	307	115.47	45	855.31
MPAD					51.63	487					51.63
Non-Cal-Am		741				8,534		150			
TOTAL	756.47	2,933	996.73	6,472	1,298.66	20,785	326.14	2,531	115.47	45	3,493.47
Supply Option IV at Baseline Production of 16,700 Acre-Feet											
Carmel	19.00	83									19.00
Del Rey Oaks											-1.85
City of Monterey	-1.22	-5	13.35	87	21.22	200	1.63	12			34.98
Pacific Grove	4.26	19	11.75	76	11.01	104	4.44	32			31.46
Sand City			67.85	441	41.30	390	38.35	280			147.50
Seaside	28.87	127	8.45	55	85.35	805	32.69	239			155.35
Monterey County	186.96	493	7.80	51	7.66	72	12.19	89	115.47	45	330.08
MPAD											-13.05
Non-Cal-Am		741				8,534		150			
TOTAL	237.86	1,458	109.20	709	166.54	10,105	89.30	802	115.47	45	703.47

B. SURFACE WATER AND GROUNDWATER RESOURCES

1. Methodology and Analysis

The analysis of hydrologic and geohydrologic impacts of the five water supply options is based on the results of simulating the water supply options using CVSIM. This mathematical model simulates the surface flows, reservoir effects, infiltration, and groundwater pumping withdrawals throughout the Monterey Peninsula Water Resource System (the Carmel River, the Carmel Valley Aquifer, and the Seaside Coastal Subbasin) (Figure IV-1). Streamflows used as inputs in CVSIM are based on USGS data recorded at Robles del Rio between October 1957 and September 1987. Mainstem flows were calculated by routing the recorded, mean daily flow at Robles del Rio upstream. In this routing the flow was adjusted for tributary inflows, reservoir losses, and diversions. Tributary inflows were estimated using regression equations developed for nine selected tributaries based on USGS data at Robles del Rio and MPWMD flow measurements on the selected streams.

Daily flows for the 1957 to 1987 period were aggregated into monthly sums and reordered to represent the daily flow record from October 1901 to September 1957. The reordering was based on the monthly flow record at San Clemente that had been reconstructed by the U.S. Army Corps of Engineers. The Corps' reconstruction was based on a correlation between annual flows of the Carmel River at San Clemente dam and Arroyo Seco River near Soledad for the years 1938 to 1978 (Oliver pers. comm.).

The methodology for analysis of CVSIM results is discussed in detail in Appendix A. A statistical analysis of the 86 years of monthly output provided the basis of this analysis.

The results of CVSIM were examined to detect changes in the hydrologic regime of the Carmel River. Changes in the hydrologic regime were used as a measure of potential impacts. While changes in the flow regime do not necessarily indicate a hydrologic impact, other resources, such as vegetation and fisheries, could be affected. (Refer to the "Vegetation" and "Fisheries" sections later in this chapter for a discussion of impacts on those resources due to changes in hydrology.)

A significant hydrologic impact is defined, for this EIR, as a complete change in the hydrologic regime. Changes could possibly occur that would influence other resources but not constitute a hydrologic impact.

The MPWMD defines five water-year types based on streamflow in the Carmel River. Those types are "wet," "above normal," "below normal," "dry," and "critically dry," and are defined based on 12.5, 25.0, 50.0, 75.0, and 87.5 percent exceedance probabilities, respectively. To assess changes in the hydrology, the changes in frequency of these water year-types and also periods of no flow were used as benchmarks.

Since the five water supply options involve different levels of production relative to the base condition, options that result in more water extracted from the system would be expected to reduce the flow in the river. Conversely, reductions in extraction would allow additional water to remain in the system. The effects of these changes on the water-year types and no-flow periods were analyzed, and representative graphs of the derived probability curves for winter and summer are included in Appendix A.

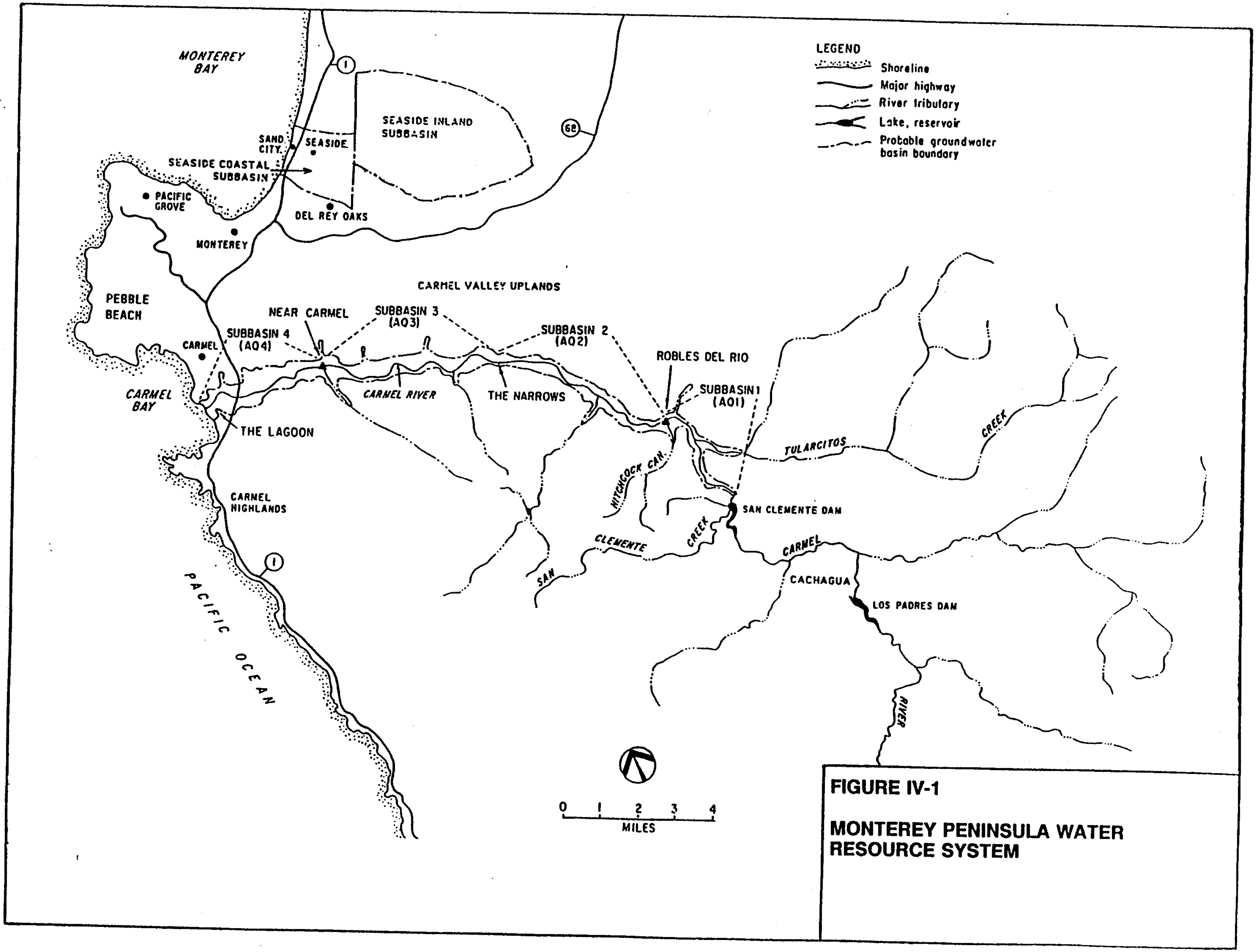


FIGURE IV-1

MONTEREY PENINSULA WATER RESOURCE SYSTEM

2. Impacts and Mitigation Measures

Supply Option I: 18,400 Acre-Feet (Current Production)

CVSIM data were analyzed by comparing the frequency of flow and groundwater storage exceeding a specified magnitude. The analysis was performed for each month.

The data for unimpaired flow presented in Chapter III were compared with the results of CVSIM assuming a production level of 18,400 acre-feet. These data demonstrate that the current production level significantly reduces the flow near Carmel as compared with the unimpaired condition. Two representative figures are presented (Figures IV-2 and IV-3). The data suggest that while flow in the winter does not vary between the two cases over the long-term, summer flows show large variations. For September and October, no-flow periods are 93 percent more frequent under Water Supply Option I than under the unimpaired condition.

No-flow periods represent a benchmark for assessing impacts on surface and groundwater resources. Periods of no flow in the Carmel River may also affect the biotic, recreational, and aesthetic uses of the river; impacts on these resources are addressed separately in subsequent sections of this chapter.

The chance of flows exceeding zero acre-feet during a year for various points along the river was tabulated from the CVSIM results (Tables IV-2 and IV-3). For Supply Option I, the chance of flow during summer in the lower river (Near Carmel and the Lagoon) being greater than zero acre-feet is small (as low as 5 percent at the Lagoon). The Near Carmel and Lagoon stations of the Carmel River have roughly the same percentage of no-flow periods, which, for summer and fall, is significantly more frequent than at the Narrows station. At Robles del Rio, no-flow periods occur, but generally only about one percent of the time (i.e., only during extreme droughts).

TABLE IV-2

FREQUENCY OF MONTHLY CARMEL RIVER VOLUME EXCEEDING ZERO ACRE-FEET (Percent)

Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
Supply Option I: 18,400 Acre-Feet (Current Production)												
Narrows	99	99	>99	>99	>99	99	99	99	99	99	99	99
Near Carmel	7	36	70	94	98	99	95	92	85	49	15	7
Lagoon	5	36	64	89	95	99	95	89	76	33	9	5
Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)												
Narrows	97	94	99	99	99	99	99	99	99	99	98	98
Near Carmel	7	36	70	94	97	99	94	90	83	49	15	6
Lagoon	5	34	64	89	94	99	92	87	64	28	6	5
Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)												
Narrows	95	95	99	99	99	99	99	99	99	99	98	95
Near Carmel	7	36	70	94	97	99	94	90	83	49	15	5
Lagoon	5	34	64	89	94	99	92	87	66	28	6	3
Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)												
Narrows	99	99	>99	>99	>99	>99	>99	>99	99	99	99	99
Near Carmel	7	36	70	94	98	99	95	92	86	49	15	7
Lagoon	5	36	67	90	95	99	95	90	77	36	9	5
Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)												
Narrows	99	99	>99	>99	>99	>99	>99	>99	>99	>99	>99	99
Near Carmel	7	38	70	94	98	99	97	93	89	49	18	9
Lagoon	5	36	67	90	97	99	97	90	79	36	10	5

Source: CVSIM, as modified by Jones & Stokes Associates.

FIGURE IV-2
CARMEL RIVER FLOW NEAR CARMEL FOR JANUARY
Frequency of Flow Greater than a Specified Value

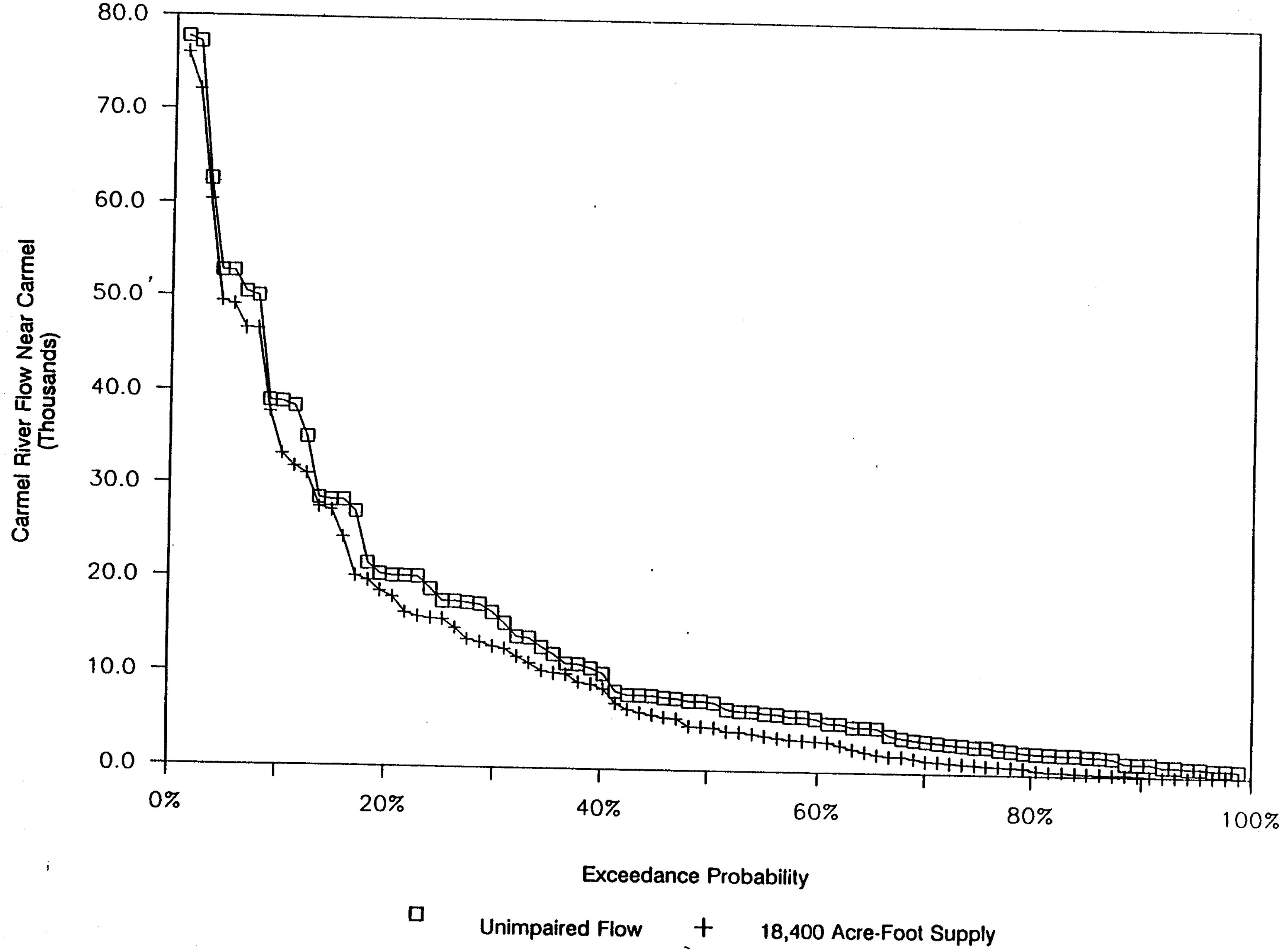


FIGURE IV-3
CARMEL RIVER FLOW NEAR CARMEL FOR AUGUST
Frequency of Flow Greater than a Specified Value

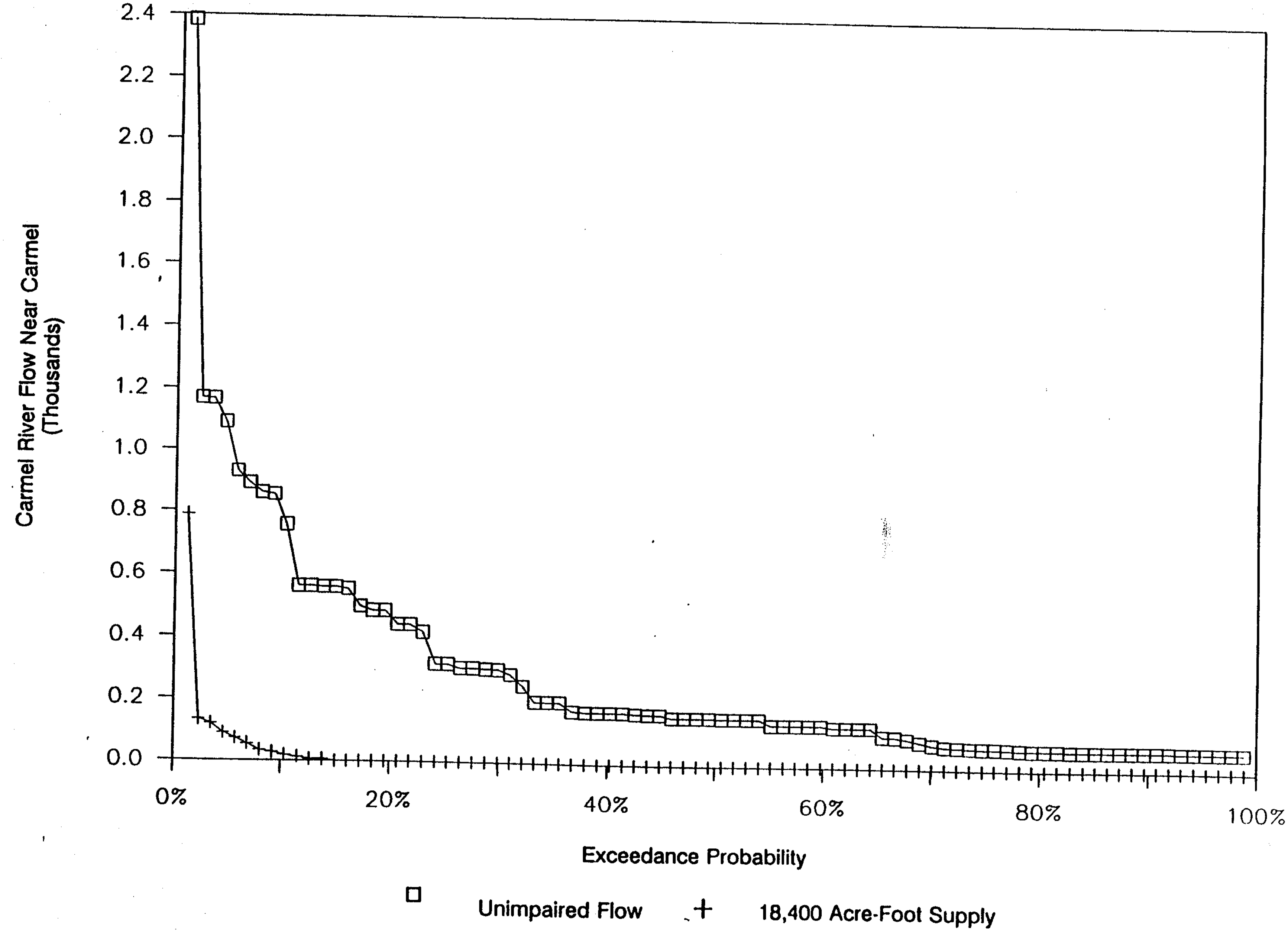


TABLE IV-3

CHANGE IN FREQUENCY OF NO-FLOW PERIODS
Compared to the Current Production Level (18,400 Acre-Feet)
(Percent)

Location	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)												
Narrows	-2	-5	0	0	0	0	0	0	0	0	-1	-1
Near Carmel	0	0	0	0	-1	0	-1	-2	-2	0	0	-1
Lagoon	0	-2	0	0	-1	0	-3	-2	-12	-5	-3	0
Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)												
Narrows	-4	-4	0	0	0	0	0	0	0	0	-1	-5
Near Carmel	0	0	0	0	-1	0	-1	-2	-2	0	0	-2
Lagoon	0	-2	0	0	-1	0	-3	-2	-10	-5	-3	-2
Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)												
Narrows	0	0	0	0	0	0	0	0	0	0	0	0
Near Carmel	0	0	0	0	0	0	0	0	1	0	0	0
Lagoon	0	0	3	1	0	0	0	1	1	3	0	2
Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)												
Narrows	0	0	0	0	0	0	0	0	0	0	0	0
Near Carmel	0	2	0	0	0	0	2	1	4	0	3	2
Lagoon	0	0	3	1	2	0	2	1	3	3	1	0

Source: CVSIM, as modified by Jones & Stokes Associates.

Note: A negative number represents an increase in the frequency of no-flow periods.

The five Carmel River water year types are determined by examining the 12.5, 25.0, 50.0, 75.0, and 87.5 percentile flows (Table IV-4). Applying this methodology to the monthly output of CVSIM allows for estimation of wet, normal, or dry months. The percentile breakpoints in Table IV-4 were applied to CVSIM output (Supply Option I) for each month to estimate the flows that establish critically dry, dry, below normal, above normal, and wet periods (Table IV-5). For example, a flow of less than 6,243 acre-feet at the Narrows would define a critically dry December (based on the 87.5 percentile). This analysis was applied to Supply Option I to define the flows corresponding to the specified percentiles. The frequency of these flows for each supply option was then estimated. Those results are presented under each supply option.

TABLE IV-4

WATER YEAR TYPES FOR THE 18,400 ACRE FOOT PRODUCTION LEVEL

Water Year Type	**Exceedance Percentile**
Wet	<25.0%
Above Normal	25.0%-50.0%
Below Normal	50.0%-75.0%
Dry	75.0%-87.5%
Critically Dry	>87.5%

Note: Percentiles are based on exceedance probability. For example, a wet year is composed of those flows that are exceeded up to 25 percent of the time. A dry year contains flows that are exceeded between 75 percent and 87.5 percent of the time.

TABLE IV-5

RIVER FLOW FOR EACH WATER-YEAR TYPE AND FOR EACH MONTH
18,400 Acre-Foot Production
(in Acre-Feet)

	Narrows				Near Carmel				Lagoon			
	25.0%*	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%
Oct	233	180	172	171	0	0	0	0	0	0	0	0
Nov	866	259	188	185	168	0	0	0	83	0	0	0
Dec	6,959	1,713	297	243	4,704	677	0	0	3,892	393	0	0
Jan	17,139	6,165	2,516	1,353	15,683	4,582	1018	169	14,478	3,892	598	6
Feb	26,369	10,954	4,126	2,551	26,373	9,422	3374	1,145	25,699	9,086	3,151	492
Mar	23,798	12,092	4,323	2,950	24,360	11,783	3811	1,930	24,333	11,462	3,522	1,531
Apr	10,137	6,055	1,985	975	10,463	5,919	1617	644	10,446	5,814	1,402	506
May	3,741	1,946	859	376	3,404	1,565	473	41	3,192	1,319	220	0
Jun	1,030	611	327	180	620	160	15	0	358	51	0	0
Jul	510	232	144	139	91	0	0	0	15	0	0	0
Aug	196	152	146	145	0	0	0	0	0	0	0	0
Sep	188	153	151	150	0	0	0	0	0	0	0	0

* Percentile breakpoints that correspond with water-year types are listed in Table IV-4.

Source: CVSIM, as modified by Jones & Stokes Associates.

The average monthly flows estimated in CVSIM show the small magnitude of river flows during the summer (Table IV-6).

The quantity of water in storage in the two groundwater basins affects riparian vegetation, inflow to the Lagoon, streamflow, vegetation and aesthetics. The frequency of maximum aquifer storage was examined for the various water supply options to assess potential impacts (Tables IV-7 and IV-8). Since CVSIM addresses aquifer storage as a uniform drawdown across an aquifer or aquifer subbasin, site-specific impacts are difficult to address. These impacts could include adverse drawdown near riparian trees or drawdown near non-Cal-Am wells. In the absence of detailed information on the amount of aquifer storage compared with potential groundwater impacts, maximum aquifer storage was used as a benchmark. As aquifer storage decreases from this benchmark, the potential for groundwater impacts increases. Examples of impacts caused by decreasing aquifer storage are discussed in the vegetation and recreation sections of this chapter.

Under Supply Option I, Subbasin AQ1 was at or near maximum storage over 99 percent of the time, while Subbasin AQ2 achieved maximum storage for all but drought periods. Subbasin AQ3 achieved maximum storage less than 80 percent of the time during winter and spring. During summer, Subbasin AQ3 never achieved maximum storage for the simulation period. Subbasin AQ4 experienced maximum storage only during winter and spring and infrequently during summer. The Seaside Coastal Subbasin achieved maximum storage about 25 percent of the simulated years.

To address the potential of overdrafting the Seaside Coastal Subbasin, the frequency of usable storage volumes in the Seaside Coastal Subbasin exceeding given levels was analyzed (Table IV-9). On average, the chance of consuming all usable storage in the aquifer increases to about one percent in winter and to two percent in summer. For example, two percent of the time there would be no usable storage during September. The current production level resulted in complete depletion of usable storage for all months of one critically dry year and for the late summer and fall of the dry years that preceded and followed that critically dry year (i.e., water year 1977).

The Seaside Coastal Subbasin contains both usable storage and nonusable storage. Nonusable storage is defined as groundwater in storage both inland and offshore, that is below sea level. CVSIM does not allow extraction from the nonusable portion of the subbasins and, in fact, does not directly account for effects from the offshore storage. When several users are pumping from the subbasins and usable storage is nearly depleted, the risk of encroaching into the nonusable portion increases. The actual risk, however, could be lessened because the nonusable offshore storage provides a buffer against the encroachment of seawater during periods of high pumpage that may deplete usable storage. The effectiveness of this offshore storage as a buffer is, however, uncertain (Oliver pers. comm.).

During the mid-1970s, high rates of pumping led to a decline in water levels below sea level over much of the subbasins, but no evidence of seawater intrusion was observed (Oliver pers. comm.). The MPWMD is undertaking a study of the Seaside Coastal Subbasin to examine and attempt to quantify the short-term pumping potential and long-term sustainable yield of the subbasin (Oliver pers. comm.).

TABLE IV-6

MEAN MONTHLY CARMEL RIVER VOLUME (Acre-Feet)

Location	July	August	September	October
		Month		
Supply Option I: 18,400 Acre-Feet (Current Production)				
Narrows	393.7	212.0	186.5	233.3
Near Carmel	125.3	15.7	5.0	12.9
Lagoon	74.0	6.2	1.8	6.5
Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)				
Narrows	383.0	206.8	180.9	226.8
Near Carmel	109.0	13.2	4.3	11.5
Lagoon	61.7	4.6	1.4	5.3
Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)				
Narrows	378.5	199.1	175.8	222.8
Near Carmel	104.7	12.5	3.7	11.5
Lagoon	58.5	4.1	1.0	5.3
Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)				
Narrows	393.7	212.6	187.6	234.9
Near Carmel	132.3	16.7	6.4	14.0
Lagoon	79.0	6.7	2.6	8.0
Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)				
Narrows	393.8	212.8	187.6	235.0
Near Carmel	139.2	18.7	7.1	14.6
Lagoon	83.7	7.9	2.9	9.1

Note: Averages are for the 1902 to 1987 simulation period.

Source: CVSIM, as modified by Jones & Stokes Associates.

TABLE IV-7

FREQUENCY OF MAXIMUM AQUIFER STORAGE
(Percent)

Location	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep
Subbasin AQ1												
I (18,400 af)	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99
II (20,000 af)	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99
III (20,500 af)	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99
IV (17,500 af)	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99
V (16,700 af)	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99	>99
Subbasin AQ2												
I (18,400 af)	97	97	97	99	99	99	99	99	99	99	98	98
II (20,000 af)	92	93	94	98	98	99	99	99	98	97	97	92
III (20,500 af)	91	92	94	98	98	99	99	99	94	93	90	91
IV (17,500 af)	98	99	99	>99	>99	>99	99	99	99	99	99	99
V (16,700 af)	98	99	99	>99	>99	>99	>99	>99	99	99	99	99
Subbasin AQ3												
I (18,400 af)	<1	2	10	31	61	78	66	32	3	<1	<1	<1
II (20,000 af)	<1	2	9	23	56	69	62	26	2	<1	<1	<1
III (20,500 af)	<1	2	8	23	55	67	61	24	2	<1	<1	<1
IV (17,500 af)	<1	2	11	41	66	82	66	32	3	<1	<1	<1
V (16,700 af)	<1	2	13	47	69	85	67	32	5	<1	<1	<1
Subbasin AQ4												
I (18,400 af)	2	5	18	51	74	86	72	43	8	<1	2	<1
II (20,000 af)	<1	5	17	48	72	84	69	41	6	<1	<1	<1
III (20,500 af)	<1	5	17	48	72	84	69	40	6	<1	<1	<1
IV (17,500 af)	2	5	21	53	76	90	72	47	8	<1	2	<1
V (16,700 af)	2	5	23	55	76	91	74	47	9	<1	2	<1
Seaside Coastal Subbasin												
I (18,400 af)	24	24	28	13	17	22	24	22	21	21	22	23
II (20,000 af)	10	17	17	8	11	15	17	16	6	6	1	6
III (20,500 af)	3	8	11	7	8	10	11	10	1	<1	<1	<1
IV (17,500 af)	24	24	29	14	18	22	24	22	22	22	22	23
V (16,700 af)	25	25	29	14	18	22	24	22	22	22	22	23

Source: CVSIM, as modified by Jones & Stokes Associates.

TABLE IV-8
CHANGE IN FREQUENCY OF MAXIMUM AQUIFER STORAGE
Compared with the Current Production Level (18,400 Acre-Feet)
(Percent)

Location	Oct	Nov	Dec	Jan	Feb	Month Mar	Apr	May	June	July	Aug	Sep
Subbasin AQ1												
II (20,000 af)	0	0	0	0	0	0	0	0	0	0	0	0
III (20,500 af)	0	0	0	0	0	0	0	0	0	0	0	0
IV (17,500 af)	0	0	0	0	0	0	0	0	0	3	0	0
V (16,700 af)	0	0	0	0	0	0	0	0	0	0	0	0
Subbasin AQ2												
II (20,000 af)	-5	-4	-3	-1	-1	0	0	0	-1	-2	-1	-6
III (20,500 af)	-6	-5	-3	-1	-1	0	0	0	-5	-6	-8	-7
IV (17,500 af)	1	2	2	0	0	0	0	0	0	0	1	1
V (16,700 af)	1	2	2	0	0	0	0	0	0	0	1	1
Subbasin AQ3												
II (20,000 af)	0	0	-1	-8	-5	-9	-4	-6	-1	0	0	0
III (20,500 af)	0	0	-2	-8	-6	-11	-5	-8	-1	0	0	0
IV (17,500 af)	0	0	1	10	5	4	0	0	0	0	0	0
V (16,700 af)	0	0	3	16	8	7	1	0	2	0	0	0
Subbasin AQ4												
II (20,000 af)	-1	-1	-1	-3	-2	-2	-3	-2	-2	0	-1	0
III (20,500 af)	-1	-1	-1	-3	-2	-2	-3	-3	-2	0	-1	0
IV (17,500 af)	0	1	3	2	2	4	0	4	0	0	0	0
V (16,700 af)	0	0	5	3	2	5	2	4	1	0	0	0
Seaside Coastal Subbasin												
II (20,000 af)	-14	-7	-11	-5	-6	-7	-7	-6	-15	-15	-21	-17
III (20,500 af)	-21	-16	-17	-6	-9	-12	-13	-12	-20	-21	-22	-23
IV (17,500 af)	0	0	1	1	1	0	0	0	1	1	0	0
V (16,700 af)	1	1	1	1	1	0	0	0	1	1	0	0

Source: CVSIM and Table IV-7, as modified by Jones & Stokes Associates.

Note: Negative numbers reflect a decrease in the frequency of maximum aquifer storage.

TABLE IV-9

FREQUENCY OF NO USABLE STORAGE IN THE SEASIDE COASTAL SUBBASIN
(Percent)

Water Supply Option		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
I	18,400 af	2	1	1	2	2	1	1	1	1	1	2	2
II	20,000 af	12	6	6	6	4	2	2	2	2	4	4	7
III	20,500 af	12	6	6	6	4	2	2	2	6	8	10	12
IV	17,500 af	2	1	1	2	2	1	1	1	1	1	2	2
V	16,700 af	2	1	1	2	2	1	1	1	1	1	2	2

Source: CVSIM, as modified by Jones & Stokes Associates

Impacts: Supply Option I would not change the existing condition of the surface water and therefore would have a less-than-significant impact.

As demonstrated following the 1977 drought, the Carmel Valley Aquifer rapidly recovered from extensive drawdown, and therefore the impact on the aquifer of continuing the current hydrologic condition is less-than-significant. Staal et al. (1987) found that the Seaside basin could be pumped at amounts greater than the annual recharge rate if such pumping only occurred for a few years. Complete depletion of the Seaside Coastal Subbasin would not affect the subbasin's ability to repel seawater, provided complete depletion of the usable storage occurred only infrequently. The current pumping rate has a less-than-significant impact on the ability of the Seaside Coastal Subbasin to repel seawater. Seawater intrusion is also not a problem in the Carmel Valley Aquifer. Water Supply Option I would, therefore, have a less-than-significant impact on the aquifer.

The effect of Water Supply Option I on non-Cal-Am groundwater users and on Lagoon hydrology would be less-than-significant.

Mitigation Measures: Although the maintenance of the current pumping rate has a less-than-significant impact on the groundwater basins, the District should continue and expand its monitoring programs of the Seaside and Carmel Valley Aquifers. The monitoring should include checking the groundwater quality and water level elevations. If the monitoring detects conditions considered adverse to the aquifer (such as increased risk of seawater intrusion), pumping could be curtailed. Well monitoring would also include large private wells. The District adopted an ordinance in March 1990 that requires monitoring of all wells that produce more than 20 acre-feet per year. Wells that pump less than 20 acre-feet per year will continue to be monitored by the power consumption or the land use method.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Comparing the periods of no flow under Supply Option II with those of the 18,400 acre-feet production level (existing conditions or Supply Option I), Supply Option II would increase the likelihood of no-flow periods in the river by up to 12 percent during summer (Table IV-3). The maximum increase would occur at the Lagoon in June. At all three stations (Near Carmel, the Lagoon, and the Narrows) there would generally be little change in the frequency of no-flow periods (at most five percent and three percent, with the exception of the case mentioned above). During winter, there would not be a change in streamflow under this option.

Table IV-5 identifies flows for each month that define the range from wet to dry periods under the 18,400-acre-foot production level. Assuming that these flows define the boundaries of wet to dry periods, then the frequency of each of these flows under the supply options would define the frequency of wet to dry periods as influenced by the supply options. For example, if Supply Option II were to alter the flow regime, then the flows that define wet to dry periods would occur more or less often than under the 18,400-acre-foot production level. The change in frequency of the wet and dry periods was computed relative to Supply Option I (Table IV-5). The frequency of wet or dry periods generally exhibited minimal changes (within three percent) at the Narrows, near Carmel, and the Lagoon stations. For example, a critically dry March, defined as 1,531 acre-feet or less entering the Lagoon under Supply Option I (Table IV-5), would occur about two percent more often under Supply Option II than under Option I. Greater differences were observed between Supply Options I and II, but these occurred in cases where the change in the magnitude of flow was small at that percentile. In these cases, the frequency is sensitive to changes in flow.

CVSIM output and Table IV-10 indicate that Supply Option II reduces the frequency of flows at the three Carmel River stations during the winter and spring. The reduction results in an increased frequency of dry and critically dry years relative to Supply Option I. The change is more pronounced at the Near Carmel and Lagoon stations during the winter and spring, when the groundwater is being recharged by surface flows. The added groundwater depletion, due to the higher production level, creates additional demand on surface flows.

Mean monthly flows (defined as the monthly average for the 86-year period) decrease less than 20 acre-feet per month from those simulated under Supply Option I. The minor change is due to the fact that streamflow, when averaged, primarily changes during extreme drought periods; streamflow is relatively unchanged from existing conditions. It should be noted that mean values tend to mask the extreme high and low value and tend toward a central value.

Comparing the maximum aquifer storage for Supply Option II with that of Supply Option I shows there is a summertime trend only for Subbasin AQ2 (Table IV-8). In AQ2, Supply Option II would decrease the frequency of attaining maximum groundwater levels by up to six percent. This means that the chance that the aquifer would discharge to the stream or that water would pond in depressions in the streambed would be reduced from existing conditions.

In Subbasin AQ4, Supply Option II results in a year-round increase in the frequency of less-than-maximum aquifer storage. The largest increase is three percent and occurs during the winter.

Subbasin AQ3 never achieved maximum storage during summer and early fall for the simulation period. During the remaining months, the frequency of maximum storage was reduced by up to nine percent.

Supply Option II increases the frequency that storage in the Seaside Coastal Subbasin is less-than-maximum by up to 21 percent. The trend of reducing the frequency of maximum storage relative to Supply Option I occurs in all months, but is greatest in the summer.

In the Seaside Coastal Subbasin, Supply Option II increases the likelihood of completely consuming the usable storage by up to 10 percent (for October) (Table IV-9). That is, a complete depletion of the usable storage in the aquifer is 10 percent more likely under this option during October than under the 18,400 acre-feet supply level. The percent difference between Options I and II for other months is less than five percent. Furthermore, during October, the usable storage would be depleted 12 percent of the time on average. Whenever the usable storage in the Seaside Coastal Subbasin is fully depleted, there is a risk of encroaching into the storage needed to repel seawater.

Because CVSIM is a mathematical representation of the physical system and related operations, it is simplified and governed by relatively rigid rules. These rules do not allow pumping to encroach into the designated "unusable" storage in the Seaside Coastal Subbasin. Under actual operations, because no rule exists that would automatically terminate pumping, pumping could possibly encroach into what is defined as unusable storage in the Seaside Coastal Subbasin. This encroachment and possible seawater intrusion, however, is not likely under actual operation. If water levels in the Seaside Coastal Subbasin decline and the risk of seawater intrusion increases, current monitoring efforts would be intensified and pumping would be curtailed.

TABLE IV-10

CHANGE IN FREQUENCY OF CARMEL RIVER FLOW DEFINING A WATER-YEAR TYPE
Water Supply Option II
(Percent)

	Narrows				Near Carmel				Lagoon			
	25.0%*	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%
Oct	0	-1.1	0	0	0	0	0	0	0	0	0	0
Nov	-0.9	0	-0.3	0	0	0	0	0	0	0	0	0
Dec	0	-1.0	-0.7	-3.1	0	-0.8	0	0	0	0	0	0
Jan	0	0	-0.4	-0.4	-3.3	-1.9	0	0	-0.2	-0.5	0	0
Feb	-0.3	0	0	0	-0.8	-2.1	-0.9	0	-1.8	-2.2	-2.0	0
Mar	0	0	0	0	-0.4	-1.4	-0.5	0	-0.5	-4.0	-1.8	-0.7
Apr	-1.3	0	0	0.1	-1.6	-2.4	-0.4	-2.2	-0.6	-0.8	-0.2	-2.4
May	0	0	0	0	-0.3	-2.9	-1.3	-1.6	-1.9	-2.8	-2.0	-2.0
Jun	-0.9	-1.5	-1.2	0	-1.0	-2.1	-1.8	-1.4	-0.3	-2.9	-2.2	-1.1
Jul	-1.5	0	0.2	0	-4.5	0	-2.6	0	-1.0	-2.6	0	0
Aug	0	0	0	0	0	0	0	0	-3.3	0	0	0
Sep	0	0	-2.6	0	0	0	0	0	0	0	0	0

Notes: The flows that determine a water-year type are listed in Table IV-5; negative values represent increases in flow frequency

*Percentile breakpoints for the water-year type are listed in Table IV-4.

Source: CVSIM, as modified by Jones & Stokes Associates.

It should also be noted that Cal-Am production from the Seaside Coastal Subbasin in CVSIM was programmed to operate within specified constraints. These constraints were designed to prevent seawater intrusion and keep average annual pumpage below the long-term yield (3,475 acre-feet per year for Cal-Am and non-Cal-Am wells) that has been estimated for the Seaside Coastal Subbasin. In all simulations, the average annual production from the Seaside Coastal Subbasin was less than the long-term yield estimate.

Impacts: Surface water flows in the Carmel River replenish following rainfall events, so the change in no-flow periods is considered a less-than-significant impact on the watershed hydrology. Changes in the Carmel River hydrologic regime may, however, affect riparian vegetation, leading to increased streambank erosion. Extensive streambank erosion could alter stream characteristics and surface water infiltration rates.

The decrease in frequency of maximum storage in Carmel Valley Aquifer Subbasins AQ3 and AQ4 due to Supply Option III would have a less-than-significant impact on the aquifer for most years. During drought years aquifer storage tends to be reduced from Supply Option I. The effect of this reduction in aquifer storage on seawater intrusion is unknown, although during drought periods the seawater/freshwater interface could move inland in response to reduced outflow. Data presented in Staal, Gardner, and Dunne (1989) suggests, however, that the possibility of this occurring is remote for this production level. The impact of seawater intrusion in the Carmel Valley Aquifer under Supply Option III is, therefore, considered less-than-significant.

As the quantity of water in storage in Subbasin AQ4 decreases, the subsurface inflow into, and therefore the quality of, the Lagoon will change. The decrease in the frequency of maximum aquifer storage would, therefore, be a potentially significant impact on the Lagoon hydrology.

Although the increase in the periods of complete depletion of the usable storage in the Seaside Coastal Subbasin is small (less than five percent), the increase represents a potentially significant impact on the basin. Staal et al. (1987) found that the aquifer could be pumped in excess of the long-term yield if it were to occur only for short periods. This point was demonstrated by the aquifer response to heavy pumping during the 1976-1977 period. Increasing the overdraft frequency, however, increases the risk of going into a drought with a depleted aquifer.

Increasing the frequency of large drawdown in the Carmel Valley Aquifer and the Seaside Coastal Subbasin could have a potentially significant impact on non-Cal-Am users of the groundwater.

Mitigation Measures: The potential impact on the Seaside Coastal Subbasin due to depletion of usable storage can be mitigated to a less-than-significant level by reducing pumping from this subbasin when little or no usable storage remains, by providing additional supplies of water, by instituting water conservation measures, or by replenishing the subbasin during wet years through reduced water supply production.

Reducing pumping from Carmel Valley Aquifer Subbasin AQ4 could lessen impacts on Lagoon hydrology, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. The impact is, therefore, considered potentially significant.

Groundwater monitoring by the District will help develop baseline conditions for tracking aquifer conditions through wet and dry years. The District already meters private wells with annual production levels greater than 20 acre-feet to assist in monitoring groundwater pumping from the Carmel Valley Aquifer and Seaside Coastal Subbasin.

Impacts on non-Cal-Am groundwater users could be mitigated either by providing Cal-Am water to these users or by curtailing Cal-Am pumping during periods of excessive drawdown. Since these measures are not modeled with CVSIM, it is unknown whether or not they would reduce the impact to a less-than-significant level. These impacts are, therefore, considered potentially significant.

While changes in flow in the Carmel River are not considered significant impacts, streamflow could be enhanced by dredging the Los Padres and San Clemente reservoirs to their original capacities. The District could also examine modifications to Cal-Am's pumping and delivery system as a means of using the available water.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

No-flow periods during summer are up to 10 percent more frequent under Supply Option III as compared with existing conditions (Table IV-3). Again, this change occurs at the Lagoon, with smaller changes occurring at the Near Carmel and the Narrows stations. Supply Option III decreases the mean monthly flows for the summer months by up to 20 percent (Table IV-6).

The change in the frequency of wet and dry years was examined for Water Supply Option III (Table IV-11). As with Supply Option II, this option results in an increased frequency of dry and critically dry periods during the winter and spring at the Near Carmel and Lagoon stations. The results are due to the additional withdrawal of water from the Monterey Peninsula Water Resource System.

Groundwater storage would be affected by this option. Table IV-8 shows that relative to existing conditions, Subbasin AQ1 shows no change in total storage during summer while Subbasin AQ2 experiences reductions of up to eight percent in the total storage. Achieving maximum storage is up to eight percent less likely under this water supply option than under existing conditions. Since this change occurs during summer it would affect surface water flows, vegetation, wildlife, and other features that rely on groundwater close to the surface. The frequency of maximum storage in Subbasin AQ3 experiences up to an 11-percent change in the winter relative to existing conditions. During summer, maximum storage in Subbasins AQ3 and AQ4 was never achieved for the simulation period.

The Seaside Coastal Subbasin responds under Supply Option III in a similar manner as under Supply Option II. The frequency of less-than-maximum aquifer storage increases by as much as 23 percent over Supply Option I. Decreases were noted for all months of the year. Supply Option III increases the chance of depleting the aquifer's usable storage during all months by up to 12 percent (Table IV-9).

TABLE IV-11

CHANGE IN FREQUENCY OF CARMEL RIVER FLOW DEFINING A WATER-YEAR TYPE
Water Supply Option III
(Percent)

	Narrows				Near Carmel				Lagoon			
	25.0%*	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%
Oct	0	-1.1	0	-1.3	0	0	0	0	0	0	0	0
Nov	-0.9	0	-0.3	0	0	0	0	0	0	0	0	0
Dec	0	-0.9	-1.7	-3.5	0	-0.8	0	0	-0.2	-0.5	0	0
Jan	0	0	-0.4	-0.5	-3.3	-2.0	-0.9	-1.1	-2.3	-2.2	-2.6	0
Feb	-0.6	0	0	0	-0.9	-2.3	-0.6	-1.3	-0.5	-4.2	-1.9	-1.3
Mar	0	0	0	-1.1	-0.7	-1.5	-0.6	-2.2	-1.0	-0.9	-0.5	-2.4
Apr	-1.4	0	0	0	-2.0	-2.7	-1.4	-2.0	-2.1	-3.2	-2.1	-2.2
May	0	-0.9	0	0	-0.3	-2.9	-3.5	-1.4	-0.4	-3.0	-2.8	-1.1
Jun	-0.9	-1.5	-1.2	-1.6	-1.2	-2.7	-4.7	0	-1.2	-5.2	0	0
Jul	-1.5	0	0	0	-4.7	0	0	0	-5.6	0	0	0
Aug	0	-1.1	0	-2.4	0	0	0	0	0	0	0	0
Sep	0	-0.6	-8.3	-3.6	0	0	0	0	0	0	0	0

Notes: The flows that determine a water-year type are listed in Table IV-5; negative values represent increased in flow frequency

*Percentile breakpoints for the water-year type are listed in Table IV-4.

Source: CVSIM, as modified by Jones & Stokes Associates.

Impacts: Surface water flows in the Carmel River replenish following rainfall events, so the change in no-flow periods is considered a less-than-significant impact on the watershed hydrology. Changes in the Carmel River hydrologic regime may, however, affect riparian vegetation, leading to increased streambank erosion. Extensive streambank erosion could alter stream characteristics and surface water infiltration rates.

The decrease in frequency of maximum storage in Carmel Valley Aquifer Subbasins AQ3 and AQ4 due to Supply Option III would have a less-than-significant impact on the aquifer for most years. During drought years aquifer storage tends to be reduced from Supply Option I. The effect of this reduction in aquifer storage on seawater intrusion is unknown, although during drought periods the seawater/freshwater interface could move inland in response to reduced outflow. Data presented in Staal, Gardner, and Dunne (1989) suggests, however, that the possibility of this occurring is remote for this production level. The impact of seawater intrusion in the Carmel Valley Aquifer under Supply Option III is, therefore, considered less-than-significant.

As the quantity of water in storage in Subbasin AQ4 decreases, the subsurface inflow into, and therefore the quality of, the Lagoon will change. The decrease in the frequency of maximum aquifer storage would, therefore, be a potentially significant impact on the Lagoon hydrology.

Although the increase in the periods of complete depletion of the usable storage in the Seaside Coastal Subbasin is small (less than five percent), the increase represents a potentially significant impact on the basin. Staal et al. (1987) found that the aquifer could be pumped in excess of the long-term yield if it were to occur only for short periods. This point was demonstrated by the aquifer response to heavy pumping during the 1976-1977 period. Increasing the overdraft frequency, however, increases the risk of going into a drought with a depleted aquifer.

The potentially-significant impacts to non-Cal-Am groundwater users discussed under Supply Option II would also occur under Supply Option III.

Mitigation Measures: The potential impact on the Seaside Coastal Subbasin due to depletion of usable storage can be mitigated to a less-than-significant level by reducing pumping from this subbasin when little or no usable storage remains, by providing additional supplies of water, by instituting water conservation measures, or by replenishing the subbasin during wet years through reduced production.

Reducing pumping from Carmel Valley Aquifer Subbasin AQ4 could lessen impacts on Lagoon hydrology, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. The impact is, therefore, considered considered potentially significant.

Groundwater monitoring by the District will help develop baseline conditions for tracking aquifer conditions through wet and dry years. The District already meters private wells with annual production levels greater than 20 acre-feet to assist in monitoring groundwater pumping from the Carmel Valley Aquifer and Seaside Coastal Subbasin.

Impacts on non-Cal-Am users of groundwater could be mitigated either by providing Cal-Am water to these users or by curtailing Cal-Am pumping during periods of excessive drawdown. Since these measures are not modeled with CVSIM, it is unknown whether or not they would reduce the impact to a less-than-significant level. These impacts are, therefore, considered potentially significant.

While changes in flow in the Carmel River are not considered significant impacts, streamflow could be enhanced by dredging the Los Padres and San Clemente reservoirs to their original capacities. The District could also examine modifications to Cal-Am's pumping and delivery system as a means of using the available water.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

As would be expected, this option results in more water in the river and in the aquifers as compared with existing conditions (Supply Option I). The incidence of summertime no-flow periods is reduced from existing conditions, such that these periods are up to three percent less likely at the Lagoon. Upstream at the Near Carmel and the Narrows stations, the frequency of dry periods is unchanged.

Supply Option IV results in a decreased frequency of dry and critically dry years as defined by the 18,400 acre-foot production level (Table IV-12). This is a direct result of reducing the production level by 900 acre-feet. The simulated change is small (generally less than 1 percent) but represents additional flow in the river.

Mean monthly flows for Supply Option IV are relatively unchanged from existing conditions, and are no greater than 20 acre-feet, compared to Supply Option I.

Little or no change was detected in the frequency of maximum storage in Subbasins AQ1 and AQ2. Changes in storage of Subbasin AQ3 experienced under Supply Option IV increase the likelihood of maximum storage by up to 10 percent (Table IV-8. This translates into a greater chance of water being in the river (either flowing or ponded) during the year, which is considered beneficial. In Subbasin AQ4, maximum storage is up to four percent more likely as compared with Supply Option I.

It should be noted that the increase in the frequency that Subbasins AQ3 and AQ4 achieve maximum storage occurs during the winter months. This is also the period when streamflow is maximum and the Lagoon may be open to the bay. Therefore, the changes in subsurface inflow to the Lagoon due to greater aquifer storage may not be as important as changes experienced in summer and fall months.

The Seaside Coastal Subbasin shows only minor differences in maximum storage under Supply Option IV as compared with Supply Option I. The frequency of no usable storage in the aquifer is identical to conditions found with Supply Option I.

Impacts: While this supply option reduces the water extracted from the Monterey Peninsula Water Resource System, the changes in streamflow and groundwater storage from the current conditions are small. Because these changes are so small, it would be difficult to classify them as being beneficial to surface water and groundwater resources of the Peninsula area. Supply Option IV would, therefore, have a less-than-significant impact on surface or groundwater resources of the area. The effect of Water Supply Option IV on non-Cal-Am groundwater users and on Lagoon hydrology would also be less-than-significant.

Mitigation Measures: As discussed under Supply Option I, groundwater conditions should be monitored to establish baseline conditions for assessment of long-term changes. These monitoring measures should be implemented even for Supply Option IV, which is a reduction from existing production.

TABLE IV-12

CHANGE IN FREQUENCY OF CARMEL RIVER FLOW DEFINING A WATER-YEAR TYPE
Water Supply Option IV
(Percent)

	Narrows				Near Carmel				Lagoon			
	25.0%*	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%
Oct	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0.3	0	0	1.0	0	0	0	0	0.1	0	0	0
Dec	0.1	0	0	0.2	0	1.4	0	0	0	0.7	0	0
Jan	0	0	0	0	0.9	0.3	0.2	0	1.8	1.3	0	0
Feb	0.4	0	0	0	0.4	0.3	3.2	0.3	0.5	0.8	1.2	1.1
Mar	0	0	0.1	0	0.1	1.3	0.8	1.3	0.1	2.9	0.4	1.0
Apr	0.8	0	0	0.1	0.8	0.6	0.2	0.5	0.8	0.4	1.3	0.8
May	0	0	0	0	0.2	1.0	0.6	1.5	0.2	1.8	0.2	2.1
Jun	1.1	0.7	0.1	0	3.5	7.8	4.3	0	6.1	9.0	1.1	0
Jul	0	0	0	0	0.7	0	0	0	1.6	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0

Note: The flows that determine a water-year type are listed in Table IV-5.

*Percentile breakpoints for the water-year type are listed in Table IV-4.

Source: CVSIM, as modified by Jones & Stokes Associates.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

As with Supply Option IV, this option results in more water in the river and in the aquifers as compared with existing conditions (Supply Option I). The incidence of summertime no-flow periods is reduced from existing conditions, such that these periods are up to three percent less likely at the Lagoon. Upstream at the Near Carmel and the Narrows stations, the frequency of dry periods is unchanged.

Supply Option V results in a decreased frequency of dry and critically dry years (Table IV-13). The reduction occurs in the winter and spring months and is generally less than three percent. The change exceeds three percent during some periods when the magnitude of flow varies only slightly near the particular percentile.

Mean monthly flows are relatively unchanged from existing conditions and are no greater than 40-acre feet compared to Supply Option I.

The variation in aquifer storage is similar to Supply Option IV with little or no change detected in the frequency of maximum storage in Subbasins AQ1 and AQ2. Changes in storage of Subbasin AQ3 experienced under Supply Option V increase the likelihood of maximum storage by up to 16 percent (Table IV-8). This translates into a greater chance of water being in the river (either flowing or ponded) during the year, which is considered beneficial. In Subbasin AQ4, maximum storage is up to five percent more likely as compared with Supply Option I.

The Seaside Coastal Subbasin shows only minor differences in the maximum storage under Supply Option V as compared with Supply Option I. The frequency of no usable storage in the aquifer is nearly identical to conditions found with Supply Option I.

Impacts: While this water supply option reduces the water extracted from the Monterey Peninsula Water Resource System, the changes in streamflow and groundwater storage from the current conditions would be small. Because these changes would be so small, it would be difficult to classify them as being beneficial to surface water and groundwater resources of the Peninsula area. Supply Option V would, therefore, have a less-than-significant impact on surface or groundwater resources of the area. The effect of Water Supply Option I on non-Cal-Am groundwater users and on Lagoon hydrology would also be less-than-significant.

Mitigation Measures: As discussed under Supply Option I, groundwater conditions should be monitored to establish baseline conditions for assessment of long-term changes. These monitoring measures should be implemented even for Supply Option V, which represents a reduction from current production.

TABLE IV-13

CHANGE IN FREQUENCY OF CARMEL RIVER FLOW DEFINING A WATER-YEAR TYPE
Water Supply Option V
(Percent)

	Narrows				Near Carmel				Lagoon			
	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%	25.0%	50.0%	75.0%	87.5%
Oct	0	0	0	0	0	0	0	0	0	0	0	0
Nov	0.5	0	0	1.0	1.4	0	0	0	0.7	0	0	0
Dec	0.2	0	0	0.2	0.3	2.6	0	0	0.1	0.8	0	0
Jan	0	0	0	0	1.6	2.6	0.2	0	3.0	4.2	0.3	0
Feb	0.5	0	0	0	0.4	1.1	3.7	1.3	0.7	1.0	2.2	1.3
Mar	0.1	0	0.4	0	0.2	1.5	2.0	1.4	0.2	3.0	1.5	1.1
Apr	1.5	0.1	0.1	0.1	1.4	0.8	0.6	0.8	1.4	0.7	1.7	2.2
May	0	0	0	0	1.1	1.9	1.8	2.1	2.8	2.0	1.7	2.1
Jun	1.1	0.7	0.1	0	5.4	11.4	5.5	1.0	6.5	12.1	3.4	0
Jul	0	0	0	0	1.8	0	0	0	2.9	0	0	0
Aug	0	0	0	0	0	0	0	0	0	0	0	0
Sep	0	0	0	0	0	0	0	0	0	0	0	0

Note: The flows that determine a water-year type are listed in Table IV-5.

*Percentile breakpoints for the water-year type are listed in Table IV-4.

Source: CVSIM, as modified by Jones & Stokes Associates.

3. Water Quality

Water quality impacts of each water supply option are related to the quantity of streamflow or groundwater discharge. The water supply options do not result in the direct discharge of pollutants, but may reduce flows that would dilute the pollutants. The MPWMD currently monitors groundwater quality in the district. The monitoring provides baseline data on groundwater quality for detection of trends. Thus far, the monitoring has detected temporary increases in Carmel Valley Aquifer nitrate concentration for several months following storm events that provide groundwater recharge. This temporary increase may be due to septic tank leachate being flushed from the soil (Oliver pers. comm.). No violations of water quality guidelines have been detected.

CVSIM results indicated only minor variation in no-flow periods for production levels of 18,400 acre-feet, 17,500 acre-feet, and 16,700 acre-feet (Supply Options I, IV, and V). Supply Options II and III increase the frequency of no-flow periods by up to 12 percent at the Lagoon. These water supply options also reduce the frequency of maximum storage in Subbasin AQ4 (possibly decreasing subsurface recharge of the Lagoon). Both factors potentially reduce fresh water available for dilution. It is important to note that these changes occur during winter months when dilution flows are generally present.

Impacts: Supply Options II and III could have a potentially significant impact on the water quality of the Monterey Peninsula Water Resource System. The impact is considered potentially significant because the impacts cannot be quantified with the available data. The reduction of the total fresh water in the Monterey Peninsula area is considered an important factor affecting water quality.

Mitigation Measures: The District has maintained a shallow groundwater quality monitoring program in Carmel since 1981. This program could be expanded to include additional monitoring wells in the Carmel Valley Aquifer and in the Seaside Coastal Subbasin. Also, surface water monitoring of the Carmel River could be expanded to provide baseline conditions at various locations. Baseline water quality conditions should be measured for both surface and groundwater. This could be accomplished through an active monitoring program of water quality constituents that affect beneficial uses. Once baseline conditions are developed (about two years of data), data for subsequent years could be statistically compared with the baseline. For example, a change in a water quality constituent would be noted if the mean concentration of the constituent is significantly different than the baseline mean concentration at a five-percent level of significance.

The parameters used for monitoring data and the statistical significance of any variations would be developed following review of the baseline data.

If changes are detected in water quality constituents, the District could modify its water use to provide sufficient streamflow or groundwater storage to offset the changes. It is unknown if these changes could be mitigated to a less-than-significant level. These impacts are, therefore, considered potentially significant.

C. VEGETATION

1. Methodology and Analysis

The water supply options could have an impact on the three vegetation communities: riparian, wetland, and upland. Groundwater extraction and export could affect riparian vegetation along the Carmel River and the wetland vegetation in the Carmel River Lagoon. Urban growth and development could have an impact on upland vegetation.

Riparian Vegetation

Groundwater extraction from wells results in a lowering of the water table locally (near the well) and at locations in the aquifer distant from the well. The lowering of the water table (drawdown) of the Carmel Valley Aquifer influences streamflow and the amount of moisture in the soil column.

Pioneer riparian species such as cottonwood and willow produce lightweight seeds which are dispersed by wind or water. Seed dispersal at the time of a falling water level is essential for successful establishment of the pioneer species (Strahan 1984). The streamflow regime influences vegetation establishment through species dispersal-germination phenology and their physiological tolerance to drought (Strahan 1987). Establishment of cottonwoods and willows can decrease if river flows are not available to disperse seeds during the spring dispersal-germination period.

Seasonal variation in the flow regime greatly influences establishment and survival of the pioneer species on gravel bars. Most cottonwood and willow seedling establishment occurs along the newly exposed surfaces of gravel bars during summer low flow regimes. During the winter, streamflows must be great enough to remove humus and freshly fallen leaf litter from the surface so that the seeds land on mineral soil (Strahan 1984). A decrease in streamflow volume can reduce mineral alluvial deposition and increase humus accumulation, thus reducing the extent of suitable sites for riparian vegetation establishment. Reduced seed dispersal and seedling establishment could change the community age class structure, decrease community vigor (i.e., productivity), and change the species composition over the long term.

Extraction of groundwater, leading to extensive drawdown, could have an adverse impact on riparian vegetation by increasing stress on existing riparian species, resulting in a direct die-off of existing species and a decrease in seedling survival.

Stress resulting from competition for water eliminates individual plants and certain nonadaptable species, reduces growth rates and net productivity, and could conceivably slow rates of community succession from existing herbaceous vegetation to woody riparian species. A unit volume of water can support only a finite amount of vegetation; if less water is available in the aquifer, or if the soils dry earlier in the year, vegetation stress can be expected.

The direct die-off of cottonwoods, willows, and boxelders along the Carmel River has been attributed to groundwater pumping (Zinke 1971). Willow and cottonwood seedling survival depends on the availability of soil moisture through the summer. With decreasing availability of soil moisture, late summer desiccation could cause the death of many seedlings. For example, mortality of two-year-old cottonwood and willows growing on river ripple bars ranged from 65 to 100 percent on soils that were dry by September 1 (McBride and Strahan 1984).

Increased stress, direct die-off, and decreased seedling survival would cause a decrease in the extent of riparian vegetation, reduced density of existing vegetation, reduced riparian community productivity and diversity, and long-term changes in community age structure.

The preferred method of assessing impacts of the water supply options on riparian vegetation would be to base the analysis on known drawdown responses of the Carmel Valley Aquifer to the five water supply options. Since no such specific historical information is available, two computer-based models and an interpretation of the results of these models have been used to assess the impacts of groundwater extraction. The two computer models used were an aquifer drawdown model and CVSIM. These computer models simulate storage and drawdowns caused by Cal-Am and non-Cal-Am well production. Cal-Am production represents 79 percent of all groundwater pumping in the Carmel Valley Aquifer.

The aquifer drawdown model predicts depth of groundwater drawdown at specific locations around a given well or wells. Output from the model may be translated readily into a set of valleywide groundwater drawdown contour maps. The model requires two sets of parameters: aquifer parameters (hydraulic conductivity, specific yield, and initial saturated thickness) and operational parameters (pumping rate and pumping duration). Image well theory is used to account for aquifer boundary conditions.

Analysis of the riparian impacts due to groundwater drawdown includes both Cal-Am and non-Cal-Am wells. Non-Cal-Am pumping has been incorporated into the CVSIM analysis to represent the total aquifer pumping. Annual drawdown simulation of non-Cal-Am wells could range from about one to five feet depending on the location of observation points in the aquifer being analyzed. This additional drawdown has been included in the aquifer drawdown simulation model.

Simulated drawdown models generally tend to underestimate the magnitude of drawdown because of the following simplified assumptions:

- Estimated pumping rates of the various Cal-Am wells are related to their respective pumping capacities;
- Pumping is continuous over the entire dry channel period;
- Complexity of aquifer geometry;
- Aquifer parameters are estimates, based on the best information available; and
- A simplification in the aquifer drawdown model that excludes relatively small effects from natural aquifer drainage, riparian evapotranspiration, surface water evaporation, and subsurface inflows to the aquifer from adjacent bedrock formations (McNiesh 1988).

To help identify potentially damaging drawdown scenarios to riparian vegetation in the Carmel Valley, McNiesh (1986) monitored plant water stress, soil water availability, and groundwater data from the Carmel Valley. The plant water stress model was developed for predicting the general impact of water table drawdown on plant water stress levels in the lower Carmel Valley riparian corridor.

After soil water becomes limiting, the plant water stress model shows that severe plant water stress generally occurs if the drawdown rate exceeds two feet in a given seven-day period, or if total seasonal drawdown exceeds eight feet below the elevation of the winter water table. Mild water stress generally occurs if the drawdown rate exceeds one to two feet in any given seven-day period, or if total seasonal drawdown measures four to eight feet below the winter water table. These rates were thought to be sufficient to induce irreversible damage to riparian vegetation in most Carmel Valley habitats, especially if repeated from year to year (McNiesh 1988). To compute the area of riparian vegetation affected, it was first necessary to map the areas of existing riparian vegetation (see McNiesh 1989a).

McNiesh (1989) used output from CVSIM to help drive the aquifer drawdown model. For this analysis, CVSIM used the hydrologic record from 1902-1987 (as discussed in Section B.1 of this chapter) as the base hydrology. Using CVSIM and the aquifer drawdown models to predict riparian vegetation impacts requires the selection of a particular water-year type (McNiesh 1988). A typical water year, a critically dry year, and an extremely dry year (representing a worst-case scenario), were used to assess the impacts of groundwater drawdown for the five water supply options.

A typical water year is defined as the 50 percent exceedance frequency values calculated by the CVSIM model applied to the 1902-1987 period. The critically dry year analysis was drawn from CVSIM reconstructed data for the 1947-1948 water years. The worst-case drought was modeled after the 1976-1977 CVSIM data, an extremely dry water year.

By comparing the groundwater drawdown maps, one for each water supply option and water year, an estimation of the length of the riparian corridor and acres of riparian vegetation affected by various drawdown categories was produced. Riparian vegetation within drawdown contours of greater than eight feet define zones of the severely water stressed and potentially damaged vegetation.

This analysis of riparian vegetation impacts allows a comparative evaluation of the relative differences and probable impacts during a typical water year, a critically dry year, and an extremely dry year from Cal-Am system productions for the five water supply options.

Output from the aquifer drawdown model and McNiesh's drawdown rate represent the best available information for riparian vegetation impact assessment and estimation of the magnitude of impacts. Plant stress analysis is developed from McNiesh's work and is supported by results from the longer CVSIM record, as needed.

In addition to McNiesh's work and the results of the computer models, Jones & Stokes Associates made a qualitative interpretation of impacts based on field visits to the Carmel Valley, a review of the literature from research in the area, and general knowledge of riparian vegetation ecology.

Lagoon Vegetation

Heavy groundwater pumping has resulted in the drawdown of the Carmel Valley Aquifer and has contributed to the elimination of surface flows in the lower Carmel River during summer. Historical information, however, indicates that summer inflow to the Carmel River Lagoon in most years ceased by 1920 (Williams 1989). Diversions for agricultural and other uses began by 1882. Completion of Old Carmel dam in the 1880s, the San Clemente Dam in 1921, and the Los Padres dam in 1948 increased the likelihood of no-flow periods in the Lagoon. Natural factors, such as drought, also contribute to the periods of no-flow conditions. The degree to which groundwater pumping contributes to the frequency and duration of no-flow periods is difficult to assess with the available data. Continued groundwater production might reduce the amount of fresh water entering the Lagoon.

Reductions in freshwater input to the Lagoon from current levels could decrease the size of the wetland or cause a change in the vegetation type. A decrease in freshwater may increase the salinity level of the marsh waters, thereby leading to a potential change in species composition. Existing brackish water species such as pickleweed, fleshy jaumea, and saltgrass may replace freshwater species. Increasing salinity levels can damage tule and cause it to disappear from present day habitat (Atwater et al. 1979).

Bands of different plant species are a common feature of coastal marshes, such as the Lagoon. These bands, which create vegetation zonation patterns in brackish and coastal salt marsh, are controlled by a complicated set of physical factors. The primary influence in determining the vertical and horizontal vegetation zonation patterns in bay tidal marshes, such as the Lagoon, is the salinity level of the marsh water (Josselyn 1983). Also contributing to vegetation zonation is surface and subsurface soil salinity, which is determined by flooding frequency and duration, evaporation, and leaching (MacDonald 1988).

Simulation results from CVSIM were used to help estimate changes in Lagoon hydrology. The modeled hydrology was then used to estimate potential impacts on vegetation, based on the impact mechanisms listed above. Historical information and other modeling efforts were also used to estimate potential impacts.

Upland Vegetation

Increasing urban growth by providing additional water could result in the conversion of existing upland vegetation communities to urban use. The best way to assess the impacts of the four water supply options on upland vegetation would be to evaluate the potential conversion of vegetation in each of the eight jurisdictions within the District boundaries. This approach is not feasible for two reasons: 1) the programmatic level of this analysis does not address site-specific information concerning the location and intensity of future development; and 2) detailed vegetation maps for each jurisdiction were not available. Impacts to upland vegetation can, therefore, be evaluated only on an areawide basis. The potential for impact is based on the assumption that increasing the amount of water supplied to a jurisdiction would result in increased development and, consequently, would increase the amount of upland vegetation potentially converted to urban uses. Changes in upland vegetation are thus assessed qualitatively, rather than quantitatively.

2. Impacts and Mitigation Measures

Supply Option I: 18,400 Acre-Feet (Current Production)

Riparian Vegetation

Water storage capacity and Cal-Am pumping capacity vary among the four subbasins of the Carmel Valley Aquifer; the effects on vegetation within each subbasin would therefore also vary.

Figures IV-4, IV-5, and IV-6 depict the groundwater drawdown patterns along the lower Carmel River for three different conditions: a typical water year, a critically dry year, and an extremely dry year.

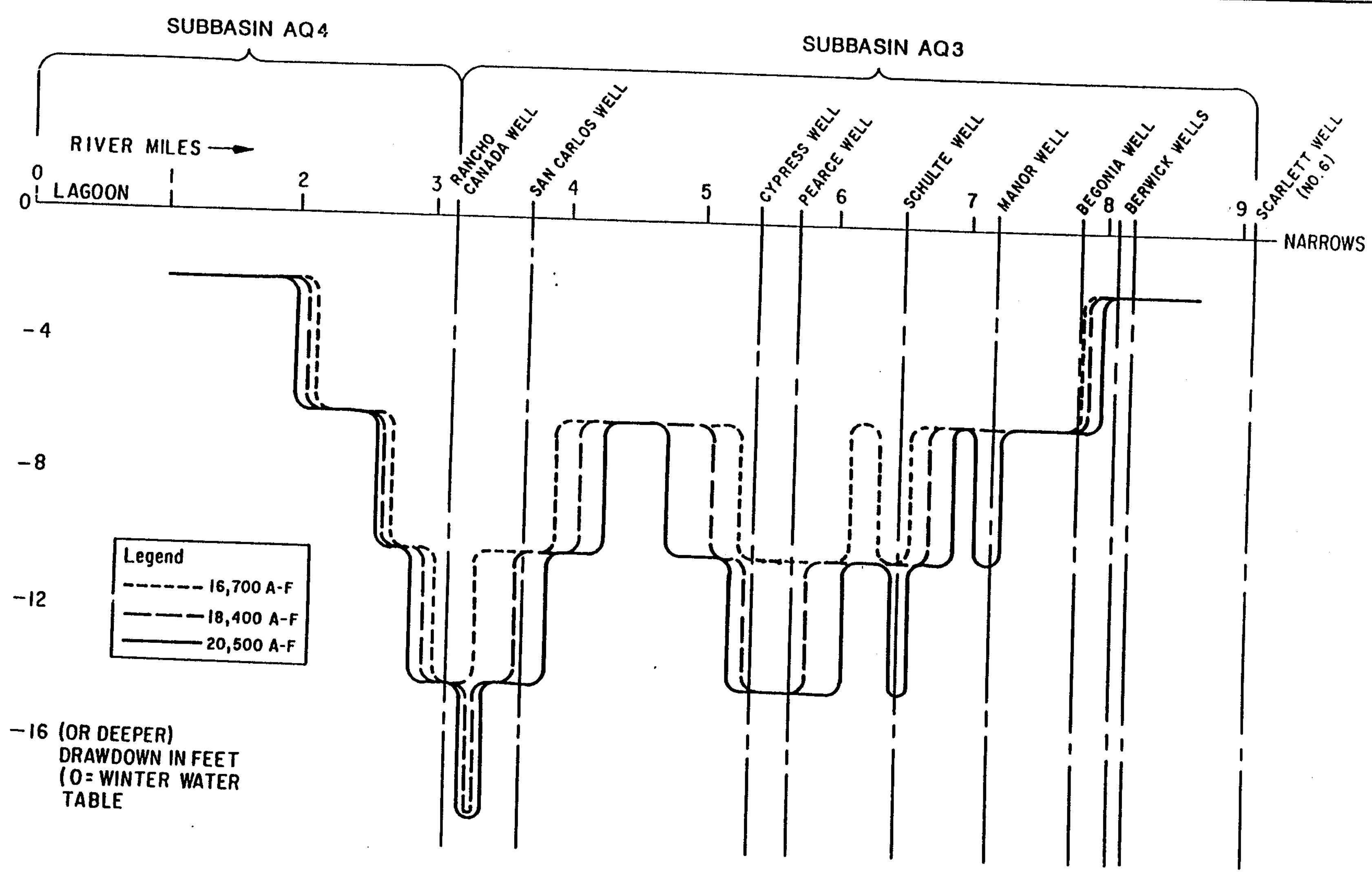


FIGURE IV-4
GROUNDWATER DRAWDOWN IN SUBBASINS AQ3 AND AQ4 FOR A TYPICAL WATER YEAR
Note: Wells are Cal-Am production wells located in Subbasins AQ3 and AQ4
Source: Adapted from McNiesh, 1989

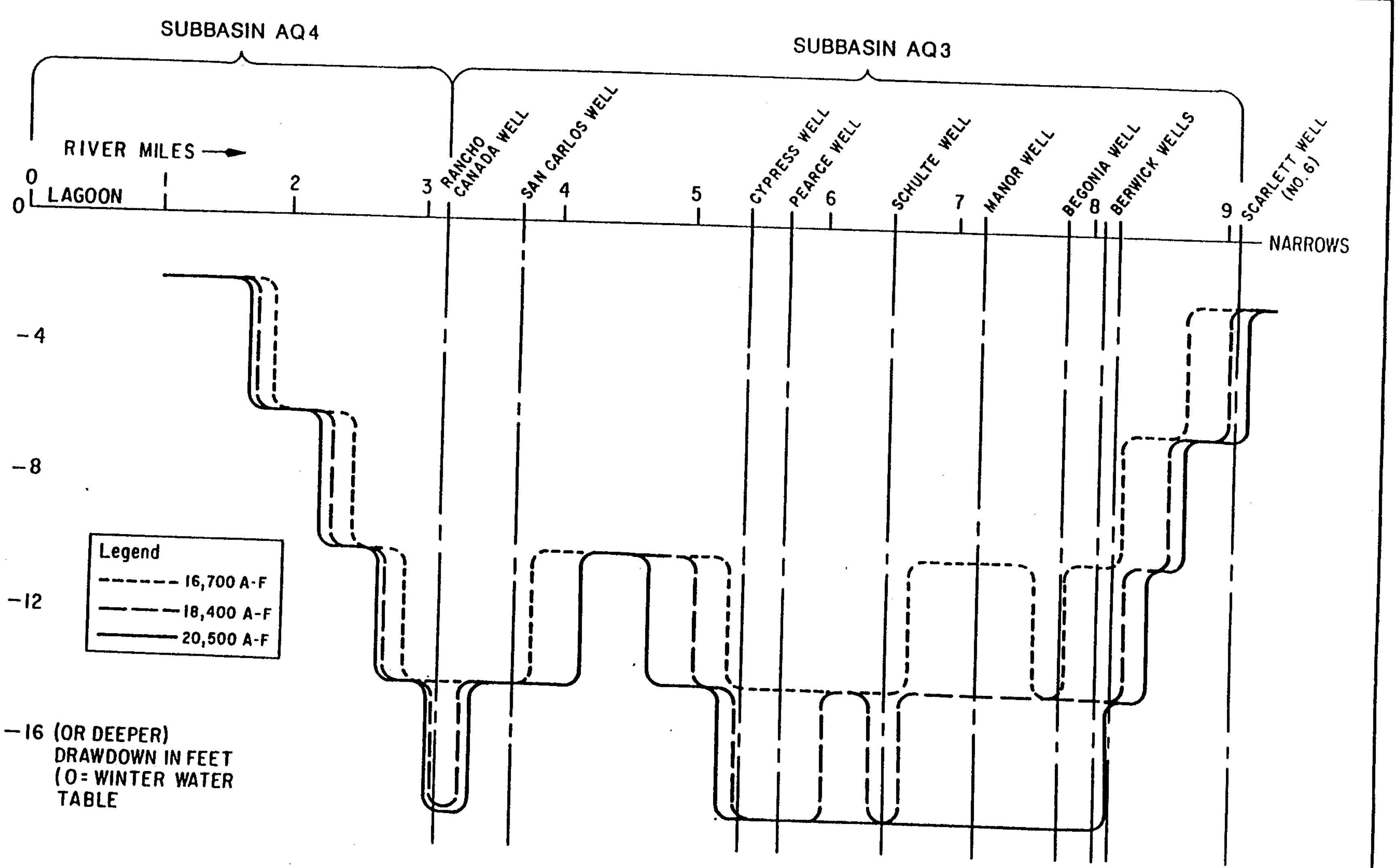


FIGURE IV-5
GROUNDWATER DRAWDOWN IN SUBBASINS AQ3 AND AQ4 FOR A CRITICALLY DRY WATER YEAR
Note: Wells are Cal-Am production wells located in Subbasins AQ3 and AQ4
Source: Adapted from McNiesh, 1989

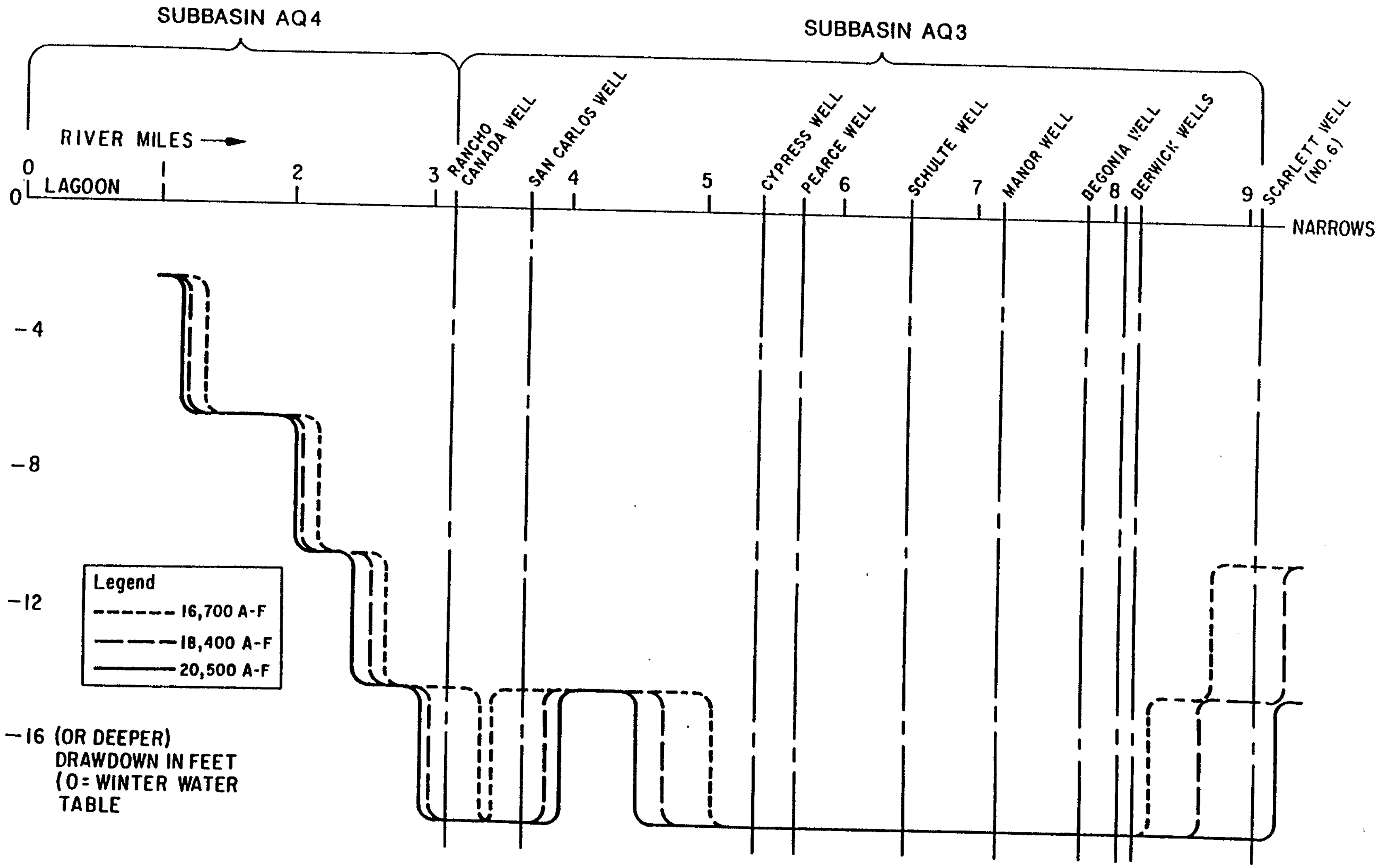


FIGURE IV-6
GROUNDWATER DRAWDOWN IN SUBBASINS AQ3 AND AQ4 FOR AN EXTREMELY DRY WATER YEAR

Note: Wells are Cal-Am production wells located in Subbasins AQ3 and AQ4

Source: Adapted from McNiesh, 1989

Oliver (1987) showed that significant drawdowns would not occur in Subbasin AQ1 as long as river flow exceeds groundwater production. Under these conditions, net subbasin storage does not change significantly and river flow is reduced by roughly the quantity of water produced. CVSIM simulation results indicate that river flow was sufficient for the 1902-1987 period to offset commercial pumping in this subbasin. Application of CVSIM over the 86-year period indicates there is always flow in Subbasin AQ1 regardless of the type of water year. Therefore, the riparian vegetation is not subjected to water stress in AQ1.

CVSIM simulation results for Subbasin AQ2 over the same 86 years demonstrated that there would be ample year-round river flow except for extended no-flow periods in 1976-1977. No-flow conditions are a response to drought and groundwater pumping.

As defined by the plant water stress model, moderate or severe stress to riparian vegetation would not occur in Subbasin AQ2 during a typical and critically dry water year because there is always channel flow, at least through the Narrows. Only during an extremely dry year do results of the aquifer drawdown model show that drawdown of greater than eight feet would occur just upstream of the Narrows. Drawdown to this extent would impose severe water stress on 3.5 acres of riparian vegetation (McNiesh 1989).

Periods of no flow at the Narrows during an extremely dry year for Supply Option I can last nine months. Periods of no flow indicate that groundwater is below the riverbed level, but not necessarily below the water stress model level. Modeled severe water stress does not occur until groundwater drawdown is at least eight feet below winter water table levels.

The two Cal-Am-operated Los Laureles Wells, located about 1,000 feet apart in Subbasin AQ2, have the largest combined pumping capacity within the subbasin. These two wells pump 34 percent of the Subbasin AQ2 pumping capacity. For each of the water supply options, drawdown at the midpoint between wells measured less than four feet for the typical water year and the two dry water years. Based on stress criteria developed by McNiesh (1989), a drawdown of less than four feet should not stress vegetation. By the end of September 1989, however, relatively minor pumping from Subbasin AQ2 resulted in severe stress and death of willows and alders located in the channel bottom between and just upstream of the Los Laureles Wells. Mature riparian vegetation growing along the higher terraces was not severely water-stressed. A deep rooting system enables this vegetation to utilize water deeper in the soil profile.

The discrepancy between predicted impacts, based on the model and actual impacts with only minor pumping, is probably due to the fact that trees located adjacent to the low water channel in this reach are shallow rooted and could not obtain water even with minor drawdown of the water table. Based on drawdown criteria defining the onset of water stress and observations of stress in 1989, drawdown would damage the riparian vegetation in Subbasin AQ2 only in dry years, if it was necessary to pump the Los Laureles wells.

Based on the groundwater drawdown model and recent field observations, impacts to riparian vegetation in Subbasin AQ2 would be significant near the Los Laureles Wells.

Simulations using the 86-year CVSIM simulation period indicate that more than 80 percent of total aquifer production during a typical year would be derived from Subbasin AQ3 (Table IV-14). CVSIM results summarized by McNiesh indicate that there is continuous flow at the Narrows during a typical year and that insignificant flow at Potrero Canyon, near the downstream limit of Subbasin AQ3, occurs from July through November. Groundwater production in this portion of the subbasin exceeds recharge capability, and the river channel dries up.

TABLE IV-14

SIMULATED CAL-AM WELL PRODUCTION
Modeled Well Production in Acre-Feet

Subbasin	16,700	17,500	18,400	20,000	20,500
AQ1	31	31	31	31	31
AQ2	126	126	126	126	126
AQ3	6,287	6,821	7,391	8,198	8,308
AQ4	1,483	1,536	1,586	1,667	1,691
Total	**7,927**	**8,514**	**9,134**	**10,022**	**10,156**
AQ3 as a percentage of total	**79%**	**80%**	**81%**	**82%**	**82%**

Note: Simulated commercial well production from the Carmel Valley Aquifer during a typical 8-month dry season under five water production options. "Typical" dry season conditions were defined from 50 percent exceedance frequency values calculated by the CVSIM model applied to the 1902-1987 period.

Source: McNiesh 1987, 1989

The CVSIM estimations of usable aquifer storage shown in Table IV-15 and Figure IV-4 indicate that median aquifer drawdowns of Subbasin AQ3 during a typical year reach a maximum of 12 feet to 16 feet or more, depending on the water supply option. Median drawdowns of this magnitude suggest extensive riparian vegetation impacts, even during typical years. Table IV-16 shows the pumping capacities of wells drawing from the Carmel Valley Aquifer.

TABLE IV-15

TOTAL AND USABLE STORAGE CAPACITIES
Carmel Valley Aquifer Subbasins

Subbasin	**Storage Capacity (Acre-Feet)** Total	Usable
AQ1	2,029	2,029
AQ2	6,099	4,502
AQ3	19,615	16,927
AQ4	20,475	5,000
Total	**48,218**	**28,458**

Note: Usable storage is less than total storage because a certain volume of groundwater is withheld as a safeguard against seawater intrusion and parts of the aquifer occur below perforations of the existing commercial wells.

Source: CVSIM; Monterey Peninsula Water Management District.

TABLE IV-16

PUMPING CAPACITIES OF CAL-AM WELLS DRAWING FROM THE CARMEL VALLEY AQUIFER

Subbasin	Well or Well Complex	Maximum Capacity (gpm)	Percent of Total Cal-Am Pumping
AQ1	Russell wells	700	3.6
	Subtotal	**700**	**3.6**
AQ2	Los Laureles wells	770	4.0
	Scarlett #6	450	2.3
	Robles	420	2.2
	Stanton	400	2.1
	Subtotal	**2,040**	**10.5**
AQ3	Pearce/Cypress	4,270	22.0
	Begonia/Berwick	4,500	23.2
	Schulte	2,100	10.8
	Scarlett #4 and #7	1,500	7.7
	San Carlos	1,300	6.7
	Manor	1,025	5.3
	Subtotal	**14,695**	**75.6**
AQ4	Rancho Canada	2,000	10.3
	Subtotal	**2,000**	**10.3**
TOTAL		**19,435**	**100.0**

Source: Modified from Oliver et al. 1987.

Based on the analysis of the two simulation models and the plant water stress model, 59 to 100 percent of the entire riparian corridor in Subbasin AQ3 is potentially affected under Supply Option I, depending on the water year. For a typical water year, 59 percent of the acreage of riparian vegetation would fall within areas where groundwater drawdown is greater than eight feet. This figure would increase to 99 and 100 percent for a critically dry year and an extremely dry year, respectively, as the demand for groundwater supply would greatly exceed recharge during corresponding low-precipitation years. Zones of drawdown greater than eight feet are generally associated with Cal-Am wells for the five water supply options (Figures IV-4, IV-5, and IV-6), regardless of the water year used to analyze drawdown.

Not only does the areal extent of the 8-foot drawdown increase with drier water years, areal extent of zones of 12- and 16-foot drawdown also increase, indicating a potential for increased severity of the impact. During an extremely or critically dry water, riparian vegetation not adapted to such severe groundwater drawdown conditions may be drought-stressed to the point they cannot recover and will die.

Whether one critically or extremely dry year would be sufficient to stress the riparian vegetation to a degree that would induce substantial die-off greater than that expected for a typical year is very difficult to assess. McNiesh (1986) identified a number of factors which would contribute to the influence of groundwater drawdown on water stress. These factors are as follows:

- Acclimatization: Vegetation established under conditions of large annual water table fluctuations will be better adapted to periods of increased drawdown than vegetation established where water table is fairly constant throughout the year. There was evidence of this during 1989 at Garland Park where alders and willows growing adjacent to the low water channel died after only minor pumping of the Los Laureles wells in Subbasin AQ2.

- Weather: Water stress would be accentuated during periods of rapid drawdown if evapotranspiration rates are high. Hot, windy weather with low relative humidity would induce high evapotranspiration rates.

- Site Conditions: Water-holding capacity of soils decreases if the texture of the soil is coarse. Soils capable of holding more water would tend to compensate for water table drawdown.

- Density of Vegetation: Sparse stands of riparian vegetation may be more protected from groundwater drawdown as long as some soil water remains available.

- Health and Age of Vegetation: Vegetation already suffering from disease or pest damage will be in greater jeopardy to die-off than healthy vegetation. Younger vegetation with rooting depths more shallow than mature vegetation would be more susceptible to water stress than deeper rooted vegetation.

Based on the factors discussed above, the amount of vegetation expected to die-off as a result of water stress is expected to be greater for the critically dry year and extremely dry year than for a typical year (Table IV-17).

TABLE IV-17

TOTAL IMPACTED AREA FOR SUBBASIN AQ3

Water Supply Option	Typical Year Acres	Typical Year Percent of Total	Critically Dry Year Acres	Critically Dry Year Percent of Total	Extremely Dry Year Acres	Extremely Dry Year Percent of Total
	Impacted Acres of Riparian Vegetation					
I (18,400 af)	50.4	59	84.0	99	84.9	100
II (20,000 af)	58.3	69	84.1	99	84.9	100
III (20,500 af)	60.1	71	84.1	99	84.9	100
IV (17,500 af)	48.6	55	83.7	99	84.9	100
V (16,700 af)	41.0	48	83.2	98	84.9	100

Source: McNiesh 1989

As discussed in the Chapter III, Section C.2, areas of the most significant remaining riparian corridor are currently being irrigated as part of a District-sponsored program. Riparian vegetation along irrigated river reaches would not be significantly impacted under Supply Option I. Monitoring of this irrigated vegetation indicates that irrigation water is meeting the physiological water requirements of the vegetation and the vegetation is not water-stressed. Riparian vegetation along river reaches not receiving irrigation water, or understory and mature riparian vegetation which may not receive adequate irrigation water in the irrigated sites, would be severely impacted under this option.

The riparian vegetation of this river reach not receiving irrigation water is stressed due to low soil moisture conditions under the current level of groundwater extraction. Without a significant decrease in the level of pumping, the extent and quality of the riparian corridor would likely decrease over time as the vegetation responds to the present pumping level. Degradation of the existing riparian vegetation not receiving irrigation water will, therefore, continue under Supply Option I. Riparian vegetation is most extensive around the San Carlos Well, and the impact on the vegetation beyond the range of the irrigation is much greater at this site than at most of the other Cal-Am wells in Subbasin AQ3.

McNiesh (1986) determined that available soil water near the Berwick, Begonia, and San Carlos Wells was typically exhausted to a depth of at least ten feet before the end of August, leaving the riparian vegetation dependent on only very deep soil water reserves and the falling water table if irrigation water is not applied. McNiesh (1986) also monitored plant water stress parameters and soil water availability in Subbasin AQ3 under normal operation of four Cal-Am production wells (Pearce, Cypress, San Carlos, and Rancho Canada). His findings revealed that production from these new wells did have an impact on vegetation by inducing elevated levels of water stress in nearby riparian vegetation. Water stress effects included premature canopy defoliation, low dawn water potential, and daytime stomatal closure. The severity of stress correlated closely with both rates of groundwater drawdown and total seasonal drawdown. As predicted by the plant water stress model, such severe water stress repeated over several years would lead to extensive loss of vegetation if sufficient irrigation water is not applied.

Groundwater withdrawal would reduce the volume and frequency of streamflow. The frequency of failure of riparian vegetation to reproduce would increase as streamflow decreases. Decreased seedling survival is evident by the current lack of recruitment of vegetation utilizing Subbasin AQ3. This reduces the density of the younger age structure, and in the long term density of riparian vegetation declines as repeated water stress also kills mature trees.

Groundwater storage decreases from highest water tables in late winter to early spring to the lowest water tables in fall. Moderate to severe water stress would occur during portions of the growing season as water table lowers to the four- and eight-foot contour defining moderate to severe water stress. Although early growth and development of willows and cottonwood occurs from February through June, growth does continue through summer and fall, and riparian vegetation is subjected to this period of stress (Woodhouse 1983).

Reproductive success would decrease as seeds, which would otherwise germinate, would not establish seedlings due to soil moisture depletion by late summer.

Loss of riparian species allows more drought-tolerant species to invade and change the composition of the riparian community. Species such as buckeye, poison-oak, and other brush species, along with nonriparian species such as cypress and eucalyptus, would become more abundant. This change in species composition is occurring near the Cypress and Pearce Cal-Am wells.

Riparian vegetation at the eastern edge of Subbasin AQ4 is limited to a narrow corridor and then broadens as one moves toward the Lagoon. In a typical water year, water table drawdown due to this supply option would impose water stress on riparian vegetation near the Rancho Canada well to 2,700 feet downstream as this vegetation is not being irrigated. Water stress would also occur to riparian vegetation not receiving irrigation water upstream from the Rancho Canada well, due to the combined effects of drawdown from this well and the San Carlos Well. Riparian vegetation in the western end of this subbasin would not be affected under Supply Option I. Depending on the type of water year analyzed, 22 to 32 percent of the riparian vegetation acreage in Subbasin AQ4 would be subjected to severe water stress (Table IV-18).

TABLE IV-18

TOTAL IMPACTED AREA FOR SUBBASIN AQ4

Impacted Areas of Riparian Vegetation

Water Supply Option		Typical Year		Critically Dry Year		Extremely Dry Year	
		Acres	Percent of Total	Acres	Percent of Total	Acres	Percent of Total
I	(18,400 af)	17.6	22	21.6	27	25.4	32
II	(20,000 af)	18.0	23	22.5	29	26.0	33
III	(20,500 af)	18.4	23	22.8	29	26.0	33
IV	(17,500 af)	17.4	22	20.5	26	24.9	32
V	(16,700 af)	17.2	22	19.1	24	24.3	31

Source: McNiesh, 1989

Mitigation measures suggested to reduce the impacts to fisheries resources along the Carmel River (see Chapter IV, Section E) may increase the area of riparian vegetation subjected to severe water stress in Subbasins AQ3 and AQ4. Drilling of new wells in Subbasin AQ4 to eliminate the pumping of groundwater in Subbasin AQ2 would provide sufficient surface flows between the Narrows and Robles del Rio to increase the juvenile steelhead rearing habitat. Additional riparian vegetation would, however, be severely water stressed as a result of increased pumping in Subbasin AQ4. The amount of water stress the vegetation would experience would depend on the location of new wells and their production levels.

Riparian vegetation along the Carmel River between the Lagoon and the Rancho Canada Golf Course is a continuous corridor. This cottonwood and willow canopy creates riparian habitat of higher quality than habitat in the remaining upstream portion of Subbasin AQ4 and most of Subbasin AQ3. Groundwater pumping would induce water stress, reduce the canopy cover, break up the continuous corridor into segments as in Subbasin AQ3, and significantly degrade the existing riparian vegetation.

Impacts to riparian vegetation in Subbasins AQ2 through AQ4 are quantified by the acreage subjected to the eight-foot or greater groundwater drawdown zone. That acreage represents riparian vegetation subjected to severe water stress which could cause a direct die-off or a gradual decline in the health of the riparian corridor. This acreage is a conservative analysis of the riparian vegetation impacted. As previously stated, the model used may underestimate the magnitude of drawdown and impacts. Discrepancies between modeled impacts and actual impacts have been noted, vis-a-vis the impacts to riparian vegetation around the Los Laureles and Berwick wells.

The result of the impacts would be a decline in riparian cover, a decrease in the reproductive success and establishment of woody riparian plant species, and an increase in more drought-tolerant species.

Lagoon Vegetation

Summertime no-flow periods are frequent at the Lagoon. Simulation results from CVSIM indicate the no-flow periods are basically the same for all water supply options.

Potential aquifer drawdown near the Lagoon was simulated by Staal, Gardner, and Dunne (1989) with a modeling scenario where groundwater is extracted from a well located approximately 8,000 feet from the shoreline with an annual demand of 1,000 acre-feet for Supply Option I. This amount is currently pumped from the Rancho Canada well located in the most upstream portion of the aquifer, 17,000 feet inland from the shoreline. Groundwater drawdown under actual conditions would likely not be as great because the Rancho Canada Well is located further inland. The modeling scenario estimated a drawdown of 1.1 feet at the Lagoon shoreline.

This modeling effort indicates that groundwater production will not likely impact the Lagoon habitat by inducing seawater intrusion. Increased groundwater production would, however, lower water levels upstream from the Lagoon. Data suggests that the Lagoon is partially supported by groundwater discharge, and this decrease in groundwater level may reduce the volume of groundwater discharge into the Lagoon (Staal, Gardner, Dunne 1989).

Reducing groundwater discharge could potentially impact the Lagoon vegetation by decreasing surface water levels and increasing salinity levels. The trend in Lagoon water depth has decreased in the last 40 years making the Lagoon shallower now than in 1949 (Williams 1989). Lagoon depths in 1929, before major groundwater pumping, were shallower than current depths, indicating other factors, such as water and sediment discharge from river flow and tidal scour, also play a roll in determining the water depth.

Salinity levels in the Lagoon are expected to vary seasonally, increasing during the winter as the Lagoon and the bay mix (Table III-5). Lagoon salinity levels recorded during the spring of 1989 have decreased from the 1988 levels indicating fluctuations in yearly salinity levels can also occur. Yearly record of salinity levels before 1988 are not available to allow historic comparison of the Lagoon salinity levels before and after the onset of Cal-Am production well pumping.

Associating Lagoon vegetation changes to Cal-Am production to identify impacts directly related to groundwater pumping is difficult. Much of the wetland vegetation has historically been impacted by cattle grazing. Since 1949, when the California Department of Parks and Recreation acquired the Lagoon property, the extent of tule cover has increased from the lack of cattle grazing (Williams 1989). In addition, 350 acres of what was part of an active channel in 1929 (along the north side of the main body of the Lagoon) has undergone a natural revegetation process since the 1940s. This area is now a vegetated wetland. Known direct impacts to vegetation due to groundwater pumping cannot be definitely substantiated with the available information.

Upland Vegetation

Upland vegetation could be affected by displacement or encroachment by new development made possible by the allocation of water to the eight affected jurisdictions under Option I at Baseline Production/Consumption Level B. Unique or limited vegetation communities such as closed-cone conifer forest or coastal dune could be significantly affected if development occurs in these communities. The extent and degree of the impacts on upland vegetation would depend on how much development occurs and where it occurs.

Impacts: The impacts to the vegetation relying on Subbasin AQ1 due to groundwater drawdown or no-flow periods in the river would be less-than-significant.

A small portion of the vegetation relying on Subbasin AQ2 (only that portion just upstream of the Narrows) would be impacted to a potentially significant level during extremely dry years. The area of impact would depend on the duration of no-flow periods. Impacts to channel bottom riparian vegetation would be significant near Los Laureles Wells.

Supply Option I would have a significant adverse impact on the nonirrigated riparian vegetation in Subbasin AQ3. Fifty-nine percent of the riparian corridor would be significantly impacted and subjected to severe water stress during a typical water year. There would be a potentially significant impact on 99 to 100 percent of the riparian vegetation during a critically or extremely dry water year.

Approximately 2,700 feet of nonirrigated riparian vegetation downstream of the Rancho Canada well in Subbasin AQ4 and between San Carlos and Rancho Canada wells would be significantly impacted by groundwater drawdown under Supply Option I for a typical year. For a critically dry year and an extremely dry year the impacted area downstream of the well would be 3,380 feet and 5,020 feet, respectively. The percentage of riparian vegetation acreage significantly impacted by groundwater drawdown in Subbasin AQ4 ranges from 22 to 32 percent of the subbasin's total acreage (Table IV-18).

Impacts to riparian vegetation are significant because of their resource value as described in Chapter III and because of the decline in riparian habitat locally and statewide.

Possible reduction of groundwater discharge into the Lagoon could result in potentially significant impacts to Lagoon vegetation through increasing salinity and deteriorating water quality. Although the potential impacts are difficult to determine, the impacts are considered potentially significant due to the declining amount of wetland vegetation locally and statewide. The impacts could result in a change in the current species composition and a decrease in the extent of the wetlands.

Upland vegetation could be affected by displacement or encroachment by new development under Supply Option I at Baseline Production/Consumption Level B. Impacts to upland vegetation due to urban growth cannot be assessed without site-specific information on the location and intensity of future development. The significance of the impacts are, therefore, unknown.

Mitigation: To minimize significant impacts on riparian vegetation in Subbasins AQ2, AQ3, and AQ4, the following mitigation measures have been identified:

- Implement a water conservation program that retains water in the river and increases groundwater storage available to riparian vegetation. MPWMD would be responsible for carrying out this program, which would require inspection of yearly water allocation amounts to determine whether established conservation goals have been met.

- Identify existing riparian areas of greatest extent and control drawdown to minimize the onset of water stress. Guarantee that no more than 10 percent of the identified riparian area would be lost due to groundwater drawdown. The riparian vegetation around the San Carlos Well is an example of the extensive riparian vegetation that should be protected. If more than 10 percent of the acreage of riparian vegetation dies in the identified zones, that acreage would be replaced with those species lost at a density of 300 trees per acre. A performance standard would be set to ensure a 70-percent survivorship of the newly planted trees after the first three years. An irrigation program should be implemented if necessary to guarantee success. If the 70-percent survival standard is not met after the third year, replant to meet the criteria. These standards are based on similar revegetation projects.

  District should identify the sites and inspect sites at least two times during the dry season to ensure the success criteria are met.

- Enhance existing riparian areas by continuing and expanding the present riparian irrigation program to meet the physiological needs of existing vegetation, and preserve areas that may be destroyed or disturbed by development. Guarantee that no more than 10 percent of the riparian vegetation in the identified sites would be lost to water stress. If more than 10 percent of the riparian vegetation in the identified sites is lost, implement a replanting project with the success criteria described above.

  The District's should prioritize areas of existing riparian vegetation to be irrigated and would identify riparian areas threatened by agricultural or urban development. The District would monitor results.

- Create new riparian habitat under the guidance of a qualified botanist and hydrologist to replace lost habitat in the lower terraces. Revegetation should be done using riparian species such as willows and cottonwood. A performance standard would be set to ensure a 70- percent survivorship of the total number of plantings after the first three years. If the 70- percent survival standard is not met after the third year, replant to meet the criteria. If site-specific conditions inhibit survivorship, new locations would be identified and replanting would take place at those locations. All plantings would be irrigated as long as necessary to ensure long-term survivorship. These tasks could also be overseen by a qualified botanist and hydrologist who would implement the revegetation plan and monitor results.

  The District should inspect the revegetation locations as needed in the first three years to ensure the success criteria is met. Inspections would continue at least quarterly thereafter to ensure long-term survivorship.

- Purchase conservation easements on upper floodplain terraces for riparian revegetation of sycamores and valley oaks. Based on the recommendation of a botanist, easements would be acquired for the revegetation program. Planting densities would be at least 200 trees per acre. A performance standard of 70 percent survival should be met after the first three years. If the performance standard is not met, new plantings would be undertaken with the modifications necessary to improve success rates. All plantings would be irrigated to ensure long-term survivorship. The District should implement the revegetation plan and monitor results.

  The District should inspect the revegetation locations as needed in the first three years to ensure the success criteria is met. Inspections would continue at least quarterly thereafter to ensure long-term survivorship.

- Remove nonriparian and non-native plant species along the riparian corridor and revegetate with riparian species. The District should identify sites where removal of nonriparian and non-native species would be removed without threatening bank stability and incorporate these sites into revegetation plans outlined above. The responsibility and monitoring requirement would be as defined above.

In the event of an occurrence of a drought year where the zone of impact increases to 99 to 100 percent of the riparian acreage, the mitigation measures described above would still apply. Irrigation of existing vegetation would increase to attempt to meet the physiologic demand of the vegetation. Deep irrigation to promote deep root extension would be one objective of the irrigation program. Deep root extension would be advantageous as the plants would be more likely to tap into existing water sources during years with a high water table. Where feasible, the amount of riparian vegetation irrigated would increase to minimize the impact. Riparian vegetation that dies during a drought period would be replaced with the same species via restoration projects described in above mitigation measures.

Implementation of these mitigation measures would reduce impacts on riparian vegetation, but it is unknown whether these impacts would be reduced to a less-than-significant level. These impacts are, therefore, considered potentially significant.

To minimize potentially significant impacts to Lagoon vegetation the following mitigation measures have been identified:

- Reduce production in the MPWRS by providing additional supplies of water and use the additional water as surface inflow to the Lagoon. Water could be pumped from the Carmel Valley Aquifer and released to the Carmel River during the dry season to maintain Lagoon surface water levels and quality. The District should record the additional volume of water flowing into the Lagoon. This volume should equal the amount of water conserved through a conservation program.

- Lagoon vegetation should be monitored to quantify its current status and long-term response to groundwater pumping. The monitoring should include mapping of the extent of the existing wetland acreage and vegetation zonation patterns. Wetland acreage would be determined by the methodology described in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989). Species composition and soil salinity levels should be monitored to identify potential changes caused by pumping-induced changes in hydrology.

  The mapping should identify the following vegetation areas: zones of vegetation dominated by tule; slightly higher ground dominated by pickleweed and fleshy jaumea; areas dominated by saltgrass; high marsh ground dominated by silverweed and baltic rush; and the transition zone between wetlands and uplands dominated by curly dock and wild radish. Elevations above sea level in which these zones lie, and their respective acreage, would be recorded. Within each vegetation zone identified, mean annual soil salinity levels in the root zone (0-12 inches) would be determined.

  Monitoring would also include survey data to map the ordinary highwater mark (1.6 feet NVGD) around the Lagoon. A survey performed in 1988 by Philip Williams and Associates, Ltd., to map the ordinary high water mark would serve as a baseline reference.

Vegetation mapping, soil salinity data, and surveying would be performed by qualified botanists, hydrologists, and survey crews. This information would be collected under the current water allocation management program to establish baseline data that would be used to identify potential impacts to the Lagoon caused by pumping-induced changes in hydrology.

To detect impacts, this monitoring would be performed every two years, comparing new data to the baseline information. Locations of soil salinity collection points would not change. A change in the Lagoon condition that could be defined as significant include:

- An increase in mean annual soil salinity levels within mapped vegetation zones exceeding the upper limit of ranges of soil salinity levels for those zones. The vegetation zones and the dominant species, and the best available information regarding soil salinity ranges for the vegetation in the corresponding zones are as follows:

  - High marsh ground (Baltic rush) 2-4 mmhos/cm,
  - Low marsh (California tule) 2-5 mmhos/cm,
  - Saltgrass dominated areas 10-20 mmhos/cm, and
  - Intermediate marsh (pickleweed) 12-25 mmhos/cm (Josselyn 1983).

  (If baseline data indicate higher soil salinity levels for a vegetation zone than indicated above, that data would set the upper limit.)

- A 10-percent increase in plant cover of more salt-tolerant plant species in a mapped vegetation zone originally dominated by plants with lower salt tolerances. An increase in soil salinity levels would also be necessary to correlate the change in vegetation with an increase in salinity. The increase would not necessarily have to surpass the upper range indicated above.

- A 10-percent decrease in the total acreage of the mapped wetlands from the baseline information.

- A shift in the elevation of the vegetation zones from baseline conditions resulting from increases in soil salinity levels.

- A 10-percent decrease in the acreage delineated by the ordinary high water mark from the baseline condition.

If monitoring identifies at least one of the above changes in Lagoon habitat, then the following measures could be implemented to increase freshwater flow into the Lagoon:

- Increased reinvestment of conserved water
- Establishment of injection wells to recharge Subbasin AQ4.
- Placement of a grout curtain near the Lagoon to create a coastal barrier.

Levels of freshwater input should allow the acreage of wetland vegetation zones to return to 100 percent of their baseline conditions. If this acreage is not achieved, a wetland restoration project would be implemented. The acreage of the successfully restored wetlands plus existing wetland acreage at the date the restoration project was started, shall equal the original baseline acreage plus 10 percent. The restoration site would be in the triangular-shaped patch in the existing wetland filled to create pastureland.

It is unknown whether implementation of these mitigation measures would lessen the potential impact on Lagoon vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

Potential impacts to upland vegetation will be addressed when specific development plans and their impacts are presented to local jurisdictions.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Subbasin AQ1 storage characteristics under Supply Option II would not change significantly from existing conditions. The vegetation associated with this subbasin would, therefore, not be affected significantly by this supply option.

The results of CVSIM, applied to the 1902-1987 period, demonstrate additional changes to Subbasin AQ2 usable storage relative to existing conditions. This would exacerbate the moderate level of plant stress identified near the upstream portion of the Narrows for the extremely dry water year, and for channel bottom vegetation near the Los Laureles Wells.

Groundwater extraction in Subbasin AQ3 under this supply option has a more significant effect on riparian vegetation than under Supply Option I. Up to 69 percent of the riparian corridor could potentially be affected during a typical water year (a 10-percent increase over existing conditions). This figure would increase to 99 and 100 percent for a critically dry and extremely dry year. Current irrigation programs must be maintained for existing riparian vegetation to not be significantly impacted by Supply Option II. As discussed above, water stress on riparian vegetation increases as the drawdown increases.

Groundwater extraction in Subbasin AQ4 under this supply option significantly increases the area of the eight-foot groundwater drawdown contour downstream of the Rancho Canada Well by approximately 300 feet. For a critically dry year and an extremely dry year, this figure would increase to 1,200 and 2,500 feet compared to a typical year. In Subbasin AQ4, 23 to 33 percent of the riparian vegetation would be significantly impacted (Table IV-12).

Conversion of upland vegetation to urban development could occur due to additional water supply and potentially be greater than under Supply Option I.

Impacts: The impacts to riparian vegetation of the river reach associated with Subbasin AQ1 would be less-than-significant. Subbasins AQ2, AQ3, and AQ4 would experience significant impacts similar to those under Supply Option I, but to a greater degree.

The impacts to Lagoon vegetation are as described with Supply Option I and are considered potentially significant.

The impacts to upland vegetation due to urban development cannot be assessed without site-specific information on the location and intensity of future development.

Mitigation Measures: The same mitigation measures for riparian vegetation and Lagoon vegetation listed under Supply Option I would apply to Supply Option II. It is unknown whether implementation of these measures would lessen the impacts to a less-than-significant level. The impacts are, therefore, considered potentially significant.

The mitigation of impacts on upland vegetation include locating and designing upland urban development to avoid sensitive upland vegetation areas, including areas containing special status plant species and areas with unique and limited plant communities such as closed-cone conifer forest and coastal dunes.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Changes to surface water or groundwater due to this supply option are not anticipated to affect riparian vegetation associated with Subbasin AQ1.

The usable storage and water table drawdown of Subbasin AQ2 would not change significantly under Supply Option III as compared with Supply Option II. This drawdown would affect nonirrigated riparian vegetation to the same extent as Supply Option II.

Groundwater extraction under Supply Option III would affect riparian vegetation associated with AQ3 to a greater degree than under Supply Options I and II. Seventy-one percent of the riparian acreage in Subbasin AQ3 would be affected under this supply option, as compared to 59 percent and 69 percent under Supply Options I and II, respectively for a typical year. This figure increases to 99 and 100 percent for a critically dry year and extremely dry year. The depth to groundwater increases as the water production increases, imposing a greater water stress on nonirrigated riparian vegetation. A sufficient supply of irrigation water must be maintained at the irrigation sites to prevent water stress on the riparian vegetation. The direct effects of water stress on vegetation, described under Supply Options I and II, would also apply to this option.

Groundwater extraction under Supply Option III would affect riparian vegetation associated with Subbasin AQ4 to a slightly greater degree than under Supply Options I and II. The zone of impact, defined by the eight-foot drawdown contour, would increase by 300 feet downstream of the Rancho Canada Well, as compared with Supply Option I for a typical year. Groundwater drawdown would significantly impact 23 to 33 percent of the riparian vegetation in Subbasin AQ4 depending on the water year (Table IV-18).

The potential effect of this supply option on wetland vegetation of the Lagoon would be the same as described under Supply Option I.

Conversion of upland vegetation to urban development could occur are to additional water supply and potentially be greater than under Supply Options I and II.

Impacts: The impact to riparian vegetation contained in the area overlying Subbasin AQ1 would be less-than-significant.

The impact on riparian vegetation in the Subbasin AQ2 area is considered significant under Supply Option III and is similar to that under Supply Option II.

Groundwater extraction under Supply Option III would have a significant adverse impact on existing nonirrigated riparian vegetation in Subbasins AQ3 and AQ4. Furthermore, the increase in the eight-foot drawdown and the associated stress on nonirrigated vegetation is considered a significant impact.

The potential effect of this supply option on wetland vegetation of the Lagoon would be the same as described under Supply Option I (potentially significant).

The impacts to upland vegetation due to urban development cannot be assessed without site-specific information concerning the location and intensity of future development.

Mitigation Measures: The same mitigation measures for riparian vegetation and Lagoon vegetation listed under Supply Option I would apply to Supply Option III. It is unknown whether implementation of these measures would lessen the impacts to a less-than-significant level. The impacts are, therefore, considered potentially significant.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production Level)

Groundwater extraction from Subbasin AQ3 under Supply Option IV would significantly affect local riparian vegetation, although to a slightly reduced degree from that described under Supply Option I. For a typical year, 55 percent of the riparian corridor would be affected under this supply option. That is, vegetation would continue to decline but to a lesser extent than under Supply Option I. However, 99-100 percent of the vegetation would potentially be impacted during a critically or extremely dry year. Other direct effects of water stress on vegetation described under Supply Option I would also apply to this option. The current irrigation program helps to maintain a portion of the existing riparian vegetation, thus offsetting some vegetation degradation.

Groundwater extraction from Subbasin AQ4 under this supply option would affect riparian vegetation to a slightly lesser degree than under Supply Option I. The zone of impact downstream from the Rancho Canada Well would be approximately 100 feet less than that described under Supply Option I. The percentage of riparian vegetation acreage subjected to severe water stress would still range from 22 to 32 percent of the total acreage in Subbasin AQ4, depending on the water year.

Lagoon vegetation impacts would be as described under Supply Option I.

Conversion of upland vegetation to urban development could occur due to additional water supply under Baseline Production/Consumption Level A only.

Impacts: Riparian vegetation in Subbasin AQ1 would be impacted to a less-than-significant level under Supply Option IV. Riparian vegetation associated with Subbasin AQ2 would experience significant impacts similar to those described for Supply Option I. Impacts near the Los Laureles Wells would be significant, and impacts on vegetation upstream of the Narrows would be potentially significant.

Nonirrigated vegetation drawing moisture from the area around Subbasins AQ3 and AQ4 would continue to experience a significant impact under this option, although to a lesser extent than under Supply Option I.

The potential effect of this supply option on wetland vegetation of the Lagoon would be the same as described under Supply Option I (potentially significant).

The impacts to upland vegetation due to urban development cannot be assessed without site-specific information concerning the location and intensity of future development.

Mitigation Measures: The same mitigation measures for riparian vegetation and Lagoon vegetation listed under Supply Option I would apply to Supply Option IV. It is unknown whether implementation of these measures would lessen the impacts to a less-than-significant level. The impacts are, therefore, considered potentially significant.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Groundwater extraction from Subbasin AQ3 under Supply Option V would significantly affect local riparian vegetation, although to a slightly reduced degree from that described under Supply Option I. An estimated 48 percent of the riparian corridor would be affected under this supply option for a typical year. This water supply option represents an 11 percent decrease in the acreage of riparian vegetation significantly impacted as compared to Supply Option I. Riparian vegetation would continue to be subjected to severe water stress around the Rancho Canada, San Carlos, Cypress, Pearce, and Schulte Cal-Am Wells.

For critically dry and extremely dry water years, 99 and 100 percent of the riparian vegetation would be severely water stressed which is the same impact that would be experienced by the other water supply options. Other direct effects of water stress on vegetation described under Supply Option I would also apply to this option. The current irrigation program helps to maintain a portion of the existing riparian vegetation, thus offsetting some vegetation degradation.

Groundwater extraction from Subbasin AQ4 under this supply option would affect riparian vegetation to a slightly lesser degree than under Supply Option I. The zone of impact downstream from the Rancho Canada well would be approximately 200 feet smaller than the 2,700 feet described under Supply Option I. Approximately from 22 to 31 percent of the total in Subbasin AQ4 would be affected (Table IV-18).

Upland vegetation would not be affected because no new development would occur under this option.

Impacts: The impacts to riparian vegetation in Subbasin AQ1 would be less-than-significant under Supply Option V. Riparian vegetation associated with Subbasin AQ2 would experience significant impacts similar to those described for Supply Option I.

Nonirrigated vegetation drawing moisture from the area around Subbasins AQ3 and AQ4 would continue to experience a significant adverse impact under this option, although to a lesser extent than under Supply Option I.

Lagoon vegetation impacts are the same as described under Supply Option I. Although the degree of the impact may be slightly reduced, the impacts are still considered potentially significant.

Because no new development within the Cal-Am service area is associated with Supply Option V, upland vegetation would be impacted to a less-than-significant level.

Mitigation Measures: The same mitigation measures for riparian vegetation and Lagoon vegetation listed under Supply Option I would apply to Supply Option V. It is unknown whether implementation of these measures would lessen the impacts to a less-than-significant level. The impacts are, therefore, considered potentially significant.

D. WILDLIFE

1. Methodology and Analysis

The impacts and mechanisms previously described for riparian vegetation affect the amount and quality of habitat available for riparian-dependent wildlife species. Those factors that serve to eliminate or degrade riparian vegetation would, therefore, reduce the available wildlife habitat at a rate proportional to the magnitude and extent of the vegetation impact.

Bird species dependent on riparian corridors, such as the red-shouldered hawk, black phoebe, yellow warbler, and Wilson's warbler, would probably show the largest decline in usable habitat.

Amphibians and reptiles that frequent and breed in riparian areas throughout their life, such as the foothill yellow-legged frog, California red-legged frog, California newt, common garter snake, and striped racer, would probably decline in numbers with reduced streamflows and loss of habitat. Mammals such as the raccoon, ringtail, ornate shrew, western gray squirrel, and desert cottontail also would probably decline in numbers.

A decrease in fresh water into the Lagoon could change the salinity levels, leading to a potential change in plant species. This would in turn lead to a change in the wildlife species composition in the Lagoon from freshwater-dependent species to wildlife able to survive in a more saline environment.

Additional water could lead to increased urban growth and result in the conversion of existing upland habitat to urban use. Potential impacts to wildlife could be significant but cannot be determined at this time because specific areas for future growth have not been identified. Therefore, changes to upland wildlife species are assessed qualitatively, rather than quantitatively.

2. Impacts and Mitigation Measures

The impacts experienced by wildlife along the Carmel River are discussed by subbasin.

Supply Option I: 18,400 Acre-Feet (Current Production)

The area around the confluence of the Carmel River with Tularcitos Creek supports dense stands of riparian woodland thicket that provide habitat for various wildlife species. Subbasin AQ1 supports surface waterflow or standing water for most of the year. This pumping level does not affect the hydrologic regime of the upper Carmel River and therefore would not affect the distribution of riparian vegetation or the wildlife resources.

As described earlier, groundwater pumping in Subbasin AQ2 would not stress riparian vegetation around the Los Laureles Wells during a typical or critically dry water year. Only during an extremely dry year would drawdown impose severe water stress on riparian vegetation in Subbasin AQ2. The area around the Los Laureles Wells supports narrow bands of riparian forest and thicket, mixed evergreen forest, and non-native annual grasslands. Wildlife use of this area is considerably less than areas of large, dense stands of riparian woodland found elsewhere along the river; however, it is still an important resource for wildlife.

The pumping regime and its associated drawdown conditions in Subbasin AQ3 currently stress that riparian vegetation not receiving irrigation water. A continued decline, or complete loss of this habitat, would result in declines in riparian-dependent wildlife.

Drawdown around the Rancho Canada Well in Subbasin AQ4 is currently severe. As with Subbasin AQ3, the decline of this resource effects wildlife that live in or travel through the area.

Under Supply Option I impacts on Lagoon vegetation are considered potentially significant, and so are the impacts on associated wildlife habitats.

Wildlife populations in the upland areas of the Cal-Am service area could possibly be affected under this option by new development made possible by water made available under Baseline Production/Consumption Level B. Any additional development would increase pressures on local wildlife populations and could directly or indirectly affect their long-term productivity and abundance. Specific impacts would be directly related to site-specific developments.

Impacts: The continuing reduction of riparian habitat near the Los Laureles Wells or loss of a movement corridor for wildlife are considered significant impacts to wildlife.

The decline or potential loss of riparian habitat associated with Subbasin AQ3 is considered a significant adverse impact on wildlife dependent on the riparian corridor.

The loss of riparian habitat due to drawdown at Rancho Canada Well and the associated decreases in wildlife species are considered significant impacts.

Wildlife species that use the Lagoon would be potentially significantly impacted by this option.

This option assumes that there would be additional development, under Baseline Production/Consumption Level B only. New upland development would, therefore, affect wildlife. Without site-specific information concerning the location and intensity of new development, however, these impacts cannot be assessed.

Mitigation Measures: Mitigation measures recommended in the "Vegetation" section (Section C) to reduce impacts on riparian habitats are also applicable to wildlife habitats. Mitigation should occur in all of Subbasin AQ3, and portions of Subbasins AQ2 and AQ4. The detailed mitigation measures described in Section C are summarized below:

- Implement a water conservation program that retains water in the river and increases groundwater storage available to riparian vegetation.
- Control drawdown in existing riparian areas of greatest extent.
- Enhance existing riparian areas through preservation from development and by continuing and expanding the current irrigation system.
- Create new riparian habitat by vegetation with willows, cottonwoods, and other riparian species.
- Acquire conservation easements for riparian revegetation.
- Remove nonriparian and non-native plant species along the riparian corridor and revegetate with riparian species.

It is unknown whether implementation of these mitigation measures would lessen impacts to riparian vegetation to a less-than-significant level. Impacts on wildlife associated with riparian vegetation are, therefore, potentially significant.

According to Section C of this chapter, impacts to Lagoon vegetation could be lessened by reducing pumping from Carmel Valley Aquifer Subbasin AQ4, although it is unknown whether this would result in less-than-significant impacts. Accordingly, it is unknown whether or not wildlife impacts associated with Lagoon vegetation would be reduced to a less-than-significant level with the implementation of this mitigation measure. These impacts would, therefore, be considered potentially significant.

In addition to mitigation measures that address riparian and Lagoon vegetation, the District could construct and maintain a series of water holes and guzzlers for wildlife along the riparian corridor. This would further lessen the impacts on wildlife.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Changes in the hydrologic regime for portions of the river and many of the subbasins, and the resulting vegetative changes have been discussed under Sections B and C of this chapter. The effects Supply Option II would have on wildlife are the same in Subbasin AQ1 as described under Supply Option I. The effect of Supply Option II on wildlife would be greater in Subbasins AQ2, AQ3, and AQ4 than under Supply Option I. Supply Option II has been shown to increase the frequency of no-flow periods from the Narrows downstream. This would affect wildlife in terms of accessibility to water and food sources. As discussed under Supply Option I, the reduction in riparian vegetation and its associated habitat would be partially offset by the District's ongoing irrigation program.

Potential effects on Lagoon wildlife would occur as impacts to the Lagoon vegetation increased.

Increasing the amount of water available for new development would result in urban growth that could affect upland wildlife.

Impacts: The further decline of riparian habitat associated with Subbasins AQ2, AQ3, and AQ4 would have a significant impact on wildlife of these areas. The increase in no-flow periods along the river would also have a significant impact on wildlife requiring a permanent water source. Wildlife species that frequent Lagoon habitat would also be significantly affected.

The impacts on wildlife species dependent of upland vegetation cannot be assessed without site-specific information concerning the location and intensity of future development.

Mitigation Measures: Mitigation measures described under Supply Option I would also apply to Supply Option II. It is unknown whether implementation of these mitigation measures would lessen impacts to wildlife dependent on riparian vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

As indicated under Supply Option I, wildlife impacts associated with Lagoon vegetation could be lessened by reducing pumping from Subbasin AQ4 of the Carmel Valley Aquifer, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. These impacts are, therefore, considered potentially significant.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would have similar effects on the wildlife of the Carmel River as Supply Option II, but to a slightly greater extent. This option would increase the decline of the riparian habitat, thereby significantly affecting wildlife. The effects of this option would be the same in Subbasin AQ1 as described under Supply Option I. The effect on riparian habitat would be greater in Subbasins AQ2, AQ3 and AQ4 than under Supply Option II or Supply Option I. The frequency of no-flow periods in the river increases under Supply Option III and would thus significantly affect wildlife dependent on the river.

Potential effects on the Carmel River Lagoon wetlands and wildlife would be similar to those described under Supply Option II.

Increasing the amount of water available for new development would result in urban growth that could affect upland wildlife.

Impacts: As with Supply Option II, a further decline of riparian habitat associated with Subbasins AQ2, AQ3, and AQ4 would have a significant impact on wildlife of these areas. Wildlife species that frequent Lagoon habitat would also be significantly affected.

The impacts on upland wildlife species cannot be assessed without site-specific information concerning the location and intensity of future development.

Mitigation Measures: Mitigation measures described under Supply Option I would also apply to Supply Option III. It is unknown whether implementation of these mitigation measures would lessen impacts to wildlife dependent on riparian vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

As indicated under Supply Option I, wildlife impacts associated with Lagoon vegetation could be lessened by reducing pumping from Subbasin AQ4 of the Carmel Valley Aquifer, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. These impacts are, therefore, considered potentially significant.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Riparian habitat would continue to decline with Supply Option IV, although to a lesser extent than under Supply Option I. Wildlife would therefore continue to be affected, even under this reduced level of supply. The less frequent no-flow periods in the river would provide additional water to wildlife species relative to Supply Option I.

Potential effects on the Lagoon wetlands and wildlife would be similar to those described under Supply Option I.

Wildlife populations in the upland areas would be affected in the same manner as discussed under Supply Option I.

Impacts: While the reduction in no-flow periods represents an improvement in river hydrology over existing conditions and should benefit wildlife, the continued decline of riparian habitat is expected to have a significant impact on wildlife population. Wildlife species that frequent Lagoon habitat would also be significantly affected.

Mitigation Measures: Mitigation measures described under Supply Option I would also apply to Supply Option IV. It is unknown whether implementation of these mitigation measures would lessen impacts to wildlife dependent on riparian vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

As indicated under Supply Option I, wildlife impacts associated with Lagoon vegetation could be lessened by reducing pumping from Subbasin AQ4 of the Carmel Valley Aquifer, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. These impacts are, therefore, considered potentially significant.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Riparian habitat would continue to decline at Supply Option V, although to a lesser extent than under Supply Option I. Wildlife would therefore continue to be affected, even under this reduced level of supply. Because of less frequent no-flow periods in the river, Supply Option V would provide additional water to wildlife species relative to Supply Option I.

Lagoon wildlife would be affected by this option in a manner similar to that under Supply Option IV.

Wildlife populations in the upland service areas of the area within the District boundaries would not be affected by this option since there would be no additional water available for new development.

Impacts: Although this water supply option represents an improvement in the quantity of water in the Carmel River, significant impacts to wildlife would occur in response to the decline in riparian and Lagoon habitat.

Mitigation Measures: Mitigation measures described under Supply Option I would also apply to Supply Option V. It is unknown whether implementation of these mitigation measures would lessen impacts to wildlife dependent on riparian vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

As indicated under Supply Option I, wildlife impacts associated with Lagoon vegetation could be lessened by reducing pumping from Subbasin AQ4 of the Carmel Valley Aquifer, but it is unknown whether or not reduced pumping would result in less-than-significant impacts. These impacts are, therefore, considered potentially significant.

3. Special-Status Wildlife Species

No known populations or critical habitats of any state-listed or federally- listed threatened or endangered wildlife species would be directly impacted by additional groundwater pumping and the related loss of riparian vegetation. This includes the state- and federally-listed endangered bald eagle, peregrine falcon, and least Bell's vireo (Chapter III, Section C.3). Suitable habitat for three federal candidate species, four state species of special concern, and two California fully-protected species would, however, be adversely affected.

Western pond turtles and California red-legged frogs require permanent surface water and are not likely to be found below the Narrows. Loss of surface water above the Narrows would result in the direct loss of pond turtle and red-legged frog habitat.

Cooper's hawks nest in dense stands of riparian and oak woodlands; loss of riparian vegetation would eliminate otherwise suitable nesting habitat. The American badger frequents a variety of habitats, but is locally dependent on the riparian corridor along the Carmel River. Ringtail would lose suitable habitat with the loss of riparian forests along the river. Loss of riparian vegetation probably would also lead to a decreased abundance of prey species for these three predators, and could reduce the suitability of their habitat.

The Carmel River corridor provides suitable habitat for both the purple martin and the California black legless lizard. Neither of these species has been observed or recently recorded within the corridor, so pumping additional groundwater would have no direct impact on these species. The California black legless lizard is, however, present in the immediate vicinity of the Carmel River Lagoon (Point Lobos Citizens Advisory Committee 1985). The northern harrier is a winter visitor and potential nester in the Lagoon wetlands. Impacts on the Lagoon wetlands would have no significant effect on either the lizard or northern harrier.

Impacts: The loss of riparian vegetation represents a decrease in suitable habitat and, therefore, is considered a significant impact on special-status wildlife species associated with the riparian corridor.

Mitigation Measures: Mitigation measures for wildlife described under Supply Option I would also apply to special-status wildlife species. It is unknown whether implementation of these mitigation measures would lessen impacts to wildlife dependent on riparian vegetation to a less-than-significant level. These impacts are, therefore, considered potentially significant.

E. FISHERIES

1. Methodology and Analysis

Of the ten fish species which reside in the Carmel River, the anadromous steelhead (*Oncorhyhcus mykis*) is considered the most important. Direct or subsurface diversion of flows from the river can interfere or block the steelhead life cycle because these fish require permanent freshwater streamflows, as well as seasonal outflow of freshwater to the ocean.

Direct or subsurface diversion of flows in the Carmel River can affect five portions of the steelhead life cycle.

Adult Upstream Migration

<u>Reduced Frequency and Magnitude of Runoff During Late Fall and Early Winter</u>

Runoff associated with early winter storms historically attracted adult steelhead into the river during December and early January. As water production from the Carmel River increases, the frequency and magnitude of flows needed to attract fish into the lower river during December and January would be reduced or eliminated. If such reductions occur in enough years or in a sequence of several years, the early part of the steelhead run would probably be reduced or lost.

<u>Insufficient Flows for Adult Habitat and Upstream Migration of Adults During Late January, February, and March</u>

Increased diversions from the Carmel River aquifer may increase the frequency and duration of periods when runoff from winter storms is sufficient to attract adult steelhead into the lower river but too low to maintain adult habitat and upstream migration. Coastal streams along central California are "flashy," meaning that streamflow during storms is often many times the streamflow following and between storms. Adult steelhead have adapted to these natural conditions by migrating upstream following storm peaks and by holding in deep pools or runs between storms.

As subsurface pumping from the lower aquifers increases, the rate and duration of recharge to the aquifers following the first winter storms would increase. Pumping could increase to a level where the lack of flows following storm peaks would threaten adult steelhead habitat. In some dry years, there is a risk that successful upstream migration would be completely eliminated.

<u>Flows for Upstream Adult Migration</u>

In two reports, Dettman and Kelley (1986 and 1987) described their investigations of the flows needed for upstream migration of adult steelhead in the Carmel River between the ocean and San Clemente Dam. They identified several critical riffles, measured the depths over them, and concluded that a flow of 75 cubic feet per second was needed to assure that steelhead could migrate over the most difficult riffles. They noted there is an increasing risk that adults would be isolated and perhaps stranded in pools between Robles del Rio and the Lagoon as flows decline below 50 cubic feet per second. They analyzed the relationship between winter runoff and an index of the number of fish passing San Clemente Dam, and concluded that large numbers of steelhead often migrate to San Clemente Dam following storms that increase the flows into the Lagoon to 200 cubic feet per second.

On the basis of their investigations, D. W. Kelley & Associates recommended flows for upstream migration that ranged from 75 to 200 cubic feet per second during the months of January, February, and March, and developed a set of flow criteria for assessing success of upstream migration based on daily flows (Tables IV-19 and IV-20). Application of daily flow criteria to the simulations for each production level from 10,000 to 20,500 acre-feet is expensive and time consuming. Because of this, the analysis for this EIR was modified by developing and applying monthly flow criteria to monthly flows during all years of the 87-year hydrologic record and by applying the daily criteria to a key sequence of years during an extended drought. This approach provides an accurate way to compare the effects of production levels in all years as well as providing a more detailed assessment during the series of years which puts the most stress on the steelhead population.

<u>Ratings of Mean Monthly Flows for Upstream Migration</u>

To develop monthly criteria, the daily flows from Tables IV-19 and IV-20, which produced at least fair overall conditions for upstream migration, were totaled. These totals were 4,300 acre-feet in January and March and 4,000 acre-feet in February. To rate monthly flows under each water supply option, the average monthly flows based on these criteria were compared to simulated mean monthly flow into the Lagoon with each level of Cal-Am production.

<u>Ratings of Daily Flows for Upstream Migration</u>

The flow criteria for upstream migration in Table IV-19 was applied to simulated daily flows under each production level during the period from 1947 to 1951--the drought which appears to have been the most constraining for adult migration. This period was more constraining than 1976-77 since fish could have been attracted into the river, but subsequently stranded as flows declined between storms.

Adult Spawning Below San Clemente Dam

Adult steelhead spawn in a 12.5-mile reach from Schulte Road to San Clemente Dam. The progeny from adults that spawn below the Narrows are usually lost because the river dries up. Dettman and Kelley (1986 and 1987) developed a relationship between spawning habitat area and streamflow in the Carmel River below San Clemente Dam and criteria to assess the number of sites where steelhead females could construct nests. The criteria are as follows:

Flow (cfs)	Number of Nest Sites	Rating
< 40	0	Zero
40 - 45	< 25	Poor
46 - 55	25 to 100	Fair
56 - 70	100 to 200	Good
> 70	> 200	Excellent

These criteria were compared to mean monthly flows at the Narrows to determine whether Cal-Am production levels of 18,400, 20,000, or 20,500 acre-feet (Supply Options I, II, and III) resulted in more periods of zero or poor opportunities for spawning between the Narrows and San Clemente Dam.

TABLE IV-19
CRITERIA FOR EVALUATING IMPACTS ON UPSTREAM MIGRATION

Life History Phase and Factor	Criteria	Quality or Risk Rating	Comments
(A) Attraction Flows	Number of Pulses per Season		Pulses are defined by different sequences of increasing flows each month. Definitions are based on a review of historical flows that were associated with migration of adult steelhead past San Clemente Dam. (See Dettman and Kelley, 1987, for description.)
	> =6	EXCELLENT	
	3-5	GOOD	
	2	FAIR	
	1	POOR	
	0	ZERO	
(B) Transportation Flows	Fraction of Days Beginning with Attraction Flows each Month with Flow < = 75 cfs		Flows measured at both the Narrows and into the Lagoon. If after an attraction flow, the flows decline below 50 cfs for more than 7 days, downgrade the quality rating one step.
	<.25	EXCELLENT	
	.25-.50	GOOD	
	.51-.75	FAIR	
	>.75	POOR	
(C) Risk of Isolating Adults in Pools	Fraction of Days Beginning with Attraction Flows Flows each Month with Flow < =50 cfs		Flows measured at both the Narrows and into the Lagoon. Increase the risk rating if flow is less than 25 cfs for more than 7 days after attraction flows. If flows below 25 cfs continue from one month to the next, carry over rating into following month, except do not carryover lethal rating.
	<.25	LOW	
	.25-.50	MED	
	.51-.75	HIGH	
	>.75	CRITICAL	
	zero flow	LETHAL	
(D) Overall Conditions for Upstream Migration each Month.		ZERO LETHAL CRITICAL POOR FAIR GOOD EXCELLENT	Based on factors B and C, rate conditions for adult upstream migration each month according to combinations in Table IV-20. Quality ratings defined as: ZERO, no attraction or migration flows; LETHAL, attraction and migration flows followed by no flow; CRITICAL, conditions may prevent steelhead migration to San Clemente Dam, depending on various unpredictable factors, such as poaching, coincidence of legal fishing days and attraction and migration flows, changes in streambed conditions, and precision of flow predictions; POOR, conditions suitable for few steelhead reaching San Clemente Dam; FAIR, conditions suitable for enough steelhead to reach San Clemente Dam to partially seed habitat upstream; GOOD, conditions suitable for enough steelhead to reach the dam fully seed habitat upstream; EXCELLENT, conditions suitable for more than enough steelhead to reach the dam.

Source: D.W.Kelley & Associates, 1989.

TABLE IV-20
CRITERIA FOR EVALUATING UPSTREAM MIGRATION
Between the Lagoon and San Clemente Dam

Rating of Transportation Flows[1]	Risk of Isolating Adults[2]	Overall Ratings of Conditions
Poor (>.75)	Lethal (zero flow)	Zero
	Critical (>.75)	Critical
	High (.51 to .75)	Poor
	Medium (.25 to .50)	Fair
	Low (<.25)	Fair
Fair (.51 to .75)	High	Fair
	Medium	Good
	Low	Good
Good (.25 to >50	Lethal	Zero
	Medium	Good
	Low	Good
Excellent (<.25)	Lethal	Zero
	Medium	Good
	Low	Excellent

[1]Fraction of days each month with flow less than or equal to 75 cfs following a mean daily attraction flow of less than or equal to 200 cfs.
[2]Fraction of days each month with flow less than or equal to 50 cfs.

Source: D.W. Kelley & Associates, 1989.

Summer Flows for Juvenile Rearing Between the Narrows and San Clemente Dam

Prior to 1983 there was no provision for release of water from the old Carmel River Dam or the San Clemente Dam to protect steelhead or other aquatic life in the lower Carmel River. Historically, the construction of these dams was the first major manipulation of flows in the basin which had far reaching effects on the steelhead population. Kelley, Dettman, and Reuter (1987) estimated that the potential adult production from habitat below the San Clemente downstream to the Narrows is only about 800 adults or about 20 percent of the total potential in the basin. The reduction in the run due to the lack of summer flow in the lower river is probably greater than 20 percent because many juveniles that rear for their first year upstream of San Clemente Dam probably would spend an additional summer rearing below San Clemente Dam if streamflows were adequate. These larger fish would then survive better after entering the ocean.

Dettman and Kelley (1986 and 1987) developed methods to rate the quality and quantity of juvenile rearing habitat in the Carmel River between the Narrows and San Clemente Dam at flows ranging from about 5 to 50 cubic feet per second. Simulated flows with operations proposed in Table IV-21 are often less than 5 cubic feet per second, so comparisons of the effects of different production levels on rearing habitat cannot be made based on their predictions of the capacity to rear juvenile steelhead.

Because of this problem, a different analysis was conducted of the effects on rearing habitat. For this analysis it was assumed that if simulated mean monthly flows were less than one cubic feet per second at the Narrows, the habitat would be insufficient and temperatures too high to rear young-of-the-year steelhead through their first summer and to rear older juveniles whose emigration was interrupted by low spring flows. This rule was applied to two 87-year simulations of monthly flows, and the number of periods during which a series of three or more years occurred with rearing habitat reduced to zero were tallied.

Two option simulations were used to account for how storage in Los Padres Reservoir would change through time. In Option A the storage in Los Padres was assumed to remain at the present level of 1,968 acre-feet. In Option B, the storage in Los Padres was assumed to decline at the average historical rate of 20 acre-feet per year over the entire 87-year simulation. The ratings of rearing habitat based on these options should be considered as the range of what is likely to happen in the next 10 to 15 years. Option A is the most optimistic because it assumes that storage will not change in the next 10 to 15 years. Option B is the most pessimistic because the long-term effects of 87 years of sediment accumulation are applied over a 10-to 15-year period.

Downstream Migration of Juveniles--Risk of Stranding Juvenile Steelhead in Early Fall and Winter

In the Carmel River, the initial flows of the water year often spill over San Clemente Dam and percolate into the aquifers below it. At the same time, some of the juvenile steelhead that have reared upstream and downstream of San Clemente Dam begin to move downstream. Although the phenomenon of early downstream migration is not well documented in the Carmel River, it has been studied in nearby Waddell Creek, Santa Cruz County. Shapovalov and Taft (1954) counted migrating steelhead for several years in Waddell Creek. Their data indicates that 25 percent of the yearling migrants, four percent of the two-year-olds, and three percent of the three-year-olds migrated to within one mile of tidewater in the Lagoon by January 1 and that by March 31 these percentages increased to 29 percent, 30 percent, and 64 percent, respectively. Based on this information, it appears that a substantial portion of the juvenile steelhead that migrate into the reach below the Narrows face a risk of being isolated and stranded as flows decline following storms in early fall and winter. The problem is probably exacerbated during years when Subbasins AQ2 or AQ3 are severely drawn down during the preceding summer.

<u>Criteria for Assessing Risk of Stranding</u>

Dettman and Kelley (1987) developed criteria to rate the risk that migrating juvenile steelhead would be isolated and stranded below the Narrows. These criteria were modified slightly by considering that a high risk occurs whenever flows at the Near Carmel station decline to less than one cubic feet per second following the first storms that are likely to cause migration of juveniles. The date of the first migration of juveniles was determined by examining daily inflow to Los Padres and San Clemente reservoirs, outflows from San Clemente Reservoir, storage in San Clemente Reservoir, flows at the Narrows, and the operation of the gates/flashboards at San Clemente Dam.

Spring Flows for Juvenile Rearing and Smolt Emigration

Adequate March, April, and May streamflows are needed for rearing steelhead smolts below San Clemente Dam and for their emigration from the lower river into the ocean. Prior to the early 1960s, the diversion of springtime flows was a minor problem for steelhead in the Carmel River because the diversion was usually a small fraction of total flow in the river. Beginning in 1959 when Cal-Am installed its first wells in the Carmel Valley aquifers, there was a gradual but steady increase in production that was met from subsurface diversions (Figure IV-7). As production increased, springtime flows in the lower river declined. The quality of habitat and survival of emigrating juveniles is directly related to the magnitude of spring flows (Dettman and Kelley 1986). Cal-Am production from the Carmel River Basin was 13,000, 12,800, and 12,200 acre-feet during the early 1960s (Figure IV-7). Increasing Cal-Am production to above 18,000 acre-feet would probably have eliminated the opportunities for successful smolt emigration in these years, because during April and May Cal-Am production would have exceeded the surface flows.

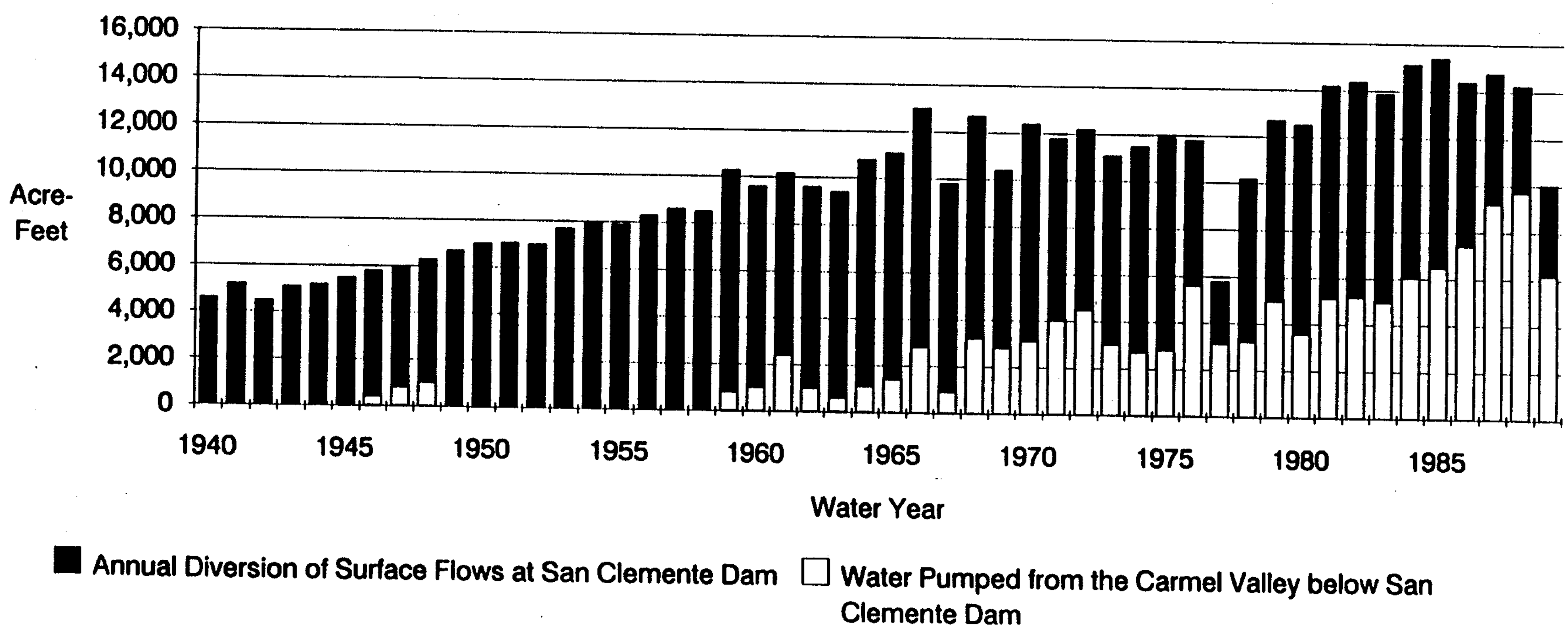
Criteria for Smolt Emigration

Dettman and Kelley (1986 and 1987) developed criteria to assess rearing habitat for yearling steelhead and the success of smolt emigration into the ocean. The criteria are ratings of the mean April 1 through May 31 flows and are based on a correlation between adult counts at San Clemente Dam, rearing habitat versus flow relationships for yearling sized steelhead, and observations of the flows needed to keep the mouth of the river open during the spring. The ratings of emigration flows were as follows:

Mean Flow (cfs)	April-May Rating
> = 100 cfs	Excellent
40 - 99 cfs	Good
20 - 39 cfs	Fair
10 - 19 cfs	Poor
.1 - 10 cfs	Critical
0 cfs	Zero

These criteria were applied to three historic drought periods, 1927 to 1934, 1947 to 1951, and 1959 to 1962, to determine how increasing production within a range of 10,000 to 20,500 acre-feet would affect success of smolt emigration. To supplement the criteria based on mean bimonthly flows, consideration was given to whether the installation of flashboards at San Clemente Dam resulted in flows less than zero for more than a day during April or May.

FIGURE IV-7
ANNUAL CAL-AM WATER PRODUCTION
1940 to 1989



Sources: U.S. Army Corps of Engineers (1940 to 1978); Monterey Peninsula Water Management District, (1979 to 1989).

Background and Description of Operation Schedule for Releasing Flows from San Clemente Reservoir

Under the District's current water supply capacity assumption (Supply Option II), the annual normal year Cal-Am production would increase to 20,000 acre-feet per year. A description of how increases in Cal-Am production affects the steelhead resource depends, in part, upon how Cal-Am operates their surface diversion at San Clemente Dam and the subsurface diversion from aquifers below it.

Previous Analyses

In two reports, Kelley, Dettman, and Turner (1982) and Dettman and Kelley (1987) analyzed the probable effect on the steelhead resource of increasing Cal-Am production to 18,000 acre-feet and 20,000 acre-feet. In each report, several assumptions were made about how the water supply system would be operated and whether other problems would be solved. The major conclusion from these reports was that increasing production to levels of either 18,000 or 20,000 acre-feet without changing the way water was diverted into the system would reduce the population of steelhead to remnant levels of a few hundred fish. Another conclusion was that it may have been possible to maintain the runs at the levels which existed in 1982 and increase the Cal-Am production from the Carmel River up to 16,700 acre-feet per year, if most of the direct diversion from San Clemente Reservoir ceased and the stored water was instead released into the stream where it could be recaptured in the aquifers below.

Since 1987, a number of changes have been and continue to be made in the way Cal-Am diverts water from the Carmel River watershed. These changes must be specified before assessing the effects of increasing production.

Description of Diversion Schedule at San Clemente Dam

In late 1987, the Carmel River Steelhead Association (CRSA) filed a complaint with the State Water Resources Control Board in relation to Cal-Am's diversion at San Clemente Dam and from the aquifers below the dam. An interim settlement of that complaint was reached in December 1988 which changed Cal-Am's operation schedule for diversion of surface flows at San Clemente Dam. Table IV-21 lists how Cal-Am would reschedule diversions at San Clemente Dam. The purpose of the new operation is to increase flow in the river from April 1 through November 30 while, at the same time, allowing Cal-Am to divert enough water to serve some of its Carmel Valley customers and to provide fire protection in the area surrounding Carmel Valley Village.

The operation in Table IV-21 was reviewed by biologists from the California Department of Fish and Game (CDFG), by the District and their consultants, and by Cal-Am. CDFG biologists emphasize that these operations are only for planning purposes and that their Department's Memorandum of Understanding with Cal-Am, which establishes flow regimes below San Clemente Dam, may be different. The operation schedule in Table IV-21 was incorporated into CVSIM, which was used to simulate daily streamflows at production levels ranging from 10,000 to 20,500 acre-feet per year.

TABLE IV-21

OPERATION SCHEDULE FOR DIVERSION OF SURFACE FLOWS
Carmel River at San Clemente

December 1st through March 31st
Diversion Based on Expected Inflow

	Maximum Diversion (cfs)	Minimum Release (cfs)
In Normal or Better Years	16.0	4.0
In Below Normal Years	5.6	4.0
In Dry and Critical Years	4.0	4.0

April 1st through November 30th
Minimum Diversion and Release Schedule

Inflow to San Clemente (cfs)	Maximum* Diversion (cfs)	Minimum Release (cfs)
< 1.0	0.0	1.0
1.1 to 5.0	1.0	1.1-4.0
5.1 to 8.0	1.1 - 4.0	4.0
8.1 to 14.0	4.0	4.1 - 10.0
14.1 to 26.0	4.1 - 16.0	10.0
>= 26.1	16.0	>= 10.1

*Diversions greater that 4.0 cfs are allowed only if Los Padres *and* San Clemente reservoirs are full and spilling

Sources: CVSIM; D.W. Kelley & Associates, 1989.

2. Impacts and Mitigation Measures

The discussion of the impacts of increased water production on the steelhead resource in the Carmel River is based on considerations of changes in flows for upstream migration, flows for spawning, flows for juvenile rearing, flows for springtime emigration, and the risk of stranding juveniles during the late fall and early winter.

Supply Option I: 18,400 Acre-Feet (Current Production)

The application of monthly criteria indicates that existing Cal-Am production of 18,400 acre-feet constrains upstream migration in about one-half of the Januarys, one-third of the Februarys, and one-quarter of the Marches in the 87-year record (Table IV-22). With existing production and even with production as low as 12,000 acre-feet the percentage of Januarys with constrained conditions is high enough to reduce the early part of the steelhead run. Considering that about one-third of the total run occurs in January, it is reasonable to estimate that up to one-third of the run could be impacted by the reduction in January flows.

TABLE IV-22

NUMBER OF YEARS WITH CONSTRAINED MONTHLY MIGRATION FLOWS*
Comparison of January, February, and March

Cal-Am Production (Acre-Feet)	January		February		March	
	Number of Years	Percent of Record	Number of Years	Percent of Record	Number of Years	Percent of Record
10,000	35	40	18	21	20	23
12,000	39	45	19	22	21	24
14,000	39	45	19	22	21	24
16,000	43	49	27	31	22	25
16,700	43	49	27	31	22	25
17,000	43	49	27	31	22	25
17,500	43	49	27	31	22	25
18,000	45	52	27	31	22	25
18,400	45	52	27	31	22	25
20,000	45	52	28	32	24	28
20,500	45	52	28	32	24	28

*Based on 86-year simulation period (water years 1902 to 1987).

Source: CVSIM; D.W. Kelly & Associates, 1989.

The application of daily criteria to flows during the late 1940s drought indicates that the historical increase in production from 10,000 to 18,000 acre-feet were the most damaging to opportunities for upstream migration. This increase eliminated upstream migration in January, February, and March of 1947 and 1948, January and February of 1949, and January of 1950 (see Table IV-23). The overall impact of the changes in migration opportunities with current production would be to severely reduce or eliminate that portion of the run which historically migrated upstream and spawned during late December through late January.

TABLE IV-23

RATINGS OF OPPORTUNITIES FOR UPSTREAM MIGRATION

Lower Carmel River from 1947 to 1951 with Flows Ranging from 10,000 to 20,500 acre-feet

Col 1 Year	Production	Number of Migration Pulse (2)	JANUARY Transportation Not Ok Days (3)	JANUARY Transportation Total Days (4)	JANUARY Transportation Days < 50 cfs Nar (5)	JANUARY Transportation Days < 50 cfs Lag (6)	JANUARY Risk of Isolation in Pools Not Ok Days (7)	JANUARY Risk of Isolation in Pools Total Days (8)	JANUARY Risk of Isolation in Pools Days < 25 cfs Nar (9)	JANUARY Risk of Isolation in Pools Days < 25 cfs Lag (10)	FEBRUARY Transportation Not Ok Days	FEBRUARY Transportation Total Days	FEBRUARY Transportation Days < 50 cfs Nar	FEBRUARY Transportation Days < 50 cfs Lag	FEBRUARY Risk of Isolation in Pools Not Ok Days	FEBRUARY Risk of Isolation in Pools Total Days	FEBRUARY Risk of Isolation in Pools Days < 25 cfs Nar	FEBRUARY Risk of Isolation in Pools Days < 25 cfs Lag	MARCH Transportation Not Ok Days	MARCH Transportation Total Days	MARCH Transportation Days < 50 cfs Nar	MARCH Transportation Days < 50 cfs Lag	MARCH Risk of Isolation in Pools Not Ok Days	MARCH Risk of Isolation in Pools Total Days	MARCH Risk of Isolation in Pools Days < 25 cfs Nar	MARCH Risk of Isolation in Pools Days < 25 cfs Lag	Overall Monthly rating for upstream migration Jan	Feb	Mar
1947	10,000	1	31	31	31	31	31	31	31	31	27	28	20	28	20	28	0	0	31	31	31	31	31	31	0	0	crit	crit	crit
	12,000	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	0	4	31	31	31	31	31	31	0	6	zero	crit	crit
	14,000	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	27	31	31	31	31	31	31	0	27	zero	crit	crit
	16,000	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28	31	31	31	31	31	31	0	28	zero	crit	crit
	16,700	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28(l)	31	31	31	31	31	31	0	31	zero	zero	crit
	18,000	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28(l)	31	31	31	31	31	31	0	31(l)	zero	zero	zero
	18,400	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28(l)	31	31	31	31	31	31	0	31(l)	zero	zero	zero
	20,000	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28(l)	31	31	31	31	31	31	0	31(l)	zero	zero	zero
	20,500	1	31	31	31	31	31	31	31	31(l)	27	28	20	28	20	28	1	28(l)	31	31	31	31	31	31	0	31(l)	zero	zero	zero
1948	10,000	2		0	-	-		0	-	-		0	-	-		0	-	-	13	19	0	0	5	19	0	0	zero	zero	good
	12,000	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	14,000	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	16,000	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	16,700	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	18,000	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	18,400	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	20,000	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
	20,500	0		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-		0	-	-	zero	zero	zero
1949	10,000	4		0	-	-		0	-	-	20	25	0	0	17	25	0	0	8	31	0	0	0	31	0	0	zero	poor	excel
	12,000	4		0	-	-		0	-	-	20	24	0	0	17	24	0	0	8	31	0	0	0	31	0	0	zero	poor	excel
	14,000	4		0	-	-		0	-	-	20	24	17	17	17	24	4	18	8	31	0	0	0	31	0	0	zero	poor	excel
	16,000	4		0	-	-		0	-	-	20	24	17	23	17	24	4	21(l)	0	23	0	0	0	23	0	0	zero	zero	excel
	16,700	4		0	-	-		0	-	-	20	24	17	23	17	24	4	22(l)	0	23	0	0	0	23	0	0	zero	zero	excel
	18,000	4		0	-	-		0	-	-	20	24	17	23	17	24	4	22(l)	0	23	0	0	0	23	0	0	zero	zero	excel
	18,400	4		0	-	-		0	-	-	20	24	17	23	17	24	4	22(l)	0	23	0	0	0	23	0	0	zero	zero	excel
	20,000	4		0	-	-		0	-	-	20	24	17	23	17	24	4	22(l)	1	23	0	0	0	23	0	0	zero	zero	excel
	20,500	4		0	-	-		0	-	-	20	24	17	23	17	24	4	22(l)	1	23	0	0	0	23	0	0	zero	zero	excel

TABLE IV-23 (Continued)

Col 1 Year	Production	Number of Migration Pulse 2	JANUARY Transportation 3 Not Ok Days	JANUARY Transportation 4 Total Days	JANUARY Transportation 5 Days < 50 cfs Nar	JANUARY Transportation 6 Lag	JANUARY Risk of Isolation in Pools 7 Not Ok Days	JANUARY Risk of Isolation in Pools 8 Total Days	JANUARY Risk of Isolation in Pools 9 Days < 25 cfs Nar	JANUARY Risk of Isolation in Pools 10 Lag	FEBRUARY Transportation Not Ok Days	FEBRUARY Transportation Total Days	FEBRUARY Transportation Days < 50 cfs Nar	FEBRUARY Transportation Lag	FEBRUARY Risk of Isolation in Pools Not Ok Days	FEBRUARY Risk of Isolation in Pools Total Days	FEBRUARY Risk of Isolation in Pools Days < 25 cfs Nar	FEBRUARY Risk of Isolation in Pools Lag	MARCH Transportation Not Ok Days	MARCH Transportation Total Days	MARCH Transportation Days < 50 cfs Nar	MARCH Transportation Lag	MARCH Risk of Isolation in Pools Not Ok Days	MARCH Risk of Isolation in Pools Total Days	MARCH Risk of Isolation in Pools Days < 25 cfs Nar	MARCH Risk of Isolation in Pools Lag	Overall Monthly rating for Jan	Feb	Mar
1950	10,000	7	12	19	7	11	7	19	0	0	7	28	0	0	0	28	0	0	25	31	11	12	11	31	0	3	fair	excel	fair
	12,000	7	12	19	7	14	7	19	0	10	7	28	0	0	0	28	0	0	25	31	11	13	11	31	4	4	poor	excel	fair
	14,000	7	12	19	7	16	7	19	0	13	7	28	0	6	0	28	0	0	25	31	11	15	11	31	4	4	poor	excel	fair
	16,000	6	12	19	7	16	7	19	0	13(l)	7	28	0	9	0	28	0	2	25	31	11	20	11	31	4	5	zero	good	fair
	16,700	6	12	19	7	16	7	19	0	13(l)	7	28	0	10	0	28	0	5	25	31	11	21	11	31	4	7	zero	good	fair
	18,000	5	12	19	7	16	7	19	0	13(l)	7	28	0	14	0	28	0	6	25	31	11	24	11	31	4	10	zero	good	fair
	18,400	5	12	19	7	16	7	19	0	13(l)	7	28	0	16	0	28	0	6	25	31	11	27	11	31	4	10	zero	good	fair
	20,000	5	12	19	7	16	7	19	0	13(l)	7	28	0	17	0	28	0	9	25	31	11	30	11	31	4	19	zero	good	fair
	20,500	4	12	19	7	16	7	19	0	13(l)	7	28	0	17	0	28	0	9	25	31	11	30	11	31	4	23(l)	zero	good	zero
1951	10,000	2	0	31	0	0	0	31	0	0	14	28	2	2	2	28	0	0	12	31	1	0	0	31	0	0	excel	good	good
	12,000	2	0	31	0	0	0	31	0	0	15	28	3	2	2	28	0	0	12	31	1	0	0	31	0	0	excel	good	good
	14,000	2	.0	31	0	0	0	31	0	0	16	28	5	2	2	28	0	0	13	31	21	1	1	31	0	0	excel	good	good
	16,000	2	0	31	0	0	0	31	0	0	17	28	7	4	4	28	0	0	14	31	2	2	2	31	0	0	excel	good	good
	16,700	2	0	31	0	0	0	31	0	0	17	28	7	4	4	28	0	0	14	31	2	2	2	31	0	0	excel	good	good
	18,000	2	1	31	0	0	0	31	0	0	18	28	8	5	5	28	0	0	15	31	2	2	2	31	0	0	excel	fair	good
	18,400	2	1	31	0	0	0	31	0	0	18	28	8	5	5	28	0	0	15	31	2	2	2	31	0	0	excel	fair	good
	20,000	2	1	31	0	0	0	31	0	0	19	28	8	7	7	28	0	0	15	31	2	2	2	31	0	0	excel	fair	good
	20,500	2	2	31	0	0	0	31	0	0	19	28	8	7	7	28	0	0	15	31	2	2	2	31	0	0	excel	fair	good

1 Water year from October through September.
2 The number of pulses that would have attracted adult steelhead during the water year.
3 The number of days in the month, following the first attraction flows of the season, that the streamflow was not greater than the 75 cfs minimum needed for transportation
4 The number of days in the month after the first attraction flows.
5 The number of days that mean daily flows at the Narrows were less than 50 cfs.
6 The number of days that mean daily flows entering the Lagoon were less than 50 cfs.
7 The number of days in the month, following the first attraction flows of the season, that the streamflow was not greater than the 50 cfs minimum needed to avoid isolating migrating adults in pools
8 The number of days in the month after the first attraction flows. Same as Column 4.
9 The number of days that mean daily flows at the Narrows were less than 25 cfs and during which adult steelhead were likely to have been in the river. A "(l)" following the number of days indicates that the river at the Narrows went dry during the month.
10 The number of days that mean daily flows at the Lagoon were less than 25 cfs and during which adult steelhead were likely to have been in the river. A "(l)" following the number of days indicates that the river at the Lagoon went dry during the month.

Source: CVSIM; Monterey Peninsula Water Management District, 1989.

Table IV-24 lists the total number of Februarys and Marches with poor or zero opportunities for spawning. Ratings of opportunities for spawning based on criteria for the number of nests that can be accommodated as a function of flow at the Narrows and a comparison to mean monthly simulated flows with Cal-Am production ranging from 10,000 to 20,500 acre-feet. Ratings of zero or poor opportunities would probably lead to underseeding of the habitat between the Narrows and San Clemente Dam with fry. With production ranging from the historical level of 14,000 acre-feet to the modified water supply capacity of 20,500, spawning would be eliminated in eight Februarys and eight Marches and constrained in two Februarys and one March. Although the impacts in individual months is significant, the overall impact on spawning and the steelhead population is probably negligible because the impacts do not occur in a series of back-to-back years.

TABLE IV-24

NUMBER OF YEARS IN 87-YEAR RECORD WITH ZERO OR POOR SPAWNING OPPORTUNITIES IN FEBRUARY AND MARCH

Cal-Am Production	Zero February	Zero March	Poor February	Poor March
10,000 Acre-Feet	8	8	2	0
12,000 Acre-Feet	8	8	2	0
14,000 Acre-Feet	8	8	2	1
16,000 Acre-Feet	8	8	2	1
18,000 Acre-Feet	8	8	2	1
18,400 Acre-Feet	8	8	2	1
20,000 Acre-Feet	8	8	2	1
20,500 Acre-Feet	8	8	2	1

Sources: CVSIM; Monterey Peninsula Water Management District, 1989.

Table IV-25 lists the number and extent of periods in which flows were insufficient between the Narrows and Robles del Rio to rear juveniles with Cal-Am production ranging from 10,000 to 22,000 acre-feet per year. Flows less than or equal to one cubic foot per second (cfs) are judged insufficient due to lack of habitat and high summer water temperatures. Option A represents summer conditions with maintenance dredging of Los Padres Reservoir, and Option B represents summer conditions without maintenance dredging and with average annual sedimentation of 20 acre-feet. Production levels of 21,000 and 22,000 acre-feet were used only for illustrative purposes. The District has no plans nor is it studying the possibility of increasing Cal-Am production to 21,000 or 22,000 acre-feet.

TABLE IV-25

OCCURRENCE OF FLOWS INSUFFICIENT TO REAR JUVENILES
Between the Narrows and Robles del Rio

Cal-Am Production (acre-feet)	Number of Periods with Flow Below One cfs at Narrows Option A[1]	Option B[2]	Number of Sequential Years in Each Period Option A	Option B	Percentage of Years in Simulated Record Option A	Option B
10,000	0	2	-	3,4	0.0	8.1
12,000	0	2	-	3,4	0.0	8.1
14,000	0	2	-	3,4	0.0	8.1
16,000	1	2	1	3,4	1.1	8.1
16,500	1	2	1	3,4	1.1	8.1
16,700	1	na	1	na	1.1	na
17,000	1	3	1	4,4,4	1.1	14.0
17,500	1	3	1	5,4,4	1.1	15.1
18,000	2	5	1,1	3,7,5,4,4	2.3	26.7
18,400	2	5	1,1	3,7,5,4,4	2.3	26.7
20,000	5	8	1,1,1,2,2	3,4,3,10,7,5,3,4	8.0	45.3
20,500	6	7	1,1,2,2,1,2	3,10,10,11,6,3,6	10.3	57.0
21,000	8	4	3,2,3,1,4,1,1,1	7,21,20,11	18.4	82.8
22,000	13	5	2,3,3,9,1,5,2, 1,4,2,1,2,2	5,7,22,20,14	42.5	85.1

[1]Summer conditions with maintenance dredging of Los Padres Reservoir.
[2]Summer conditions without maintenance dredging of Los Padres and with average annual sedimentation of 20 acre-feet per year in Los Padres Reservoir.

Source: CVSIM; Monterey Peninsula Water Management District, 1989.

Figure IV-8 illustrates the percentage of years in the simulated 87-year record when flows were insufficient to rear juveniles between the Narrows and Robles del Rio (see last two columns in Table IV-25).

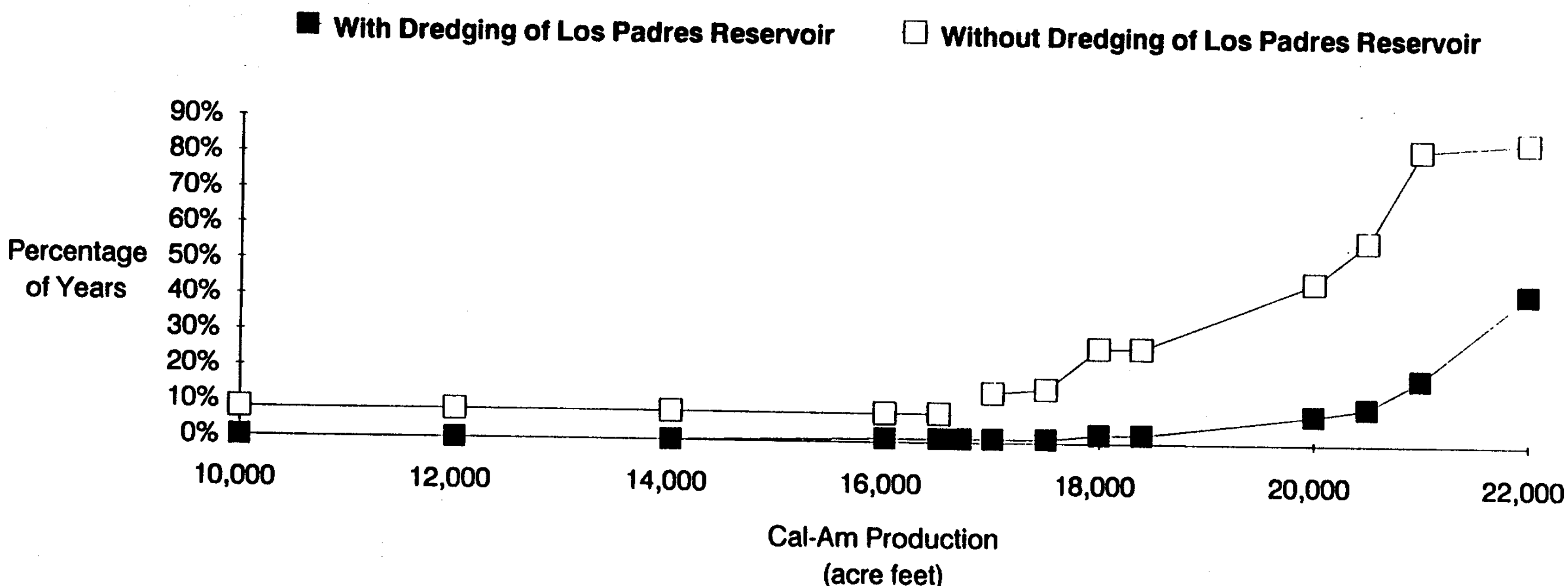
It is generally believed that steelhead populations can withstand droughts with the loss of juveniles during one or two dry summers without suffering permanent damage. This is because their life cycle is complex, with juveniles migrating to the ocean at one to three years of age and with adults first migrating upstream after one to four years in the ocean. This flexibility insures that not all of the progeny from a given brood are subjected to the same environmental conditions. There is, however, a limit to this flexibility. For example, three years in a row with poor or zero rearing habitat would jeopardize an entire brood, as well as impact major portions of at least two additional broods. More than three years in a row with zero rearing habitat indicates a very serious problem. The likely outcome is the reduction of returns for several years following an extended dry spell.

Based on these scenarios, if no additional sediment fills Los Padres Reservoir, the current Cal-Am production of 18,400 acre-feet would not damage rearing habitat in the Carmel River between the Narrows and Robles Del Rio. If, however, large volumes of additional sediment enter Los Padres Reservoir over the next 10 to 15 years, this could severely damage rearing habitat because storage in Los Padres Reservoir is essential for maintaining summer flows upstream of the Narrows. The extent to which habitat could be damaged depends upon how much sediment enters Los Padres and when it enters. If several hundred acre-feet entered in one year, as it did following the Marble Cone Fire, habitat would be reduced to levels near those listed under Option B in Table IV-25 and illustrated by the upper line in Figure IV-8. This scenario would reduce the population of juvenile steelhead below San Clemente Dam. Because of the extended number of back-to-back years with zero rearing habitat, the impact of Option B could be severe enough to reduce the adult run below San Clemente Dam to a remnant level.

The criteria for stranding were compared to daily flows at the Near Carmel station during three dry periods--1928 to 1934, 1947 to 1951, and 1959 to 1963. Table IV-26 lists the number of days and percent of time between the first day of migration and March 31st that juveniles would be at risk of stranding in the lower river. With production ranging from 10,000 to 20,500 acre-feet, juveniles would be at risk from 3 percent to 22 percent of the time during the period between October and March. The degree of risk due to increases in production varies from one year to the next. For example, in 1933 increases up to and beyond 18,400 acre-feet make no difference in the risk because flows were sustained following the first storm on January 15th and because the aquifers filled quickly. But in 1931 an increase in production from 14,000 acre-feet to 18,400 acre-feet increases the number of days with risk from 11 (13 percent of the time) to 49 (58 percent of the time).

It is not known how well the steelhead population can tolerate the risks tabulated in Table IV-26. The overall impact to the resource probably depends upon the duration of the risk each year and upon whether the risk occurs during a sequence of back-to-back years. An isolated year or two of significant risk can probably be tolerated, but more than two years in a row or in close sequence would probably damage the run. With this in mind, the sequences in Table IV-26 indicate that the current production level of 18,400 acre-feet is high enough to damage the run.

FIGURE IV-8
PERCENTAGE OF YEARS WITH FLOWS INSUFFICIENT TO REAR JUVENILES
Between Robles del Rio and the Narrows



Source: CVSIM; Monterey Peninsula Water Management District, 1989.

TABLE IV-26

RISK OF STRANDING JUVENILE STEELHEAD IN LOWER CARMEL RIVER
Number and Percentage of Days with High Risk between October and March
Cal-Am Production Ranging from 10,000 to 20,500 Acre-Feet[1]

Water Year	Date of First Migration Past Narrows	10,000		12,000		14,000		16,000		16,700		18,000		18,400		20,000		20,500		Days Each Year
		no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	
1927	29-Oct	10	6	11	7	11	7	16	10	17	11	30	19	39	25	47	31	47	31	154
1928	1-Dec	0	0	4	3	7	6	16	13	31	25	36	30	37	30	37	30	37	30	122
1929	13-Dec	0	0	0	0	0	0	17	16	17	16	17	16	17	16	17	16	17	16	109
1930	15-Jan	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	76
1931	6-Jan	0	0	9	11	11	13	32	38	44	52	49	58	49	58	49	58	49	58	85
1932	1-Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	122
1933	1-Jan	0	0	2	2	2	2	2	2	2	2	2	2	5	6	7	8	7	8	90
1934	2-Dec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
1947	29-Nov	9	7	25	20	48	39	54	44	54	44	55	45	55	45	55	45	55	45	123
1948	26-Feb	0	0	3	9	3	9	4	11	4	11	4	11	4	11	11	31	12	34	35
1949	31-Dec	0	0	1	1	1	1	15	16	15	16	18	20	18	20	20	22	23	25	91
1950	13-Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4	78
1951	2-Nov	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	150
1959	6-Jan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85
1960	16-Jan	0	0	4	5	4	5	4	5	4	5	4	5	4	5	5	7	5	7	76
1961	4-Dec	1	1	21	18	50	42	73	62	76	64	76	64	76	64	76	64	76	64	118
1962	5-Dec	33	28	52	44	53	45	54	46	54	46	57	49	57	49	58	50	58	50	117
1963	15-Oct[2]	34	20	66	39	94	56	96	57	97	58	100	60	100	60	100	60	100	60	168
Total Days		87		198		285		384		416		449		462		483		490		1,919
Percent of Total Days with Potential Risk			5		10		15		20		22		23		24		25		26	

[1]High Risk defined as days when streamflow at Near Carmel station is less than or equal to 1 cfs, following day with first migration of fish past the Narrows.
[2]Estimates for 1963 from simulation used for Draft Allocation Report, estimate at Cal-Am production of 16,700 acre-feet interpolated from estimates at 16,000 and 18,000 acre-feet.

Source: CVSIM; Monterey Peninsula Water Management District, 1989.

Under Supply Option I, juveniles would be at risk about one-quarter of the time during these four periods. More important is the sequence of risks during the periods from 1927 to 1929 and from 1961 to 1963. For example, from 1961 to 1963, juveniles were subjected to risks for periods ranging from 57 to 100 days each year. During the 1975 to 1981 period, the number of days with significant risk ranged from six days in 1978 to 129 days in 1976, and in six of these years the risk lasted at least 20 days each year (Table IV-26).

Table IV-27 lists April and May flows, average April through May flows, and ratings of the quality of those flows for emigrating smolts in the Carmel River. With current Cal-Am production, spring flows would have most constrained the emigration of smolts during five back-to-back years from 1930 to 1934. The pattern of conditions during these years, poor, zero, critical, critical, and critical, would have impacted the run for several years following the 1930s drought by reducing returns of adult steelhead, probably to remnant levels. The pattern of emigration conditions from 1959 to 1962 would have damaged the adult run for two or three years, but may not have reduced the run to remnant levels because the dry spell lasted only three years.

Table IV-28 lists the impact of increasing production on the problem created by the operation of the spillway gates at San Clemente Dam. Cal-Am is permitted to raise the gates at San Clemente as early as March 15 of below normal, dry, and critical years, and as early as April 15 of normal and above years. After the gates are raised in the CVSIM simulation, flows in the river below San Clemente Dam drop precipitously, the emigration of juveniles past the dam is probably delayed as San Clemente Reservoir fills, and the smolts in the lower river may be subjected to higher mortality due to stranding or predation.

Although average spring flows listed in Table IV-28 were often greater than zero in many of the dry spells, there were cases with zero flows in the lower river following closure of the spill gates. As Cal-Am production increases from 10,000 to 20,500 acre-feet, the time period with zero flows in the lower river increases and this increases the risk that the emigration of smolts would be jeopardized. According to the CVSIM simulation, current Cal-Am production and the current operation of the spill gates combine to increase the risk and reduce the success of smolt emigration during droughts. For example, the flow was zero for 19 days during April and May of 1959, 13 days during 1960, and 46 days during 1961. Similarly, the flow was zero for 46 days during 1947 and 23 days during 1948.

Figure IV-9 illustrates the periods in which flow conditions constrained smolt emigration during three historical droughts (1927 to 1934; 1947 to 1951; and 1959 to 1962).

TABLE IV-27
MEAN FLOWS INTO CARMEL RIVER LAGOON AND RATING OF SUCCESS OF SMOLT EMIGRATION
During Three Historic Droughts with Cal-Am Production from 10,000 to 20,500 acre-feet

	Mean April Flow into Lagoon with Production:									Mean May Flow into Lagoon with Production:								
Year	10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500	10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500
1927	109.9	107.6	105.2	102.9	102.0	100.5	100.0	98.2	97.6	59.2	55.9	52.7	49.4	48.4	46.4	45.9	43.8	43.4
1928	164.4	162.0	159.7	157.3	156.5	154.9	154.5	152.6	152.0	9.5	7.2	6.6	6.1	5.9	5.7	5.5	4.8	4.6
1929	51.5	49.1	46.8	44.4	43.7	42.6	42.3	40.9	40.5	9.1	6.7	5.1	4.3	4.0	3.8	3.7	3.4	3.2
1930	30.0	27.5	25.4	23.7	23.2	22.3	22.0	16.6	16.5	5.0	2.9	2.2	1.9	1.9	1.9	1.9	1.1	0.5
1931	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1932	22.8	20.3	18.0	16.4	15.9	14.8	14.5	13.5	13.1	6.2	4.2	3.5	3.3	2.9	2.4	2.4	1.7	1.5
1933	5.3	3.9	2.6	1.6	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1934	22.7	20.7	19.4	18.0	17.6	16.8	16.5	15.5	15.2	1.7	1.3	1.3	1.1	1.0	0.8	0.8	0.5	0.5
1947	16.1	13.5	11.7	5.2	2.9	2.1	2.1	0.0	0.0	2.7	1.4	1.0	0.9	0.2	0.2	0.0	0.0	0.0
1948	98.6	84.1	58.2	35.7	30.3	24.4	23.7	21.9	21.9	22.7	19.5	16.2	7.9	5.4	1.1	1.1	1.1	1.1
1949	74.3	72.0	69.6	67.3	66.4	64.9	59.8	31.8	28.5	8.9	5.9	4.1	3.6	3.4	3.3	3.3	1.1	1.1
1950	77.9	75.6	73.2	70.8	68.8	62.7	60.5	48.8	43.8	19.7	16.5	13.3	11.3	10.8	10.2	10.1	8.6	6.8
1951	27.3	24.8	23.0	21.5	21.0	20.1	19.8	18.6	18.3	26.0	22.7	18.7	14.7	13.4	12.2	12.0	11.4	11.3
1959	19.3	16.8	14.5	13.1	12.7	11.8	11.6	10.5	10.1	7.7	4.8	3.0	2.4	2.3	2.2	2.1	1.9	1.8
1960	22.7	20.2	17.7	15.2	11.2	10.2	8.7	5.4	2.7	17.9	14.7	11.9	9.7	8.9	7.5	7.2	2.5	2.5
1961	5.8	4.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	71.2	69.0	67.0	65.1	64.4	58.3	53.2	36.7	31.2	18.8	15.5	12.3	9.8	9.6	9.2	9.1	3.7	3.5

	Mean April through May Flow into Lagoon with Production:									Rating of Spring Flows for Emigrating Smolts								
Year	10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500	10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500
1927	84.6	81.7	78.9	76.1	75.2	73.5	73.0	71.0	70.5	good	good	good	good	good	good	good	good	good
1928	86.9	84.6	83.1	81.7	81.2	80.3	80.0	78.7	78.3	good	good	good	good	good	good	good	good	good
1929	30.3	27.9	25.9	24.4	23.9	23.2	23.0	22.1	21.8	fair	fair	fair	fair	fair	fair	fair	fair	fair
1930	17.5	15.2	13.8	12.8	12.6	12.1	11.9	8.8	8.5	poor	poor	poor	poor	poor	poor	poor	crit	crit
1931	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	crit	zero	zero	zero	zero	zero	zero	zero	zero
1932	14.5	12.2	10.8	9.8	9.4	8.6	8.5	7.6	7.3	poor	poor	poor	poor	crit	crit	crit	crit	crit
1933	2.7	2.0	1.3	0.8	0.1	0.1	0.1	0.0	0.0	crit	crit	crit	crit	crit	crit	crit	zero	zero
1934	12.2	11.0	10.3	9.5	9.3	8.8	8.7	8.0	7.8	poor	poor	poor	crit	crit	crit	crit	crit	crit
1947	9.4	7.5	6.3	3.1	1.6	1.2	1.1	0.0	0.0	crit	crit	crit	crit	crit	crit	crit	zero	zero
1948	60.7	51.8	37.2	21.8	17.9	12.7	12.4	11.5	11.5	good	good	fair	fair	poor	poor	poor	poor	poor
1949	41.6	38.9	36.9	35.4	34.9	34.1	31.5	16.4	14.8	good	fair	fair	fair	fair	fair	fair	poor	poor
1950	48.8	46.0	43.3	41.1	39.8	36.5	35.3	28.7	25.3	good	good	good	good	good	fair	fair	fair	fair
1951	26.6	23.7	20.9	18.1	17.2	16.1	15.9	15.0	14.8	fair	fair	fair	poor	poor	poor	poor	poor	poor
1959	13.5	10.8	8.7	7.8	7.5	7.0	6.8	6.2	5.9	poor	poor	crit	crit	crit	crit	crit	crit	crit
1960	20.3	17.4	14.8	12.5	10.0	8.8	7.9	4.0	2.6	fair	poor	poor	poor	poor	crit	crit	crit	crit
1961	2.9	2.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	crit	crit	crit	zero	zero	zero	zero	zero	zero
1962	45.0	42.2	39.7	37.4	37.0	33.7	31.2	20.2	17.4	good	good	good	fair	fair	fair	fair	fair	poor

Ratings of smolt emigration flow(April through May) based on following criteria:

Excellent	flow >= 100 cfs
Good	flow 40 - 99 cfs
Fair	flow 20 - 39 cfs
Poor	flow 10 - 19 cfs
Critical	flow 0.1 < 10 cfs
Zero	flow 0.0

Source: CVSIM; Monterey Peninsula Water Management District, 1989.

TABLE IV-28

NUMBER AND PERCENTAGE OF DAYS WITH ZERO FLOW IN LOWER CARMEL RIVER During Three Historic Droughts

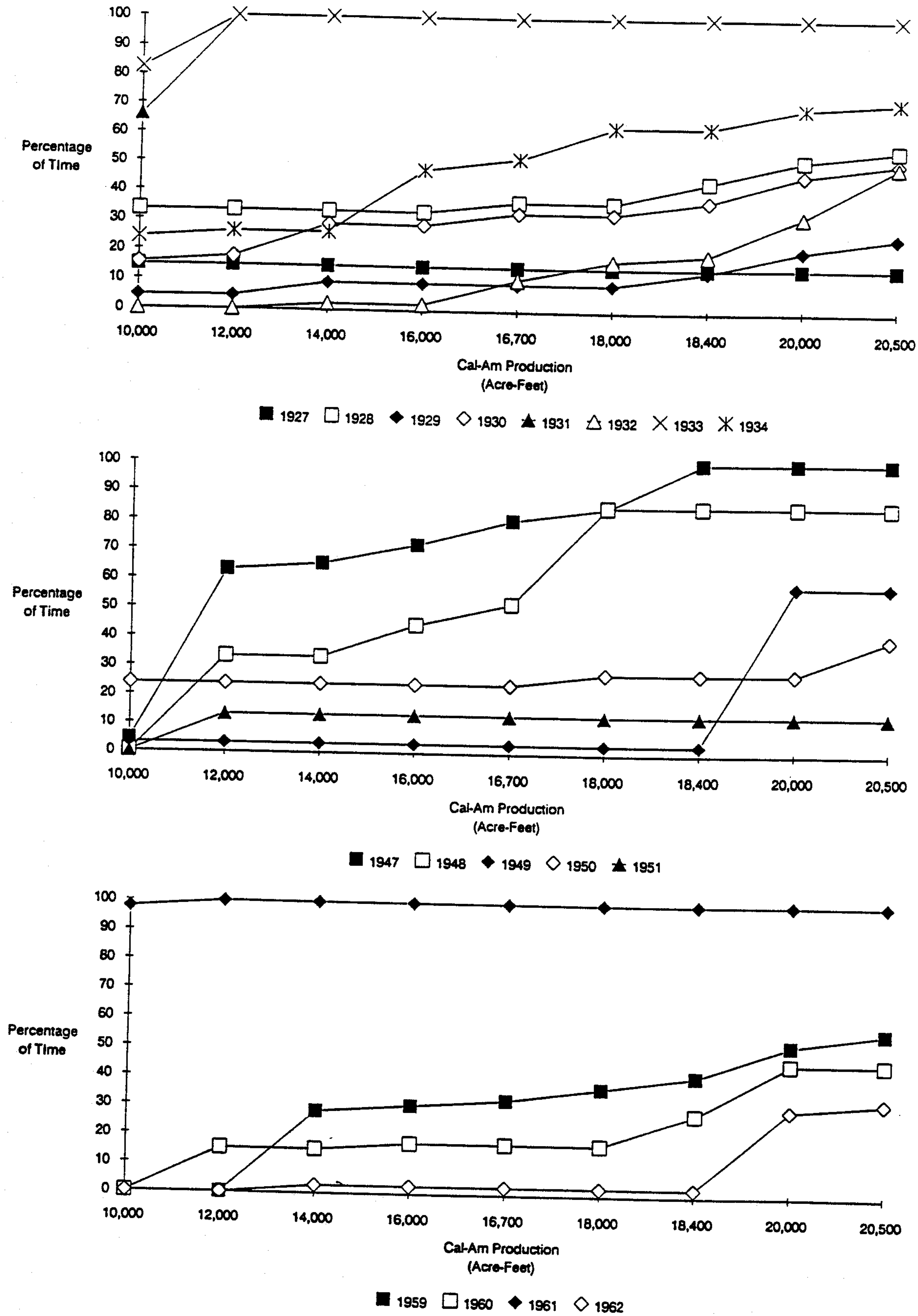
Water Year	Date of Closure of Gates	Number of Days With Cal-Am Production Ranging from 10,000 to 20,500 acre-feet								
		10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500
1927	15-Apr	7	7	7	7	7	7	7	7	7
1928	5-May	9	9	9	9	10	10	12	14	15
1929	19-Apr	2	2	4	4	4	4	6	9	11
1930	17-Apr	7	8	13	13	15	15	17	21	23
1931	15-Apr	31	47	47	47	47	47	47	47	47
1932	16-Apr	0	0	1	1	5	8	9	15	23
1933	16-Apr	38	46	46	46	46	46	46	46	46
1934	16-Apr	11	12	12	22	24	29	29	32	33
1947	16-Apr	2	29	30	33	37	39	46	46	46
1948	5-May	0	9	9	12	14	23	23	23	23
1949	1-May	1	1	1	1	1	1	1	18	18
1950	7-May	6	6	6	6	6	7	7	7	10
1951	17-Apr	0	6	6	6	6	6	6	6	6
1959	16-Apr	0	0	13	14	15	17	19	24	26
1960	16-Apr	0	7	7	8	8	8	13	21	21
1961	16-Apr	45	46	46	46	46	46	46	46	46
1962	25-Apr	0	0	1	1	1	1	1	11	12

Water Year	Percentage of Time with Zero Flow								
	10,000	12,000	14,000	16,000	16,700	18,000	18,400	20,000	20,500
1927	15	15	15	15	15	15	15	15	15
1928	33	33	33	33	37	37	44	52	56
1929	5	5	9	9	9	9	14	21	26
1930	16	18	29	29	33	33	38	47	51
1931	66	100	100	100	100	100	100	100	100
1932	0	0	2	2	11	17	20	33	50
1933	83	100	100	100	100	100	100	100	100
1934	24	26	26	48	52	63	63	70	72
1947	4	63	65	72	80	85	100	100	100
1948	0	33	33	44	52	85	85	85	85
1949	3	3	3	3	3	3	3	58	58
1950	24	24	24	24	24	28	28	28	40
1951	0	13	13	13	13	13	13	13	13
1959	0	0	28	30	33	37	41	52	57
1960	0	15	15	17	17	17	28	46	46
1961	98	100	100	100	100	100	100	100	100
1962	0	0	3	3	3	3	3	30	32

Source: CVSIM; Monterey Peninsula Water Management District, 1989.

FIGURE IV-9

PERCENTAGE OF TIME WITH ZERO FLOWS
Carmel River Lagoon



Impacts: Because current Cal-Am production of 18,400 acre-feet will likely lead to a remnant run of adult steelhead downstream of San Clemente Dam by increasing the risk that juveniles would be stranded in fall and early winter, and by reducing the success of smolt emigration, Supply Option I would result in a significant adverse impact.

Mitigation Measures: Several measures could be implemented to mitigate the impacts of Supply Option I. These include the following:

- If additional sediment enters Los Padres and San Clemente Reservoirs and reduces the ability to maintain flows upstream of the Narrows, a permanent, fully-funded program to rescue juveniles would be instituted. The goal of this program would be to rescue juveniles from the reach between Robles Del Rio and the Narrows and to transplant them into the reach between Robles Del Rio and San Clemente Dam, if habitat is available there, or into a holding facility below San Clemente Dam. Either of these options would probably require that juveniles be fed and the facilities be maintained on a daily basis. As discussed under Section B, "Surface and Groundwater Resources," the effect of reservoir sedimentation on streamflow could be offset to a limited degree by dredging Los Padres and San Clemente reservoirs to their original storage capacities.

- Partial reconstruction of the fish ladder at San Clemente Dam and a change in the operation of the spillway gates to allow adult steelhead to pass upstream and juvenile steelhead to pass downstream without being interrupted by lowering or raising the gates.

- Additional modifications to the downstream end of the spillway at Los Padres Dam to keep steelhead smolts and kelts from being impinged against the exposed bedrock below the spillway chute.

- If additional sediment enters Los Padres and San Clemente Reservoirs and reduces the ability to maintain flows upstream of the Narrows, drilling of new wells in Subbasin AQ4 to increase Cal-Am production capacity during drought years and eliminate pumping from AQ2, except during years when unimpaired runoff does not exceed the 12.5 percentile rank.

- Expansion of the program to capture and transport smolts downstream during critical years which is being implemented as part of a cooperative agreement by MPWMD and Cal-Am. Under the current agreement, this program is required only in critical years.

- A program to prevent stranding of early fall and winter migrants by capturing them whenever such a risk exists.

- A program to attract adults into the Lagoon and transport them upstream of the Narrows. In many Februarys, streamflow would be sufficient for adult migration upstream of the Narrows, but insufficient into the Lagoon for attracting adults into the river. This program would attract adult steelhead into the Lagoon by creating artificial freshets with a system of pumps.

Successful implementation of these mitigation measures would possibly result in a viable steelhead run in the Carmel River under Supply Option I. The mitigated impact of Supply Option I would, therefore, be potentially significant.

Supply Option II: 20,000 Acre-feet (Current Water Supply Capacity)

The application of monthly flow criteria indicates that increasing Cal-Am production from 18,400 to 20,000 acre-feet would result in one additional February and two additional Marches when migration would be constrained. The application of daily flow criteria during the late 1940s drought indicates that an increase in production from 18,400 to 20,000 acre-feet would not impact flows which attract steelhead into the river, but slightly increases the risk that steelhead would be isolated in pools after they migrate into freshwater (see Table IV-23, February 1950).

Based on this information, it appears that increasing production from 18,400 to 20,000 acre-feet would further reduce opportunities for upstream migration.

The application of monthly flow criteria indicates that increasing Cal-Am production from 18,400 to 20,000 acre-feet would have no significant impact on opportunities for adult spawning. At 18,400 and 20,000 acre-feet production, no spawning would occur during eight Februarys and Marches (Table IV-24).

Increasing Cal-Am production from 18,400 to 20,000 acre-feet would result in flow less than one cubic feet per second at the Narrows during 8 percent of the years in the hydrologic record, if no additional sediment entered Los Padres Reservoir. As with Cal-Am production of 18,400 acre-feet, the impact to summer rearing habitat depends on preventing any further loss of reservoir storage. If large volumes of sediment enter Los Padres and San Clemente during the next 10 to 15 years, the production level of 20,000 acre-feet would significantly impact rearing habitat upstream of the Narrows. In the worst-case scenario--Option B listed in Table IV-25 and illustrated in Figure IV-8--rearing habitat would be eliminated in 45 percent of the years. As illustrated in Figure IV-8, the risk to juveniles upstream of the Narrows increases as Cal-Am production increases. Depending upon the amount of sediment stored in Los Padres, the risk to juvenile rearing habitat with a Cal-Am production level of 20,000 acre-feet may be unacceptable. Because of the uncertainty regarding erosion and the loss of reservoir storage, it is not possible to conclusively determine the impact of the Cal-Am production level of 20,000 acre-feet on juvenile rearing habitat.

Increasing production from 18,400 to 20,000 acre-feet would slightly increase the risk that juveniles would be stranded in the lower river following late fall and early winter storms. The overall percentage of days with risk increases only from 24 percent to 26 percent, but there are major impacts in specific years. For example, the number of days with risk increases from 4 to 11 during 1948 and from 39 to 47 during 1927. The impact of these changes would be to further reduce the overall success of downstream emigration by interrupting, delaying, and stranding juveniles while they move downstream.

Increasing Cal-Am production from 18,400 to 20,000 acre-feet per year would exacerbate problems for emigrating smolts. For example, during the 1930s drought the quality of flow conditions is reduced from a pattern of poor, zero, critical, critical, and critical during 1930, 1931, 1932, 1933, and 1934 to a pattern of critical, zero, critical, zero, and critical when production increases to 20,000 acre-feet (Table IV-27). In addition, increases to 20,000 acre-feet usually increases the percent of time during April and May when flows into the Lagoon decline to zero. For example, in 1960 the percentage of time with zero flow increases from 28 percent at 18,400 to 64 percent at 20,000 acre-feet (Table IV-28).

The emigration conditions at a production level of 20,000 acre-feet is severe enough to result in remnant level runs of steelhead into the Carmel River Basin. Steelhead resources cannot withstand several years in a row with critical or zero emigration conditions without being reduced to very low levels. This problem is not unique to the Carmel Basin. Several large streams, including the Santa Clara, Santa Ynez, Ventura, and Salinas River Basins, which once had substantial runs and still have some potential to produce juvenile steelhead, do not have consistent, viable steelhead runs because critical conditions for downstream emigration occur during too many years.

Impacts: Supply Option II would significantly impact the steelhead resource in the Carmel River because it increases the risk that juveniles would be stranded in fall and early winter, reduces the success of smolt emigration, and possibly reduces the juvenile rearing habitat between the Narrows and Robles Del Rio. This would reduce the run downstream of San Clemente Dam to remnant levels. Supply Option II would also reduce the run of adults upstream of San Clemente Dam to remnant levels by increasing the risk that juveniles would be stranded during fall and early winter, and by reducing the success of smolt emigration.

Mitigation Measures: The measures listed under Supply Option I could be implemented to mitigate the impacts of Supply Option II. Successful implementation of these measures could possibly result in a viable steelhead run in the Carmel River under Supply Option II. The mitigated impact would, therefore, be potentially significant.

Supply Option III: 20,500 Acre-feet (Modified Water Supply Capacity)

The application of monthly flow criteria indicates that increasing Cal-Am production from 20,000 to 20,500 acre-feet would not further constrain migration conditions (Table IV-22).

The application of daily flow criteria during the late 1940s drought indicates that a production level of 20,500 acre-feet would impact flows which attract steelhead into the river by reducing the number of pulses in some years would increase the risk that steelhead would be isolated in pools after they had migrated into freshwater.

The application of monthly flow criteria indicates that increasing Cal-Am production from 20,000 to 20,500 acre-feet has no significant impact on opportunities for adult spawning (Table IV-24).

Increasing Cal-Am production to 20,500 acre-feet results in flows less than one cubic feet per second at the Narrows during 10 percent of the years in the hydrologic record (Figure IV-8). With the assumption that no more sediment enters Los Padres Reservoir, production of 20,500 does not result in any sequences of three years in a row with zero habitat. With an assumption of 20 acre-feet entering Los Padres, however, a production of 20,500 would reduce rearing habitat in 57 percent of the record. As with the impact of production at 20,000 acre-feet, it is not possible to conclusively determine the impact of 20,500 acre-feet of production on juvenile rearing because this depends on how quickly Los Padres fills with sediment.

Increasing production from 20,000 to 20,500 acre-feet slightly increases the risk that juveniles would be stranded in the lower river following late fall and early winter storms. The overall percentage of days with risk increases from 25 percent to 26 percent (Table IV-26). The overall success of smolt migration to the ocean would be reduced by interrupting, delaying, and stranding juveniles while they migrate downstream.

Increasing production from 20,000 to 20,500 acre-feet exacerbates problems for emigrating smolts in some years by reducing spring flows and increasing the percentage of time with zero flow in the lower river (Tables IV-27 and IV-28). For example, the number of days with zero flows in the lower river increases from 7 to 10 days in 1950 and from 15 to 23 days in 1932 (Table IV-28). The impact of increasing production from 20,000 to 20,500 acre-feet would be to further increase the risk that the success of smolt emigration would be reduced. Considering that the risk for emigrating smolts at 20,000 acre-feet probably leads to a remnant run means that at 20,500 acre-feet the reduction to remnant status would probably occur sooner and the number of fish in the remnant run would be lower.

Impacts: Supply Option III would significantly impact the steelhead resource in the Carmel River because it increases the risk that juveniles would be stranded in fall and early winter, reduces the success of smolt emigration, and possibly reduces juvenile rearing habitat between the Narrows and Robles del Rio. This would reduce the run downstream of San Clemente Dam to remnant levels. Supply Option III would also reduce the run of adults upstream of San Clemente Dam to remnant levels by increasing the risk that juveniles would be stranded during fall and early winter, and by reducing the success of smolt emigration.

Mitigation Measures: The measures listed under Supply Option I could be implemented to mitigate the impacts of Supply Option II. Successful implementation of these measures could possibly result in a viable steelhead run in the Carmel River under Supply Option III. The mitigated impact would, therefore, be potentially significant.

Supply Option IV: 17,500 Acre-Feet (Minimum Fish Protection Production)

Supply Option IV is defined as the minimum Cal-Am production level which protects the steelhead population. A determination of this requires consideration of what is meant by "least damaging" or "protection." The following paragraphs explain the criteria used to define these concepts.

Production Level Causing "No Harm" to the Steelhead Population

Resource protection can be defined as the set of environmental conditions which can continue without harming a resource or permanently reducing it to some lower level. In this context, protection of the steelhead population in the Carmel River would mean defining the circumstances under which diversions from the river could continue with "no harm" to steelhead. In an October 11, 1983, letter to District Manager Bruce Buel, biologist Don Kelley considered this question in relation to the diversion at San Clemente Dam and concluded that a properly screened diversion could be used without significant harm to steelhead, so long as it was restricted to periods when the flow at the Carmel gauge remained greater than 200 cubic feet per second from November 1 through June and 100 cubic feet per second from July through October. These constraints would restrict diversion to winter periods of high flow. Production that could be met with such constraints would be very low, ranging from zero acre-feet in dry and critical years to about 9,000 acre-feet (approximately 49 percent of the current Cal-Am production of 18,400 acre-feet) in the wettest years.

Without the importation of water from some unknown source, it is unrealistic to base a definition of protection for steelhead on the concept of "no significant" harm. Based on the available evidence, it appears that some level of harm must be accepted. A major question is how much harm can be tolerated and still meet the goal of the State's steelhead policy which is to maintain a vigorous, healthy population of returning adults with natural reproduction.

Production Levels Associated with a Healthy, Vigorous Steelhead Population--The Minimum Fish Protection Production Level

In the previous section, the impacts on the steelhead population of increasing production to 20,000 or 20,500 acre-feet were assessed by examining how production affected five key portions of the steelhead life cycle in the Carmel River. A similar approach can be used to define levels of Cal-Am production which promote the consistent production of smolts which in turn would lead to viable runs of adult steelhead.

To begin developing an estimate of the minimum fish protection supply option, flow criteria for each life history stage were applied to simulated flows with Cal-Am production ranging from 10,000 to 18,400 acre-feet. For each portion of the life cycle, a determination was made of the production level which resulted in a risk of producing historical periods in which there would be three sequential years of conditions which would lead to three years of remnant level smolt production. This production was then selected as the level not to exceed without producing a risk that the population would be reduced to remnant levels. If none of the production levels were associated with a risk of producing remnant runs, then the highest level of production was judged acceptable. After flow criteria were applied to each of the five life history phases, the most restrictive of the five was selected as the minimum fish protection level of production.

Production Level Associated with Viable Runs Based on Adult Upstream Migration

After a preliminary review of upstream migration opportunities during 87 years of the hydrologic record, the historical period from 1947 through 1951 was chosen as the most restrictive for adult migration. Table IV-23 outlines the effect of increasing production on adult upstream migration during these years. This information indicated there is little risk that production levels as high as 20,500 acre-feet would result in three years with critical or zero ratings for adults during the entire migration season. However, production levels as low as 12,000 acre-feet created zero or critical opportunities for upstream migration in three sequential Januarys and those as low as 16,000 created critical or zero opportunities in three Februarys (Table IV-23, see 1947, 1948, and 1949). For these reasons, 14,000 acre-feet was selected as the production level associated with viable upstream migration conditions.

Production Level Associated with Viable Runs Based on Spawning Habitat

The production of remnant runs of adult steelhead due to insufficient spawning habitat is unlikely because most of the spawning habitat in the Carmel Basin is thought to be upstream of San Clemente Dam and is probably not influenced by increases in production which affect spawning habitat between the Narrows and Robles del Rio.

The portion of the steelhead population returning to the habitat between the Narrows and Robles del Rio could be influenced by insufficient opportunities for spawning. Table IV-24 summarizes the effects of increasing production on spawning habitat below San Clemente Dam. This information indicates remnant conditions are not produced by production levels up to 20,500 acre-feet. For this reason, 20,500 acre-feet was selected as the production level associated with viable spawning conditions (Table IV-29).

TABLE IV-29

SUMMARY OF PRODUCTION AND CONDITIONS SUPPORTING VIABLE STEELHEAD RUNS

Life History Stage	Production Resulting in a Remnant Run	Recommended Production not to Exceed (acre-feet)
Adult Migration	unknown	14,000
Adult Spawning	unknown	20,500
Juvenile Rearing*	18,000 to 20,500	17,500
Risk of Stranding Juveniles in Fall and Winter	14,000	14,000
Smolt Emigration	14,000 to 16,000	14,000

Recommended Production for Minimum Fish Protection

17,500 ACRE-FEET PER YEAR with the successful implementation of the mitigation measures outlined under the discussion of Supply Option I.

14,000 ACRE-FEET PER YEAR without the successful implementation of the mitigation measures discussed under Supply Option I.

*Range producing remnant run based on juvenile rearing depends on frequency and magnitude of sediment entering Los Padre reservoir. Production up to 20,500 acre-feet may be tolerated if a dredging program maintains the current storage in Los Padres.

Source: Monterey Peninsula Water Management District, 1989.

Production Level Associated with Viable Runs Based on Juvenile Rearing

The quality and quantity of summer rearing habitat between the Narrows and Robles del Rio is an important factor in determining the return of steelhead to the Carmel River downstream of Robles del Rio. It may also influence the adult run upstream of San Clemente Dam, because some juveniles that rear upstream of the Dam spend an additional summer rearing in habitat between the Narrows and Robles del Rio, particularly during years when the normal springtime emigration is interrupted by low spring flows. For this reason, it is appropriate to examine summer conditions between the Narrows and Robles del Rio as a factor which influences the steelhead run into the Carmel River.

Table IV-25 lists and Figure IV-8 illustrates the effect of increasing production on juvenile rearing habitat between the Narrows and Robles del Rio. The finding that the Cal-Am production level does not produce a sequence of three back-to-back years with zero rearing habitat depends on the frequency and magnitude of sediment entering Los Padres Reservoir. For the purposes of determining the minimum level of production providing protection for the steelhead, the safest method is to determine the level of production which does not depend on an assumption that Los Padres Reservoir would be dredged. With this in mind it appears that production levels as low as 10,000 acre-feet are associated with two cases in which summer habitat between the Narrows and Robles del Rio is eliminated for at least three sequential years.

Following the approach outlined at the beginning of the section, a production level less than 10,000 acre-feet should be selected for juvenile rearing. While this is appropriate for the portion of the population downstream of Robles del Rio, it is not appropriate based on a consideration of the entire run because not all of the progeny from upstream spawners spend an additional summer rearing in the reach between the Narrows and Robles del Rio. A production level of 17,500 acre-feet was selected as acceptable for juveniles (Table IV-29). Above this level there is a dramatic increase in the number of years and duration of cases with zero habitat between the Narrows and Robles del Rio (Table IV-25 and Figure IV-8).

Production Level Associated with Viable Runs Based on the Risk of Stranding Juveniles in Fall and Early Winter

The risk of stranding juveniles below the Narrows probably influences the steelhead run returning to the Carmel River Basin. All juveniles must at sometime emigrate through this reach on their way to the ocean. For this reason, it is appropriate to examine the risk that juveniles would be stranded by low flow conditions following their migration downstream past the Narrows, before they enter the ocean, and before the lower aquifer Subbasins AQ3 and AQ4 are fully recharged.

Table IV-26 list the number of days that juveniles are at risk of stranding during three key historical drought periods. The historical droughts were chosen because they represent periods with the highest chance that juveniles would be stranded. The number of days or percentage of time with high risk that can be tolerated by the steelhead population is unknown. But, it is reasonable to assume, if more than 50 percent of the period between the date of first migration and March 31 have a high risk, then a large portion of the juveniles migrating downstream during this period would be harmed.

The period from water year 1961 to 1963 is the most harmful. Even at 12,000 acre-feet of production there are many days of low flows during the fall and early winter months. Production levels exceeding 14,000 acre-feet produce long periods with high risks during the 1961 to 1963 period and usually increase the extent and duration of the risk during the other droughts (Table IV-26). For this reason, production not exceeding 14,000 acre-feet was selected as acceptable for this portion of the steelhead life cycle (Table IV-29).

Production Level Associated with Viable Runs Based on Conditions for Smolt Emigration

A determination of the production which produces viable runs based on emigration conditions is important because the survival of the entire annual production of smolts can be jeopardized by the withdrawal of subsurface flows and groundwater in the lower Carmel River. As production of water from the lower aquifers increases, the frequency and magnitude of spring flows in the lower river would be reduced and in some cases eliminated. If this occurs too often, especially in back-to-back years, the returns of adult steelhead would be reduced to remnant levels.

Tables IV-27 and IV-30 list and Figure IV-9 illustrates the problems encountered by emigrating smolts during three historical droughts. The ratings of emigration conditions in Table IV-27 indicate that a production level of only 10,000 acre-feet produced poor or critical conditions during five consecutive years of the 1927 to 1934 drought. The population probably could have sustained itself with this set of conditions because the critical years were separated by years with poor conditions. At productions greater than or equal to 18,000 acre-feet, there were two cases

(1959-1961 and 1931-1934) with three or more years of back-to-back critical or zero emigration conditions. Even at 16,000 acre-feet of production, the conditions during 1959, 1960, and 1961 narrowly surpassed a rating of critical, critical, and zero. Production exceeding 14,000 acre-feet usually increased the number of days and percent of time with zero flow in the lower Carmel River (Table IV-28 and Figure IV-9). This is serious because the zero flow periods coincide with periods when the seaward migration of smolts is interrupted for several days to weeks by the closure of the flood gates at San Clemente. This information indicates that the survival of steelhead smolts would be reduced by production levels ranging from 14,000 to 16,000 acre-feet per year. For this reason, a production not exceeding 14,000 acre-feet per year was selected as acceptable for the smolt emigration (Table IV-29).

Summary of the Acceptable Production Levels and Selection of the Minimum Acceptable Fish Protection Production Level

Table IV-29 summarizes the production levels which were selected as acceptable for preventing conditions that would result in a remnant run of adult steelhead based on five portions of the steelhead life cycle in the Carmel River Basin. It is important to note that even with these production levels there would be several periods during future years in which the runs would be at low levels. The population should, however, rebound following these periods.

If the minimum fish protection production level is defined as the level which prevents the steelhead population from being reduced to remnant levels, then a production of 14,000 acre-feet should not be exceeded because a higher production level would damage conditions for smolt emigration and place the early fall and winter downstream migrants at high risk.

Impacts: Cal-Am production of 17,500 acre-feet would likely lead to a remnant run of adult steelhead downstream of San Clemente Dam by increasing the risk that juveniles would be stranded in fall and early winter, and by reducing the success of smolt emigration. Supply Option IV would, therefore, result in a significant adverse impact.

Mitigation Measures: The measures listed under Supply Option I could be implemented to mitigate the impacts of Supply Option IV. Successful implementation of these measures would result in a viable steelhead run. The mitigated impact of Supply Option IV would, therefore, be less-than-significant.

Supply Option V: 16,700 Acre-feet (Environmentally Least Damaging Production)

One option the Monterey Peninsula Water Management District Board of Directors is considering is to reinvest the water savings from conservation programs into drought reserve. This would reduce Cal-Am production by nine percent from the current 18,400 acre-feet to 16,700 acre-feet per year.

The application of monthly flow criteria for upstream migration indicates that reducing Cal-Am production from 18,400 to 16,700 acre-feet would improve migration conditions during three Januarys (Table IV-22). This would reduce the risk that the early part of steelhead run would be lost, but it would not eliminate the risk because the risk is high at production levels as low as 12,000 acre-feet.

The application of daily flow criteria during the late 1940s drought indicates that reducing production to 16,700 acre-feet sometimes increases streamflow between winter storms and improves conditions for migrating adult steelhead. For example, in march 1947 this reduction reduces the rating for upstream migration from zero to critical and conserves the only opportunity for successful migration (Table IV-23). Although the reduced production improves conditions in some months, there still are sequences of three years when February is without opportunities for successful upstream migration. This would probably reduce the run of adults in the middle of the migration season.

The application of monthly flow criteria indicates that reducing Cal-Am production to 16,700 has no significant impact on opportunities for adult spawning (Table IV-24).

Reducing Cal-Am production to 16,700 acre-feet per year results in flows less than one cubic feet per second at the Narrows during between one and eight percent of the years in hydrologic record, depending on the assumption of how much sediment enters Los Padres Reservoir (Table IV-25 and Figure IV-8). This production reduces the frequency and duration of cases with more than three back-to-back years to insignificant levels, even without a program to dredge and maintain storage in Los Padres Reservoir.

Reducing Cal-Am production to 16,700 acre-feet significantly reduces the risk that juveniles would be stranded in some years, but the overall impact to juveniles during the fall and winter months is not reduced to levels of non-significance. For example, in 1927 the number of days with risk is reduced from 30 days at 18,400 acre-feet to 17 days at 16,700 acre-feet. There are, however, still unacceptable extended periods during 1961, 1962, and 1963 with a high risk of stranding.

The application of monthly and daily criteria for smolt emigration indicates that reducing Cal-Am production to 16,700 acre-feet improves conditions for smolts during two years (1950 and 1960), but produces unacceptable periods of critical and zero conditions in other years, particularly during the drought extending from 1930 to 1934.

Impacts: Cal-Am production of 16,700 acre-feet would likely lead to a remnant run of adult steelhead downstream of San Clemente Dam by increasing the risk that juveniles would be stranded in fall and early winter, and by reducing the success of smolt emigration. Supply Option V would, therefore, result in a significant adverse impact.

Mitigation Measures: The measures listed under Supply Option I could be implemented to mitigate the impacts of Supply Option V. Successful implementation of these measures would result in a viable steelhead run. The mitigated impact of Supply Option V would, therefore, be less-than-significant.

F. RECREATION

1. Methodology and Analysis

This section examines recreation potential under the water supply options based on information from the "Groundwater and Surface Water Resources," "Vegetation," "Fisheries," and "Wildlife" sections of this chapter. Impacts on recreation from the supply options can be classified as either direct or indirect. Water-dependent recreation, such as fishing, may be directly impacted when the quantity of water in the Carmel River and aquifer system changes. Indirect impacts can occur on the river corridor if water-enhanced recreation such as bird-watching, golfing, and hiking is affected by flows and drawdowns.

Both direct and indirect impacts are assessed by evaluating the effects of changes in river flows and riparian vegetation on sport fishing opportunities in the river, on recreational opportunities at Garland Ranch Regional Park, and on other recreation activities within the corridor that are enhanced by water or vegetation.

Fishing season for steelhead in the Carmel River occurs from November 15 to February 28. When flows at the Near Carmel gauging station are below 200 cubic feet per second, angling is prohibited. Currently, based on the results of CVSIM, the frequency of flows exceeding 200 cubic feet per second at the Near Carmel gauge ranges from 2 to 46 percent for the period November through February. Using this level as a benchmark, the water supply options are assessed for their impacts on potential fishing days.

Saving water through conservation and leaving the water in the Monterey Peninsula Water Resource System (MPWRS) may enhance riparian vegetation and streamflow.

2. Impacts and Mitigation Measures

Supply Option I: 18,400 Acre-Feet (Current Production)

Current conditions of streamflow and aquifer drawdown would remain unchanged from existing conditions under this option.

Riparian vegetation in Subbasins AQ2, AQ3, and part of AQ4 that is not presently irrigated is currently suffering stress under the 18,400 acre-foot supply level. Continuation of water withdrawals at the current level would lead to eventual decline and loss of non-irrigated vegetation relative to existing conditions. The loss of vegetation would affect recreation that is enhanced by the riparian vegetation, including bird-watching, fishing, and golf.

The potential number of fishing days from November 15 through February 28 would remain unchanged from existing conditions. The steelhead population may, however, be adversely affected by the continued loss of riparian vegetation, adversely affecting fishing recreation on all sections of the river.

Supply Option I would not affect recreation at Garland Ranch Regional Park.

Impacts: The impacts to recreation that would occur in Subbasins AQ2, AQ3, and part of AQ4 due to loss of riparian vegetation that is not currently irrigated would be significant.

Fishing recreation would be significantly affected by reductions in the fish stock caused by this supply option (see Section E, "Fisheries").

Mitigation Measures: Refer to the "Vegetation" section (Section C) for mitigation of adverse impacts on the riparian corridor and to the "Fisheries" section (Section E) for mitigation of adverse impacts on fish stocks.

Even with the successful implementation of these mitigation measures, the impacts of Supply Option I on recreation would be potentially significant. For purposes of CEQA, however, the impacts would have no environmental significance.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would involve an annual withdrawal of 20,000 acre-feet of water from the Carmel Valley aquifer and the Seaside Coastal Subbasin.

Garland Ranch Regional Park would be directly affected by Supply Option II. Due to aquifer storage at or near maximum levels, the river within the park frequently has pools of standing water during periods when other sections of the river are dry. During June through November, Supply Option II would cause these pools to dry up as much as 61 percent more often than under current conditions. These impacts would, however, be less-than-significant.

Supply Option II would not affect fishing recreation as compared to existing conditions based on the frequency of flows greater than 200 cfs.

This option would significantly affect non-irrigated riparian vegetation within Subbasin AQ3 and part of Subbasin AQ4 of the Carmel River corridor. Recreation along this section of river that is enhanced by the presence of riparian vegetation, including bird-watching, fishing, and golf, would be affected. The decline in riparian habitat would reduce the quantity and diversity of birds, resulting in diminished bird-watching opportunities. Loss of riparian vegetation may lead to loss of food for fish, consequently decreasing the fish population and reducing opportunities for fishing recreation. Golf courses overlying these subbasins include Carmel Valley Ranch, Carmel Valley Golf and County Club, and Rancho Canada Golf Club. The loss of riparian habitat would affect the visual quality of these golfing areas, potentially reducing players' enjoyment of the sport.

Impacts: Supply Option II would have less-than-significant impacts on recreation such as hiking and bird-watching at Garland Ranch Regional Park.

Supply Option II would have less-than-significant impacts on bird-watching recreation associated with Subbasin AQ3 and part of AQ4 because this section of the river corridor is not extensively used for bird-watching. Golfing at Carmel Valley Ranch, Carmel Valley Golf and Country Club, and Rancho Canada Golf Club would not be significantly impacted by changes in riparian vegetation.

Supply Option II would have a significant impact on fishing recreation based on the effect of this option on fish stocks (see Section E, "Fisheries").

Mitigation Measures: Refer to the "Vegetation" section (Section C) for mitigation for adverse impacts on riparian vegetation and to the "Fisheries" section (Section E) for mitigation of adverse impacts on the steelhead fishery.

Even with implementation of these mitigation measures, the impacts of Supply Option II on recreation would be potentially significant. For purposes of CEQA, however, these impacts would have no environmental significance.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Impacts: The impacts of Supply Option III would be similar, though slightly greater, to those of Supply Option II.

Mitigation Measures: The mitigation measures listed under Supply Option II would reduce the adverse impacts of Supply Option III; even with implementation of these mitigation measures, however, the impacts of Supply Option III on recreation would be potentially significant. For purposes of CEQA, however, these impacts would have no environmental significance.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Under Supply Option IV, the amount of water removed from the Monterey Peninsula Water Resource System would be less than under existing conditions.

Although this water supply option would lessen the effect on vegetation relative to Options I, II, and III, vegetation, aesthetics, and recreational use by children and adults would be affected by the continued decline in riparian vegetation. This impact is considered potentially significant, but could be mitigated by offering other recreational options.

Garland Ranch Regional Park would be directly affected by Supply Option IV. During periods of maximum aquifer storage in AQ2, the river channel within the park frequently has pools of standing water when other sections of the river are dry. During June through November, Supply Option IV would cause these pools to become dry one percent less often than under Supply Option I, which would be beneficial to water-enhanced recreation, such as hiking and bird-watching.

Under Supply Option IV the Carmel River steelhead fishery would remain above a remnant run, so the impacts on fishing recreation of this option would be less-than-significant.

This option would improve the riparian corridor compared with existing conditions. Non-irrigated riparian vegetation in Subbasins AQ3 and part of AQ4 would, however, still experience stress leading to decline relative to existing conditions.

Impacts: Recreation enhanced by the riparian vegetation would be adversely affected by the continued decline in riparian vegetation. Supply Option IV would have a significant impact on fishing recreation based on the effect of this option on fish stocks (see Section E, "Fisheries").

Mitigation Measures: Section C, "Vegetation," lists mitigation measures that would lessen recreation impacts related to riparian vegetation, but is unknown whether the impacts would be reduced to a less-than-significant level. For the purposes of CEQA, however, these impacts would have no environmental significance.

Section E, "Fisheries," lists mitigation measures that would reduce the recreation impacts related to diminished fish stocks to a less-than-significant level.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Under Supply Option V, the amount of water removed from the Monterey Peninsula Water Resource System would be less than under existing conditions.

Although this water supply option would lessen the effect on vegetation compared with the other supply options, vegetation, aesthetics, and recreational use by children and adults would be affected by the continued decline in riparian vegetation.

Garland Ranch Regional Park would be directly affected by Supply Option V. During periods of maximum aquifer storage in AQ2, the river channel within the park frequently has pools of standing water when other sections of the river are dry. During June through November, Supply Option V would cause these pools to become dry one percent less often than under Option I, which would be beneficial to water-enhanced recreation, such as hiking and bird-watching.

Under Supply Option V the Carmel River steelhead fishery would remain above a remnant run, so the impacts on fishing recreation of this option would be less-than-significant.

This option would improve the riparian corridor relative to existing conditions. However, non-irrigated riparian vegetation in Subbasins AQ3 and part of AQ4 would still experience some stress, but less than under Supply Option IV.

Impacts: Recreation enhanced by the riparian vegetation would be adversely affected by the continued decline in riparian vegetation. Supply Option V would have a significant impact on fishing recreation based on the effect of this option on fish stocks (see Section E, "Fisheries").

Mitigation Measures: Section C, "Vegetation," lists mitigation measures that would lessen recreation impacts related to riparian vegetation, but is unknown whether the impacts would be reduced to a less-than-significant level. For the purposes of CEQA, however, these impacts would have no environmental significance.

Section E, "Fisheries," lists mitigation measures that would reduce the recreation impacts related to diminished fish stocks to a less-than-significant level.

G. AESTHETICS

1. Methodology and Analysis

The water supply options have the potential to affect the views and aesthetic character of the Carmel River and its corridor by altering the quantity of flowing or standing water and by reducing available groundwater leading to loss of vegetation or other water-dependent features.

Changes in the magnitude of streamflow and the frequency of no-flow periods affects the aesthetic character of the valley. For example, flowing water or a dry river bed offers two different components of a view. It has been assumed, for the purposes of this analysis, that the presence of water enhances the aesthetic qualities of views.

Adverse or excessive aquifer drawdown may affect the health, quantity, and diversity of riparian vegetation, thus impacting the visual qualities of the area. Riparian vegetation adds color and variety to views and is considered a positive visual resource. Since the *Carmel Valley Master Plan* has determined that native riparian vegetation is a key element of the visual character of the valley, the loss of native riparian vegetation can be considered to detract from the aesthetics of the area.

Potential effects on the aesthetics of the area are assessed by comparing the variation in both streamflow and riparian vegetation under each supply option with existing conditions. Streamflow is evaluated in terms of the frequency of dry periods. The river corridor from San Clemente Dam to the Lagoon is divided into four sections corresponding to the underlying aquifer subbasins (Figure IV-1). These subbasins are referred to in the discussion of impacts. Information on river flows used in this discussion is discussed in Section B of this chapter. Discussions of the aesthetics of riparian vegetation are based on impacts described previously in Section C of this chapter.

The District's ongoing riparian vegetation irrigation program protects vegetation in certain areas. For a detailed discussion of this program and its impacts on riparian vegetation, refer to Section C of this chapter.

MPWMD's proposed water conservation program would allow water conservation savings by jurisdictions to be rededicated for future development. If, however, some water is conserved and stored in the Carmel River hydrologic system, then riparian vegetation could be enhanced and periods where the river is dry would occur with less frequency. These changes would have a positive aesthetic impact and would last until the stored water is removed and used by the jurisdictions to accommodate population growth. For this analysis, the impact of water conservation is not considered in detail.

The water supply options and associated base production levels that generate water for Cal-Am would allow for new development in the jurisdictions served by the MPWMD. New development would change the aesthetics of these areas; however, growth-related aesthetic changes are not evaluated because the impacts are too speculative and are best discussed in the environmental documentation for specific projects.

2. Impacts and Mitigation Measures

Supply Option I: 18,400 Acre-Feet (Current Production)

The current hydrologic and geohydrologic regimes of the Carmel River system would remain unchanged under this option. The availability of water in the Carmel River would, therefore, remain the same as current conditions.

Non-irrigated riparian vegetation in Subbasins AQ2, AQ3, and part of AQ4 are experiencing stress under the current level of supply. Continuation of this supply level would lead to continued decline and loss of non-irrigated vegetation.

Impacts: Significant adverse aesthetic impacts would occur in Subbasins AQ2, AQ3, and part of AQ4 due to the continued loss of riparian vegetation.

Mitigation Measures: Mitigation measures for impacts to riparian vegetation are discussed in Section C, "Vegetation," of this chapter. Even with implementation of the mitigation measures listed in Section C, the impacts of Supply Option I on aesthetics would be potentially significant.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Compared to existing conditions, Option II would have negative aesthetic impacts resulting from changes in river flows. Periods when the river at the Narrows experiences no-flow would increase in frequency, by up to 24 percent over the 18,400 acre-foot supply level, thereby negatively affecting the aesthetic qualities of the lower river corridor. Over the long term, during the summer months, visitors and residents viewing the area would experience more days when water is not present in the river.

During periods when Subbasin AQ2 is at maximum capacity (no drawdown), Garland Ranch Regional Park, which is visible from the river and from Laureles Grade, experiences an aesthetic benefit associated with pools of standing water when other sections of the river are dry. From June through November, Supply Option II would cause these pools to dry up as much as 61 percent more often than under existing conditions.

Changes in riparian vegetation in Subbasin AQ1, small portions of AQ2, AQ4, and around the Carmel River Lagoon would be significant, and thus aesthetics would be degraded from existing conditions. Groundwater withdrawal in Subbasin AQ3 and downstream of the Rancho Canada Well in Subbasin AQ4 would reduce nonirrigated riparian vegetation within these sections. Riparian vegetation would become less dense and diverse. Where they depend on groundwater, some cottonwoods, willows, and box elders would die, reducing the 35- to 60-foot-tall overstory canopy. The riparian corridor would become more shrublike, and would be invaded by nonriparian and non-native species, altering the aesthetic character of the area.

Impacts: Supply Option II would cause significant adverse aesthetic impacts to the Carmel Valley River corridor and to views that depend on this resource. The long-term increase in the frequency of no-flow periods would be a potentially significant impact on the visual resources of the area. Supply Option II would also result in significant adverse impacts to views at Garland Ranch Regional Park and nearby scenic roads.

The vegetative changes in Subbasins AQ2, AQ3, and a portion of AQ4 would be significant adverse impacts on the aesthetics of the region.

Mitigation Measures: Section C of this chapter, "Vegetation," details mitigation of adverse impacts to vegetation. Even with implementation of these mitigation measures, the impacts of Supply Option II on aesthetic resources associated with riparian vegetation would be potentially significant. No mitigation measures have been identified that would decrease the frequency of low-flow periods in the Carmel River, so adverse aesthetic impacts resulting from low-flow periods would be a potentially significant impact.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

This option would remove 20,500 acre-feet of water annually from the Monterey Peninsula Water Resource System. Impacts would be similar to those under Supply Option II, but would be slightly more severe.

Impacts: The impacts of Supply Option III would be essentially the same as under Supply Option II.

Mitigation Measures: Mitigation measures would be the same as those under Supply Option II. Even with these mitigation measures, the impacts of Supply Option III would be potentially significant. No mitigation measures have been identified that would decrease the frequency of low-flow periods in the Carmel River, so adverse aesthetic impacts resulting from low-flow periods would be a potentially significant impact.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Under this option, non-irrigated riparian vegetation in Subbasin AQ3 and part of Subbasin AQ4 would continue to experience stress leading to decline. This would be a significant adverse impact on the aesthetic character of the area. Supply Option IV would, nonetheless, be more aesthetically beneficial than Supply Options I, II, and III.

A reduction in available water supply could have an adverse effect on urban aesthetics. Under Supply Option IV, water reduction could reduce the amount of available water for irrigation of open space, landscape, and lawns, thus creating a "brown lawn effect."

Impacts: The impacts of continued loss of riparian vegetation are similar to those under Supply Option I and are considered significant. The "brown lawn effect" in urban areas is aesthetically unpleasant and would be considered a potentially significant impact.

Mitigation Measures: The mitigation measures for riparian habitat are the same as those identified under Supply Option I; even with implementation of these measures, the impacts on riparian habitat would be potentially significant. The brown lawn effect in urban areas can be mitigated to a less-than-significant level by using drought-resistant landscaping and vegetation.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Under this option, non-irrigated riparian vegetation in Subbasin AQ3 and part of Subbasin AQ4 would continued to experience stress leading to decline. This would be an significant adverse impact on the aesthetic character of the area. Nonetheless, Supply Option V would have less impact on aesthetics than the other supply options.

As with Supply Option IV, a reduction in available water supply could have an adverse impact on urban aesthetics. Under Supply Option V, water reduction could reduce the amount of available water for irrigation of open space, landscape, and lawns, thus creating a "brown lawn effect."

Impacts: Aesthetic impacts associated with the loss of riparian vegetation would be similar to Option IV, although slightly less; they would still, however, be considered significant. The "brown lawn effect" is aesthetically unpleasant and would be considered a potentially significant impact.

Mitigation Measures: Mitigation measures for riparian vegetation would be the same as discussed under Option I. Even with these measures, aesthetic impacts associated with riparian vegetation would be potentially significant. The brown lawn effect can be mitigated to a less-than-significant level by using drought-resistant landscaping and vegetation.

H. DROUGHT IMPACTS

1. Methodology and Analysis

As described in Chapter III, the District has devised a strategy for imposing water rationing during drought conditions. After a public hearing and the declaration of a water supply emergency, the District can impose one of four phases of water rationing. Table IV-30 summarizes the key aspects of these phases. As Table IV-30 shows, the goals for reduction in water use under the District's rationing ordinance differ somewhat from those used in the Carmel Valley Simulation Model (CVSIM). The baseline for the District's reduction goal under the rationing ordinance is water use during a base year. On the other hand, the CVSIM establishes a baseline demand level that is the production level for the water supply option increased to reflect dry-year conditions.

Under the water rationing strategy, the District monitors hydrologic conditions and water production on a monthly basis to anticipate drought conditions. The District would declare rationing phases to reduce water use before water supply shortages would naturally limit the amount of water available.

The District Board determines whether rationing is necessary and what level of rationing is needed by comparing expected demand and expected supply within a water year. Expected demand includes demand for the remainder of the current water year plus a selected target level of drought reserve for the following year. The target drought reserve varies as a function of water supply conditions. As dry conditions persist or worsen, the actual reserve is drawn-on and the target reserve factor is lowered. Expected supply includes current usable reservoir and aquifer storage plus expected inflow for the remainder of the water year.

District staff has tested this water rationing strategy using CVSIM. Based on this testing, the District adopted the water rationing ordinance for Phases I and II in August 1988 and for Phase III in December 1988.

Uncertainty in satisfying water demand within the District is dependent on hydrologic conditions (rainfall and streamflow), water supply facilities, and management of the system. Probabilities associated with drought conditions can be estimated only by analysis of the historical record. Based on an analysis of the 1902-1987 period, District staff estimates a recurrence interval of more than 200 years for the 1976-1977 drought. In other words, 99.5 percent of all annual streamflow would be expected to be higher than this drought period. The recurrence interval does not mean that a similar drought cannot or will not occur for another 200 years. Thus, it cannot be used as a predictor of the severity or timing of the next drought.

The current (1987-1989) drought, coupled with Cal-Am water production that is 9.3 percent greater than that during 1976, has caused the District to implement rationing. The statistical severity of this drought can only be determined after it is over. It may affect the recurrence interval of the 1976-1977 drought.

The California Environmental Quality Act (CEQA) defines a significant effect as a "substantial adverse change in the physical conditions which exist in the area affected by the proposed project." The implication is that the adverse change is a continuous, permanent change. Furthermore, the impact is a physical change, not a social or economic inconvenience.

By its very nature, a drought occurs infrequently. Thus, the hardships caused by a drought are not continuous or permanent. However, a drought with a frequency of, say, once every 10 years could approach the concept of continuous and permanent.

The hardships on customers that are caused by shortfalls in supply capacity depend on the magnitude of the shortfall, the frequency of the shortfall, the nature of the water use, the season of the year, the manner in which the customer reduces water usage, and the extent of permanent water conservation savings already in place. For a residential customer, a severe shortfall might be one that causes the loss and subsequent replacement of landscaping. But such a shortfall that occurred very infrequently, such as once every 50 years, could not be considered as serious as a similar shortfall that occurred once every 10 years.

A shortfall that occurs in the summer when reduction in landscape irrigation could mitigate the problem would be less of a hardship than an equal shortfall in the winter when there is little irrigation and water reductions would have to come from indoor uses.

Permanent water conservation savings can be achieved by installing low-flush toilets, low-flow shower nozzles, and drip irrigation. Unfortunately, the long-term water savings are often reallocated or rededicated to new growth, rather than assigned to a drought reserve. As the level of permanent water conservation savings increases, it becomes more difficult to implement temporary reductions in water use, and the hardships of a shortfall would increase with the re-occurrence of droughts with the same severity.

The economic cost of rationing is difficult to quantify. Certainly, the cost of rationing would be less than the cost of shortfalls in the absence of rationing. Costs could be incurred by the losses of landscaping (by residential and non-residential customers) and the loss of business activity by motels, hotels, restaurants, and other high water-using businesses.

The District Board has adopted criteria, or policy variables, for judging the severity of shortfalls in meeting system demand. As shown in Table IV-31, these criteria are a maximum annual shortfall of 25 percent and a maximum monthly shortfall of 40 percent. Although these criteria were established based on a consideration of the effects on water customers, they were not established based on the CEQA definition of environmental effect. Thus, these criteria do not, in themselves, determine whether the impacts of a supply option would be significant.

Furthermore, the criteria do not include a frequency of occurrence. Thus, no distinction is made between the severity of a 25 percent annual shortfall (or 40 percent monthly shortfall) that occurs once every 10 years and the severity of one that occurs once every 86 years.

The Board should review these criteria to see if they are still relevant or if they should be revised. The Board could consider adopting criteria that include the frequency of a zero shortfall (e.g., 90 or 95 percent of the time there would be no shortfall; conversely, the frequency of shortfalls would be limited to 5 or 10 percent).

Water supply facilities and management operating rules are programmed into CVSIM. The model permits the analysis of the five supply options under "what if" conditions. Using the 86 years of hydrologic data and CVSIM, the District staff simulated the rules for the water rationing phases as described in Table IV-30 for each of the five supply options. The assumptions incorporated in CVSIM were analyzed and the output analyzed for each water supply option.

TABLE IV-30

WATER RATIONING PHASES

Phase	Restrictions	Water Availability Criteria	Goal for Reduction in Use MPWMD Ordinance	CVSIM	Limitation on Setting Meters	Target Drought Reserve, Percent
I	Mandatory water waste restrictions	No risk	-	0	No	100
II	Mandatory restrictions upon non-essential water use	Low risk	10	10	No	80
III	Mandatory water use restrictions	Medium risk	20	15	Yes	55
IV	Mandatory maximum water policies	High risk	40*	25	_*	30

*Not adopted by the District as of March 1990.

Source: Monterey Peninsula Water Management District, 1990.

2. Impacts and Mitigation Measures

The impacts of drought conditions are described for each supply option in terms of the frequency and magnitude of shortfalls under the supply option, the level of risk or uncertainty associated with the supply option, the frequency with which limitations on the issuance of new meters are instituted, and the level of rationing hardships resulting from the option.

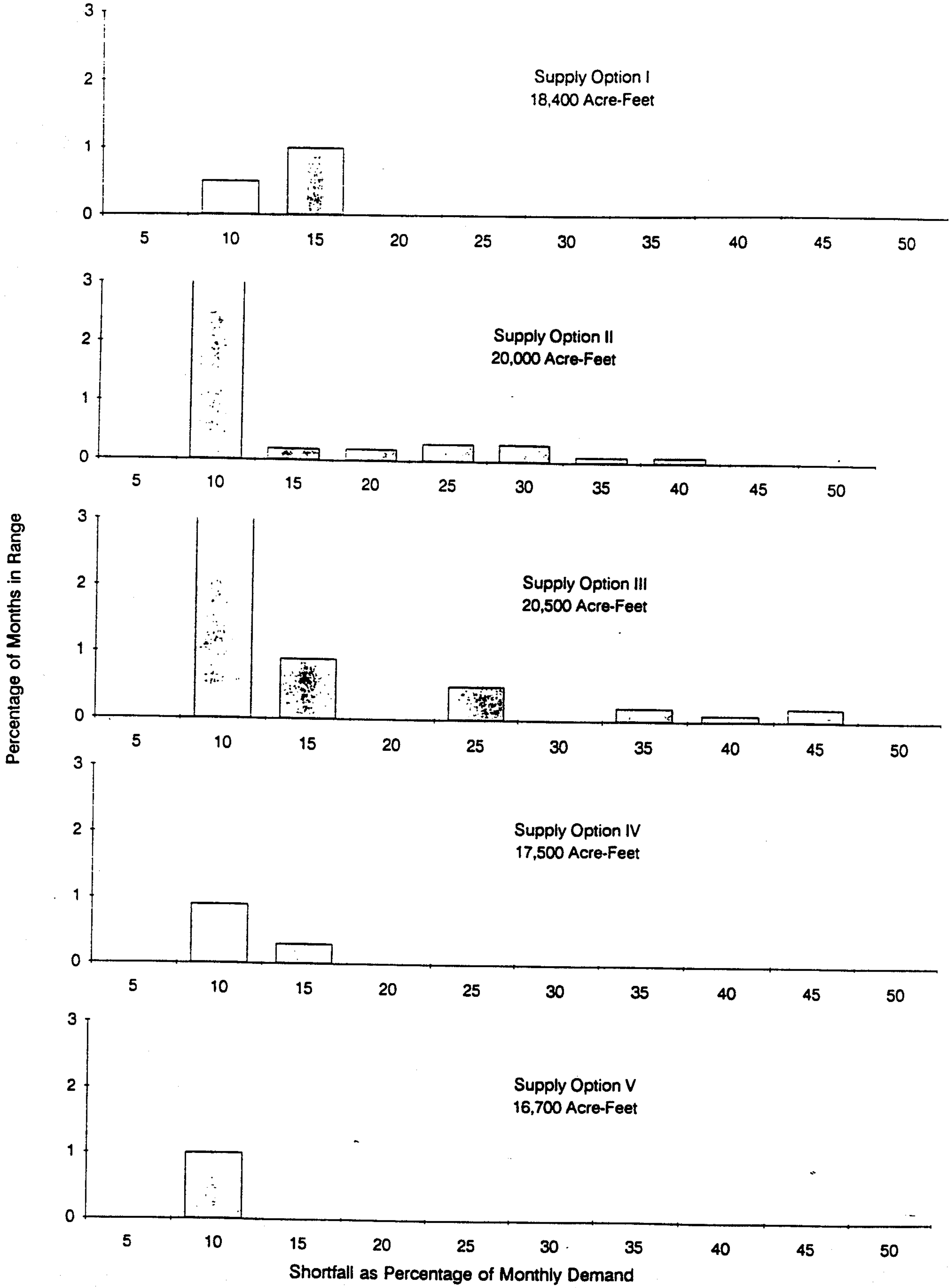
Supply Option I: 18,400 Acre-Feet (Current Production)

<u>Frequency and Magnitude of Shortfalls</u>

Figure IV-10 summarizes the results of the analyses. For each supply option, the figure shows the percentage of months in the 1902-1987 period for which a shortfall is of the magnitude shown by the ranges. Imposed rationing accounts for all of the months of shortfall. For Supply Option I, shortfalls occur in 1.5 percent of the months.

Impacts: Table IV-31 summarizes the frequency of the annual and monthly shortfalls and the maximum shortfalls. The shortfall is the amount, or percentage, by which the monthly or annual production is less than the corresponding demand, as calculated by the CVSIM model. For Supply Option I, a shortfall occurs in 5.8 percent of the years, or about one year in 17. When a shortfall occurs, it occurs for an average of 3 months during the year.

FIGURE IV-10
OCCURRENCE OF MONTHLY SHORTFALLS
1902 to 1987



Shortfalls occur in about 1.5 percent of the months under Supply Option I. The maximum monthly shortfall is 15.0 percent, while the maximum annual shortfall is 11.4 percent.

When the District imposes rationing, the period of supply shortfalls would be extended, but the maximum shortfall would be reduced.

TABLE IV-31

FREQUENCY AND MAGNITUDE OF SHORTFALLS
1902 TO 1987

	Annual Shortfall			Monthly Shortfall	
Water Supply Option	**Frequency Percent**	**Average Months Per Year of Shortfall**	**Maximum Shortfall Percent***	**Frequency Percent**	**Maximum Shortfall Percent***
MPWMD Criteria			25.0		40.0
I: 18,400 Acre-Feet	5.8	3.0	11.4	1.5	15.0
II: 20,000 Acre-Feet	16.3	3.3	20.3	4.5	38.7
III: 20,500 Acre-Feet	18.6	3.8	24.0	5.5	43.6
IV: 17,500 Acre-Feet	3.5	4.0	8.8	1.2	15.0
V: 16,700 Acre-Feet	2.3	5.0	6.7	1.0	10.0

*Percentage of average demand, not nominal demand.

Source: MPWMD and Water Resource Associates, 1989

Implementation of Supply Option I provides no additional water supply for areas under MPWMD jurisdiction. If no further growth occurs, the frequency and magnitude of shortfalls would remain the same. Implementation of this option, therefore, creates impacts on the frequency and magnitude of shortfalls that are less-than-significant.

Mitigation Measures: None required.

<u>Level of Risk/Uncertainty</u>

Figure IV-11 shows the probability of the occurrence of yield for each supply option from the results of the simulation analyses. About 94 percent of the time, the yield for Supply Option I would be 100 percent of the demand. The data point at 100 percent (right-hand side of figure) shows the yield obtained during the simulation of the 1977 water year--the driest year of record.

Impacts: In the driest year, this option produces about 89 percent of the demand. MPWMD criterion is 75 percent. The impact of the level of risk/uncertainty is thus less-than-significant.

Mitigation Measures: None required

Frequency of New Meter Limitations

The current District water rationing strategy does not require a limitation on water meter settings for Phases I through II. In January 1990, under Phase III rationing, the District implemented a limitation on the setting of new meters for multi- family, commercial, industrial, and private open space developments. As of January 1990, the District had not established specific rules for Phase IV rationing, although a limitation on new water meter connections is a likely component.

Table IV-32 summarizes the number of months in which Level 4 (Phase IV of the District's water rationing rules) is in effect during the simulation of the five supply options. All the months occur during the simulations of the 1976-1977 drought conditions.

TABLE IV-32

SUMMARY OF RATIONING FROM CVSIM RESULTS

Water Supply Option	Rationing Duration at Level 4* Months	Percent
I: 18,400 Acre-Feet	0	0.0
II: 20,000 Acre-Feet	6	0.6
III: 20,500 Acre-Feet	10	1.0
IV: 17,500 Acre-Feet	0	0.0
V: 16,700 Acre-Feet	0	0.0

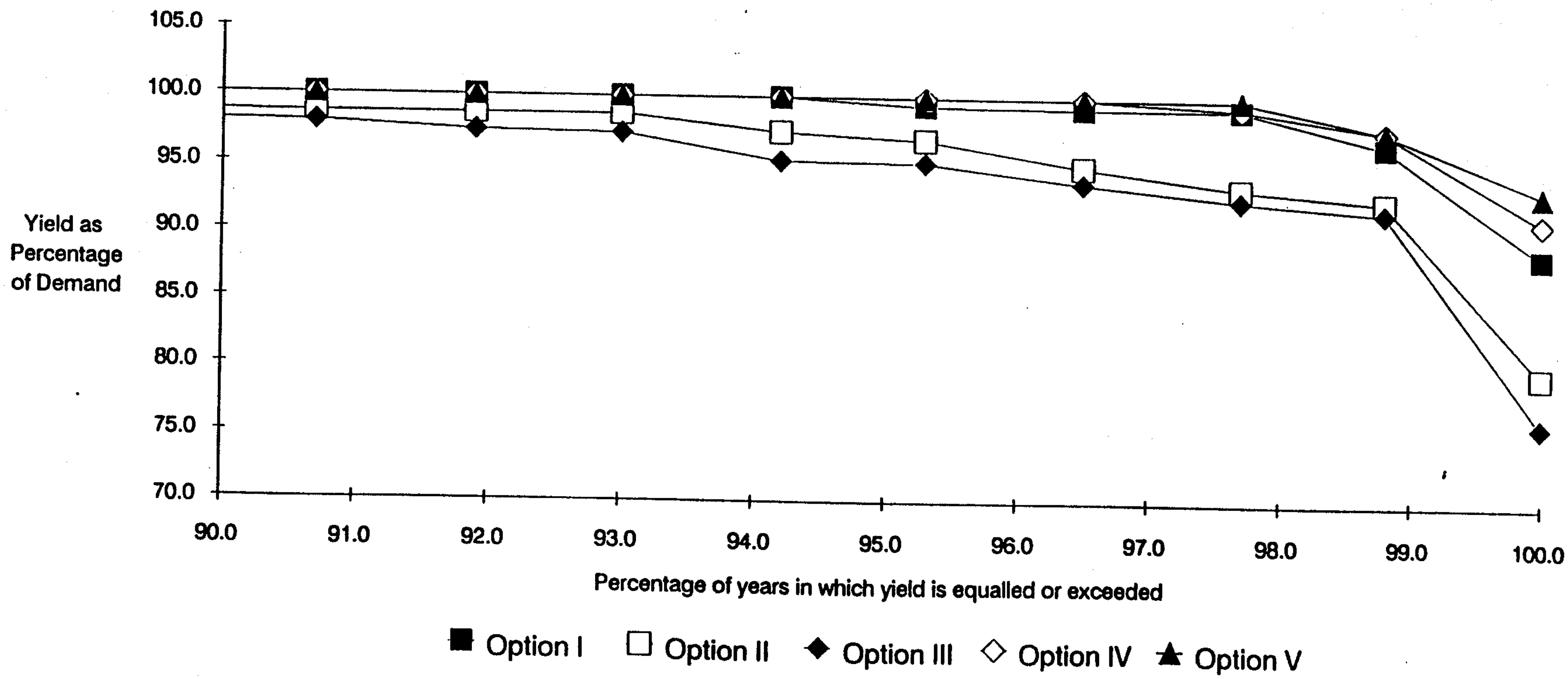
*Level 4 corresponds to Phase IV of District's Water Rationing Rules

Source: Water Resource Associates, 1989.

Impacts: Since there were no months at Rationing Level 4, under Supply Option I, there is no impact on the frequency of new meter limitations.

Mitigation Measures: None required.

FIGURE IV-11
UNCERTAINTY OF YIELD



Source: Water Resource Associates, 1989.

Rationing Hardships

The purpose of rationing is to reduce water demand so that it stays in balance with the yield of the water supply system that has been reduced by dry-weather conditions. Factors such as the following affect water rationing impacts:

- Severity of the drought
- Magnitude of the rationing goal (i.e., 10 percent versus 40 percent)
- Season of the year during which rationing is imposed (i.e., summer versus winter)
- Extent of structural water conservation measures adopted (e.g., low-flow showers and toilets)
- Elasticity of water use (e.g., human consumption versus washing sidewalks)

Figure IV-12 shows the rationing levels that are imposed during the CVSIM analysis of each water supply option. Rationing always led to a shortfall in demand, but sometimes shortfalls occur without rationing having been imposed or shortfalls exceed the level of rationing. For Supply Option I, rationing is imposed 1.5 percent of the time with 15 percent being the highest rationing goal.

Figure IV-13 shows how rationing is imposed during the simulations in relation to the month of the year. For Supply Option I, rationing occurs more often during February and March than in the remainder of the year.

Impacts: The impacts of the rationing hardships of Supply Option I are considered less-than-significant.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Frequency and Magnitude of Shortfalls

Figure IV-10 summarizes the results of the analysis of the monthly shortfalls.

Impacts: Table IV-31 summarizes the frequency of the monthly shortfalls and the maximum shortfall. The frequency of monthly shortfalls increases from 1.5 percent for Supply Option I to 4.5 percent for Supply Option II. The maximum monthly shortfall increases from 15.0 percent for Supply Option I to 38.7 percent for Supply Option II. The maximum annual shortfall increases from 11.4 percent for Supply Option I to 20.3 percent for Supply Option II. The impact of Supply Option II on the frequency and magnitude of shortfalls is less-than-significant.

Mitigation Measures: The frequency and magnitude of shortfalls could be reduced by water conservation, water reclamation, development of additional water storage, and/or modification of existing rationing goals.

Water conservation and water reclamation could reduce the demand for potable water. As such, they would represent a shift to another water supply option. Water conservation and water reclamation would reduce the frequency and magnitude of shortfalls if the freed-up water is neither reallocated to the jurisdictions nor rededicated by the jurisdictions. If all the water is reallocated or rededicated, the frequency and magnitude of shortfalls would worsen. The construction of additional water storage would reduce, if not eliminate, shortfalls, depending on how much additional growth is permitted.

Increasing the well pumping capacity in the four Carmel Valley aquifer subbasins would permit increased pumping and thus reduce, if not eliminate, the shortfalls. In September 1977, the month of the maximum shortfall of 38.7 percent, the Carmel Valley subbasins contained 6,900 acre-feet of water--more than enough to offset the total 1977 shortfall of 5,189 acre-feet. The increased pumping would, however, increase aquifer drawdown (i.e., lower water table levels) and possibly increase the impacts on riparian vegetation.

Figure IV-13 shows, for Supply Option II, that rationing occurs more during the early months of the year (January through April) than in the remainder of the year. Since the season of the year affects the rationing hardship, it is relevant to compare Figure IV-13 with the distribution of water use shown on Figure IV-14. The data shown are the distribution pattern used in CVSIM for calculating monthly water demand from the annual demand. The highest use occurs during the six months of May through October, while the lowest use occurs during the period November through April. Comparison of Figures IV-13 and IV-14 indicates that CVSIM imposes higher rationing during periods of lower water use and lower rationing during periods of higher water use.

Modifying the rationing goals shown in Table IV-30 can mitigate the impacts caused by large shortfalls in water supply. Table IV-33 shows the proposed rationing goals for each of the District's four phases of water rationing. The proposed rationing goals recognize the elasticity of water use in different seasons (i.e., it is easier to achieve a higher percentage reduction in water use in the summer than in the winter). The summer goals are similar to the current goals, but the winter goals are lower. The basis for determining when to impose each rationing phase might also be changed. For example, the target drought reserve factor (shown in Table IV-30) might be increased for Phases II and III, and possibly Phase IV.

TABLE IV-33
PROPOSED RATIONING GOALS

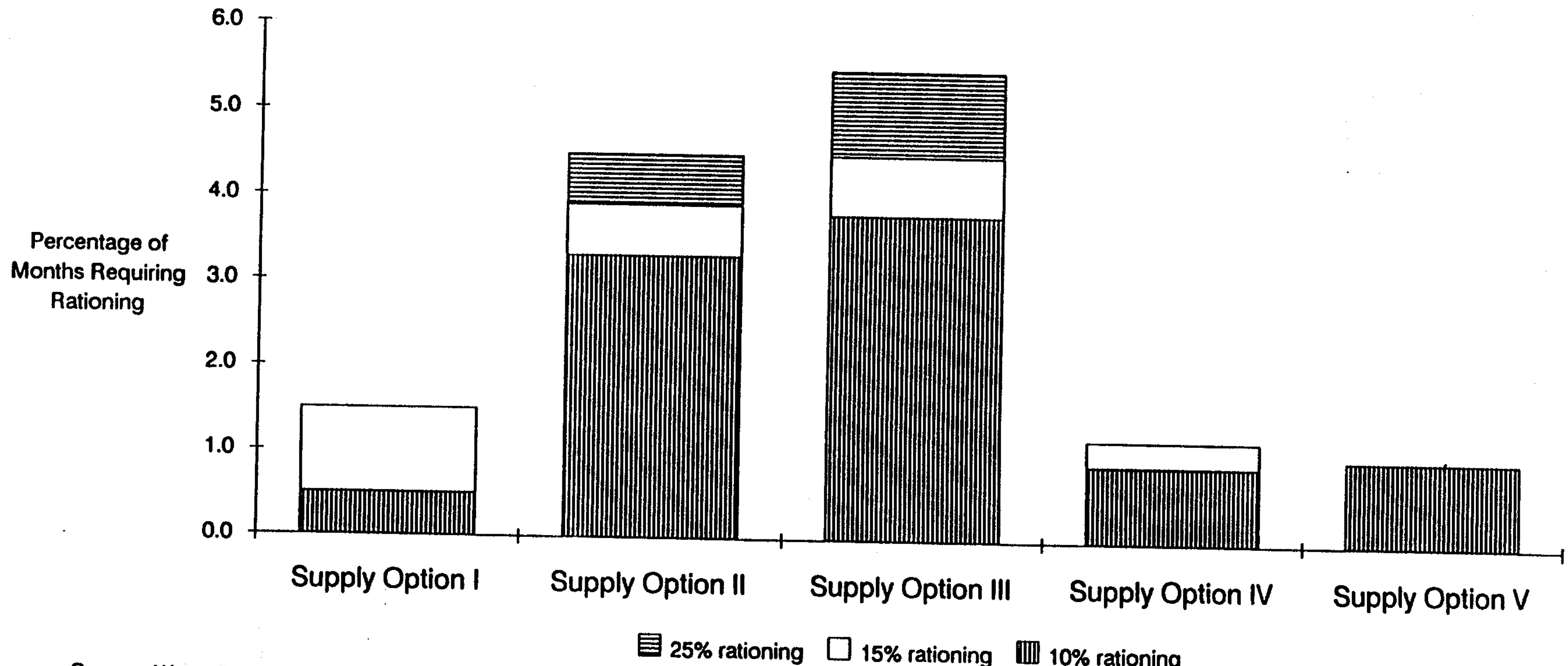
Phase	Rationing Goal (Percent) Winter[1]	Summer[2]
I	0	0
II	0	10
III	10	25
IV	20	45

[1]November through April
[2]May through October

Source: Water Resource Associates, 1989.

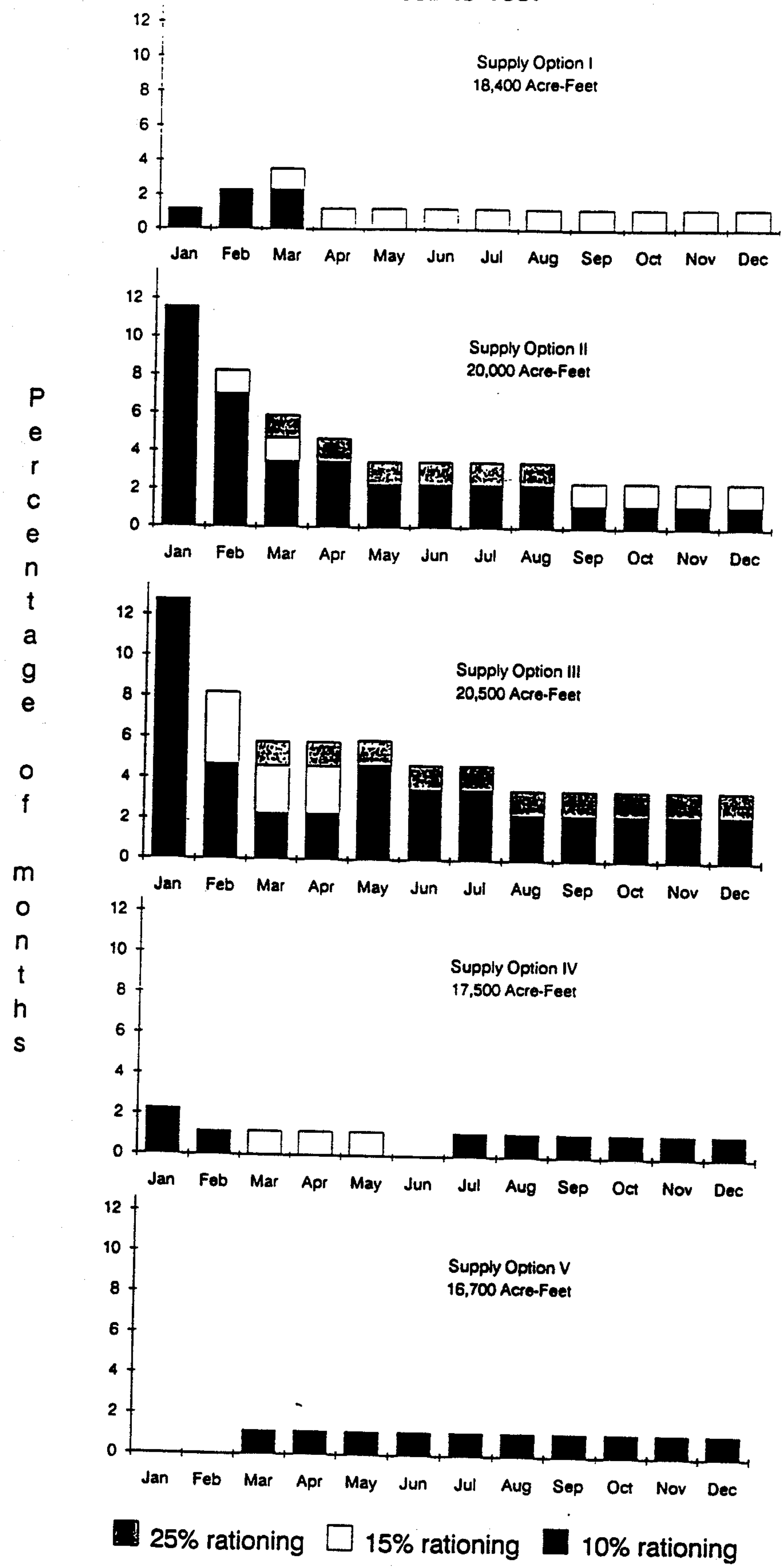
The effect of altering the rationing goals is evaluated by applying them to Supply Options II and III for the period January 1976 to January 1978. The shortfalls for the current and the proposed rationing goals are shown on Figure IV-15 as a percentage of the monthly demand. For Supply Option II, rationing at the ten percent level is imposed during the summer of 1976 under the proposed goals, when none is required under the current goals. Rationing at 25 percent is required from May through October 1977. The peak shortfall decreases from 38.7 to 25 percent.

FIGURE IV-12
OCCURRENCE OF RATIONING LEVELS



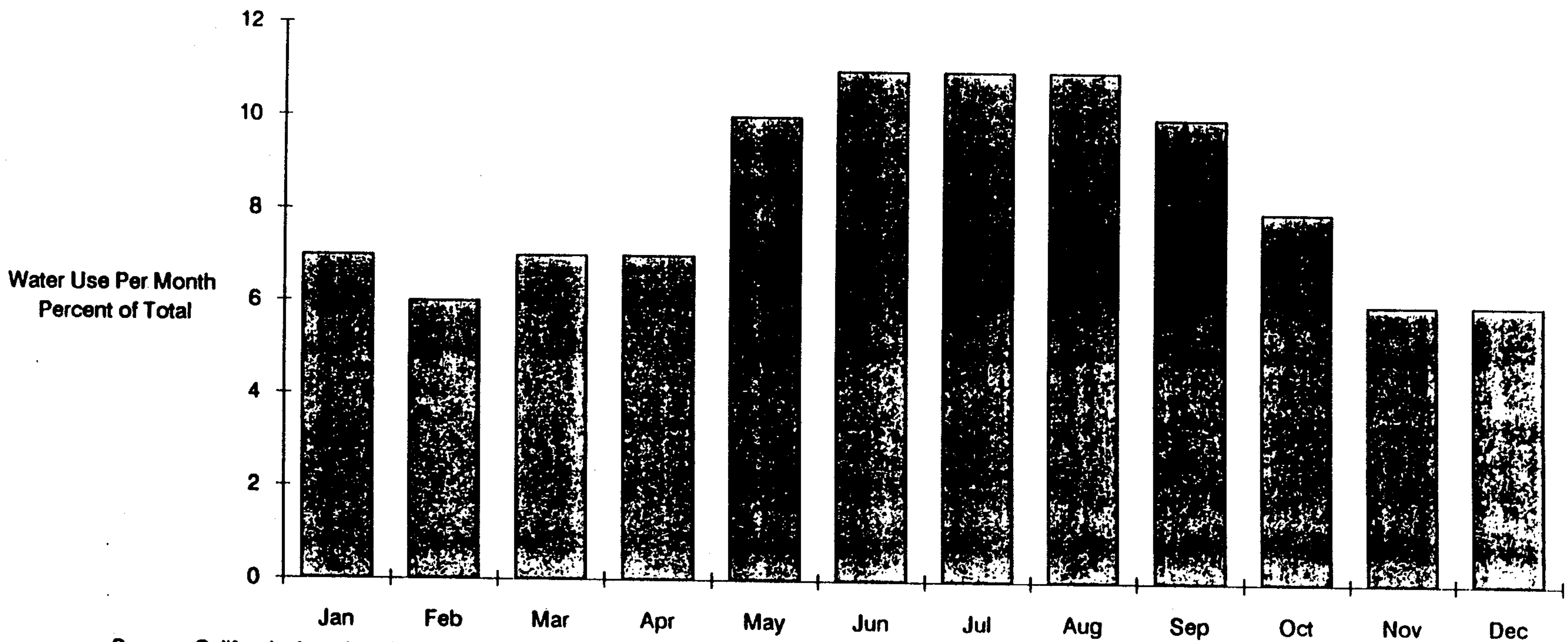
Source: Water Resource Associates, 1989.

FIGURE IV-13
OCCURRENCE OF RATIONING LEVELS
1902 to 1987



Source: Water Resource Associates

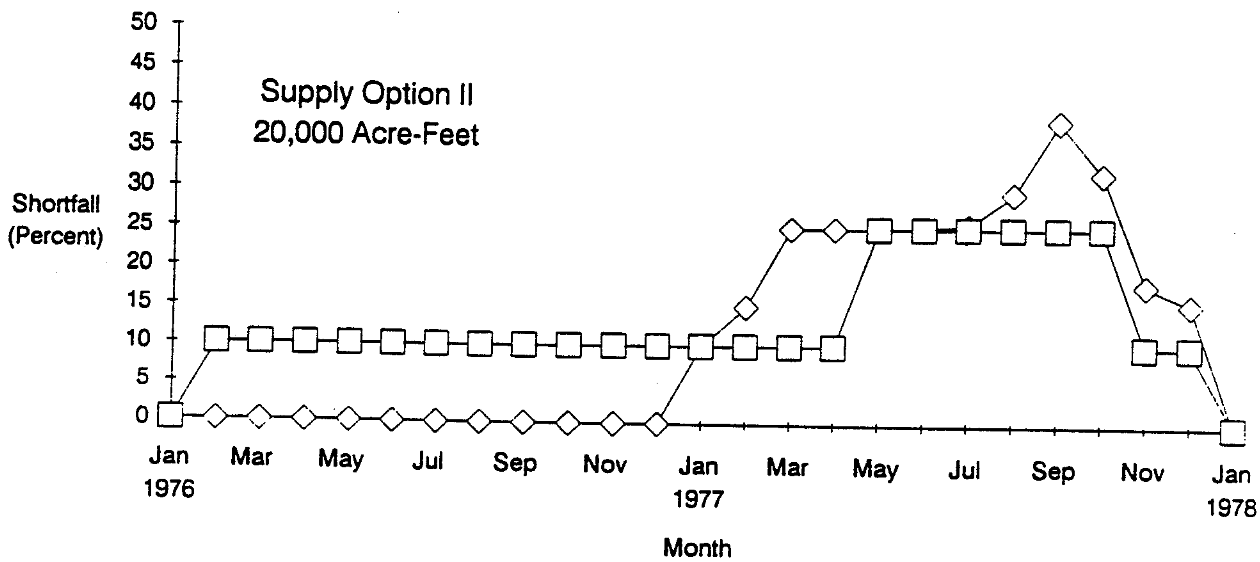
FIGURE IV-14
MONTHLY DISTRIBUTION OF WATER USE
Cal-Am System

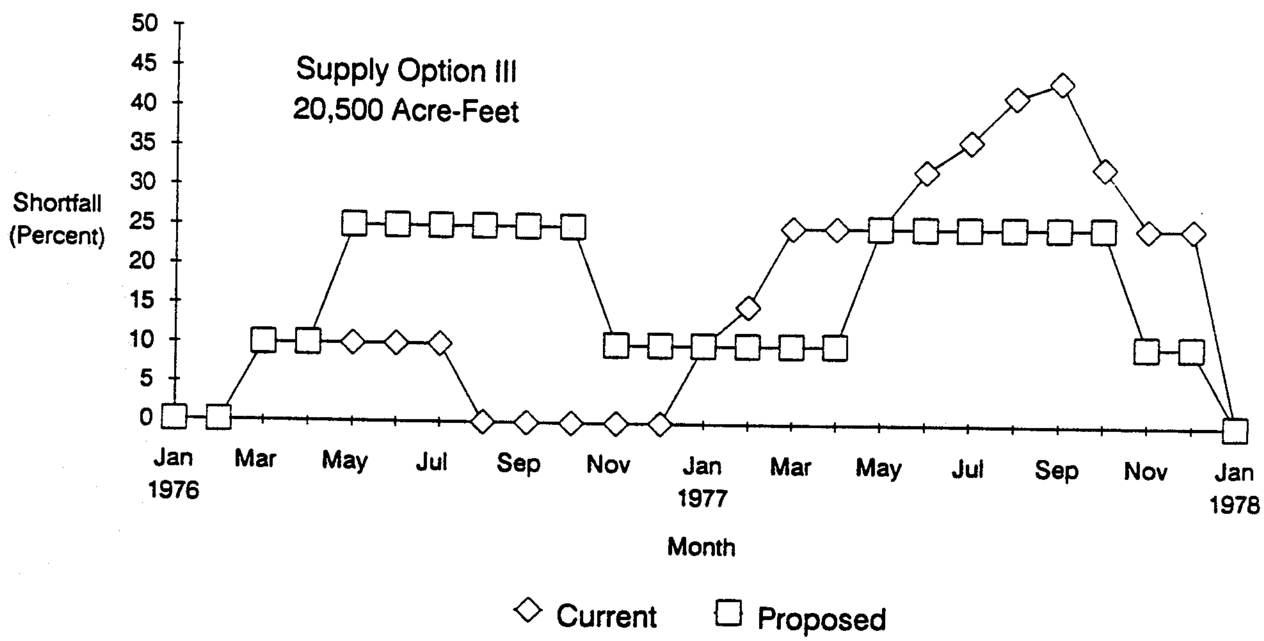


Source: California-American Water Company, 1989.

FIGURE IV-15

ALTERNATIVE RATIONING GOALS





Source: Water Resource Associates

The proposed rationing goals increase the rationing in 1976 (thus, increase the rationing hardship), but reduce the shortfall in 1977 (thus, reduce the peak rationing hardship). It would be easier for customers to achieve relatively fixed rationing goals (even though higher than the existing ones), than to achieve a goal that varies each month. The rationing goals programmed into the CVSIM model should be increased by five percent because they are applied to a demand level that has been increased by five percent because of dry weather conditions.

With the implementation of the proposed rationing rules, the impact of Supply Option II on the frequency and magnitude of shortfalls would decrease and remain at a less-than-significant level.

Level of Risk/Uncertainty

Figure IV-11 shows the results of the simulation analysis. About 93 percent of the time, the yield for Supply Option II would be at least 99 percent of the demand.

Impacts: In the driest year, this option produces about 78 percent of the demand, a decrease from the 89 percent production under Supply Option I. The District criterion is 75 percent. The impact on the level of risk/uncertainty is less-than-significant.

Mitigation Measures: None required.

Frequency of New Meter Limitations

Table IV-32 summarizes the number of months in which Level 4 (Phase IV) is in effect during the simulation of the water supply options. If the District imposes limitations on the setting of new meters for these months, limitations would be in effect for six months, an increase from none under Supply Option I, but still less than one percent of the months.

Impacts: Since new meter limitations are not included in the Phase IV regulations, there would be no impact of Supply Option II on limitation frequency. If the District includes limitations in the Phase IV regulations, no water meters would be issued during the 6-month period. Construction starts would be delayed 6 months. There would be a temporary loss of construction jobs and a delay in some new job openings. Based on Table III-22, the value of construction deferred for a 6-month period would average $60 million. Revenues to districts and municipalities from permit fees would decrease for the period in which new meter settings are limited. If the District includes limitations in the Phase IV regulations, the impact of Supply Option II would be less-than-significant.

Mitigation Measures: None required.

Rationing Hardships

Figure IV-12 shows the rationing levels that are imposed during the CVSIM analysis of each water supply option. For Supply Option II, rationing is imposed 4.5 percent of the time (an increase from 1.5 percent in Supply Option I) with 25 percent being the highest rationing goal.

Figure IV-13 shows how rationing is imposed in relation to the month of the year. Rationing occurs more often during the early months of the year (January through April) than in the remainder of the year. The 25 percent rationing level occurs from March through August.

Subsequent to the Draft EIR, CVSIM was modified to incorporate the revised target drought reserve for Phase IV water rationing (from 0 to 30 percent). The maximum level of rationing increased from 15 to 25 percent. This demonstrates that the rationing levels are sensitive to the value of the target drought reserve. The frequency and magnitude of rationing can be affected by this parameter.

Impacts: The impact of Supply Option II on rationing hardships would be less-than-significant.

Mitigation Measures: Modifying the rationing goals and the criteria for imposing rationing (as described above) would affect the hardships created. Based on simulation analysis as shown in Figure IV-15, greater rationing would occur in 1976, but less in 1977. The maximum shortfall would decrease from 38.7 percent to 25.0 percent. The impact of Supply Option II on rationing hardships would remain at a less-than-significant level.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Frequency and Magnitude of Shortfalls

Figure IV-10 summarizes the results of the analysis of the monthly shortfalls. Table IV-31 summarizes the frequency of the monthly shortfalls and the maximum shortfall.

Impacts: The frequency of monthly shortfalls increases from 1.5 percent for Supply Option I to 5.9 percent for Supply Option III. The maximum monthly shortfall increases from 15.0 percent for Supply Option I to 43.6 percent for Supply Option III--which is greater than the District criterion of 40 percent. Thus, by District policy, this supply option is unacceptable. The maximum annual shortfall increases from 11.4 percent for Supply Option I to 24.0 percent for Supply Option III. The environmental impact of Supply Option III on the frequency and magnitude of shortfalls is less-than-significant.

Mitigation Measures: The frequency and magnitude of shortfalls could be reduced by the mitigation measures described under Supply Option II. The shortfalls for the current and the proposed rationing goals are shown as a percentage of the monthly demand on Figure IV-15. For Supply Option III, rationing at the 25 percent level is imposed during the simulation of the summer of 1976 under the proposed goals, when ten percent is required under the current goals. Ten percent rationing is imposed in the period November through April, while 25 percent rationing is required from May through October 1977. The peak shortfall decreases from 43.6 percent to 25.0 percent. The impact of Supply Option III on the frequency and magnitude of shortfalls would remain at a less-than-significant level.

Level of Risk/Uncertainty

Figure IV-11 shows the results of the simulation analysis. About 91 percent of the time, the yield for Supply Option III would be about 98 percent of the demand.

Impacts: In the driest year, this option produces about 76 percent of the nominal demand--a decrease from the 89 percent production under Supply Option I. The District criterion is 75 percent. The impact on the level of risk/uncertainty is less-than-significant.

Mitigation Measures: None required.

Frequency of New Meter Limitations

Table IV-32 summarizes the number of months in which Level 4 (Phase IV) is in effect during the simulation of the water supply options. If the District imposes limitations for these months, they would be in effect for about ten months--an increase from none under Supply Option I, but still only about one percent of the months.

Impacts: Since new meter limitations are not included in the Phase IV regulations, there would be no impact of Supply Option III on limitation frequency. As described under Supply Option II, if the District includes limitations in the Phase IV regulations, construction starts would be delayed for 10 months, there would be a temporary loss of construction jobs and a delay in some job openings, and permit fee revenues would decrease to districts and municipalities. If the District includes limitations in the Phase IV regulations, the impact of Supply Option II would be less-than-significant.

Mitigation Measures: None required.

Rationing Hardships

Figure IV-12 shows the rationing levels that are imposed during the CVSIM analysis of each water supply option. For Supply Option III, rationing is imposed 5.5 percent of the time (an increase from 1.5 percent in Supply Option I) with 25 percent being the highest rationing goal.

Figure IV-13 shows how rationing is imposed in relation to the month of the year. Rationing occurs more often during the early months of the year (January through April) than in the remainder of the year. The 25 percent rationing level occurs from March through December.

Impacts: The impact of Supply Option III on rationing hardships would be less-than-significant.

Mitigation Measures: Modifying the rationing goals and the criteria for imposing rationing (as described under Supply Option II) would affect the hardships created. Based on simulation analysis as shown in Figure IV-15, greater rationing would occur in 1976, but less in 1977. The maximum shortfall would decrease from 43.6 percent to 25.0 percent. The impact of Supply Option III on rationing hardship would remain at a less-than-significant level.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Frequency and Magnitude of Shortfalls

Figure IV-10 summarizes the results of the analysis of the monthly shortfalls. Table IV-31 summarizes the frequency of the monthly shortfalls and the maximum shortfall.

Impacts: Monthly shortfalls decrease from 1.5 percent for Supply Option I to 1.2 percent for Supply Option IV. The maximum monthly shortfall remains the same as Supply Option I at 15.0 percent. The maximum annual shortfall decreases from 11.4 percent for Supply Option I to 8.8 percent for Supply Option IV. Selection of this option would affect the frequency and magnitude of shortfalls to a less-than-significant level.

Mitigation Measures: None required.

Level of Risk/Uncertainty

Figure IV-11 shows the results of the simulation analyses. About 96 percent of the time, the yield for Supply Option IV would be 100 percent of the demand--slightly greater than for Supply Option I.

Impacts: In the driest year, this option produces about 91 percent of the demand, an increase from the 89 percent production under Supply Option I. The District criterion is 75 percent. The impact on the level of risk/uncertainty is, therefore, less-than-significant.

Mitigation Measures: None required.

Frequency of New Meter Limitations

Table IV-32 summarizes the number of months in which Level 4 (Phase IV) is in effect during the simulation of the water supply options. For Supply Option IV, rationing Level 4 was never achieved.

Impacts: Since there were no months at rationing Level 4, there is no impact of Supply Option IV on the frequency of new meter limitations.

Mitigation Measures: None required.

Rationing Hardships

Figure IV-12 shows the rationing levels that are imposed during the CVSIM analysis of each water supply option. For Supply Option IV, rationing is imposed 1.2 percent of the time (a decrease from 1.5 percent in Supply Option I) with 15 percent being the highest rationing goal.

Figure IV-13 shows how rationing is imposed in relation to the month of the year. Rationing occurs at 15 percent during March through May.

Impacts: The impact of Supply Option IV on rationing hardships is less-than-significant.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Frequency and Magnitude of Shortfalls

Figure IV-10 summarizes the results of the analysis of monthly shortfalls. Table IV-31 summarizes the frequency of the monthly shortfalls and the maximum shortfall.

Impacts: Monthly shortfalls decrease from 1.5 percent for Supply Option I to 1.0 percent for Supply Option V. The maximum monthly shortfall decreases to 10 percent from 15 percent for Supply Option I. The maximum annual shortfall decreases from 11.4 percent for Supply Option I to 6.7 percent for Supply Option V. Selection of this option would create a less-than-significant impact on the frequency and magnitude of shortfalls.

Mitigation Measures: None required.

Level of Risk/Uncertainty

Figure IV-11 shows the results of the simulation analyses. About 98 percent of the time, the yield for Supply Option V would be 100 percent of the demand--4 percent greater than for Supply Option I.

Impacts: In the driest year, this option produces about 93 percent of the demand--an increase from the 89 percent production under Supply Option I. The District criterion is 75 percent. The impact on the level of risk/uncertainty is, therefore less-than-significant.

Mitigation Measures: None required.

Frequency of New Meter Limitations

Table IV-32 summarizes the number of months in which Level 4 (Phase IV) is in effect during the simulation of the water supply options. For Supply Option V, rationing Level 4 was never reached.

Impacts: Since there were no months at rationing Level 4, there is no impact of Supply Option V on frequency of new meter limitations.

Mitigation Measures: None required.

Rationing Hardships

Figure IV-12 shows the rationing levels that are imposed during the CVSIM analysis of each water supply option. For Supply Option V, rationing is imposed 1.0 percent of the time (a decrease from 1.5 percent in Supply Option I) with 10 percent being the highest rationing goal.

Figure IV-13 shows how rationing is imposed in relation to the month of the year. Rationing at 10 percent occurs during March through December.

Impacts: The impact of Supply Option V on rationing hardships is less-than-significant.

Mitigation Measures: None required.

I. TRAFFIC

1. Methodology and Analysis

This analysis estimates the traffic volumes that would be generated by each proposed water supply option, both by specific residential and business development located within the MPWMD boundaries, both within the Cal-Am service area and by those outside the Cal-Am service area (non-Cal-Am development).

The non-Cal-Am area includes unincorporated portions of Monterey County associated with five specific areas: Hidden Hills, Laguna Seca, Monterra, Ryan Ranch, and Carmel Valley. For all water supply options, non-Cal-Am development would lead to 741 single-family residential units, 150 motel rooms, and 8,534 new employees.

Increased in-commuting from outside of the Monterey Peninsula area is not explicitly considered in this analysis. A specific number of new jobs has been estimated for each supply option. However, no attempt has been made to estimate the percentage of those jobs filled by in-commuters versus those filled by Monterey Peninsula residents.

Traffic volumes for each of the five water supply options at the two base production levels have been estimated by conducting travel demand forecasts. These forecasts were made by quantifying trip generation based on the land use mix that is expected to result from the growth accommodated under each supply option. The analysis assumes that all trips are generated by private automobile, although some trips would probably be generated by public transit. This analysis also assumes that drivers tend to minimize trip distances, and that trips are distributed according to existing traffic patterns.

Because traffic impacts generated indirectly by the water supply options would create a regional impact on major transportation arterials, specific trip distribution and traffic assignment are not discussed in this analysis. A qualitative analysis of trip distribution and assignment is discussed in Chapter V.

Trip generation is based on the following average rates published by the Institute of Transportation Engineers:

- 10 daily trips per single-family residential unit,
- 6.6 daily trips per multi-family residential unit,
- 10.5 average trips per hotel room (average weekday vehicle trips),
- 20.6 average trips per golf course employee (average weekday vehicle trip ends),
- 35 trips per 1,000 square feet of retail commercial space,
- 4.7 daily trips per commercial office employee,
- 4.0 daily trips per heavy commercial/light industrial employee,
- 17 daily trips per school employee, and
- 13.4 daily trips per airport employee.

Trip generation for each supply option was developed by applying the above conversions to the development potential estimates in Table IV-1. The "employment" category in Table IV-1 was converted into commercial, heavy industrial, and light industrial employees based on numbers developed by EIP Associates (EIP 1988).

The traffic analysis that follows is divided into two sections. The first section analyzes the impacts of the five water supply options on traffic using a baseline water production level of 18,400 acre-feet. The second section discusses the same five water supply options using a baseline water production level of 16,700 acre-feet.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400 /17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

This option would provide no additional water for future growth within the District, therefore, no additional vehicle trips would be directly generated by selection of this option.

Traffic-related impacts associated with tourism would continue to increase, presumably at current rates. In addition, increased growth in non-Cal-Am areas would generate traffic on Monterey Peninsula roads. Non-Cal-Am development would lead to an additional 741 single-family residential units, 150 motel rooms, and 8,534 new employees and 134,546 trips associated with full buildout (Table IV-34). Without an in-depth traffic study, however, it is not possible to accurately predict the impacts of the non-Cal-Am development on Monterey Peninsula roadways.

The data presented in Table IV-34 indicate that traffic conditions on the Monterey Peninsula would deteriorate to LOS E or F on all segments if planned freeway improvements are not implemented.

TABLE IV-34

AVERAGE DAILY TRIP GENERATION
Baseline Production/Consumption Level A (18,400 Acre-Feet)

Location/ Description	Supply Option I 18,400 Acre-Feet	Supply Option II 20,000 Acre-Feet	Supply Option III 20,500 Acre-Feet	Supply Option IV 17,500 Acre-Feet	Supply Option V 16,700 Acre-Feet
Carmel	0	2,740	3,992	0	0
Del Rey Oaks	0	314	551	0	0
City of Monterey	0	13,205	25,257	0	0
Pacific Grove	0	8,407	11,776	0	0
Sand City	0	16,658	20,981	0	0
Seaside	0	23,009	27,868	0	0
Monterey County	0	13,320	16,288	0	0
MPAD	0	576	1,943	0	0
Non-Cal-Am	134,546	134,546	134,546	134,546	134,546
Total ADT	**134,546**	**212,775**	**243,203**	**134,546**	**134,546**

Note: Average daily trip generation (ADT) assumes that water will be distributed according to Distribution Alternative IV.

Source: Institute of Transportation Engineers, 1983, 1987.

The 1988 Regional Transportation Plan (Monterey County Transportation Commission 1988) identifies the following highway improvements to better regional traffic conditions:

- Constructing the Hatton Canyon Freeway to bypass the existing SR 1 from 0.3 mile south of the Carmel River to 0.1 mile south of SR 1 and SR 68 (Holman Highway),

- Widening Carmel Valley Road from SR 1 to Carmel Rancho Boulevard and from Via Petra to Valley Greens Road,

- Widening SR 68 with a climbing lane between the junction with SR 1 and Presidio Boulevard,

- Widening SR 68 to four lanes from its junction with SR 1 to Los Laureles Grade (east of Terero Drive), and

- Widening SR 1 from SR 68 to Ord Village.

These road improvements are based on employment forecasts prepared in 1989 by AMBAG. The forecast shows Monterey County employment would increase by 22,620 jobs by 1995. The employment calculations used on this EIR show an increase of 22,276 jobs during the same period. Traffic increases for the worst-case situation (Supply Option III at the 16,700 acre-feet base production level) are consistent with the traffic assumed for the roadway improvements mentioned above.

With the road improvements discussed above, traffic conditions for segments 1, 6, and 8 would be expected to improve to acceptable levels, with LOS in the C and D range (EIP Associates 1988). Segments 2, 3, 4, 7, and 9 would remain unchanged as a result of the above improvements.

Impacts: Implementing Supply Option I would not provide water for new development in the Cal-Am service area and would, therefore, have no project-related impact on traffic. The region would continue to experience significant traffic impacts, however, from sources unrelated to the project, such as tourism, commute trips from Marina and Salinas, and traffic from non-Cal-Am development. As a consequence, five of the eight segments analyzed would continue to experience unacceptable LOS even if the planned improvements are implemented. Only segment 1 (SR 1) could be expected to meet the Monterey County standard of LOS C.

Mitigation Measures: No mitigation measures are required; however, the following measures could alleviate traffic impacts from future growth outside of the Cal-Am service area:

- MPWMD should ask the transportation authorities to implement the planned improvements listed above to improve LOS on segments 1, 6, and 8; and

- Improve LOS to C or D on segments 2, 3, 7, and segments by:

  - widening SR 1 to six lanes between Carmel Hill and the Sloat undercrossing,

  - widening SR 1 to eight lanes from the Sloat undercrossing to the junction with SR 68, and

  - widening SR 68 to six lanes from the east junction with SR 1 to SR 218. These improvements are not included in the 1988 Regional Transportation Plan.

Cost estimates and funding sources are not available for the improvements listed above. In addition, the MPWMD lacks the authority to implement the above-mentioned improvements, and consequently, would not be able to carry out the required monitoring and mitigation pursuant to

AB 3180. As a result, the proposed mitigation measures are unlikely to be implemented without the cooperation of other public agencies.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would provide an additional 1,488 acre-feet of potable water for future development in the Cal-Am service area. This supply option (in conjunction with Distribution Alternative IV) would allow development of 2,005 single-family residential units, 2,052 multi-family units, commercial and industrial uses generating 12,974 employees, and 1,399 hotel rooms.

Under Supply Option II, total ADT would increase by approximately 212,775 trips: 134,546 trips (63 percent) from non-Cal-Am development and 78,229 trips (27 percent) from Cal-Am development (Table IV-34).

A portion of these total trips would be distributed among the Monterey Peninsula freeways, while other trips would be limited to surface street destinations. An undetermined number of additional trips would also be expected from normal increases in day-use tourism and employee commuting to the Peninsula. Without an in-depth traffic study, it is not possible to assign trip distribution and traffic assignments to specific roadways.

Traffic conditions on the Monterey Peninsula are expected to deteriorate to LOS E or F on all segments if planned freeway improvements are not implemented based on data presented in Table IV-34. With the improvements identified in the Supply Option I discussion above, traffic conditions on segments 1, 6, and 8 would be expected to improve to acceptable levels, with LOS in the C and D range (EIP Associates 1988). Additional vehicle trips from areas outside the peninsula would further degrade the traffic conditions in the Cal-Am service area.

Impacts: The additional average daily vehicle trips generated by the increase in water supply under Supply Option II would generally worsen the LOS on Monterey Peninsula freeways. Even with planned improvements, five of the eight segments analyzed would continue to experience unacceptable levels of service. The impact of Supply Option II on traffic is considered significant.

Mitigation Measures: Planned improvements identified for Supply Option I would apply to Supply Option II. Without an in-depth traffic analysis, however, it is not known whether all of the traffic improvements identified above would reduce the impacts of Supply Option III to a less-than-significant level.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would provide an additional 1,953 acre-feet of potable water for future development in the Cal-Am service area. Under the District's current allocation formula (Distribution Alternative II), this water supply would allow the development of 2,281 residential units, 2,941 multi-family units, commercial and industrial uses involving 14,752 employees, and 1,738 hotel rooms.

Under Supply Option III, the total ADT would increase by approximately 243,203 trips: 134,546 trips (55 percent) from non-Cal-Am development and 108,657 trips (45 percent) from Cal-Am development (Table IV-34).

A portion of these total trips would be distributed among Monterey Peninsula freeways, while other trips would be limited to surface street destinations. An undetermined number of additional trips would also be expected from normal increases in tourism and employees commuting to the peninsula. This option would have the greatest effect on regional transportation systems of the water supply options for the 18,400 acre-feet base production level.

The data in Table IV-34 and LOS estimates at buildout of the Monterey Peninsula area (EIP Associates 1988) indicate that traffic conditions on the Peninsula would deteriorate to LOS E or F on all segments if planned freeway improvements are not implemented. With the improvements identified above for Option I, traffic conditions on segments 1, 6, and 8 would be expected to improve to LOS C, D, and E, respectively. All other segments would be expected to deteriorate to LOS E or F. Additional vehicle trips from areas outside the Monterey Peninsula would further degrade the traffic conditions within the District boundaries.

Impacts: The additional ADT that would be generated by Supply Option III would generally worsen the LOS on Monterey Peninsula freeways relative to Supply Options I and II. Even with planned improvements, five of the eight segments analyzed would continue to experience unacceptable LOS. Only segment 1 (SR 1) could be expected to meet the Monterey County standard of LOS C. The adverse traffic-related impacts of Supply Option III are, therefore, considered significant. At this level of analysis, the relative difference between implementing Supply Option II or III is considered negligible since these options would further deteriorate traffic conditions on freeway segments that currently fail to meet Monterey County's standard of LOS C.

Mitigation Measures: Planned improvements identified for Supply Option I would apply to Supply Option III. Without an in-depth traffic analysis, however, it is not known whether all of the traffic improvements identified above would reduce the impacts of Supply Option III to a less-than-significant level.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production Level)

Supply Option IV would supply approximately 17,500 acre-feet per year of potable water for use in the Cal-Am service area. No additional growth attributable to Cal-Am water would be expected under this option. Each freeway segment would continue to experience a decrease in the LOS due to traffic-related impacts associated with tourism, in-commuting, and growth associated with increases in non-Cal-Am water.

Under Supply Option IV, non-Cal-Am development would directly increase the total ADT in the project area by approximately 134,546 trips. No development within the Cal-Am service area would result from Supply Option IV.

Based on traffic volumes presented in Table IV-34, traffic conditions on the Monterey Peninsula are expected to deteriorate to LOS E or F on all segments if planned freeway improvements are not considered. Planned freeway improvements would improve the LOS on segments 1, 6, and 8.

Impacts: As with Supply Option I, implementation of Supply Option IV would not increase the amount of water available for new development in the Cal-Am service area and would, therefore, have no project-related impacts. Traffic impacts would be similar to those described in Table IV-

34 for Supply Option I. These impacts are significant but are unrelated to the Water Allocation Program.

Mitigation Measures: Planned improvements identified for Supply Option I would apply to Supply Option IV.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would supply approximately 16,700 acre-feet of potable water for use in the Cal-Am service area. No additional growth would be expected as a result of this option. However, continued growth in non-Cal-Am areas, as well as increases in tourist and in-commuting traffic, would continue to affect traffic conditions. Planned freeway improvements would improve the LOS on segments 1, 6, and 8.

Non-Cal-Am development under Supply Option V would directly increase the total ADT in the project area by approximately 134,546 trips associated with non-Cal-Am development. No development within the Cal-Am service area would result from Supply Option V.

Impacts: Supply Option V would have no impacts on traffic, although traffic conditions would continue to worsen as a result of development outside of the Cal-Am service area.

Mitigation Measures: Planned improvements identified for Supply Option I would apply to Supply Option V.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would allow development of an additional 1,581 acre-feet of potable water for future development in the Cal-Am service area. Under the District's current allocation formula (Distribution Alternative IV), this water supply would allow development of 2,102 single residential units, 2,113 multi-family units, commercial and industrial uses involving 13,263 employees, and 1,472 hotel rooms.

Under Supply Option I, the total ADT in the district would increase by approximately 220,829 trips: 134,546 trips (61 percent) from non-Cal-Am development and 86,283 trips (39 percent) from Cal-Am development (Table IV-35).

A portion of these total trips would be distributed among the Monterey Peninsula freeways, while other trips would be limited to surface street destinations. An undetermined number of additional trips would also be expected from normal increases in tourism and employee in-commuting to the peninsula.

Data from Table IV-35 indicate that traffic conditions on the Monterey Peninsula would deteriorate to LOS E or F on all segments if planned freeway improvements are not implemented. With the improvements identified in the Supply Option I discussion under the 18,400 acre-feet base production level, traffic conditions on segments 1, 6, and 8 would be expected to improve to acceptable levels, with LOS in the C and D range (EIP Associates 1988). Additional vehicle trips from areas outside the peninsula would further degrade the traffic conditions in the Cal-Am service area.

Impacts: The impacts are similar to those discussed under Supply Option II. The deterioration in LOS is more severe for all supply options under the 16,700-acre-feet base production level as compared to the 18,400-acre-feet base production level because of the increased difference between the baseline production and the supply amount.

Mitigation Measures: Mitigation measures for these impacts are the same as those listed under Supply Option I (18,400-acre-feet base production level).

It is unknown, however, whether, all of these traffic improvements would reduce the impact of Supply Option I (16,700 acre-feet base production level) to a less-than-significant level.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would provide an additional 1,488 acre-feet of potable water for future development in the Cal-Am service area. Under the District's current allocation formula (Distribution Alternative IV), this water supply would allow development of 2,739 single residential units, 6,527 multi-family units, commercial and industrial uses involving 18,854 employees, and 2,351 hotel rooms.

Under Supply Option II, the total ADT in the district would increase by approximately 311,840 trips: 134,546 trips (43 percent) from non-Cal-Am development and 177,294 trips (57 percent) from Cal-Am development (Table IV-35).

TABLE IV-35

AVERAGE DAILY TRIP GENERATION
Baseline Production/Consumption Level B (16,700 Acre-Feet)

Location/ Description	Supply Option I 18,400 Acre-Feet	Supply Option II 20,000 Acre-Feet	Supply Option III 20,500 Acre-Feet	Supply Option IV 17,500 Acre-Feet	Supply Option V 16,700 Acre-Feet
Carmel	3,946	7,381	9,140	830	0
Del Rey Oaks	343	1,132	1,396	0	0
City of Monterey	17,539	52,860	54,360	1,762	0
Pacific Grove	9,325	18,063	20,789	2,244	0
Sand City	17,375	31,190	25,839	9,604	0
Seaside	24,436	38,505	42,949	14,686	0
Monterey County	13,514	23,005	25,979	8,187	0
MPAD	804	5,159	6,526	0	0
Non-Cal-Am	134,546	134,546	134,546	134,546	134,546
Total ADT	**220,829**	**311,840**	**331,523**	**171,859**	**134,546**

Note: Assumes water distribution Alternative IV

Source: Institute of Transportation Engineers, 1983, 1987.

Impacts: The additional ADT that would be generated by Supply Option II would generally worsen the LOS on Monterey Peninsula freeways. Even with planned improvements, five of the eight segments analyzed would continue to experience unacceptable LOS. Only segment 1 (SR 1) could be expected to meet the Monterey County standard of LOS C. Therefore, the adverse traffic-related impacts of Supply Option II are considered significant.

Mitigation Measures: Planned improvements identified for Supply Option I would apply to Supply Option II. It is unknown, however, whether all of the traffic improvements identified above would reduce the impacts of Supply Option II to a less-than-significant level.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would allow development of an additional 3,534 acre-feet of potable water for future development in the Cal-Am service area. Under the District's current allocation formula (Distribution Alternative IV), this water supply would allow development of 2,933 single residential units, 6,473 multi-family units, commercial and industrial uses involving 20,786 employees, and 2,530 hotel rooms.

Under Supply Option III, the total ADT within the District boundaries would increase by approximately 331,523 trips: 134,546 trips (41 percent) from non-Cal-Am development and 196,977 trips (59 percent) from Cal-Am development (Table IV-35).

Impacts: The additional ADT that would be generated by Supply Option III are considered a significant adverse impact. This option involves the greatest difference in supply volume between the base production level and the supply amount; therefore, it is the worst-case scenario and the adverse effects would be the most severe.

Mitigation Measures: Planned improvements identified for Supply Option I (18,400-acre-feet base production level) would apply to Supply Option III. It is unknown, however, whether or not these improvements will reduce the identified impacts to a less-than-significant level.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Supply Option IV would provide of an additional 744 acre-feet of potable water for future development in the Cal-Am service area. Under the District's current allocation formula, this water supply would allow development of 1,458 single residential units, 710 multi-family units, commercial and industrial uses involving 10,105 employees, and 802 hotel rooms.

Under Supply Option IV, the total ADT within the District boundaries would increase by approximately 171,859 trips: 134,546 trips (78 percent) from non-Cal-Am development and 37,313 trips (22 percent) from Cal-Am development (Table IV-35). The increase in traffic would deteriorate the LOS on the freeway and surface streets, as under the previous water supply options.

Impacts: The additional ADT that would be generated by Supply Option IV would be a significant adverse impact on the traffic pattern and LOS of local and regional roadways.

Mitigation Measures: Planned improvements identified for Supply Option I (18,400-acre-feet base production level) would apply to Supply Option IV. It is unknown, however, whether or not these improvements will reduce the identified impacts to a less-than-significant level.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would supply approximately 16,700 acre-feet per year of potable water for use in the Cal-Am service area. No additional growth would be expected as a result of this option. However, continued growth in non-Cal-Am areas, as well as increases in tourist and in-commuting traffic, would continue to affect traffic conditions.

The non-Cal-Am development associated with Supply Option V would directly increase the total ADT in the project area by approximately 134,546 ADT.

Impacts: Supply Option V would have no impact on traffic although the increase in ADT due to non-Cal-Am development would continue to worsen traffic conditions.

Mitigation Measures: Planned improvements identified for Supply Option I (18,400-acre-feet base production level) would apply to Supply Option V.

J. SCHOOLS

1. Methodology and Analysis

This analysis estimates the impacts of students "generated" by additional development on the Monterey Peninsula school districts. The analysis estimates school impacts caused by development under the water supply options in areas served by Cal-Am and assumed development in non-Cal-Am areas. While the District's Water Allocation Program will not affect development in non-Cal-Am areas, assumed development is analyzed to assess the cumulative impact of increased student enrollment on school districts within the area. Student yield was estimated by multiplying the number of residential dwelling units expected for each school district by the students per dwelling unit type shown in Table IV-36.

This analysis assumes that all the development that would occur in Del Rey Oaks, Monterey, Seaside, and Sand City would generate students who would attend Monterey Peninsula Unified School District (MPUSD). Additionally, students located in the following unincorporated areas outside of the Cal-Am service area are also assumed to attend schools in the MPUSD: Hidden Hills, Laguna Seca, and Monterra.

Development in Pacific Grove is assumed to generate students who would attend schools in Pacific Grove Unified School District (PGUSD). Carmel Unified School District (CUSD) would be attended by students generated by residential development in Carmel-by-the-Sea, Carmel Valley (a non-Cal-Am area), and the remaining unincorporated portions of Monterey County located within the Cal-Am service area. Although actual attendance by students residing in unincorporated Monterey County (e.g., Del Monte Forest) would probably be dispersed among the districts, prospective distribution of these students is not available.

This analysis estimates the overall effect of additional water supply on student yields in each of the three school districts. It does not estimate the effects on individual schools. This analysis may therefore indicate that all new students could be accommodated in a school district according to the district capacities shown in Table III-19. As discussed in Chapter IV, the distribution of students within a district may indicate that additional individual school capacity is needed, even if the remaining overall district capacity appears to be adequate.

The following analysis is divided into two major sections. The first section examines the impacts of student generation using a base production of 18,400 acre-feet of available water. This base is the current production of the Cal-Am system, and it assumes no water conservation. The second section examines the impacts of student generation using a base production of 16,700 acre-feet of available water. This base assumes that 16,700 acre-feet could supply current water needs through an aggressive water conservation policy.

TABLE IV-36

STUDENT GENERATION UNDER ALL SUPPLY OPTIONS
Distribution Alternative IV at Baseline Production/Consumption Level A (18,400 Acre-Feet)

School/ District	Number of du	Supply Option I* K-8	Supply Option I* 9-12	Supply Option I* Total	Number of du	Supply Option II K-8	Supply Option II 9-12	Supply Option II Total	Number of du	Supply Option III K-8	Supply Option III 9-12	Supply Option III Total	Number of du	Supply Option IV* K-8	Supply Option IV* 9-12	Supply Option IV* Total	Number of du	Supply Option V* K-8	Supply Option V* 9-12	Supply Option V* Total
Monterey Unified																				
Single-family	690	345	173	518	768	384	192	576	743	372	186	557	690	345	173	518	690	345	173	518
Multi-family	0	0	0	0	1,680	336	168	504	2,344	469	234	703	0	0	0	0	0	0	0	0
Subtotal		345	173	518		720	360	1,080		840	420	1,260		345	173	518		345	173	518
Pacific Grove Unified																				
Single-family	0	0	0	0	70	35	18	53	96	48	24	72	0	0	0	0	0	0	0	0
Multi-family	0	0	0	0	286	57	29	86	450	90	45	135	0	0	0	0	0	0	0	0
Subtotal		0	0	0		92	46	138		138	69	207	0	0	0	0	0	0	0	0
Carmel Unified																				
Single-family	51	26	13	38	1,167	584	292	875	1,442	721	361	1,082	51	26	13	38	51	26	13	38
Multi-family	0	0	0	0	86	17	9	26	147	29	15	44	0	0	0	0	0	0	0	0
Subtotal		26	13	38		601	300	901		750	375	1,126		26	13	38	0	26	13	38
Total Students - All Districts		371	185	556		1,413	706	2,119		1,729	864	2,593		371	185	556		371	185	556

*Student generation under Supply Options I, IV, and V is entirely attributable to non-Cal-Am development.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would provide no additional water for future growth in the Cal-Am service area. However, non-Cal-Am development would cause the student population in the MPUSD to increase by 518 students, or 15 percent of the MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). MPUSD would have sufficient capacity for elementary, middle, and high school students.

Although non-Cal-Am development would add no new students to PGUSD, it would add 38 new students to the CUSD, all of whom could be absorbed easily by the CUSD elementary, middle, and high schools.

Impacts: Under Supply Option I, there would be a minor increase in student populations in the MPUSD, PGUSD, and CUSD as a result of new non-Cal-Am development, but no increase associated with growth within the Cal-Am service area. Supply Option I would, therefore, have no project-related impacts.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Under Supply Option II new development (both Cal-Am and non-Cal-Am) within the MPWMD boundaries would increase the total student population in all districts by 2,119 students. Based on the data presented in Table IV-36, the student population of MPUSD would increase by approximately 1,080 students, or 31 percent of MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). Sixty-six percent of the new students would attend elementary and middle schools, and 34 percent would attend high schools (Table IV-36). The remaining capacity estimates in Table III-19 show that MPUSD schools would have adequate capacity for elementary and middle school students, high school enrollment would exceed current capacity by 122 students.

PGUSD would receive approximately 138 students, or 19 percent of the total remaining capacity in the district (Table IV-36). Based on the data in Table III-19, PGUSD would have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option II. New students within CUSD would exhaust approximately 94 percent of the district's total remaining capacity. CUSD would have adequate capacity to house elementary and middle school students, but increase in high school enrollment would exceed current capacity by 40 students.

Impacts: The MPUSD, PGUSD, and CUSD elementary and middle schools could provide adequate school housing with existing facilities based on the data presented in Tables III-19 and IV-36. In addition, the PGUSD high school system has adequate capacity to handle the expected student population generated by Supply Option II. Thus, the expected secondary growth impacts on the MPUSD and CUSD elementary and middle schools and the entire PGUSD school system would be less-than-significant.

Enrollment at MPUSD and CUSD high schools could exceed remaining capacity from cumulative development in Cal-Am and non-Cal-Am areas if no new schools or portable classrooms were constructed before buildout of the development supported by Supply Option II. While development directly affected by the MPWMD Water Allocation Program (i.e., Cal-Am) would not in itself result in school overcrowding, it would contribute to the cumulative effects of increased enrollment. The cumulative impacts would, nonetheless, be less-than-significant because school districts in California are authorized to collect school impact fees on new development for the construction of new facilities or installation of portable classrooms.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Under Supply Option III new development (both Cal-Am and non-Cal-Am) would increase the student population in all districts by 2,593 students. Based on the data presented in Table IV-36, the student population in MPUSD would increase by approximately 1,260 students, or 37 percent of the district's total remaining capacity as of the 1986-1987 school year (Table III-19). The estimates of remaining capacity listed in Table III-19 show that MPUSD would have adequate capacity for elementary and middle school students but would exceed high school capacity by approximately 182 students under Supply Option III.

The PGUSD would receive approximately 207 students, or 29 percent of the total remaining school capacity in the district (Table IV-36). This estimate assumes that only development in Pacific Grove would generate students that would attend PGUSD. CUSD would receive approximately 1,126 new students, or 117 percent of the district's total remaining school capacity.

Based on the data in Table III-19, PGUSD appears to have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option III. The expected CUSD student generation would exceed the capacity of all schools. CUSD elementary and middle school remaining capacity of 694 students would be exceeded by 56 students. Similarly, CUSD high school remaining capacity of 260 students would be exceeded by 115 students.

Impacts: The MPUSD elementary and middle school system and the entire PGUSD system have adequate capacity to serve the additional student population that would occur under Supply Option III. The growth impacts of Supply Option III on MPUSD elementary and middle school and the PGUSD school system are considered less-than-significant.

Enrollment at MPUSD and CUSD high schools would exceed capacity if no new schools or portable classrooms were constructed before buildout of the development supported by Supply Option III. Cal-Am development would also contribute to the cumulative increase in CUSD elementary and middle school enrollments beyond existing remaining capacity. The impacts would, nonetheless, be less-than-significant because school districts in California are authorized to collect school impact fees on new development.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production Level)

Supply Option IV would accommodate no additional development and thus generate no new student population in the Cal-Am area. Non-Cal-Am development would, however, cause the student population in the MPUSD to increase by 518 students, or 15 percent of the MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). MPUSD would have sufficient capacity for elementary, middle, and high school students.

Although non-Cal-Am development would add no new students to PGUSD, it would add 38 new students to the CUSD, all of whom could be absorbed easily by the CUSD elementary, middle, and high school systems.

Impacts: Under Supply Option IV, there would be a minor increase in student populations in the MPUSD, PGUSD, and CUSD as a result of new non-Cal-Am development, but no increase associated with growth within the Cal-Am service area. Supply Option IV would, therefore, have no project-related impacts.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would accommodate no additional development and thus generate no new student population in the Cal-Am area. As discussed under Supply Option IV, non-Cal-Am development would cause the student population in the MPUSD to increase by 518 students, or 15 percent of the MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). MPUSD would have sufficient capacity for elementary, middle, and high school students.

Impacts: Supply Option V would have no impact on schools within the Cal-Am service area. Growth within the non-Cal-Am area would, however, create a small increase in the student populations in the MPUSD, PGUSD, and CUSD, but existing capacity is adequate to absorb these students.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Under Supply Option I, new development within the boundaries of the Monterey Peninsula Water Management District, both Cal-Am and non-Cal-Am, would increase the current student population in all school districts by 2,153 students. Based on the data presented in Table IV-37, the student population of MPUSD would increase by approximately 1,105 students, or 32 percent of MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). Sixty-six percent of the new students would attend elementary and middle schools, and 34 percent would attend high schools (Table IV-37). The remaining capacity estimates in Table III-19 show that MPUSD would have adequate capacity for elementary and middle school students but insufficient capacity for high school students.

PGUSD would receive approximately 128 students, or 18 percent of the total remaining capacity in the district (Table IV-37). CUSD would receive approximately 96 percent of the district's total remaining capacity. According to the data shown in Table III-19, PGUSD would have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option I. CUSD would have adequate capacity to house elementary and middle school students but insufficient capacity to house the expected increase in high school students.

TABLE IV-37

STUDENT GENERATION UNDER ALL SUPPLY OPTIONS
Distribution Alternative IV at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

School/ District	Number of du	Supply Option I K-8	Supply Option I 9-12	Supply Option I Total	Number of du	Supply Option II K-8	Supply Option II 9-12	Supply Option II Total	Number of du	Supply Option III K-8	Supply Option III 9-12	Supply Option III Total	Number of du	Supply Option IV K-8	Supply Option IV 9-12	Supply Option IV Total	Number of du	Supply Option V* K-8	Supply Option V* 9-12	Supply Option V* Total
Monterey Unified																				
Single-family	766	383	192	575	682	341	171	512	655	328	164	491	812	406	203	609	690	345	173	518
Multi-family	1,767	353	177	530	3,957	791	396	1,187	4,651	930	465	1,395	583	117	58	175	0	0	0	0
Subtotal		736	368	1,105		1,132	566	1,699		1,258	629	1,887		523	261	784		345	173	518
Pacific Grove Unified																				
Single-family	82	41	21	62	132	66	33	99	147	74	37	110	19	10	5	14	0	0	0	0
Multi-family	222	44	22	67	1,035	207	104	311	1,289	258	129	387	76	15	8	23	0	0	0	0
Subtotal		85	43	128		273	137	410		331	166	497		25	12	37		0	0	0
Carmel Unified																				
Single-family	1,192	596	298	894	1,925	963	481	1,444	2,131	1,066	533	1,598	627	314	157	470	51	26	13	38
Multi-family	88	18	9	26	435	87	44	131	533	107	53	160	51	10	5	15	0	0	0	0
Subtotal		614	307	920		1,050	525	1,574		1,172	586	1,758		324	162	486		26	13	38
Total Students - All Districts		1,435	718	2,153		2,455	1,227	3,682		2,761	1,381	4,142		871	436	1,307		371	185	556

*Student generation under Supply Option V is entirely attributable to non-Cal-Am development.

Impacts: The MPUSD, PGUSD, and CUSD elementary and middle schools could provide adequate school housing with existing facilities based on the data presented in Tables III-19 and IV-37. In addition, the PGUSD high school system has adequate capacity to handle the expected student population generated by Supply Option I. Thus, the expected growth impacts on the MPUSD and CUSD elementary and middle schools and the entire PGUSD school system would be less-than-significant. While development within the Cal-Am area would not in itself lead to overcrowding at MPUSD and CUSD high schools, it would contribute to the cumulative impacts of increased student enrollment. The impact of this option on high schools is considered less-than-significant since development fees could be charged to construct new school facilities or install portable classrooms.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Under Supply Option II new development within the MPWMD boundaries would increase the current student population in all school districts by 3,682 students, including both Cal-Am and non-Cal-Am development. Based on the data presented in Table IV-37, the student population of MPUSD would increase by approximately 1,699 students, or 49 percent of MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). Sixty-six percent of the new students would attend elementary and middle schools, and 34 percent would attend high schools (Table IV-37). The remaining capacity estimates in Table III-19 show that MPUSD would have adequate capacity for elementary and middle school students but insufficient capacity for high school students.

PGUSD would receive approximately 273 students, or 38 percent of the total remaining capacity in the district (Table IV-37). CUSD would receive approximately 164 percent of the district's total remaining capacity. According to the data shown in Table III-19, PGUSD would have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option II. CUSD would have insufficient capacity to house both elementary and middle school and high school students.

Impacts: The MPUSD and PGUSD elementary and middle schools could provide adequate school housing with existing facilities based on the data presented in Tables III-19 and IV-37. In addition, the PGUSD high school system has adequate capacity to handle the expected increase in student population expected under Supply Option II. The expected growth impacts on the MPUSD and CUSD elementary and middle schools and the entire PGUSD school system would thus be less-than-significant. While development within the Cal-Am area would not in itself lead to overcrowding at MPUSD and CUSD high schools, it would contribute to the cumulative impacts of increased student enrollment. The impacts of this option on the MPUSD and CUSD are considered less-than-significant since development fees for new classrooms could accompany new growth.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Water made available under Supply Option III would accommodate new development that would increase the student population in all school districts serving the area within MPWMD's boundaries by 4,142 students. Based on the data presented in Table IV-37, the student population in MPUSD would increase by approximately 1,887 students, or 55 percent of the district's total remaining capacity as of the 1986-1987 school year (Table III-19). The estimates of remaining capacity listed in Table III-19 show that MPUSD would have adequate capacity for elementary and middle school students but would exceed high school capacity by approximately 391 students under Supply Option III.

The PGUSD would receive approximately 497 students, or 70 percent of the total remaining school capacity in the district (Table IV-37). This estimate assumes that only development in Pacific Grove would generate students that would attend PGUSD schools. CUSD would receive approximately 1,758 new students, or 183 percent of the district's total remaining school capacity.

Based on the data in Table III-19, PGUSD appears to have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option III. The expected CUSD student generation would exceed the capacity of all the schools in the district. Remaining CUSD elementary and middle school capacity of 694 students would be exceeded by 478 students. Remaining CUSD high school capacity of 260 students would be exceeded by 308 students.

Impacts: The MPUSD elementary and middle school system and the entire PGUSD system have adequate capacity to serve additional enrollment resulting from development supported by Supply Option III. The growth impacts of Supply Option III on MPUSD elementary and middle school and the PGUSD school system are considered less-than-significant. Cal-Am development would also contribute to the cumulative increases in CUSD elementary and middle school enrollment beyond existing remaining capacity. Impacts on the high school systems are also considered less-than-significant because school districts are authorized to levy impact fees to finance school construction.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Under Supply Option IV new development would increase the student population in all districts by 1,307 students, including development in the Cal-Am and non-Cal-Am areas. Based on the data presented in Table IV-37, the student population in MPUSD would increase by approximately 784 students, or 23 percent of the district's total remaining capacity as of the 1986-1987 school year (Table III-19). The estimates of remaining capacity listed in Table III-19 show that MPUSD would have adequate capacity for elementary and middle school students but would exceed high school capacity by approximately 23 students under Supply Option IV.

The PGUSD would receive approximately 37 students, or 5 percent of the total remaining school capacity in the district (Table IV-37). This estimate assumes that only development in Pacific Grove would generate students that would attend PGUSD. CUSD would receive approximately 486 students, or 51 percent of the district's total remaining school capacity. Based on the data in Table III-19, PGUSD would have sufficient remaining capacity at all school levels to accommodate expected student populations under Supply Option IV. In addition, sufficient CUSD student capacity would remain for elementary, middle, and high schools.

Impacts: The entire PGUSD and CUSD systems and the MPUSD elementary and middle school system have adequate capacity to serve additional student enrollment that would result from development supported by Supply Option IV. The growth impacts of Supply Option IV on the entire PGUSD and CUSD systems and the MPUSD elementary and middle school systems are considered less-than-significant.

Enrollment at MPUSD high schools would exceed capacity if no new schools or portable classrooms were constructed before buildout of the development assumed under Supply Option IV. While development within the Cal-Am area would not in itself lead to overcrowding at MPUSD and CUSD high schools, it would contribute to the cumulative impacts of increased student enrollment. The impacts would, nonetheless, be less-than-significant.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would accommodate no additional development and thus generate no new students in the within the Cal-Am service area. Non-Cal-Am development would, however, cause the student population in the MPUSD to increase by 518 students, or 15 percent of the MPUSD's remaining capacity as of the 1986-1987 school year (Table III-19). MPUSD would have sufficient capacity for elementary, middle, and high school students.

Although Non-Cal-Am development would add no new students to PGUSD, it would add 38 new students to the CUSD, all of which could be easily absorbed by the CUSD elementary, middle, and high school system.

Impacts: Supply Option V would have no impact on schools within the Cal-Am service area. Growth within the non-Cal-Am area would, however, create a small increase in the student populations in the MPUSD, PGUSD, and CUSD, but existing capacity is adequate to absorb these students.

Mitigation Measures: None required.

K. WASTEWATER

1. Methodology and Analysis

The wastewater impact analysis consists of two parts. First, estimates are made of the wastewater volumes that would be generated by growth in Cal-Am and non-Cal-Am service areas. Then, those wastewater volumes are compared to the capacity of existing wastewater treatment systems. The existing Monterey Peninsula wastewater treatment facilities include those operated by three agencies: the Monterey Regional Water Pollution Control Agency (MRWCPA), the Carmel Sanitary District (CSD), and the Pebble Beach Community Services District (PBCSD).

The wastewater analysis examines ten water supply options. The first five options include wastewater generated under a base production of 18,400 acre-feet (no conservation option). The second five options examine wastewater generated assuming a base production of 16,700 acre-feet (conservation option). For each option, single- and multi-family residential units are assumed to generate 210 gallons per day (gpd) per unit, hotels are assumed to generate 200 gpd per room, and commercial and industrial uses are assumed to generate 14.5 gpd per employee.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would provide no additional water for future growth. However, 309,353 gpd of wastewater would be generated by growth in non-Cal-Am areas (Table IV-38). This growth would result from water supplied from sources outside the Cal-Am system. Non-Cal-Am wastewater is assumed to be treated at the MRWPCA's regional wastewater treatment plant (8.0 MGD of remaining capacity) and at the CSD/PBCSD joint treatment plant (0.8-1.8 MGD of remaining capacity). The wastewater flows expected from this option would be 3 to 4 percent of the combined remaining capacity of these facilities (8.8-9.8 MGD). From a regional perspective, treatment facilities are adequate to handle the additional flows expected under Supply Option I.

TABLE IV-38

TOTAL AVERAGE WASTEWATER GENERATION FOR ALL SUPPLY OPTIONS
Alternative IV at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)
(Gallons Per Day)

	Option I	Option II	Option III	Option IV	Option V
Carmel-by-the-Sea	0	57,540	81,843	0	0
Del Rey Oaks	0	9,870	17,220	0	0
City of Monterey	0	210,100	321,646	0	0
Pacific Grove	0	104,601	153,931	0	0
Sand City	0	267,652	336,984	0	0
Seaside	0	133,091	153,728	0	0
Monterey County	0	227,716	281,971	0	0
MPAD	0	624	2,103	0	0
Non-Cal-Am	309,353	309,353	309,353	309,353	309,353
Total	**309,353**	**1,320,546**	**1,658,777**	**309,353**	**309,353**

Note: Wastewater generation is based on 210 gpd per dwelling unity for residential uses and 200 gpd per hotel room.

Wastewater generation for commercial and industrial uses is based on generation rate of 14.5 gpd per employee. This rate assumes that all commercial and industrial uses would be non-water intensive uses (Metcalf and Eddy, Inc. 1979).

Source: Planning Analysis and Development 1988.

Impacts: Combined remaining treatment capacity appears to be adequate to handle future wastewater flows. Option I would thus have no impact on wastewater generation.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Under Supply Option II new development would generate 1,320,546 gpd of additional wastewater (Table IV-38). This volume of additional wastewater would be treated at the MRWPCA's regional wastewater treatment plant and the CSD/PBCSD joint treatment plant (0.8-1.8 MGD of remaining capacity). The wastewater flows expected from this option would be 13-15 percent of the combined remaining capacity of these facilities. From a regional perspective, treatment facilities could easily handle the additional flows which would occur under Supply Option II.

Impacts: Combined remaining treatment facility capacity appears to be adequate to handle future wastewater flows. The impact of additional project-related wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Under Supply Option III new development that would generate 1,658,777 gpd of additional wastewater (Table IV-38). As with Supply Option II, this additional wastewater would be treated at existing project area treatment facilities. The wastewater flows expected from this option would be 17-19 percent of the combined remaining capacity of these facilities. This option would, therefore, demand slightly more wastewater treatment capacity than Supply Option II, but existing facilities could adequately handle the additional flows.

Impacts: Combined treatment facility capacity (remaining capacity) is adequate to handle future wastewater flows generated under Supply Option III. The impact of additional wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Supply Option IV would provide no additional water for future growth. However, 309,353 gpd of wastewater would be generated by growth in non-Cal-Am areas (Table IV-38). This growth would result from water supplied from sources outside the Cal-Am system. The wastewater flows expected from this option would be 3 to 4 percent of the combined remaining capacity of these facilities. The treatment facilities are adequate to handle the additional flows expected under Supply Option IV.

Impacts: Option V would thus have no impact on wastewater generation.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would provide no additional water for future growth. However, 309,353 gpd of wastewater would be generated by growth in non-Cal-Am areas as mentioned above.

Impacts: The combined remaining treatment capacity is adequate to handle future wastewater flows. The impact of additional project-related wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would support new development that would generate approximately 1,351,603 gpd of additional wastewater (Table IV-39). The wastewater flows expected from this option would be 14-15 percent of the combined remaining capacity of the regional treatment plant and the CSD/PBCSD joint facility. From a regional perspective, treatment facilities are probably adequate to handle the additional flows expected under Supply Option I.

TABLE IV-39

TOTAL AVERAGE WASTEWATER GENERATION FOR ALL SUPPLY OPTIONS
Alternative IV at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)
(Gallons Per Day)

	Option I	Option II	Option III	Option IV	Option V
Carmel-by-the-Sea	60,060	140,356	159,135	17,430	0
Del Rey Oaks	10,710	28,945	33,639	0	0
City of Monterey	223,306	580,677	692,222	22,520	0
Pacific Grove	101,926	287,464	345,256	27,858	0
Sand City	279,203	501,077	556,026	154,265	0
Seaside	134,882	200,671	220,995	97,693	0
Monterey County	231,295	404,973	459,623	133,737	0
MPAD	870	5,583	7,062	0	0
Non-Cal-Am	309,353	309,353	309,353	309,353	309,353
Total	**1,351,603**	**2,459,096**	**2,783,310**	**762,855**	**309,353**

Note: Wastewater generation is based on 210 gpd per dwelling unity for residential uses and 200 gpd per hotel room.

Wastewater generation for commercial and industrial uses is based on generation rate of 14.5 gpd per employee. This rate assumes that all commercial and industrial uses would be non-water intensive uses (Metcalf and Eddy, Inc. 1979).

Source: Planning Analysis and Development 1988.

Impacts: The impacts of this option on wastewater treatment facilities are considered less-than-significant.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would support new development that would generate approximately 2,459,096 gpd of additional wastewater (Table IV-39). The wastewater flows expected from this option would be 25-27 percent of the combined remaining capacity of the facilities. From a regional perspective, treatment facilities could handle the additional flows expected under Supply Option II.

Impacts: Combined remaining treatment facility capacity is adequate to handle future wastewater flows. The impact of additional wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would support new development that would generate approximately 2,783,310 gpd of additional wastewater (Table IV-39). This volume of additional wastewater, which is the largest of all ten supply options, would be treated at the MRWPCA's regional wastewater treatment plant and the CSD/PBCSD joint treatment plant. The wastewater flows expected from this option would amount to between 28 and 32 percent of the combined remaining capacity of these facilities. The treatment facilities are adequate to handle the additional flows expected under Supply Option III.

Impacts: Combined remaining treatment facility capacity is adequate to handle future wastewater flows. The impact of additional wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Supply Option IV would support new development that would generate 762,855 gpd of additional wastewater (Table IV-39). The wastewater flows expected from this option would be 8-9 percent of the combined remaining capacity of the treatment facilities. Existing wastewater treatment facilities could easily handle the additional flows.

Impacts: Combined remaining treatment facility capacity is adequate to handle future wastewater flows generated under Supply Option IV. The impact of additional project-related wastewater generation is, therefore, considered less-than-significant.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would provide no additional water for future growth. However, 309,353 gpd of wastewater would be generated by growth in non-Cal-Am areas.

Impacts: Option V would have no impact on wastewater flows.

Mitigation Measures: None required.

L. HOUSING AND POPULATION GROWTH

1. Methodology and Analysis

CEQA generally requires that EIRs address project or program effects on housing, and specifically that they analyze how a proposal would affect existing housing, whether or not it would create a demand for additional housing, and whether or not it would induce substantial growth or concentration of population. Because the District's Allocation Program does not constitute a "development project" in the conventional sense, no demand for additional housing would be created and no population growth or concentration would be induced. It is conceivable, however, that the program could affect existing housing, particularly in situations where the housing market is constrained by lack of available water for new housing growth. In any case, the impacts of the Allocation Program on housing and population would result only in economic or social effects, which according to CEQA shall not be treated as significant effects on the environment, unless the economic or social effects in turn cause physical changes in the environment. Any such potential physical changes are addressed separately in this EIR. Accordingly, the direct housing- and population-related environmental impacts of the Allocation Program are, for the purposes of this analysis, determined not to be significant.

This analysis of the five water supply options considers only the total amount housing development and population that can be supported within the District boundaries by each of the water supply options and not where it would occur.

Table IV-40 shows the housing and population growth which could be supported by water allocated according to Distribution Alternative IV (the proposed alternative) under those supply option/baseline production level combinations providing additional water for the Cal-Am system.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would, by definition, not necessarily change existing conditions within the Cal-Am service area. While there could conceivably be some shifting among uses, it is not likely that there would be any significant growth or decline in the Cal-Am service area housing stock. As under all water supply options, the non-Cal-Am area would accommodate 741 new single-family units which could house 1,760 new residents.

The primary concern with respect to housing under Option I would be that the housing market would be artificially constrained, thereby reducing the supply of housing available, and thus increasing the demand for and cost of the available units.

Impacts: For CEQA purposes, Supply Option I would have no housing-related impacts.

Mitigation Measures: None required.

TABLE IV-40
HOUSING AND POPULATION GROWTH POTENTIAL
Distribution Alternative IV

Supply Option II at Baseline Production of 18,400 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	274		274	492
Del Rey Oaks	1	46	47	123
City of Monterey	-50	814	764	1,684
Pacific Grove	70	286	356	727
Sand City		765	765	1,576
Seaside	127	55	181	534
Monterey County	842	86	928	2,204
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	2,005	2,051	4,056	9,100

Supply Option III at Baseline Production of 18,400 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	348	40	388	697
Del Rey Oaks	3	79	82	214
City of Monterey	-77	1,247	1,170	2,579
Pacific Grove	96	450	546	1,114
Sand City		963	963	1,985
Seaside	127	55	181	534
Monterey County	1,043	107	1,150	2,731
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	2,280	2,941	5,221	11,614

Supply Option I at Baseline Production of 16,700 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	286		286	514
Del Rey Oaks	2	49	51	133
City of Monterey	-53	865	812	1,790
Pacific Grove	82	222	304	620
Sand City		798	798	1,644
Seaside	127	55	181	534
Monterey County	855	88	943	2,240
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	2,039	2,077	4,116	9,235

Supply Option II at Baseline Production of 16,700 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	375	281	656	1,178
Del Rey Oaks	3	132	135	354
City of Monterey	-138	2,250	2,112	4,654
Pacific Grove	132	1,035	1,167	2,383
Sand City		1,432	1,432	2,952
Seaside	127	143	269	792
Monterey County	1,499	154	1,653	3,927
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	2,738	5,427	8,165	17,999

Supply Option III at Baseline Production of 16,700 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	379	358	737	1,323
Del Rey Oaks	3	151	154	402
City of Monterey	-165	2,683	2,518	5,549
Pacific Grove	147	1,289	1,436	2,934
Sand City		1,598	1,598	3,295
Seaside	127	219	346	1,016
Monterey County	1,701	175	1,875	4,454
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	2,933	6,472	9,405	20,732

Supply Option IV at Baseline Production of 16,700 Acre-Feet

	Single-Family Units	Multi-Family Units	Total Units	Population
Carmel	83		83	150
Del Rey Oaks				
City of Monterey	-5	87	81	179
Pacific Grove	19	76	95	194
Sand City		441	441	908
Seaside	127	55	181	534
Monterey County	493	51	544	1,292
MPAD				
Non-Cal-Am	741		741	1,760
TOTAL	1,458	709	2,167	5,016

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

In addition to 741 new single-family units in the non-Cal-Am area, Supply Option II would result in an increased supply of both single-family units (1,264) and multi-family units (2,051) within the Cal-Am service area. The total population growth associated with this housing stock growth would be 9,100 residents. Strictly from a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option II would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Water made available under Supply Option III would support the development of an additional 1,539 single-family units and 2,941 multi-family units in the Cal-Am service area, in addition to the 741 non-Cal-Am single-family units. These new units could accommodate an additional 11,614 new residents. From a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option III would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Fish Protection Production)

Under Supply Option IV, there would be no new water available for housing or population growth, although it is assumed that non-Cal-Am development of 741 new single-family units and 1,760 new residents would take place.

Impacts: For CEQA purposes, Supply Option IV would have no environmental impacts.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would result in no additional water for housing development within the Cal-Am service area. As with the other supply options, there would, however, be additional housing development in non-Cal-Am areas within the district. This development would amount to 741 new single-family units which would accommodate 1,760 new residents.

Impacts: For CEQA purposes, Supply Option IV would have no environmental impacts.

Mitigation Measures: None required.

3. **Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)**

Supply Option I: 18,400 Acre-Feet (Current Production)

In addition to 741 new single-family units in the non-Cal-Am area, Supply Option I would result in an increased supply of both single-family units (1,298) and multi-family units (2,941) within the Cal-Am service area. The total population growth associated with this housing stock growth would be 9,235 residents. Strictly from a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option II would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would result in an additional 1,997 single-family units and 5,427 multi-family units within the Cal-Am service area and 741 new single-family units in the non-Cal-Am area. The total population growth associated with Cal-Am housing stock growth would be 16,239 residents, and the non-Cal-Am units would accommodate an additional 1,760 residents. Strictly from a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option II would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Water made available under Supply Option III would support the development of an additional 2,192 single-family units and 6,472 multi-family units in the Cal-Am service area, in addition to the 741 non-Cal-Am single-family units. These new units could accommodate an additional 20,732 new residents. From a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option III would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Fish Protection Production)

In addition to 741 new single-family units in the non-Cal-Am area, Supply Option II would result in an increased supply of both single-family units (717) and multi-family units (709) within the Cal-Am service area. The total population growth associated with this housing stock growth would be 5,160 residents, with 1,760 of these outside of the Cal-Am service area. Strictly from a housing market perspective, this option would, therefore, have a beneficial effect on the Monterey Peninsula's housing supply.

Impacts: While Supply Option IV would generally have beneficial housing-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Supply Option V would result in no additional water for housing development within the Cal-Am service area. As with the other supply options, there would, however, be additional housing development in non-Cal-Am areas within the district. This development would amount to 741 new single-family units which would accommodate 1,760 new residents.

Impacts: For CEQA purposes, Supply Option IV would have no environmental impacts.

Mitigation Measures: None required.

M. EMPLOYMENT

1. Methodology and Analysis

Employment generation is a topic not specifically mandated by CEQA to be addressed in EIRs. The following paragraphs, therefore, simply summarize the level of job growth likely to result from the four water supply options being analyzed. For purposes of this analysis, it is assumed that any job growth is beneficial.

Table IV-41 shows the employment growth which could be supported by water allocated according to Distribution Alternative IV (the proposed alternative) under those supply option/baseline production level combinations providing additional water for the Cal-Am system.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would, by definition, not necessarily change existing conditions within the Cal-Am service area. While there could conceivably be some shifting among uses, it is not likely that there would be any significant growth or decline in the service area employment market. The non-Cal-Am area within the District would, however, experience the addition of 8,534 new jobs, most of which would be associated with the development of Ryan Ranch. The addition of these jobs would occur regardless of the actions taken as a result of the District's Allocation Program. The impacts of this job growth would, therefore, not be related to this project.

Impacts: For CEQA purposes, Supply Option I would have no project-related impacts.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would result in an increased supply of jobs within the Cal-Am service area, with employment increasing by 5,485 new jobs. From a employment market perspective, this option would, therefore, have a beneficial effect on the Cal-Am service area. The same level of non-Cal-Am employment growth would occur as under Supply Option I.

Impacts: While Supply Option II would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

TABLE IV-41
EMPLOYMENT GROWTH POTENTIAL
Distribution Alternative IV

Supply Option II at Baseline Production of 18,400 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel				
Del Rey Oaks				
City of Monterey	1,880	89		1,969
Pacific Grove	389	97		486
Sand City	676	389		1,065
Seaside	1,329	302		1,631
Monterey County	123	121	45	290
MPAD	43			43
Non-Cal-Am	8,534			8,534
TOTAL	12,975	999	45	14,019

Supply Option III at Baseline Production of 18,400 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel	25			25
Del Rey Oaks				
City of Monterey	2,879	137		3,016
Pacific Grove	529	126		655
Sand City	852	489		1,341
Seaside	1,635	367		2,002
Monterey County	153	150	45	348
MPAD	145			145
Non-Cal-Am	8,534			8,534
TOTAL	14,752	1,271	45	16,067

Supply Option I at Baseline Production of 16,700 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel				
Del Rey Oaks				
City of Monterey	1,999	95		2,094
Pacific Grove	461	125		586
Sand City	705	405		1,111
Seaside	1,356	308		1,664
Monterey County	125	123	45	294
MPAD	60			60
Non-Cal-Am	8,534			8,534
TOTAL	13,240	1,057	45	14,342

Supply Option II at Baseline Production of 16,700 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel	179			179
Del Rey Oaks	41			41
City of Monterey	5,197	247		5,444
Pacific Grove	703	129		832
Sand City	1,266	728		1,994
Seaside	2,329	441		2,770
Monterey County	220	216	45	481
MPAD	385			385
Non-Cal-Am	8,534			8,534
TOTAL	18,854	1,761	45	20,660

Supply Option III at Baseline Production of 16,700 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel	301			301
Del Rey Oaks	62	2		64
City of Monterey	6,196	295		6,491
Pacific Grove	779	130		909
Sand City	1,548	792		2,340
Seaside	2,630	441		3,071
Monterey County	249	245	45	539
MPAD	487			487
Non-Cal-Am	8,534			8,534
TOTAL	20,785	1,904	45	22,735

Supply Option IV at Baseline Production of 16,700 Acre-Feet

	Employment	Hotel	Golf Course	Total Employees
Carmel				
Del Rey Oaks				
City of Monterey	200	10		210
Pacific Grove	104	26		130
Sand City	390	224		614
Seaside	805	191		996
Monterey County	72	71	45	188
MPAD				
Non-Cal-Am	8,534			8,534
TOTAL	10,105	521	45	10,672

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

In addition to the 8,534 new jobs resulting from non-Cal-Am development, Supply Option III would support an increase of 7,533 jobs within the Cal-Am service area. From an employment market perspective, this option would, therefore, have a beneficial effect on employment.

Impacts: While Supply Option III would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Fish Protection Production)

Supply Option IV would not necessarily change existing conditions within the Cal-Am service area. While there could conceivably be some shifting among uses, it is not likely that there would be any significant growth or decline in the service area employment market. As with all supply options, the non-Cal-Am area within the District would, however, experience the addition of 8,534 new jobs. The addition of these jobs would occur regardless of the actions taken as a result of the District's Allocation Program. The impacts of this job growth would, therefore, not be related to this project.

Impacts: For CEQA purposes, Supply Option IV would have no project-related impacts.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Under Supply Option V, no water would be available for growth within the Cal-Am service area. This option would, therefore, not change existing conditions within the Cal-Am service area. Again, as with all supply options, the non-Cal-Am area within the District would experience the addition of 8,534 new jobs. The addition of these jobs would occur regardless of the actions taken as a result of the District's Allocation Program. The impacts of this job growth would, therefore, not be related to this project.

Impacts: For CEQA purposes, Supply Option IV would have no project-related impacts.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would result in an increased supply of jobs within the Cal-Am service area, with employment increasing by 5,808 new jobs. From a employment market perspective, this option would, therefore, have a beneficial effect on the Cal-Am service area. As with all supply options under Baseline Production/Consumption Level A, the non-Cal-Am area within the District would experience the addition of 8,534 new jobs.

Impacts: While Supply Option II would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II could result in the addition of 12,126 new jobs within the Cal-Am service area. From a employment market perspective, this option would, therefore, have a beneficial effect on the Cal-Am service area. The same level of non-Cal-Am employment growth would occur as under Supply Option I.

Impacts: While Supply Option II would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

In addition to the 8,534 new jobs resulting from non-Cal-Am development, Supply Option III would support an increase of 14,201 jobs within the Cal-Am service area. From an employment market perspective, this option would, therefore, have a beneficial effect on employment.

Impacts: While Supply Option III would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Fish Protection Production)

Supply Option IV could result in the addition of 2,138 new jobs within the Cal-Am service area. From a employment market perspective, this option would, therefore, have a beneficial effect on the Cal-Am service area. The same level of non-Cal-Am employment growth would occur as under all the other supply options.

Impacts: While Supply Option II would generally have beneficial employment-related impacts, for CEQA purposes, it would result in no environmental impact.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

Under Supply Option V, no water would be available for growth within the Cal-Am service area. This option would, therefore, not change existing conditions within the Cal-Am service area. Again, as with all supply options, the non-Cal-Am area within the District would experience the addition of 8,534 new jobs. The impacts of this job growth would, therefore, not be related to this project.

Impacts: For CEQA purposes, Supply Option IV would have no project-related impacts.

Mitigation Measures: None required.

N. CONSTRUCTION INDUSTRY

1. Methodology and Analysis

The amount of water supplied to customers of Cal-Am could affect the construction industry on the Peninsula in several ways. The primary effect of supplying and allocating varying amounts of water to urban customers within the Cal-Am service area would be to control and limit the amount of new construction that would otherwise occur under unconstrained market conditions. Limiting the water supply, particularly under Supply Options I, IV, and V means that a building moratorium may be required within the Cal-Am service area. Such a moratorium may not only apply to new construction, but also to additions and modifications to existing structures that intensify water use. None of the water supply options would satisfy the long-term demand for water indicated by Cal-Am service area growth projections.

The slowdown or elimination of new construction activity within the Cal-Am service area would result in the direct loss of construction jobs and the loss of other local jobs indirectly related to the construction industry. According to the construction data presented in Table III-25, construction between 1980 and 1986 totaled approximately $719.2 million, or approximately $102.7 million per year. Based on an estimated average of one construction job per $84,800 in construction value (Bartolotto in Planning Analysis & Development 1988), new construction from 1980-1986 generated an estimated 1,210 annual construction jobs within the Cal-Am service area.

The spending of construction and construction-related companies and employees indirectly generates employment in the local area, estimated at approximately 1.1 job per each construction job (Bartolotto in Planning Analysis and Development 1988). New construction in the Cal-Am service area generated an estimated annual 1,330 indirect jobs in the local area between 1980 and 1986, based on this estimated relationship of direct employment to indirect employment.

The following impact discussions focus on the construction value and employment supported by the five water supply options under Distribution Alternative IV. Additionally, each water supply option is evaluated for two baseline water production levels, the 18,400-acre-feet level and the 16,700-acre-feet level.

Project implementation would affect the three major components of construction activity--residential projects, commercial projects, and miscellaneous projects--to varying degrees. The programmatic nature of this project and the accompanying lack of specifics regarding the kinds of future development that would occur within the Cal-Am service area limit the analysis that can be performed on these three components of construction activity. For example, commercial projects vary greatly in size and construction value. Similarly, the future level of construction associated with nonresidential and noncommercial projects is difficult to judge.

Because of these limitations, the impact analysis focuses on changes in the level of residential construction activity supported by water supplied under the five water supply options. The changes in residential construction value and employment are estimated based on the average per-unit construction values of new single-family and multi-family housing in the Cal-Am service area between 1980 and 1986, as shown in Table III-25. Residential construction between 1980 and 1986 averaged $35.2 million per year and accounted for an estimated 415 annual construction jobs and 457 annual indirect jobs in the local area.

Some level of construction activity would continue within the Cal-Am service area regardless of the magnitude of new water supplies because of the continued need for public works construction; remodeling; garage construction; well, fence, and private roadways construction; and other miscellaneous construction projects that do not increase water demand or that cause offsetting reductions in water demand. As shown in Table III-25, these "other" construction projects accounted for 33 percent of the value of all construction, and an estimated 400 of the 1,210 total annual construction jobs and 440 of the 1,330 total annual indirect jobs related to construction, within the Cal-Am service area between 1980 and 1986. For the purposes of this analysis, the employment related to "other" construction projects is assumed to remain unchanged regardless of whether the project or a project alternative is implemented. In addition, some development would occur in subdivisions supported by non-Cal-Am water.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I would limit water production within the Cal-Am service area to existing levels. New residential construction would occur only in subdivisions supported by non-Cal-Am water. No new commercial development would occur within the Cal-Am service area. The construction value of the projected 741 single-family units in subdivisions supported by non-Cal-Am water would total an estimated $90.8 million and would support an estimated 1,070 person-years of construction work, in addition to an estimated 1,177 person-years of indirect work in the area (Table IV-42). Based on average annual residential construction rates between 1980 and 1986, the water supplied under Supply Option I would support existing levels of residential-related employment and income for approximately 2.6 years. Existing employment related to commercial construction would cease upon implementation of Supply Option I.

Impacts: The loss of construction-related income and employment is considered a significant, unavoidable impact on the local economy and construction industry, since it would result in the near-term loss of existing jobs in housing-related industries and the immediate loss in commercial construction-related industries. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: Construction businesses and workers affected by the decline of new construction work would be required to move to other areas of the region or shift to non-construction-related jobs or businesses in the local area. No mitigation measures are available to reduce the local economic impacts of the loss of employment under Supply Option I to less-than-significant levels.

TABLE IV-42

AVERAGE VALUE OF RESIDENTIAL DEVELOPMENT FOR WATER DISTRIBUTION ALTERNATIVE IV
Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Location/Description	Water Supply Option I Value	Water Supply Option II Value	Water Supply Option III Value	Water Supply Option IV Value	Water Supply Option V Value
Carmel					
Single-family residential	$ 0	$ 33,560	$ 42,623	$ 0	$ 0
Multi-family residential	0	0	1,541	0	0
Total value	**$ 0**	**$ 33,560**	**$ 44,164**	**$ 0**	**$ 0**
Del Rey Oaks					
Single-family residential	$ 0	$ 122	$ 367	$ 0	$ 0
Multi-family residential	0	1,772	3,044	0	0
Total value	**$ 0**	**$ 1,895**	**$ 3,411**	**$ 0**	**$ 0**
Monterey					
Single-family residential	$ 0	$ (6,124)	$ (9,431)	$ 0	$ 0
Multi-family residential	0	31,363	48,046	0	0
Total value	**$ 0**	**$ 25,239**	**$ 38,615**	**$ 0**	**$ 0**
Pacific Grove					
Single-family residential	$ 0	$ 8,574	$ 11,758	$ 0	$ 0
Multi-family residential	0	11,019	17,338	0	0
Total value	**$ 0**	**$ 19,593**	**$ 29,096**	**$ 0**	**$ 0**
Sand City					
Single-family residential	$ 0	$ 0	$ 0	$ 0	$ 0
Multi-family residential	0	11,019	17,338	0	0
Total value	**$ 0**	**$ 29,475**	**$ 37,103**	**$ 0**	**$ 0**
Seaside					
Single-family residential	$ 0	$ 15,555	$ 15,555	$ 0	$ 0
Multi-family residential	0	2,119	2,119	0	0
Total value	**$ 0**	**$ 17,674**	**$ 17,674**	**$ 0**	**$ 0**
Monterey County					
Single-family residential	$ 0	$ 103,128	$ 127,747	$ 0	$ 0
Multi-family residential	0	3,313	4,123	0	0
Total value	**$ 0**	**$ 106,442**	**$ 131,869**	**$ 0**	**$ 0**

TABLE IV-42
(Continued)

Location/Description	Water Supply Option I Value	Water Supply Option II Value	Water Supply Option III Value	Water Supply Option IV Value	Water Supply Option V Value
Monterey Peninsula Airport District					
Single-family residential	$ 0	$ 0	$ 0	$ 0	$ 0
Multi-family residential	0	0	0	0	0
Total value	$ 0	$ 0	$ 0	$ 0	$ 0
Non-Cal-Am Development Potential					
Single-family residential	$ 90,758	$ 90,758	$ 90,758	$ 90,758	$ 90,758
Multi-family residential	0	0	0	0	0
Total value	$ 90,758	$ 90,758	$ 90,758	$ 90,758	$ 90,758
Total	$ 90,758	$ 324,634	$ 392,691	$ 90,758	$ 90,758
Estimated employment (person-years)					
Direct employment	1,070	3,828	4,631	1,070	1,070
Indirect employment	1,177	4,211	5,094	1,177	1,177
Total employment (person-years)	2,248	8,039	9,725	2,248	2,248

Notes:
Value of construction shown in thousands of dollars.
Construction values = $122,480 per single-family unit, $38,529 per multi-family unit.
Employment generators = one direct job per $84,800 construction values, 1.1 indirect jobs per direct job.

Source: Jones & Stokes Associates

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Water made available by selection of Supply Option II, would support a moderate level of new construction within the Cal-Am service area. Supply Option II would support the construction of 2,005 new single-family residential units and 2,052 new multi-family units. In addition, commercial development, including retail, office, and hotel development, would be supported by Supply Option II. The level of commercial construction supported by Supply Option II has not been quantified because of the wide variety of potential commercial-type projects.

Based on the 1980-1986 value-per-unit averages shown in Table III-25, the value of residential construction supported by Supply Option II would be approximately $324.6 million. This level of residential construction activity would support an estimated 3,828 person-years of construction work, in addition to an estimated 4,211 person-years of indirect work in the area.

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Supply Option II would support existing levels of residential construction-related employment and income for approximately nine years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after nine years. A gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity, or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would dampen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option II, construction within the Cal-Am service area would gradually decrease until a major new source of water becomes available, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option II on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III, would support a higher level of construction activity within the Cal-Am service area than Supply Option II. Supply Option III would support the construction of 2,281 new single-family residential units and 2,941 new multi-family units. In addition, commercial development, including retail, office, and hotel development, would be supported by Supply Option III.

The value of residential construction supported by this option would be an estimated $392.7 million, based on the value-per-unit averages shown in Table III-25. This range of residential construction activity would support an estimated 4,631 person-years of construction work, in addition to an estimated 5,094 person-years of indirect work in the area.

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Option III would support existing levels of residential construction-related employment and income for approximately 11 years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after 11 years. Similar to Supply Option II, a gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity, or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would dampen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option III, construction within the Cal-Am service area would gradually decrease, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option III on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Under Supply Option IV, water supplied within the Cal-Am service area would be 900 acre-feet less than the current supply level. Other than the development of 741 single-family units in subdivisions supported by non-Cal-Am water, no new residential or commercial construction which would intensify water use would occur within the Cal-Am service area, unless more than 900 acre-feet of water could be saved through water conservation measures. As with all the supply options, some level of construction activity would occur under Supply Option IV due to the need for public works construction and other miscellaneous construction work.

The construction-related employment and income effects under Supply Option IV would be similar to the effects under Supply Option I.

Impacts: The loss of construction-related income and employment is considered a significant, unavoidable impact on the local economy and construction industry. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: No mitigation measures are available to reduce the local economic impacts of the loss of employment under Supply Option IV to less-than-significant levels.

Supply Option V: 16,700 Acre-Feet (Environmentally Least Damaging Production)

The effects of Supply Option V would be similar to the effects under Supply Options I and IV. Please refer to the above discussions.

Impacts: The loss of construction-related income and employment is considered a significant, unavoidable impact on the local economy and construction industry. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: No mitigation measures are available to reduce the local economic impacts of the loss of employment under Supply Option V to less-than-significant levels.

3. **Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)**

Supply Option I: 18,400 Acre-Feet (Current Production)

Water made available by selection of Supply Option I would support a moderate level of new construction within the Cal-Am service area. Supply Option I would support the construction of 2,102 new single-family residential units and 2,113 new multi-family units. In addition, commercial development, including retail, office, and hotel development, would be supported by Supply Option I. The level of commercial construction supported by Supply Option I has not been quantified because of the wide variety of potential commercial projects.

Based on the 1980-1986 value-per-unit averages shown in Table III-25, the value of residential construction supported by Supply Option I would be approximately $338.9 million. This level of residential construction activity would support an estimated 3,996 person-years of construction work, in addition to an estimated 4,396 person-years of indirect work in the local area (Table IV-43).

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Option I would support existing levels of residential construction-related employment and income for approximately 10 years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after 10 years. A gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would lessen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option I, construction within the Cal-Am service area would gradually decrease, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option I on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

TABLE IV-43

AVERAGE VALUE OF RESIDENTIAL DEVELOPMENT FOR WATER DISTRIBUTION ALTERNATIVE IV
Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Location/Description	Water Supply Option I Value	Water Supply Option II Value	Water Supply Option III Value	Water Supply Option IV Value	Water Supply Option V Value
Carmel					
Single-family residential	$ 42,623	$ 45,930	$ 46,420	$ $10,166	$ 0
Multi-family residential	1,387	10,827	13,793	0	0
Total value	$ 44,010	$ 56,757	$ 60,213	$ 10,166	$ 0
Del Rey Oaks					
Single-family residential	$ 245	$ 367	$ 367	$ 0	$ 0
Multi-family residential	1,888	5,086	5,818	0	0
Total value	$ 2,133	$ 5,453	$ 6,185	$ 0	$ 0
Monterey					
Single-family residential	$ (6,491)	$ (16,902)	$ (20,209)	$ (612)	$ 0
Multi-family residential	33,328	129,072	103,373	3,352	0
Total value	$ 26,836	$ 112,170	$ 83,164	$ 2,740	$ 0
Pacific Grove					
Single-family residential	$ 10,043	$ 16,167	$ 18,005	$ 2,327	$ 0
Multi-family residential	8,553	39,878	49,664	2,928	0
Total value	$ 26,836	$ 112,170	$ 83,164	$ 2,740	$ 0
Sand City					
Single-family residential	$ 0	$ 0	$ 0	$ 0	$ 0
Multi-family residential	30,746	55,174	61,569	16,991	0
Total value	$ 30,746	$ 55,174	$ 61,569	$ 16,991	$ 0
Seaside					
Single-family residential	$ 15,555	$ 15,555	$ 15,555	$ 15,555	$ 0
Multi-family residential	2,119	5,510	8,438	2,119	0
Total value	$ 17,674	$ 21,065	$ 23,993	$ 17,674	$ 0
Monterey County					
Single-family residential	$ 104,720	$ 183,598	$ 208,338	$ 60,383	$ 0
Multi-family residential	3,391	5,933	6,743	1,965	0
Total value	$ 108,111	$ 189,531	$ 215,081	$ 62,348	$ 0

TABLE IV-43
(Continued)

Location/Description	Water Supply Option I Value	Water Supply Option II Value	Water Supply Option III Value	Water Supply Option IV Value	Water Supply Option V Value
Monterey Peninsula Airport District					
Single-family residential	$ 0	$ 0	$ 0	$ 0	$ 0
Multi-family residential	0	0	0	0	0
Total value	$ **0**	$ **0**	$ **0**	$ **0**	$ **0**
Non-Cal-Am Development Potential					
Single-family residential	$ 90,758	$ 90,758	$ 90,758	$ 90,758	$ 90,758
Multi-family residential	0	0	0	0	0
Total value	$ **90,758**	$ **90,758**	$ **90,758**	$ **90,758**	$ **90,758**
Totals	$ **338,865**	$ **586,952**	$ **608,632**	$ **205,931**	$ **90,758**
Estimated employment (person-years)					
Direct employment	3,996	6,922	7,177	2,428	1,070
Indirect employment	4,396	7,614	7,895	2,671	1,177
Total employment (person-years)	**8,392**	**14,535**	**15,072**	**5,100**	**2,248**

Note:

Value of construction shown in thousands of dollars.

Construction values = $122,480 per single-family, $38,529 per multi-family.
Employment generators = one direct job per $84,800 construction values, 1.1 indirect jobs per direct job.

Source: Jones & Stokes Associates

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Water made available by selection of Supply Option II would support a higher level of new construction activity within the Cal-Am service area than Supply Option I. Supply Option II would support the construction of 2,739 new single-family residential units and 6,527 new multi-family units. In addition, commercial development, including retail, office, and hotel development, would be supported by Supply Option II. The level of commercial construction supported by Supply Option II has not been quantified because of the wide variety of potential commercial projects.

Based on the 1980-1986 value-per-unit averages shown in Table III-25, the value of residential construction supported by Supply Option II would be approximately $586.9 million. This level of residential construction activity would support an estimated 6,922 person-years of construction work, in addition to an estimated 7,614 person-years of indirect work in the local area.

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Option I would support existing levels of residential construction-related employment and income for approximately 17 years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after 17 years. A gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would lessen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option II, construction within the Cal-Am service area would gradually decrease, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option II on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Water made available by selection of Supply Option III would support the highest level of construction within the Cal-Am service area among the five supply options. Supply Option III would support the construction of 2,933 new single-family residential units and 6,473 new multi-family units. In addition, commercial development, including retail, office, and hotel development, would be supported by Supply Option III.

Based on the 1980-1986 value-per-unit averages shown in Table III-25, the value of residential construction supported by Supply Option III would be approximately $608.6 million. This level of residential construction activity would support an estimated 7,177 person-years of construction work, in addition to an estimated 7,895 person-years of indirect work in the local area.

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Option III would support existing levels of residential construction-related employment and income for approximately 17 years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after 17 years. A gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would lessen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option III, construction within the Cal-Am service area would gradually decrease, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option III on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Water made available by selection of Supply Option IV would support moderate levels of construction within the Cal-Am service area. Supply Option IV would support the construction of 1,458 new single-family residential units and 710 new multi-family units. In addition, a small amount of commercial development, including retail, office, and hotel development, would be supported by Supply Option IV.

Based on the 1980-1986 value-per-unit averages shown in Table III-25, the value of residential construction supported by Supply Option IV would be approximately $205.9 million. This level of residential construction activity would support an estimated 2,428 person-years of construction work, in addition to an estimated 2,671 person-years of indirect work in the local area.

Based on average annual residential construction rates between 1980 and 1986, the water supplied under Option IV would support existing levels of residential construction-related employment and income for approximately six years. Commercial construction and other miscellaneous construction projects would probably extend beyond this period; construction would, however, probably slow after six years. A gradual construction slowdown within the Cal-Am service area would allow construction workers and businesses to gradually adjust to lower levels of construction activity or to seek work or business elsewhere. The gradual loss of construction-related jobs and income would lessen the severity of the impact on the local economy and construction industry, even though individual cases of unemployment and business dislocation would occur.

Impacts: Under Supply Option IV, construction within the Cal-Am service area would gradually decrease, leading to gradual reductions in construction-related employment and income. Because firms and employees would have time to adjust to decreased construction levels, the impacts of Supply Option IV on the construction industry are considered adverse, but less-than-significant. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Environmentally Least Damaging Production)

The effects of Supply Option V would be similar to the effects under Supply Option I - 18,400 Acre-Feet Base Production. Please refer to the above discussion.

Impacts: The loss of construction-related income and employment is considered a significant unavoidable impact on the local economy and construction industry. For the purposes of CEQA, however, economic effects are not to be considered significant direct environmental impacts.

Mitigation Measures: No mitigation measures are available to reduce the local economic impacts of the loss of employment under Supply Option V to less-than-significant levels.

O. TOURISM

1. Methodology and Analysis

This section evaluates the impacts of the water supply options on tourism. The options could have an impact on tourism by altering the aesthetics of the Carmel Valley, and/or by altering recreational opportunities. Visitation patterns of tourists could change in response to these impacts. Information on the number of visits to the Carmel Valley by tourists is unavailable; however, popular tourist attractions in the Carmel Valley are identified in Chapter III of this report. The water supply options would alter the aesthetics and recreational opportunities of facilities but are not expected to significantly impact visitation patterns in terms of the overall level of regional tourism.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Tourism would be unchanged by Supply Option I, under which no additional hotel development would occur within the Cal-Am service area. As tourism in California increases, the demand for tourist facilities in the Monterey area should increase. Keeping the level of tourist facilities constant may represent a lost opportunity to keep pace with demand.

Impacts: For CEQA purposes, Option I would have no impact.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would adversely impact the aesthetics and recreational opportunities and facilities that rely on the Carmel River, but would not be expected to significantly alter visitation patterns. Option II would, however, allow for increased hotel development, thereby increasing opportunities for tourist activities.

Impacts: While Option II would have a generally beneficial impact on tourism by providing for additional hotel development, for CEQA purposes it would have no environmental impact.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

The impacts of Supply Option III would be similar to those discussed under Option II.

Impacts: While Option III would have a generally beneficial impact on tourism by providing for additional hotel development, it would have no environmental impacts for CEQA purposes.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

A reduction in available water supply could reduce aesthetic value, which in turn could reduce tourism. Supply Option IV could reduce the water available for irrigation of open space, landscape, and lawns, thus creating the brown lawn effect. Dead or water-stressed vegetation is less aesthetically pleasing and may discourage tourism in the area. This impact is considered a potentially significant impact, which can be mitigated by a transition to drought-resistant types of landscaping and vegetation.

Supply Option IV is expected to have a beneficial impact on the aesthetics and recreational opportunities and facilities of the Carmel Valley, but is not expected to significantly alter visitation patterns in terms of the overall level of regional tourism compared with existing conditions. New hotel development would not occur under Supply Option IV. In fact, hotel occupancy could be affected if hotels had to close rooms to not exceed their available water supply. Localized reductions in visitation could potentially occur under Supply Option IV.

Impacts: For CEQA purposes, Option IV would have no impact.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

A reduction in available water supply could reduce aesthetic value, which in turn could reduce tourism. Supply Option V could reduce the water available for irrigation of open space, landscape, and lawns, thus creating brown lawns. Dead or water-stressed vegetation is less aesthetically pleasing and may discourage tourism in the area. This impact is considered a potentially significant impact, which can be mitigated by a transition to drought-resistant types of landscaping and vegetation.

Supply Option V is expected to have a beneficial impact on aesthetics and recreational opportunities and facilities associated with the Carmel River. It is not, however, expected to significantly alter visitation patterns in terms of the overall level of regional tourism relative to existing conditions. New hotel development would not occur under Supply Option V. In fact, hotel occupancy could be affected if hotels had to close rooms to not exceed their available water supply. Localized reductions in visitation could potentially occur under Supply Option V.

Impacts: For CEQA purposes, Option V would have no impact.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

All Water Supply Options

Under the 16,700 acre-feet base production level, additional water for growth is generated under Supply Options I through IV. All of these options involved a large degree of water conservation, which would be accomplished by many methods, including altering urban landscaping. Hotels would also employ water conservation measures.

While water conservation would assist in reducing water demand, water users are more sensitive to drought with conservation in place than without conservation in place. For example, a hotel that does not practice water conservation can conserve water in a drought; the hotel that is conserving water doesn't have the option for additional conservation during periods of short supply. The only response for the hotels that practice conservation would be to close hotel rooms to bring demand into line with supply.

Impacts: In general, Supply Options I through IV would generate water for new hotel rooms. The impacts would be similar to those described under the 18,400 acre-feet base production level. The extent to which implemented conservation measures would affect tourism during periods of short water supply is unknown.

Option V would allow for no new additional hotel development within the Cal-Am service area. Keeping the level of tourist facilities constant may represent a lost opportunity to keep pace with demand.

For CEQA purposes, none of the water supply options would have an environmental impact.

Mitigation Measures: None required.

P. MILITARY

1. Methodology and Analysis

The four military operations under MPWMD jurisdiction--the Presidio of Monterey, the Naval Postgraduate School, the Coast Guard group, and the Naval Reserve Station--would not be adversely affected by adoption of any of the water supply options unless water was not available to accommodate future expansion plans.

The Presidio of Monterey plans to increase its on-site housing by approximately 775 bachelor units; however, this planned housing expansion should be completed by the time the Water Allocation Program is adopted and implemented. Selection of any of the supply options should, therefore, not affect the Presidio of Monterey.

The Naval Postgraduate School recently adopted a master plan that includes the expansion of classroom, library, and child care facilities. No new housing was proposed in the master plan; however, long-range plans are being discussed for the development of 400 new residential units at the on-site La Mesa Village residential compound. This housing would be used to house personnel who are currently residing off-site. Supply options that limit future water supplies to existing levels, or less, could limit the future expansion of on-site housing at the Naval Postgraduate School.

No expansion plans are being considered for either the Coast Guard group operations or the Naval Reserve Station. Implementation of a water allocation plan should therefore not affect either of these military facilities.

2. Impacts and Mitigation Measures Baseline Production Level A (18,400 Acre-Feet/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Future expansion of the Naval Postgraduate School could be affected by implementation of Supply Option I, which limits Cal-Am service area water supply levels to existing levels. Water conserved on-site could be used to support the construction of all or part of the 400 units needed to house personnel currently living off-site. The inability of the Naval Postgraduate School to expand its housing, however, would not change existing conditions; personnel currently living off-site would continue to reside in off-site housing. Implementation of Supply Option I would not adversely affect operations of the Naval Postgraduate School.

Impacts: Supply Option I would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would support the construction of an estimated 4,057 dwelling units within the Cal-Am service area, assuming implementation of water distribution Alternative IV. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option II.

Impacts: Supply Option II would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would support the construction of an estimated 5,222 dwelling units within the Cal-Am service area. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option III.

Impacts: Supply Option III would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

The effects of Supply Option IV would be similar to the effects under Supply Option I. Please refer to the above discussion.

Impacts: Supply Option IV would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option V:16,700 Acre-Feet (Least Environmentally Damaging Production)

The effects of Supply Option V would be similar to the effects of Supply Options I and IV. Please refer to the above discussions.

Impacts: Supply Option V would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Supply Option I under the 16,700 acre-feet base production level would support the construction of an estimated 4,215 dwelling units within the Cal-Am service area, assuming adoption of water distribution Alternative IV. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option I.

Impacts: Supply Option I would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Supply Option II would support the construction of an estimated 9,266 dwelling units within the Cal-Am service area. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option II.

Impacts: Supply Option II would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Supply Option III would support the construction of an estimated 9,406 dwelling units within the Cal-Am service area. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option III.

Impacts: Supply Option III would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Supply Option IV would support the construction of an estimated 2,168 dwelling units within the Cal-Am service area. Housing at the Naval Postgraduate School could be constructed as part of the service area housing expansion supported by Supply Option IV.

Impacts: Supply Option IV would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Supply Option V:16,700 Acre-Feet (Least Environmentally Damaging Production)

Future expansion of the Naval Postgraduate School could be affected by implementation of Supply Option V, which limits Cal-Am service area water supply levels to existing levels. Water conserved on-site could be used to support the construction of all or part of the 400 units needed to house personnel currently living off-site. The inability of the Naval Postgraduate School to expand its housing, however, would not change existing conditions; personnel currently living off-site would continue to reside in off-site housing. Implementation of Supply Option V would not adversely affect operations of the Naval Postgraduate School.

Impacts: Supply Option V would have no impact on military facilities within the Cal-Am service area.

Mitigation Measures: None required.

Q. FISCAL

1. Methodology and Analysis

According to Section 15131 of the *CEQA Guidelines* "economic or social information may be included in an EIR or may be presented in whatever form the agency desires." This section of the *CEQA Guidelines* provides for the inclusion of the fiscal effects of a project at the discretion of the responsible agency. In addition, Section 15131(a) of the guidelines states that "economic or social effects of a project shall not be treated as significant effects on the environment." MPWMD has included the following evaluation of the general fiscal effects of the proposed project within the Cal-Am service area in an effort to provide additional discretionary information concerning the economic and social effects of the proposed project.

The fiscal analysis included in this EIR is necessarily limited in scope and detail by the programmatic nature of the proposed project. Specific fiscal impacts on individual jurisdictions can be identified and evaluated only when detailed information concerning the type, timing, value, and location of future development within each jurisdiction is available. In addition, detailed fiscal analysis requires data concerning acceptable level of service standards for public services, per-capita service cost relationships, required staffing levels, and public service capacity conditions for projected future levels of growth for each jurisdiction. Since the water supply options relate to districtwide water supplies and the growth that could occur within the district under each water supply level, little of the necessary detailed data is available to conduct quantitative fiscal analyses for each jurisdiction within the Cal-Am service area. Given the general nature of the water supply options, only general statements can be made regarding the districtwide fiscal effects of the various water supply options. The water supply options are evaluated assuming Water Distribution Alternative IV.

2. Impacts and Mitigation Measures at Baseline Production/Consumption Level A (18,400/17,112 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Very little new residential and commercial development would occur within the Cal-Am service area, beyond development that could occur within subdivisions supported by non-Cal-Am water and development that could be supported through water conservation measures, under Supply Option I. Public expenditures, which are generally linked to population, wage, and price levels, would increase over time due to inflationary pressures, increased levels of public services, and nominal population growth. Public revenues would increase over time as nonresidential and noncommercial development expands the Cal-Am service area's property tax base, and jurisdictions adjust charges for current services and development fees to offset inflation-related cost increases. The existing relationships between public costs and revenues, summarized in Table III-33, would not be substantially altered under Supply Option I.

The District anticipates the funding of new water projects through connection fees levied on new development. Reducing the amount of new residential and commercial development that could occur within the Cal-Am service area would also reduce the connection fee revenues received by the District. The fiscal effect of this reduction in revenues should, however, be minimized by the fact that reducing growth would also reduce the need for new water projects.

Impacts: For CEQA purposes, fiscal impacts under Supply Option I are not considered significant.

Mitigation Measures: None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Since development and population growth would occur within the Cal-Am service area under Supply Option II, the existing relationship between public expenditures and revenues would change. In general, revenues generated by residential development only partially offset the costs generated by providing services to new residents. Revenues generated by commercial uses, including property tax revenues, sales tax revenues, transient occupancy tax revenues, and business license tax revenues, often serve to offset costs generated by population growth.

An indication of the incremental balance of public costs and revenues within the Cal-Am service area under Supply Option II is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel and golf course development, would receive 51 percent of the total water supply under Water Distribution Alternative IV. The water allocations between commercial and residential uses, and the level of development implied by the allocations, indicate that adequate public revenues may be generated by commercial uses to offset cost increases generated by residential development. The net fiscal effect of Supply Option II on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse fiscal effects should not be substantial.

Impacts: For CEQA purposes, fiscal impacts under Supply Option II are not considered significant.

Mitigation Measures: None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Similar to Supply Option II, Supply Option III would support new residential and commercial growth within the Cal-Am service area, generating new flows of public revenues and costs. As discussed above, an indication of the balance between incremental costs and revenues is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel development, would receive 51 percent of the total water supply, depending on the water distribution alternative adopted. The water allocations between commercial and residential uses indicate that the public revenues generated by commercial uses may be sufficient to offset cost increases generated by residential development. The net fiscal affect of Supply Option III on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse affects should not be substantial.

Impacts: For CEQA purposes, fiscal impacts under Supply Option III are not considered significant.

Mitigation Measures: None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

The fiscal effects of Supply Option IV would be similar to the effects under Supply Option I. Virtually no new residential and commercial development would occur under Supply Option IV. Public expenditures and revenues, which are generally linked closely with population, wage, and price levels, would increase only slightly over time. The existing relationship between public costs and revenues, summarized in Table III-33, would not be substantially altered under Supply Option IV.

The District funds new water projects through connection fees levied on new development. Reducing the amount of new development within the Cal-Am service area would also reduce the connection fee revenues received by the District. The fiscal effect of this reduction in revenues would, however, be minimized by the fact that reducing growth would also reduce the need for new water projects.

Impacts: For CEQA purposes, fiscal impacts under Supply Option IV are not considered significant.

Mitigation Measures: None required.

Supply Option V: 16,700 Acre-Feet (Least Environmentally Damaging Production)

The fiscal effects of Supply Option V would be similar to the effects of Supply Options I and IV. Please refer to the above discussions.

Impacts: For CEQA purposes, fiscal impacts under Supply Option V are not considered significant.

Mitigation Measures: None required.

3. Impacts and Mitigation Measures at Baseline Production/Consumption Level B (16,700/15,572 Acre-Feet)

Supply Option I: 18,400 Acre-Feet (Current Production)

Since development and population growth would occur within the Cal-Am service area under Supply Option I, the existing relationship between public expenditures and revenues would change. In general, revenues generated by residential development only partially offset the costs generated by providing services to new residents. Revenues generated by commercial uses, including property tax revenues, sales tax revenues, transient occupancy tax revenues, and business license tax revenues, often serve to offset costs generated by population growth.

An indication of the incremental balance of public costs and revenues within the Cal-Am service area under Supply Option I is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel and golf course development, would receive 52 percent of the total water supply under water distribution Alternative IV. The water allocations between commercial and residential uses, and the level of development implied by the allocations, indicate that adequate public revenues may be generated by commercial uses to offset cost increases generated by residential uses. The net fiscal effect of Supply Option I on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse fiscal effects should not be substantial.

Impacts. For CEQA purposes, fiscal impacts under Supply Option I are not considered significant.

Mitigation Measures. None required.

Supply Option II: 20,000 Acre-Feet (Current Water Supply Capacity)

Similar to Supply Option I, Supply Option II would support new residential and commercial growth within the Cal-Am service area, generating new flows of public revenues and costs. As discussed above, an indication of the balance between incremental costs and revenues within the Cal-Am service area is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel and golf course development, would receive 50 percent of the total water supply under Supply Option II. The water allocations between commercial and residential uses, and the level of development implied by the allocations, indicate that the public revenues generated by commercial uses may be sufficient to offset cost increases generated by residential uses. The net fiscal effect of Supply Option II on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse fiscal effects should not be substantial.

Impacts. For CEQA purposes, fiscal impacts under Supply Option II are not considered significant.

Mitigation Measures. None required.

Supply Option III: 20,500 Acre-Feet (Modified Water Supply Capacity)

Similar to Supply Options I and II, Supply Option III would support new residential and commercial growth within the Cal-Am service area, generating new flows of public revenues and costs. As discussed above, an indication of the balance between incremental costs and revenues within the Cal-Am service area is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel and golf course development, would receive 50 percent of the total water supply under Supply Option III. The water allocations between commercial and residential uses, and the level of development implied by the allocations, indicate that the public revenues generated by commercial uses may be sufficient to offset cost increases generated by residential uses. The net fiscal effect of Supply Option III on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse fiscal effects should not be substantial.

Impacts. For CEQA purposes, fiscal impacts under Supply Option III are not considered significant.

Mitigation Measures. None required.

Supply Option IV: 17,500 Acre-Feet (Minimum Acceptable Fish Protection Production)

Similar to Supply Options I, II, and III, Supply Option IV would support new residential and commercial growth within the Cal-Am service area, though at lower levels, generating new flows of public revenues and costs. As discussed above, an indication of the balance between incremental costs and revenues within the Cal-Am service area is provided by the proposed allocation of additional water to residential and commercial uses under the five water distribution alternatives. Commercial uses, including hotel and golf course development, would receive 51 percent of the total water supply under Supply Option IV. The water allocations between commercial and residential uses, and the level of development implied by the allocations, indicate that the public revenues generated by commercial uses may be sufficient to offset cost increases generated by residential uses. The net fiscal effect of Supply Option IV on specific jurisdictions within the Cal-Am service area is inconclusive; however, adverse fiscal effects should not be substantial.

Impacts. For CEQA purposes, fiscal impacts under Supply Option IV are not considered significant.

Mitigation Measures. None required.

Supply Option V:16,700 Acre-Feet (Least Environmentally Damaging Production)

Very little new residential and commercial development would occur within the Cal-Am service area, beyond development that could occur within subdivisions supported by non-Cal-Am water and development that could be supported through water conservation measures, under Supply Option V. Public expenditures, which are generally linked to population, wage, and price levels, would increase over time due to inflationary pressures, increased levels of public services, and nominal population growth. Public revenues would increase over time as nonresidential and noncommercial development expand the district's property tax base, and jurisdictions adjust charges for current services and development fees to offset inflation-related cost increases. The existing relationships between public costs and revenues, summarized in Table III-33, would not be substantially altered under Supply Option V.

The District anticipates the funding of new water project through connection fees levied on new development. Reducing the amount of new residential and commercial development that could occur within the Cal-Am service area would reduce the connection fee revenues received by the District. The fiscal effect of this reduction in revenues should, however, be minimized because a reduction in growth would also reduce the need for new water projects.

Impacts. For CEQA purposes, fiscal impacts under Supply Option V are not considered significant.

Mitigation Measures. None required.

R. AIR QUALITY

1. Methodology and Analysis

This section discusses the air pollution impacts expected from growth caused by the water supply options. Emission forecasts for the North Central Coast Air Basin (NCCAB) are shown in Figure IV-16. These forecasts are based on the 1987 Regional Population and Employment Forecast prepared by the Association of Monterey Bay Area Governments. The 1987 forecast projects Monterey County employment to increase by 22,620 between 1988 and 1995 (AMBAG 1988). Supply Option III at Baseline Production Level B (16,700 acre-feet) would result in a population increase of 22,276, which is the largest increase resulting from any of the supply options. The level of growth assumed for this EIR is, therefore, consistent with the projections used by AMBAG.

The forecasts predict a general decline in reactive organic gases (ROG) and carbon monoxide (CO) between current conditions and the mid-1990s, followed by increases in ROG and CO to the year 2005. ROG reductions between current conditions and the mid-1990s are mainly due to motor vehicle emission controls. The upward trend following the mid-1990s is due to increasing solvent use and motor vehicle activity. Similarly, CO emissions would decline through the mid-1990s due to motor vehicle emission controls. Afterwards, rising mobile source activities and stationary source fuel combustion would cause overall CO emissions to increase (Monterey Bay Unified Air Pollution Control District and Association of Monterey Bay Area Governments 1989).

Projected PM_{10} and CO emissions show a constant increase between 1987 and 2005. PM_{10} emissions are predicted to continually increase at an annual rate of 1.5 percent, mainly from road travel and construction activity. NOx emissions remain at current levels until the mid-1990s when total NOx emissions increase to the year 2005. Near-term NOx emissions would remain relatively constant due to motor vehicle emission controls balancing out increasing stationary source fuel combustion. After 1995, overall NOx emissions will gradually rise because of increasing mobile and stationary source activity (Monterey Bay Unified Air Pollution Control District and Association of Monterey Bay Area Governments 1989). The relative effect of these yearly emissions on localized ambient air quality concentrations is unknown, although Monterey Bay Unified Air Pollution Control District is developing a model that would use annual ozone precursor emission levels to predict ozone air pollution concentrations (Monterey Bay Unified Air Pollution Control District and Association of Monterey Bay Area Governments 1989).

Prediction of air emissions that would be generated indirectly by each water supply alternative is not possible without in-depth modeling analyses. However, a rough estimate of the relative impacts of each option can be made by comparing the ADT generated by each option.

Using ADT to estimate relative impacts has a number of weaknesses. As mentioned above, emissions do not directly translate into ground level concentrations. In addition, the water supply options would cause air emissions from sources other than motor vehicles. For example, while vehicles contribute 70 to 80 percent of total CO emissions, they contribute only about 25 percent of ROG emissions (Figures IV-17 and IV-18).

2. Impacts and Mitigation Measures

Tables IV-34 and IV-35 show the total ADT generated by each water supply option for both base production levels. Supply Options I, IV, and V under Baseline Production/Consumption Level

A and Supply Option V under Baseline Production/Consumption Level B would result in no new growth in the Cal-Am service area. Instead, all growth would occur in the non-Cal-Am service area. Each of these options would generate 134,546 trips and the air emissions associated with this growth.

The remaining six supply options (two of the 18,400 acre-feet base production and four at the 16,700 acre-feet base production) would generate growth in the Cal-Am service area. Of these, Supply Option III (16,700 acre-feet base production) would generate the largest number of ADT (331,523) while Supply Option IV (18,400 acre-feet base production) would generate the least (171,859). Supply Option III (16,700 acre-feet base production) would generate 2.5 times as much ADT as those options generating no new growth in the Cal-Am service area. Supply Option III (16,700 acre-feet base production) would have the largest impact on air quality since it would result in the largest quantity of ADT and would cause a significant decrease in LOS.

Impacts: Air quality in the North Central Coast Air Basin will continue to deteriorate as a result of traffic associated with new development outside of the Cal-Am service area. Supply Options I, IV, and V at Baseline Production/Consumption Level A and Supply Option V at Baseline Production/Consumption Level B would support no new development and thus would have no impact on air quality. It is impossible to estimate the air quality impacts of the other supply options without performing detailed air quality modeling analyses. Supply Options II and III at Baseline Production/Consumption Level A and Options I, II, III and IV at Baseline Production/Consumption Level B would lead to increases in growth and associated ADT on the Monterey Peninsula and would therefore contribute to the cumulative impacts of worsening regional air quality. Whether increases in ADT will lead to increases in ambient concentrations of ozone, PM_{10}, and CO depends on whether growth-related emissions will be outweighed by improvements in emission controls. Since the North Central Coast Air Basin is currently classified as a nonattainment area for federal ozone standards, and because ozone modeling has not yet been performed to determine whether future improvements are likely, ROG and NOx emissions associated with each supply option are assumed to be a significant impact.

Currently, no monitoring is conducted for CO in the North Central Coast Air Quality Management District. Based on continued decreases in LOS and increases in traffic congestion, however, it is likely that CO ambient standards will be violated. The CO emissions are, therefore, assumed to cause a significant impact on air quality.

PM_{10} emissions emitted primarily from additional traffic on area roadways are also a significant impact. Because the area is currently nonattainment for PM_{10}, and because future emissions of PM_{10} are expected to increase, the water supply options which allow for new development would have a significant impact on air quality.

Mitigation Measures: Planned emission control measures, including transportation control measures identified in the *1989 Air Quality Management Plan* should be implemented to reduce the air quality impacts of the water supply options. In addition, the traffic mitigation measures described in the Chapter IV traffic impacts and mitigation section should also be implemented. However, without detailed air quality modeling, it is impossible to determine whether these measures would reduce the air quality impacts of the water supply options to a less-than-significant level.

It should also be noted that the Monterey Peninsula Water Management District does not have the legal authority to implement air quality control measures.

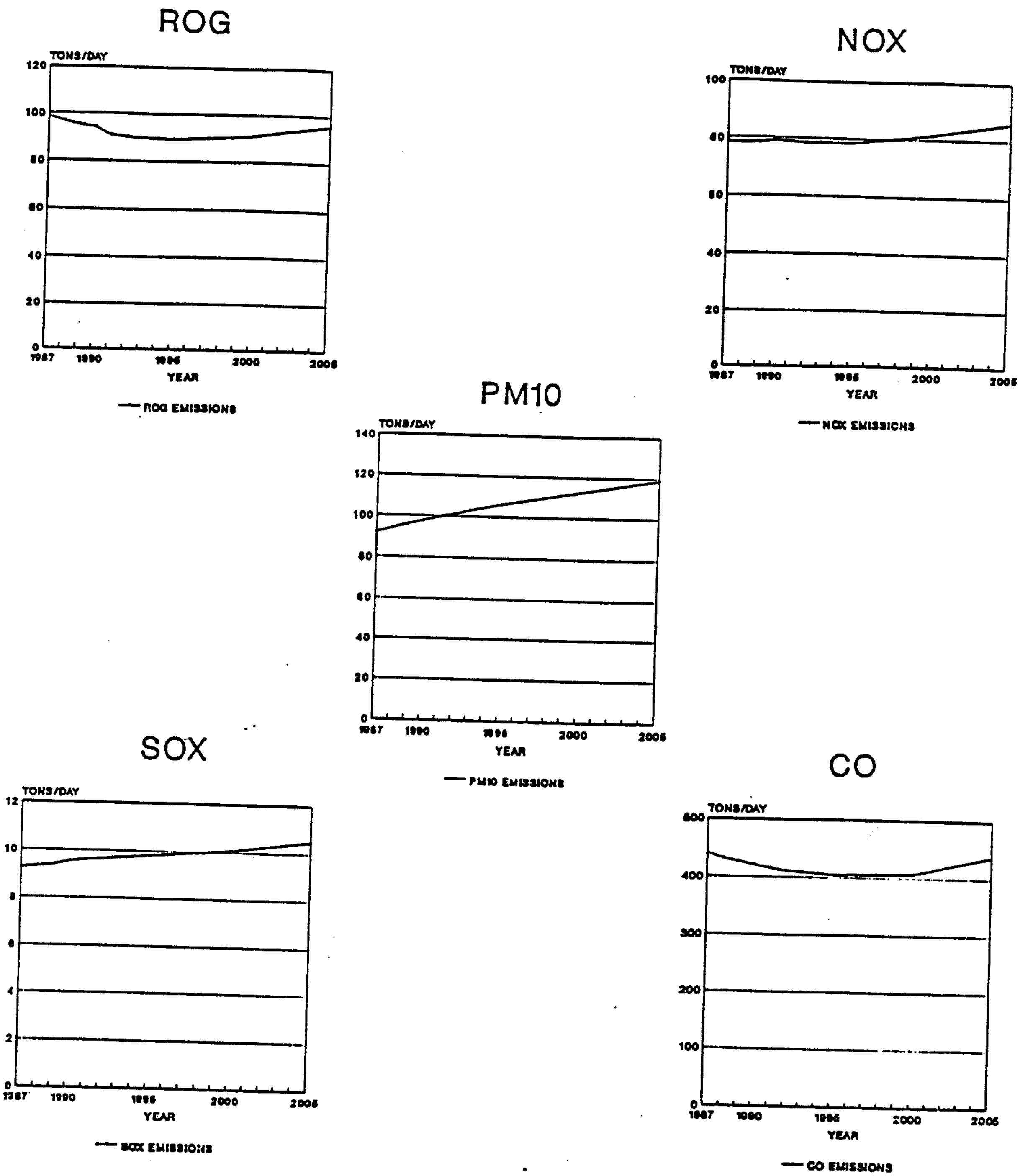


FIGURE IV-16

EMISSION FORECASTS
North Central Coast Air Basin

Source: MBUAPCD and AMBAG, 1989

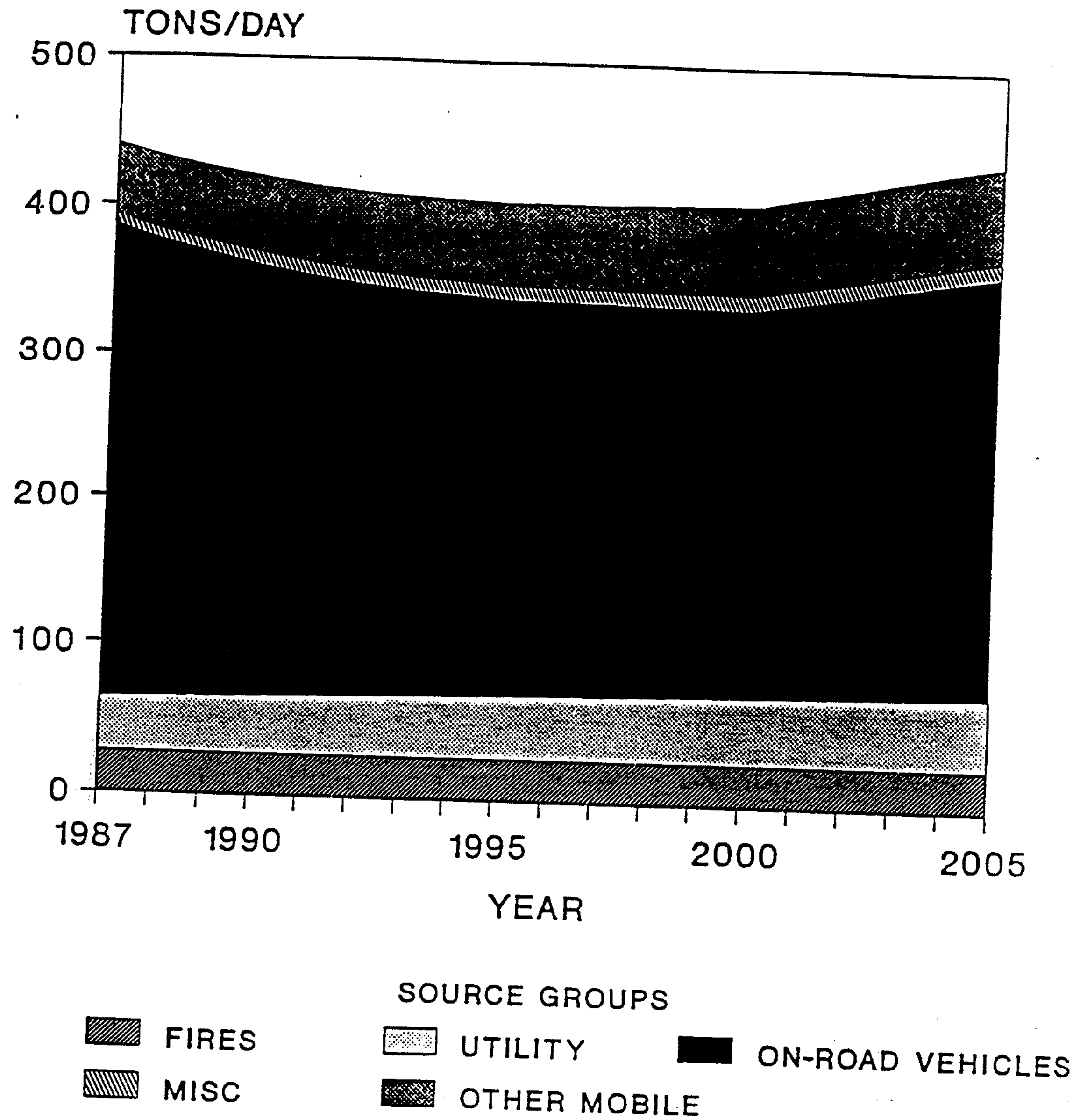


FIGURE IV-17

CO EMISSION FORECASTS
North Central Coast Air Basin

Source: MBUAPCD and AMBAG, 1989

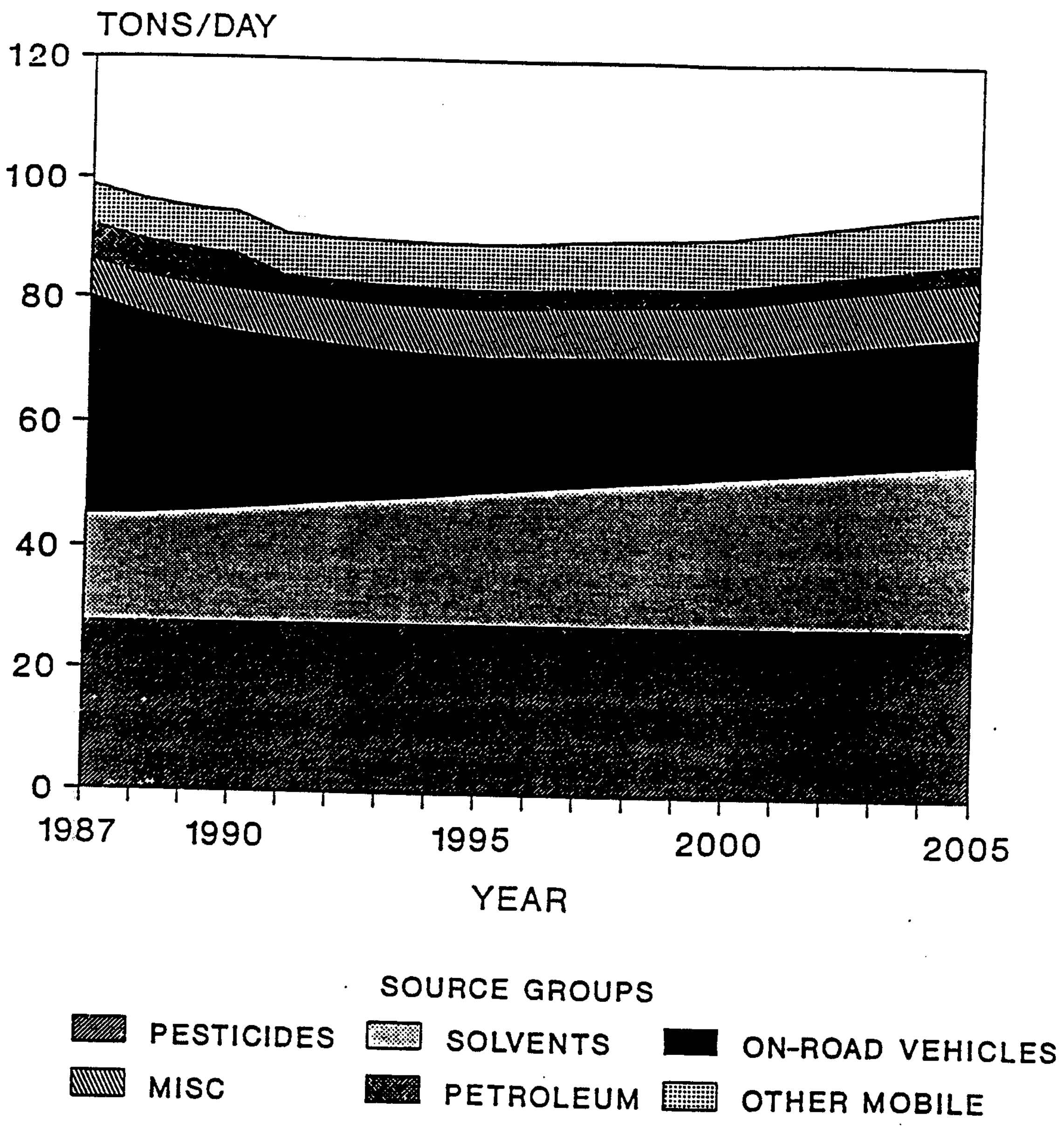


FIGURE IV-18

ROG EMISSION FORECASTS
North Central Coast Air Basin

Source: MBUAPCD and AMBAG, 1989

S. SUMMARY

As noted in the introduction to this chapter, the impacts of the water supply options can be divided into two broad categories: the impacts related to water production itself, and the cumulative impacts of water consumption within the Cal-Am service area. The impacts associated with water consumption can be further classified generally as either public service and facility impacts or socioeconomic impacts.

For the purposes of CEQA, economic or social impacts are not to be "treated as significant effects on the environment" (*CEQA Guidelines* §15131). Nonetheless, these impacts, both positive and negative, will be important considerations in District Board decisions concerning the Allocation Program and need to be weighed against more traditional environmental impacts.

Table IV-44 summarizes the impacts of the five water supply options *without* mitigation measures applied. The impacts are classified as:

S - Significant Adverse Impact
P - Potentially Significant Impact
L - Less than Significant Impact
B - Beneficial Impact
N - No Impact
U - Unknown Impact

Table IV-45 summarizes the impacts of the five water supply options *with* mitigation measures applied.

In both tables, the cells containing an "S" (Significant Adverse Impact) or "P" (Potentially Significant Impact) are highlighted.

TABLE IV-44
ENVIRONMENTAL IMPACT SUMMARY
WATER SUPPLY OPTIONS
(Without Mitigation Measures)

Impact Category		Baseline Production Level*	Supply Option I	Supply Option II	Supply Option III	Supply Option IV	Supply Option V
Surface Water Resources			L	L	L	L	L
Seaside Coastal Subbasin			L	P	P	L	L
Carmel Valley Aquifer			L	L	L	L	L
Lagoon Hydrology			L	P	P	L	L
Non-Cal-Am Groundwater Users			L	P	P	L	L
Water Quality			L	P	P	L	L
Riparian Vegetation:	AQ1		L	L	L	L	L
	AQ2		S	S	S	S	S
	AQ3		S	S	S	S	S
	AQ4		S	S	S	S	S
Lagoon Vegetation			P	P	P	P	P
Upland Vegetation			U	U	U	U	L
Riparian Wildlife			S	S	S	S	S
Lagoon Wildlife			P	P	P	P	P
Upland Wildlife			U	U	U	U	L
Special-Status Wildlife			S	S	S	S	S
Fisheries			S	S	S	S	S
Recreation			N	N	N	N	N
Aesthetics			S	S	S	S	S
Shortfall Frequency/Magnitude			N	N	N	N	N
Level of Risk/Uncertainty			N	N	N	N	N
Frequency of New Meter Limitations			N	N	N	N	N
Level of Rationing Hardship			N	N	N	N	N
Traffic		A	N	S	S	N	N
		B	S	S	S	S	N
Schools		A	N	L	L	N	N
		B	L	L	L	L	N
Wastewater		A	N	L	L	N	N
		B	L	L	L	L	N
Housing		A	N	N	N	N	N
		B	N	N	N	N	N
Employment		A	N	N	N	N	N
		B	N	N	N	N	N
Construction Industry		A	N	N	N	N	N
		B	N	N	N	N	N
Tourism		A	N	N	N	N	N
		B	N	N	N	N	N
Military		A	N	N	N	N	N
		B	N	N	N	N	N
Fiscal Impacts		A	N	N	N	N	N
		B	N	N	N	N	N
Air Quality		A	N	S	S	N	N
		B	S	S	S	S	N

*A = Baseline Production Level A (18,400 acre-feet)
B = Baseline Production Level B (16,700 acre-feet)

S = Significant Adverse Impact
P = Potentially Significant Impact
L = Less Than Significant Impact
N = No Environmental Impact
U = Unknown Impact

TABLE IV-45
ENVIRONMENTAL IMPACT SUMMARY
WATER SUPPLY OPTIONS
(With Full Mitigation Measures)

Impact Category	Baseline Production Level*	Supply Option I	Supply Option II	Supply Option III	Supply Option IV	Supply Option V
Surface Water Resources		L	L	L	L	L
Seaside Coastal Subbasin		L	L	L	L	L
Carmel Valley Aquifer		L	L	L	L	L
Lagoon Hydrology		L	P	P	L	L
Non-Cal-Am Groundwater Users		L	P	P	L	L
Water Quality		L	P	P	L	L
Riparian Vegetation: AQ1		L	L	L	L	L
AQ2		P	P	P	P	P
AQ3		P	P	P	P	P
AQ4		P	P	P	P	P
Lagoon Vegetation		P	P	P	P	P
Upland Vegetation		U	U	U	U	L
Riparian Wildlife		P	P	P	P	P
Lagoon Wildlife		P	P	P	P	P
Upland Wildlife		U	U	U	U	L
Special-Status Wildlife		P	P	P	P	P
Fisheries		P	P	P	L	L
Recreation		N	N	N	N	N
Aesthetics		P	P	P	P	P
Shortfall Frequency/Magnitude		N	N	N	N	N
Level of Risk/Uncertainty		N	N	N	N	N
Frequency of New Meter Limitations		N	N	N	N	N
Level of Rationing Hardship		N	N	N	N	N
Traffic	A	N	L	L	N	N
	B	U	U	U	U	N
Schools	A	N	L	L	N	N
	B	L	L	L	L	N
Wastewater	A	N	L	L	N	N
	B	L	L	L	L	N
Housing	A	N	N	N	N	N
	B	N	N	N	N	N
Employment	A	N	N	N	N	N
	B	N	N	N	N	N
Construction Industry	A	N	N	N	N	N
	B	N	N	N	N	N
Tourism	A	N	N	N	N	N
	B	N	N	N	N	N
Military	A	N	N	N	N	N
	B	N	N	N	N	N
Fiscal Impacts	A	N	N	N	N	N
	B	N	N	N	N	N
Air Quality	A	N	U	U	N	N
	B	U	U	U	U	N

*A = Baseline Production Level A (18,400 acre-feet)
B = Baseline Production Level B (16,700 acre-feet)

S = Significant Adverse Impact
P = Potentially Significant Impact
L = Less Than Significant Impact
N = No Environmental Impact
U = Unknown Impact