Public Review
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FINAL

EVALUATION OF MPWMD FIVE-YEAR MITIGATION PROGRAM, 1991-1996

A component of the MPWMD WATER ALLOCATION PROGRAM EIR

Prepared by

Monterey Peninsula Water Management District
187 Eldorado, Monterey, CA 93940
408/649-4866

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EXECUTIVE SUMMARY

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EVALUATION OF FIVE-YEAR MITIGATION PROGRAM FOR 1991-1996

Prepared by MPWMD Staff
October 1996

A. INTRODUCTION

The Monterey Peninsula Water Management District (MPWMD) is a special District created by the California legislature with the mission to "manage, augment and protect water resources for the benefit of the community and the environment" of the greater Monterey Peninsula area. The District encompasses about 170 square miles and serves a population of about 112,000 people. The Monterey Peninsula depends solely on seasonably variable local resources for water supply, primarily surface and ground water in the Carmel River Basin. The California-American Water Company (Cal-Am), an investor-owned public utility, provides water to about 95 percent of customers within the District.

This report describes and evaluates the effectiveness of the Monterey Peninsula Water Management District's (MPWMD) Five-Year Mitigation Program. A Five-Year Mitigation Plan was adopted in November 1990 by the District Board as a blueprint for action when it certified the Final Environmental Impact Report (EIR) on the effects of the MPWMD Water Allocation Program. Diversion of water from the Carmel River Basin to meet the water needs of the community results in damage to the Carmel River environment. State law requires that steps (mitigation measures) be taken to reduce these adverse impacts, and that the results be monitored and reported to the public.

The MPWMD Water Allocation Program balances water supply and demand, and determines how much water can be taken from the Monterey Peninsula Water Resources System (MPWRS) to serve the community. The MPWRS consists of: surface water diverted from the Carmel River, groundwater pumped from wells in Carmel Valley near the river, and groundwater pumped from the coastal area of the Seaside Basin. Water from these sources is used within MPWMD boundaries, including the cities of Carmel, Del Rey Oaks, Monterey, Pacific Grove, Sand City, and Seaside; the Monterey Peninsula Airport District; and certain unincorporated areas of Monterey County (Carmel Valley, Pebble Beach, and others).

In November 1990, the MPWMD Board committed to: (1) fund and implement the Five-Year Mitigation Program from July 1991 through June 1996; and (2) after five years, evaluate the program as a whole and recommend improvements, if needed.

In July 1995, the State Water Resources Control Board (SWRCB) issued Order No. WR 95-10, which addressed complaints lodged against Cal-Am about its water diversions from the Carmel River to serve the community. The SWRCB Order directed Cal-Am to carry out any aspect of the Five-Year Mitigation Program that the Water District does not continue after June 30, 1996. At a public hearing held on May 20, 1996, the District Board received the Draft Evaluation Report and voted to continue the Mitigation Program for another five years, from July 1996 through June 2001. Responses to comments on the draft report were accepted by the Board at its June 1996 meeting. At the September meeting, the Board received an Implementation Plan for the Mitigation Program for fiscal years 1997-2001.

B. REPORT PURPOSE AND DESCRIPTION OF ACTIVITIES

The purposes of this Evaluation Report include:

- identify program goals set in 1990 mitigation plan,
- describe mitigation measures carried out by MPWMD in 1991-1996,
- summarize program costs for the 1991-1996 period,
- determine how well problems identified in the 1990 EIR were addressed (program effectiveness), and
- make recommendations to improve the program.

The Evaluation Report focuses on the Carmel River hydrology and biological resources such as the steelhead fishery, riparian corridor (streamside vegetation), and Carmel River Lagoon. The District's water conservation efforts are also described because conservation helps to reduce the impacts of community water use on the river environment. However, the conservation program is not evaluated in the report because it receives separate funding, oversight and review.

The Evaluation Report does not address the separate question of whether the Water Allocation Program itself should be amended. A review of the Water Allocation Program quantities and water distribution formula was described as a necessary follow-up action when the Final EIR for the Water Allocation Program was certified in 1990. This review is scheduled to take place in FY 1996-97.

The Five-Year Mitigation Program focused on four major environmental programs:

(1) maintain a viable steelhead resource,

(2) protect and manage riparian vegetation and dependent wildlife;

(3) prevent harm to the Carmel River Lagoon and associated wildlife, and

(4) reduce adverse impacts to the aesthetic values of the Carmel River riparian corridor.

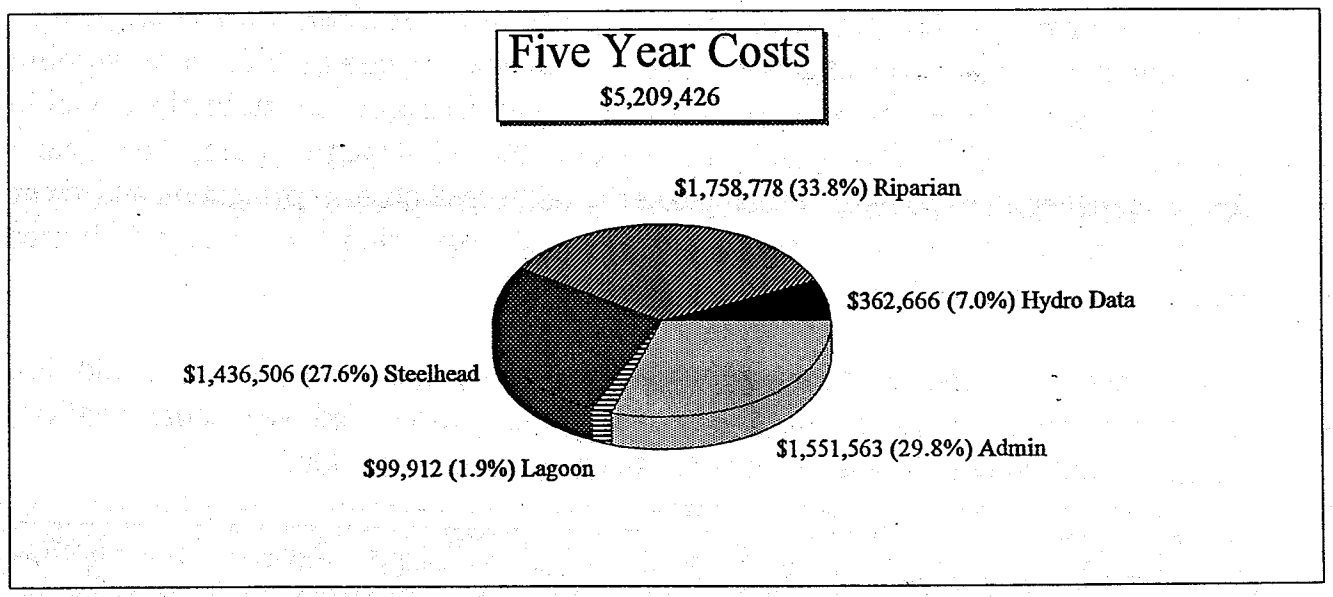
When the Five-Year Mitigation Program was approved in 1990, it was designed to incorporate all or portions of several required District programs that were ongoing at that time. These included the Interim Relief Program to maintain a viable population of steelhead, especially during the 1987-91 drought years; the Carmel River Management Program, which primarily addressed erosion protection and river restoration; the Irrigation Program for riparian vegetation; and many activities related to monitoring water quantity and quality.

District activities associated with the four major programs noted above, in addition to other supporting programs such as hydrologic monitoring and water conservation, are described in the evaluation report. These activities include:

- Rescue and transport of steelhead at various times of the year when river flow is inadequate, and construct facilities to hold rescued fish;
- Conduct fish passage experiments at Los Padres Dam to determine necessary modifications to the spillway to improve passage conditions;
- Prepare a Riparian Corridor Management Plan for the Carmel River;
- Carry out the Riparian Corridor Management Program, which includes erosion protection and riparian habitat restoration projects, irrigation of streamside vegetation, river channel clearing, habitat monitoring, ordinance enforcement, public information and technical assistance;
- Obtain FEMA grants to repair flood disaster damage;
- Contribute to Carmel River Lagoon Enhancement Plan investigations, including lagoon habitat monitoring;
- Implement water conservation and management policies to reduce impacts to the river environment; and
- Monitor surface and ground water quantity and quality.

C. *PROGRAM COSTS AND FUNDING*

In 1990, the total costs for the Mitigation Program were estimated to be about $3.6 million for the July 1991-June 1996 period. The actual program costs (including all personnel and overhead costs) for the 5½-year period from January 1991 through June 1996 total about $5.2 million, an average of about $1 million per year. Actual costs were greater than the 1990 estimates due to incomplete cost estimates in 1990, a different allocation of funds to pay for staff and overhead, unanticipated construction costs due to state and federal regulations, and greater than normal program costs due to the 1987-91 drought and flood damage in 1993 and 1995.



The 1990 mitigation plan included hiring four new permanent staff members; three were actually hired. Due to the extensive time commitment required, the District has found that most mitigation program elements can be completed at less cost using in-house resources rather than retaining consultants or contracting with other entities. One important exception is construction projects, where a formal bid process by qualified contractors is followed.

Consumption of water by the community results in harm to the river environment. Thus, since June 1991 the District Board has a set user fee, collected as a percent of the water bills of Cal-Am and Seaside Municipal water system customers, to pay for the required river mitigation program. The current fee is 6.015 percent of the water bill (total of water charge and service charge). An additional 1.11 percent of the bill supports water conservation activities. In FY 1996-97, the river mitigation program user fee is expected to produce $1.2 million in revenue.

D. PROGRAM IMPLEMENTATION AND EFFECTIVENESS

The evaluation report describes the river mitigation activities in detail and assesses their effectiveness. With few exceptions, the District has carried out all elements of the program as described in the 1990 Mitigation Plan, and program goals have been met. The SWRCB recognized the program's completeness in that no additional program elements were recommended in the SWRCB's 1995 Order on Carmel River water rights issues.

Steelhead Resource: Nearly 30,000 fish have been successfully rescued and transported to safe waters. Both adult and juvenile fish populations have increased several-fold in the Carmel River since 1990, and the steelhead resource is no longer considered a "remnant run." Improvements have been made to the Los Padres Dam spillway and two sets of passage studies have been conducted. Spawning gravel placement has improved the number and quality of steelhead spawning sites. The Sleepy Hollow steelhead rearing facility has been completed and is being tested with an initial groupof 500 fish, though it and other planned facilities have been delayed (or may not be constructed) due primarily to regulatory constraints.

Riparian Corridor: The District constructed six major erosion control projects that improved the stability of river banks and (with one exception) held up well to the 1995 floods; restored 18 acres and enhanced another 16 acres of riparian habitat through plantings and irrigation; restored 9,000 lineal feet of Carmel River streambank, where lush vegetation now exists where denuded river banks once occurred; annually cleared the channel along the lower 15 miles of the Carmel River to reduce erosion hazards; monitored vegetation and wildlife to better understand the human impacts on the dynamics of the riparian corridor; obtained over $660,000 in approved or pending grants from FEMA for flood disaster repairs; and provided technical assistance and public information to hundreds of riverfront property owners. The MPWMD and other agencies identified the need to streamline and coordinate the permit process for property owners who plan to undertake construction projects. The MPWMD organized public meetings to assist property owners in obtaining project permits.

Carmel River Lagoon: Progress on the Lagoon Enhancement Plan has been hampered by budget cuts within the California Department of Parks and Recreation, the lead agency for the Lagoon. The District developed a long-term monitoring strategy and conducted baselines studies of the lagoon characteristics so that future changes can be accurately tracked. These efforts will enable reliable estimates of the amount and quality of water needed to support a healthy lagoon ecosystem.

Aesthetics: The river corridor aesthetic value is directly related to the success of the riparian program. District restoration efforts and channel clearing have resulted in a more diverse, stable riparian environment. Aesthetic values have improved, but still suffer when lack of flow results in a dry river bed in Summer and Fall.

Water Conservation: Water use per connection is roughly 25 percent less in the 1990s than in the 1980s. Management agreements between the District, Cal-Am and the California Department of Fish and Game resulted in an additional 0.7 mile of continuous Carmel River flow, thereby increasing habitat for fish and wildlife.

Hydrologic Monitoring: Monitoring of surface and ground water quantity and quality supports many District programs, including the river mitigation activities. The hydrologic information enables District staff to effectively schedule fish rescues and irrigation of riparian vegetation; evaluate water supply status and develop management schemes to meet municipal and environmental needs; and provides an early warning of water quality problems that could harm the supply for people or wildlife. In contrast to other areas in Monterey County, no seawater intrusion or nitrate contamination of groundwater has occurred within the District.

E. RECOMMENDATIONS

In general, the District recommends that mitigation program activities be continued due to their demonstrated effectiveness. However, certain changes are recommended for each program. Key recommendations include:

- Defer construction of mid-Carmel Valley steelhead holding facility, and find alternative for Lagoon acclimation facility;
- Improve fish passage at all Cal-Am facilities on the Carmel River;
- Repair and construct new erosion control projects, and update project construction standards;
- Develop success criteria for riparian plantings;
- Rebuild emergency irrigation system in key locations prior to next drought;
- Address effects of federal listing of red-legged frog as a threatened species and steelhead as a proposed endangered species on District river projects;
- Obtain additional grants for flood damage repair;
- Obtain concurrence and coordination of other agencies on river program;
- Update environmental information developed in the early 1980s; and
- Upgrade weather stations for hydrology program.

F. CONCLUSIONS

During the July 1991 through June 1996 period, the Mitigation Program resulted in improvements to the Carmel River environment, particularly for steelhead and riparian resources. Recommended additions to the program would increase its effectiveness. Lack of adequate streamflow in Summer and Fall prevents the District's efforts from fully mitigating the impacts of water extraction practices in the Carmel Valley. Until adequate streamflow is restored, continuation of the programs described herein will be necessary to avoid significant environmental harm. Continued conservation efforts will help reduce the community's impact on the river by lessening overall water demand. Hydrologic monitoring will continue to supports a variety of programs, and function as an early warning system for surface and ground water problems that may affect people and wildlife.

The District's Strategic Plan approved in April 1996 includes the overarching goal to work with Cal-Am to legalize the existing water supply and restore adequate streamflow in the Carmel River so that an extensive river mitigation program is not needed in the future. However, some aspects of the mitigation program (at reduced effort) may be needed even after streamflow is restored because it takes many years for a healthy ecosystem to develop in areas that have been damaged. With adequate streamflow, certain program components (such as fish rescues) would not be needed except in a drought emergency.

At a May 20, 1996 public hearing, the District Board voted to continue the river mitigation program for another five years. The Board directed staff to develop an Implementation Plan for the July 1996-June 2001 period which prioritizes the recommendations found in the 1991-1996 Evaluation Report (based on the constraints imposed by anticipated revenues), and identifies the timeline and estimated costs for major capital projects.

The Implementation Plan for FY 1997-2001 was received by the Board in August 1996. The total estimated cost for the recommended program, including factors for annual inflation, is nearly $8.8 million. This includes all expenses associated with personnel, administrative overhead, construction, operation and maintenance, purchase of major equipment, contingency reserve, and co-funding of related programs. The actual program budget for each year will be set by the Board as part of the annual MPWMD budget development and approval process.

WATER ALLOCATION PROGRAM EIR
EVALUATION OF FIVE-YEAR MITIGATION PROGRAM

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INTRODUCTION AND SETTING

I. INTRODUCTION

A. Report Purpose and Background

The purpose of this report is to describe and evaluate the effectiveness of the Monterey Peninsula Water Management District's (MPWMD or District) Five-Year Mitigation Program, which was adopted in 1990 by the District Board when it certified the Final Environmental Impact Report (EIR) on the effects of the MPWMD Water Allocation Program. The Water Allocation Program determines how much water can be taken from local resources to serve the community.

The purposes of this report include:

- identify program goals,
- determine how well mitigation measures were carried out (implementation),
- summarize program costs,
- determine how well problems identified in the 1990 EIR were addressed (effectiveness), and
- make recommendations for the future, including specific changes that could be made to the existing program to increase effectiveness.

The report is to be used as a decision-making tool by the District's elected Board as well as other agencies that have the authority to manage the environmental resources of the Carmel River. Background information on the District and its Water Allocation Program, the existing setting, and elements of this report is provided in the following sections.

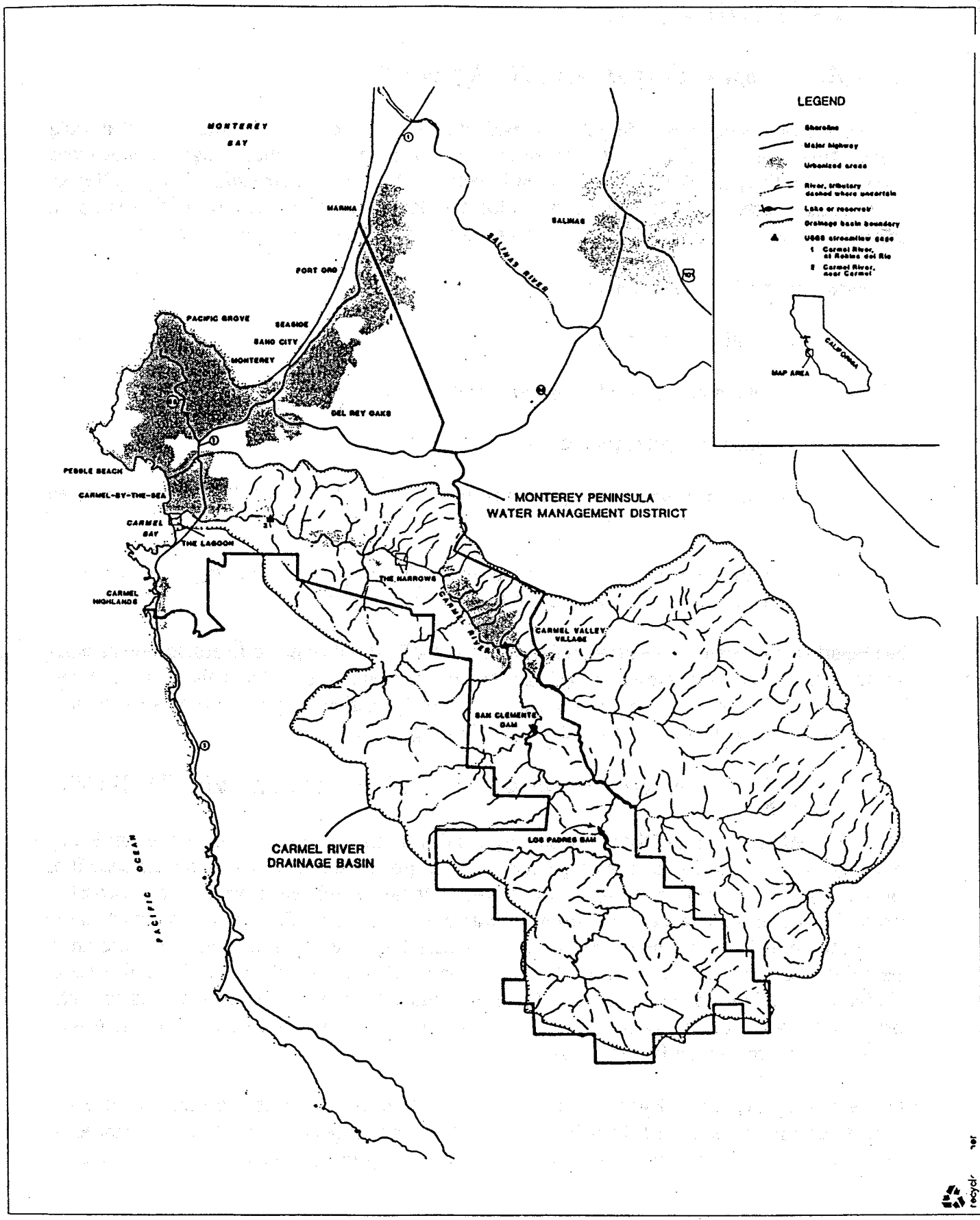
1. Monterey Peninsula Water Management District (MPWMD)

The MPWMD is a special District created by the California legislature in 1977 and ratified by voters in 1978. Its mission is to "manage, augment and protect water resources for the benefit of the community and environment" of the greater Monterey Peninsula area. The District is responsible for regional water supply planning within a 170-square mile area consisting primarily of the Monterey Peninsula and Carmel Valley (**Figure I-1**). The District boundaries encompass the cities of Carmel, Del Rey Oaks, Monterey, Pacific Grove, Sand City, Seaside and portions of Marina, Fort Ord and unincorporated Monterey County. The District's population is currently estimated at about 112,000 people. Several million people may visit the area each year as it is an internationally-known tourist destination.

The Monterey Peninsula depends solely upon variable local resources, primarily surface and ground water from the Carmel River Basin, to meet its water supply needs. About 95 percent of the customers within the District are supplied with water by the California-American Water

MPWMD BOUNDARIES

FIGURE I-1



SOURCE: MPWMD

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Company (Cal-Am), an investor-owned public utility. About 80 percent of the total water produced within the District boundaries in normal years is supplied by Cal-Am. The MPWMD works closely with Cal-Am on many programs, including water supply augmentation, conservation, and management of existing supply.

2. *Water Allocation Program*

In its enabling legislation, the District was given a broad mandate not only to augment the water supply, but also balance supply and demand. One of the District's first products was a 1979 Final Report to the California Coastal Commission, in which the District characterized the existing supply and demand, determined procedures to revise supply estimates, projected future water use, and developed model ordinances that could be used to fairly allocate water supplies among member jurisdictions.

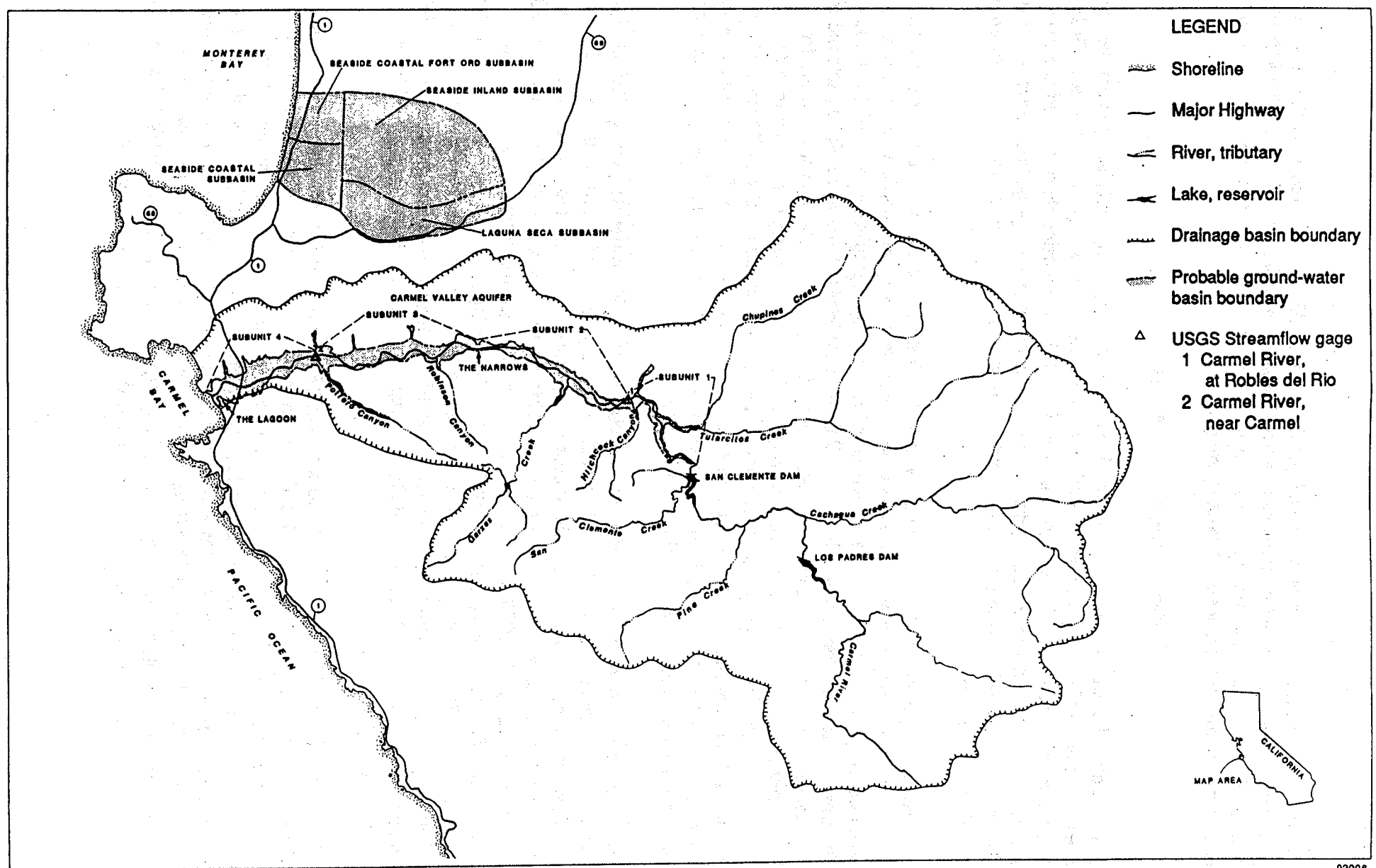
So that the eight political jurisdictions within the District (i.e., the six cities named above, portions of Monterey County and the Monterey Peninsula Airport District) can maintain their water demand within the limits of available supply, the District implemented a Water Allocation Program. This program, which began in 1980 with MPWMD Ordinance No. 1, sets the total amount of water production that can be taken by Cal-Am and non-Cal-Am water users from the Monterey Peninsula Water Resources System (MPWRS), and determines how much water is allotted to each of the eight jurisdictions within the Cal-Am system. The MPWRS is shown in **Figure I-2** and consists of: (1) surface water diverted from the Carmel River at San Clemente Dam, (2) ground water pumped from the Carmel Valley alluvial aquifer, and (3) ground water pumped from the coastal area of the Seaside Basin.

The allocation system is a key element in the process by which water demand and water supply are kept in balance. From September 1980 until July 1993, if a jurisdiction's water usage exceeded its allocated supply, District regulations required that a moratorium be declared on all new water connections in that jurisdiction. (This practice ceased with Ordinance No. 70 as described below.) In 1987, the City of Carmel-by-the-Sea faced this situation and filed suit against the District challenging the Water Allocation Program. As part of a court-ordered settlement, an EIR was prepared on the allocation amount and distribution of water among the member jurisdictions within the District. The EIR evaluated five water production options, ranging from 16,744 AF/year to 20,500 AF/year of Cal-Am production, in addition to six distribution alternatives.

Until November 1990, the District allocated 20,000 AF/year of Cal-Am production, based on normal year demand. The Water Allocation Program Final EIR, certified on November 5, 1990 found that this level of production had significant adverse effects on the environment. On December 13, 1990, the District Board finalized Ordinance No. 53 which formally set the new normal year allocation for the Cal-Am system at 16,744 AF (Option V, the lowest amount analyzed in the EIR), and 3,137 AF for the non-Cal-Am users within the Monterey Peninsula Water Resource System, resulting in a total of 19,881 AF/year for the MPWRS as a whole. Because estimated normal year demand for the Cal-Am system was estimated at nearly 17,000

MONTEREY PENINSULA WATER RESOURCES SYSTEM

FIGURE I-2



AF, the Board also passed Ordinance No. 52, which placed a temporary moratorium on all new connections. The moratorium was in effect from January 1, 1991 to August 19, 1993.

In June 1993, District Ordinance No. 70 was adopted. This ordinance ended the moratorium and amended the production limit to a maximum of 17,619 AF/year for the Cal-Am system and 3,054 AF/year for the non-Cal-Am system, or 20,673 AF/year for the MPWRS as a whole. These changes occurred because permits were received by Cal-Am to operate a large, new municipal well (the Paralta Well) that draws from ground water in the coastal area of the Seaside Basin. Another important change made by Ordinance No. 70 is that a total of 308 AF/year Cal-Am metered sales were allotted to the eight member juridictions within the District, and 50 AF were set aside for a District reserve. Instead of tracking a jurisdiction's share of the 17,619 AF total Cal-Am system amount, only a jurisdiction's share of the "Paralta allocation" is tracked to determine compliance with Ordinance No. 70. The District compares total community (Cal-Am) water use to the Cal-Am system production limit.

Ordinance No. 73, adopted in February 1995, eliminated the 50 AF District reserve and allocated the remaining amount (34.72 AF) to the eight jurisdictions in equal amounts. Ordinance No. 74 and 75 were adopted in March and April 1995, respectively, to allow reinvestment of water saved through toilet retrofits and other permanent types of savings. The passage of Ordinance No. 83 in April 1996 slightly revised the allocation amounts to 17,621 AF/year and 3,046 AF/year for the Cal-Am and non-Cal-Am systems, respectively, which results in a total of 20,667 AF/year for the MPWRS.

3. *Five-Year Mitigation Plan and Program*

According to the California Environmental Quality Act (CEQA), the basic purpose of an EIR is to (1) inform governmental decision-makers and the public about potential, significant environmental effects of proposed activities, (2) identify ways the environmental damage can be avoided or significantly reduced, and (3) prevent significant, avoidable environmental damage by requiring changes in projects through the use of feasible alternatives or mitigation measures. An agency can also find that a project with significant environmental effects may be approved if (1) it publicly discloses that there is no feasible way to lessen or avoid the adverse effects, and (2) it specifically identifies how expected benefits from the project outweigh the general policy to avoid or reduce significant environmental impacts. This is done via a "Statement of Overriding Considerations," which becomes part of the project approval record.

Mitigation measures (i.e., actions to reduce environmental harm) were recommended in the Water Allocation Program EIR whenever a water supply option was identified as having "potentially significant" or "significant" impacts. The EIR also designated an impact as "potentially significant" when the degree of the impact was unknown or when the success of a mitigation measure could not be predicted.

*(a) **Five-Year Mitigation Plan for Option V**--* On November 5, 1990, the MPWMD Board certified the Final EIR, adopted findings which included a comprehensive mitigation program, and set Option V (16,744 AF Cal-Am production) as the new water allocation limit for the Cal-Am

system. Even though Option V was the least damaging alternative of the five options analyzed in the EIR, water production at this level still resulted in significant, adverse environmental impacts that must be mitigated. Thus, the findings adopted by the Board included a document entitled "Five-Year Mitigation Plan for Option V" (MPWMD, 1990), intended to serve as the blueprint for a comprehensive mitigation program to be carried out from July 1991 through June 1996. The findings also included several other general mitigation measures.

Table I-1 summarizes the major mitigation measures for each impact topic -- steelhead fishery, riparian habitat, Carmel River lagoon and aesthetic resources. For each impact topic, the 1990 Five-Year Mitigation Plan described then-existing District activities, identified the purpose of the mitigation measures, described how the measures would be implemented and what facilities would be needed, quantified how often the measures would be needed, summarized a monitoring and reporting program, identified permits required, and provided preliminary cost estimates.

Table I-2 provides the rough estimate of capital costs and operation and maintenance (O&M) costs for each program that was approved by the Board in 1990. Including annual costs of then-existing District environmental programs in addition to capital and annual costs of new Board-approved mitigations stemming from the Water Allocation Program EIR, the capital costs for the comprehensive District program were estimated in 1990 to be about $442,700. Annual costs were estimated in 1990 to total about $638,100 per year. The Board-approved mitigation program entailed hiring four new permanent staff members (riparian program manager and three fishery technicians at 75% time) in addition to several seasonal river maintenance workers. Two additional fishery technicians would be needed during drought years.

The 1990 Five-Year Mitigation Plan incorporated and subsumed all or portions of several District programs that were ongoing at the time. These included the Interim Relief Program to maintain a viable population of steelhead, especially during the 1987-92 drought years; the Carmel River Management Program, which primarily addressed erosion control; and several elements of District hydrologic monitoring (water quantity and quality) activities. These and other then-existing programs are described in more detail in Sections II through V. Revenues and expenses for the Interim Relief and Carmel River Management Programs, which were in existence at the time the Mitigation Program was initiated, are included in the financial totals reported elsewhere in this report.

(b) Program Funding -- In June 1991 the Board set a new user fee, collected on the water bills of Cal-Am and Seaside Municipal water system customers, of 6.824 percent of the sum of the water and service charges. The new ordinance, Ordinance No. 55, also ended the user fee (8.75 percent) previously collected to fund the Interim Relief Program. Included in the total new fee was a portion equal to 2.11 percent to fund water conservation programs not part of the Mitigation Program. In October of the same year, the Board adopted Ordinance No. 58 which amended the previous ordinance by increasing the total user fee from 6.824 to 8.125 percent of the water bill. Of the total, only 6.015 percent was allocated to the Mitigation Program with the remainder going to water conservation activities. Given the then-current level of Cal-Am water sales, the new rate was expected to generate approximately $850,000 in annual user fees to finance both annual and capital costs of the Five-Year Mitigation Program. In August 1992, the Board

Table I-1

SUMMARY OF MPWMD FINAL FIVE-YEAR MITIGATION PROGRAM
November 1990

STEELHEAD FISHERY

Continue existing programs
Capture and transport emigrating smolts in spring
Prevent stranding of fall/winter juvenile migrants
Rescue juveniles downstream of Robles del Rio in summer
Modify spillway and transport smolts around Los Padres Dam

RIPARIAN VEGETATION AND WILDLIFE

Continue existing programs
Conservation and water distribution management
Prepare and oversee Riparian Corridor Management Plan
Implement Riparian Corridor Management Program
Expand soil moisture and vegetative stress monitoring

LAGOON VEGETATION AND WILDLIFE

Continue existing programs
Assist with lagoon enhancement plan investigations
Expand long-term lagoon monitoring program
Identify feasible alternatives to maintain adequate lagoon volume

AESTHETICS

Restore riparian vegetation (see above)

TABLE I-2

COST ESTIMATES FOR FINAL MITIGATION PROGRAM FOR OPTION V
November 1990

(Values shown are fully funded by MPWMD for five years.)

MITIGATION PROGRAM	CAPITAL COST			ANNUAL COST		
	Existing	New	Total	Existing	New	Total
Fisheries	$ 9,000	407,700	416,700	$ 12,800	200,100	212,900 (1)
Riparian Vegetation and Wildlife	$ 0	10,000	10,000	$295,000	121,000	416,000
Lagoon Vegetation and Wildlife	$ 26,000	25,000	51,000	$ 1,200	2,000	3,200
Aesthetics	$ 0	0	0	$ 6,000	0	6,000
GRAND TOTAL	$ 35,000	$442,700	$477,700	$315,000	$323,100	$638,100
ESTIMATED TOTAL COST OF BOARD APPROVED NEW PROGRAMS		$442,700				$323,100
ANNUAL FUNDS NEEDED TO CONTINUE EXISTING ENVIRONMENTAL PROGRAMS		N/A				$315,000
TOTAL MITIGATION PROGRAM COST		$442,700				$638,100

NOTE 1: Annual cost estimates for fishery resources are averages; the annual costs could be as high as $382,000 in individual critically dry years and as low as $78,700 in wet years.

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adopted Ordinance No. 61, which reduced the total user fee to 7.125 percent, which is the existing rate. The percentage of the user fee (6.015%) allocated to the Mitigation Program has remained unchanged since 1991. In Fiscal Year 1996-97 the Mitigation Program user fee is expected to produce $1.2 million in revenue.

(c) Annual Reports– CEQA (Pub. Res. Code 21081.6) requires that the lead agency (in this case, MPWMD) adopt a reporting or monitoring program to insure compliance with mitigation measures adopted with the certification of an EIR. Finding Nos. 387 through 404 adopted by the District Board on November 5, 1990 describe mitigation measures associated with the Water Allocation Program EIR; many mitigation measures entail preparation of annual monitoring reports. Thus, the District prepared annual reports for the Five-Year Mitigation Program to respond to these requirements.

Annual reports in 1991, 1992 and 1993 covered the calendar year January 1 through December 31 in order to be consistent with the District's overall annual report (year-end review of accomplishments). Because this time period conflicts with the District's budget cycle (July 1 - June 30), it was determined that an 18-month report (January 1994 through June 30, 1995) was needed to bridge the transition from a calendar year to a fiscal year in 1994-95. The fifth and last annual report covers the period July 1, 1995 through June 30, 1996.

Each annual report first addressed general mitigations relating to water supply and demand, followed by mitigation measures relating to specific environmental resources (i.e., the Five-Year Mitigation Program) and a summary of costs. For each impact topic, the mitigation measure adopted as part of the Final EIR is briefly described, followed by a summary of activities relating to the topic in 1994-95. Monitoring results, where applicable, are also presented. **Table I-3** summarizes progress on the mitigation measures for the Five-Year Mitigation Program, based on the annual reports and activities carried out in the 1991-1996 period. Four annual reports covering the period July 1991 through June 1995 are on file in the District office; the fifth (covering the period July 1995-June 1996) will be prepared in Fall 1996.

(d) Five-Year Assessment– In 1990, the District Board committed to: (1) fund and implement the mitigation program over a five-year period (July 1991 through June 1996), and (2) after five years, reassess the allocation program as a whole, including the mitigation program, based on results of the mitigation monitoring studies, development of new water supplies, and other factors. Necessary amendments to the program would be made at that time.

The Five-Year Mitigation Program formally began in July 1991 with the new fiscal year. It will end on June 30, 1996 unless renewed by District Board action. It is notable that the State Water Resources Control Board (SWRCB) in its Order WR 95-10 (July 1995), which addressed complaints lodged against Cal-Am due to its water diversions from the Carmel River, directed Cal-Am to carry out any aspect of the Five-Year Mitigation Program that the Water District does not continue after June 30, 1996. This evaluation of the Five-Year Mitigation Program is one part of an effort to determine the magnitude and cost of a future program, and the District's role in carrying out the mitigation program in the future. Due to the deadlines set by the SWRCB and the need to prepare the District's budget for Fiscal Year 1996-97 by June 1996, the evaluation of

Table I-3

PROGRESS ON MPWMD FIVE-YEAR MITIGATION PROGRAM [1]
JULY 1, 1991 THROUGH JUNE 30, 1996
Prepared October 1996

MITIGATION MEASURES	1991	1992	1993	1994/95	1995/96
WATER MANAGEMENT	ongoing	ongoing	ongoing	ongoing	ongoing
Monitor Water Resources	ongoing	ongoing	ongoing	ongoing	ongoing
Manage Water Production	ongoing	ongoing	ongoing	ongoing	ongoing
Manage Water Demand	ongoing	ongoing	ongoing	ongoing	ongoing
Monitor Water Usage	ongoing	ongoing	ongoing	ongoing	ongoing
Augment Water Supply	ongoing	ongoing	ongoing	ongoing	ongoing
Allocation of New Supply	ongoing	ongoing	ongoing	ongoing	ongoing
Determine Drought Reserve	ongoing	ongoing	ongoing	ongoing	ongoing
STEELHEAD FISHERY					
Capture/Transport Emigrating Smolts in Spring					
Smolt rescues	ongoing	ongoing	not needed	ongoing	not needed
Build acclimation facility/tagging study					permit denied
Prevent Stranding of Fall/Winter Juvenile Migrants					
Juvenile rescues	ongoing	not needed	not needed	ongoing	not needed
Build mid-Valley holding facility					deferred
Rescue Juveniles Downstream of Robles del Rio in Summer					
Juvenile rescues	ongoing	ongoing	ongoing	ongoing	ongoing
Build Sleepy Hollow holding/rearing facility	not needed	not needed	not needed; design/permits	final design; bids	construction

MITIGATION MEASURES	1991	1992	1993	1994/95	1995/96
Modify Spillway/Transport Smolts Around Los Padres Dam	none	mortality study	CDFG modify	CDFG modify; recommendation	repeated mortality study
Monitoring Activities for Mitigation Plan					
Adults at San Clemente Dam	ongoing	ongoing	construct fish counter	complete fish counter	ongoing
Juvenile population	ongoing	ongoing	ongoing	ongoing	ongoing
Other Activities Not Required by Mitigation Plan					
Spawning habitat restoration	grant applic.	404 permit	project	monitor/maint.	monitor/maint.
Fish planting (steelhead broodstock program)	none	planting	planting	planting	none
Modify critical riffles	none	modify	monitoring	monitor/maint.	monitor/maint.
RIPARIAN VEGETATION AND WILDLIFE					
Conservation and Water Distribution Management	ongoing	ongoing	ongoing	ongoing	ongoing
Prepare/Oversee Riparian Corridor Management Plan		draft	draft	draft	deferred
Implement Riparian Corridor Management Program					
Cal-Am well irrigation (4 wells)	ongoing	ongoing	ongoing	ongoing	ongoing
Channel clearing	ongoing	ongoing	ongoing	ongoing	ongoing
Vegetation monitoring	ongoing	ongoing	ongoing	ongoing	ongoing
Track and pursue violations	ongoing	ongoing	ongoing	ongoing	ongoing
River Care Guide booklet				draft	final completed
CRMP Erosion Protection Program	ongoing	ongoing	ongoing	ongoing	ongoing
Expand Soil Moisture and Vegetative Stress Monitoring	ongoing	ongoing	ongoing	ongoing	ongoing

MITIGATION MEASURES	1991	1992	1993	1994/95	1995/96
LAGOON VEGETATION AND WILDLIFE					
Assist with Lagoon Enhancement Plan Investigations	ongoing	plan complete	none [2]	none [2]	assist Caltrans[2]
Expand Long-Term Lagoon Monitoring Program					
Water quality/quantity	ongoing	ongoing	ongoing	ongoing	ongoing
Vegetation/soils	none	none	work plan	veg. mapped	HRG study [3]
Identify Alternatives to Maintain Lagoon Volume	none [2]	none [2]	none [2]	elevation and bathymetry surveyed for wetland and lagoon	bathymetry resurveyed in lagoon transects
AESTHETICS					
Restore Riparian Vegetation (see above)	ongoing	ongoing	ongoing	ongoing	ongoing

Note 1: The Five-year Mitigation program began on July 1, 1991 and runs through June 30, 1996. Annual reporting was in calendar years (Jan-Dec) for 1991, 1992 and 1993. Annual reporting switched to fiscal years (July-June) starting July 1, 1994 to better conform with the District's budget process.

Note 2: Mitigation measures are dependent on implementation of the Lagoon Enhancement Plan by the California Department of Parks and Recreation, the land owner and CEQA lead agency. Reorganization of CDPR and budget constraints have halted work on the Lagoon Enhancement Plan through most of 1996. Portions of the Enhancement Plan will be implemented by Caltrans as part of a "mitigation banking" project over the next few years.

Note 3: Baseline study, "Biologic Assessment of Carmel River Lagoon Wetlands," completed by Habitat Restoration Group (HRG) in November 1995.

U:\HENRI\WP\ALLOEIR\5YRREV96\SUMTAB96.WPD

the Five-Year Mitigation Program began prior to the program's formal termination date. Revenues and program costs for the six months beginning January 1996 through June 1996 are budget values and therefore tend to overstate actual expenses.

B. Existing Setting

1. Hydrologic Setting

The Carmel River drains a 255 square-mile watershed in the rugged Santa Lucia range. In the upper watershed, the river and its tributaries flow in deep, steep-sided canyons. For its last 15 miles, the river flows across the relatively flat Carmel Valley floor to the Pacific Ocean. **Figure I-2** shows the Carmel River and its principal tributaries. The following paragraphs briefly summarize the hydrologic setting of the area. For more detailed information, consult Chapter 7, Volume I of the Final EIR/EIS on the Monterey Peninsula Water Supply Project (MPWMD 1994).

(a) Rainfall– Over 90 percent of the average annual rainfall occurs between November and April, with January and February being the wettest months. The average annual rainfall varies from about 40 inches in the southernmost portion of the basin, near Ventana Cones, to about 14 inches along the northeast perimeter of the basin. Annual rainfall at San Clemente Dam, about 18 miles upstream from Carmel Bay (**Figure I-2**), has averaged 20.49 inches between 1921 and 1995, with a maximum of 44.91 inches in water year 1983.

(b) Streamflow– The first winter rains replenish soils that have dried out during the summer; consequently, little runoff occurs until December. Early runoff from the upper watershed refills Los Padres and San Clemente Reservoirs, which have been drawn down during the preceding months. After filling the reservoirs, usually by mid-December, water overflows to the lower river. Because groundwater pumping has lowered the water level in the aquifer subunits that lie below the lower river, most of these early flows percolate into the ground, depleting flow in the river. When groundwater levels have risen, the period of highest streamflow begins, usually occurring from January through April. Average monthly flows of 200 to 400 cubic feet per second (cfs) occur at this time. When the first of the large flows reaches the lagoon at the river mouth, the storm waters cross the sand barrier that separates the lagoon from the ocean, and flow to the ocean begins. A channel is bulldozed through the sand barrier by the Monterey County Public Works Department in anticipation of the large flows, in order to reduce the risk of flooding in the residential area surrounding the lagoon.

After the rain stops, the river recedes. Ocean waves then close the channel through the beach, and the lagoon forms again. Usually the river dries up in the lower valley (below the Narrows) by July. From July until the rains begin, the only water remaining in the lower river is in isolated pools that gradually dry up as the groundwater table declines in response to pumping.

Streamflow in the Carmel River is "flashy," that is, it responds rapidly to rainfall over the watershed. Peak flows vary greatly from year to year, ranging from less than 50 cubic feet per second (cfs) to over 15,000 cfs. Flow in the river is measured continuously at two locations by

the U.S. Geological Survey -- 3.6 river miles from the river mouth at the "near Carmel" gaging station, and 14.4 river miles from the river mouth at the Robles del Rio gaging station. The District also estimates the volume of river flow that passes by San Clemente Dam. The mean annual inflow (1902-1996) is 68,700 AF.

Figure I-3 demonstrates the variability in streamflow from year to year. In the past 20 years, there have been two significant drought events -- a two-year event in 1976-77, when the community experienced rationing of 50 gallons per day (a 47 percent reduction); and a five-year event in 1987-91, when the community experienced mandatory 20 percent rationing for 28 months. Very wet years occurred in 1983, 1993 and 1995. Two major floods occurred in January and March 1995, which resulted in significant areas of flooding, erosion and property damage along the Carmel River, including loss of the Highway One Bridge.

The District has classified water years based on selected exceedence frequencies. In general, five classes -- wet, above normal, below normal, dry, and critically-dry -- were defined based on the 25.0, 50.0, 75.0, and 87.5 exceedence frequencies, respectively. Exceedence frequency refers to the number of times that a particular value will be equaled or exceeded during a specific series of events. For example, if the 87.5 percent exceedence frequency for unimpaired streamflow in January at San Clemente Dam is 1,400 acre-feet, this means that the flow in January is equal to or greater than 1,400 acre-feet 87.5 percent of the time.

*(c) **Storm Flow, Channel Geometry and Bank Erosion**--* The lower reach of the Carmel River is an alluvial river, which is a river that flows over an accumulation of sediment deposited and reworked by the river in an earlier time. This means that the shape and character of the river channel are mainly determined by the supply, erosion and deposition of sediment transported by the flow. In an alluvial river, if the flow increases with no matching increase of sediment, the channel erodes, becoming deeper and wider to accommodate it. If the flow decreases with no matching decrease in sediment, sediment is deposited and the channel decreases in size.

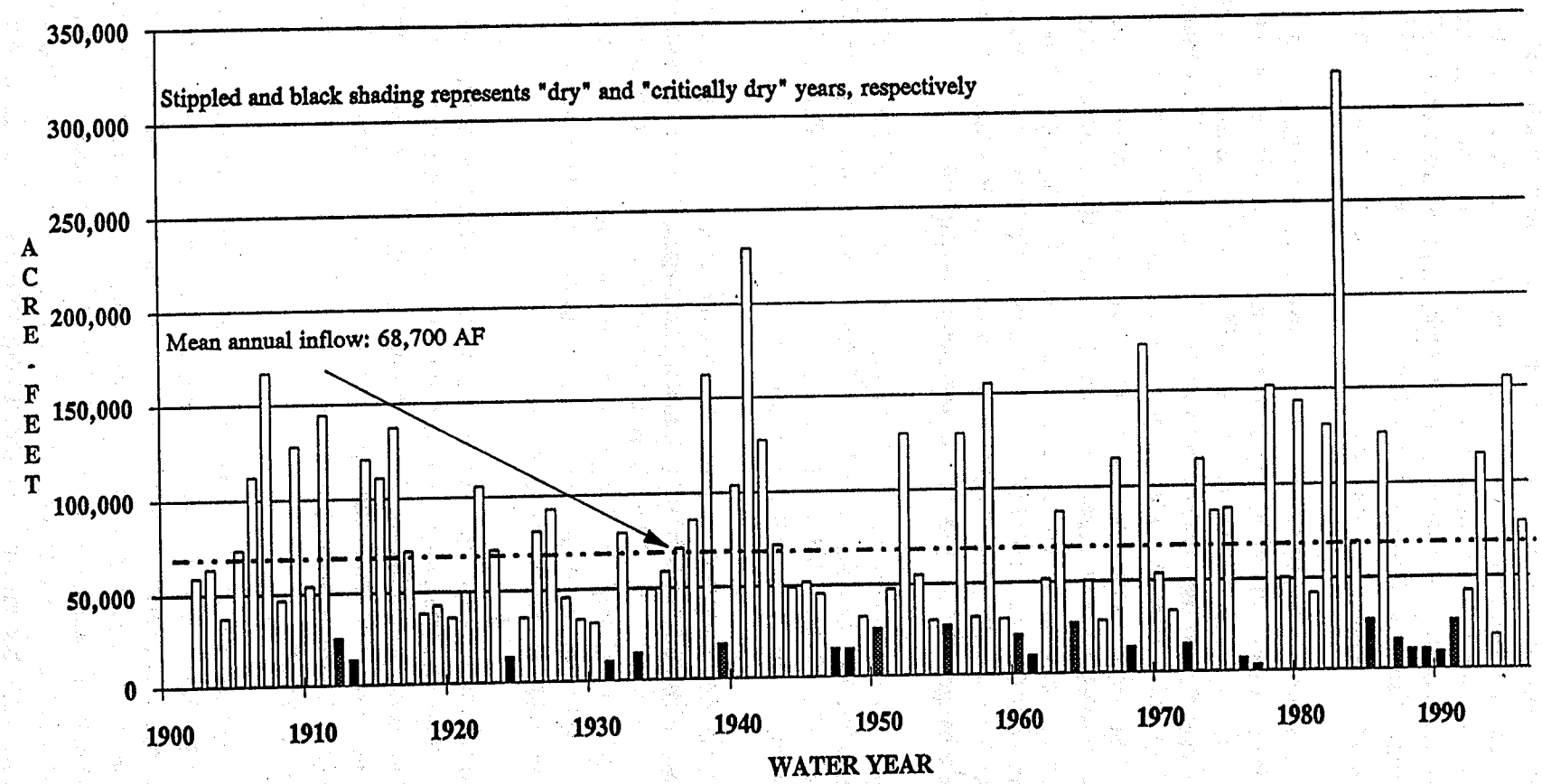
Although alluvial rivers are naturally unstable, continuously changing in time and space in response to floods and other natural events, a dynamic equilibrium is established over a period of many years; this natural balance can be disturbed by man's activities, as has occurred in the Carmel River.

The completion of San Clemente Dam in 1921 resulted in a phenomenon called armoring, where fine river bed materials were washed out, leaving only coarse materials in the reach just below the dam. Farther downstream, the Carmel River adjusted by deepening or incising, confining flood flows to the main river channel, rather than spreading over the floodplain. This increased the speed of water flow and the rate of channel bottom and bank erosion, although bank erosion was limited by the growth of riparian vegetation, which generally protected the banks from erosion. By about 1940, the river channel had adjusted to the presence of San Clemente Dam and a new dynamic equilibrium had been established.

In the mid- and late 1970s, a considerable amount of riparian vegetation was lost as the 1976-77 drought and ground water pumping dramatically lowered the water table in parts of the valley.

FIGURE I-3

UNIMPAIRED CARMEL RIVER FLOW AT SAN CLEMENTE DAM: 1902-1996



Note: Inflow for Water Year 1996 is projected.

With the banks unprotected by riparian vegetation, the river adjusted to flood flows by eroding both the channel bed and the stream banks. After the storm flows passed, the eroded materials were redeposited in the channel bed. As a result of this process, middle reaches of the river between the Narrows and Riverside RV Park, have changed drastically from a narrow, deep, meandering channel with well-developed riffles and pools to a wide, shallow channel with eroded banks and an unstable bed. Please see Section IV of this report for more information.

(d) Ground Water Hydrology– The principal water-bearing geologic structure in the Carmel Valley is the younger alluvium, consisting of poorly consolidated boulders, gravel, sand and silt deposited by the Carmel River in the last 10,000 years. The thickness of the alluvium increases in a downstream direction from zero above the Carmel Valley Filter Plant, to more than 200 feet west of Highway 1 near the river mouth, with a typical thickness of 50 to 100 feet. The Carmel Valley Aquifer is unconfined and is highly permeable, recharging rapidly after extended dry periods. The aquifer is underlain by much less permeable bedrock formations consisting of pre-Tertiary age igneous and metamorphic rocks, and Tertiary age sedimentary rocks. Only a few wells on the valley floor have been drilled through the alluvial sediments into underlying bedrock. Because the permeability of these rocks is considerably less than the alluvial sediments, ground water exchange with the alluvium is assumed to be limited.

The aquifer can be divided into four subunits: Subunits 1 and 2 are collectively referred to as the upper aquifer, and Subunits 3 and 4 are referred to as the lower aquifer (**Figure I-2**). A map and profile of the Carmel Valley Alluvial Aquifer is shown in **Figure I-4**, which also shows the location of Cal-Am's production wells in the Carmel Valley.

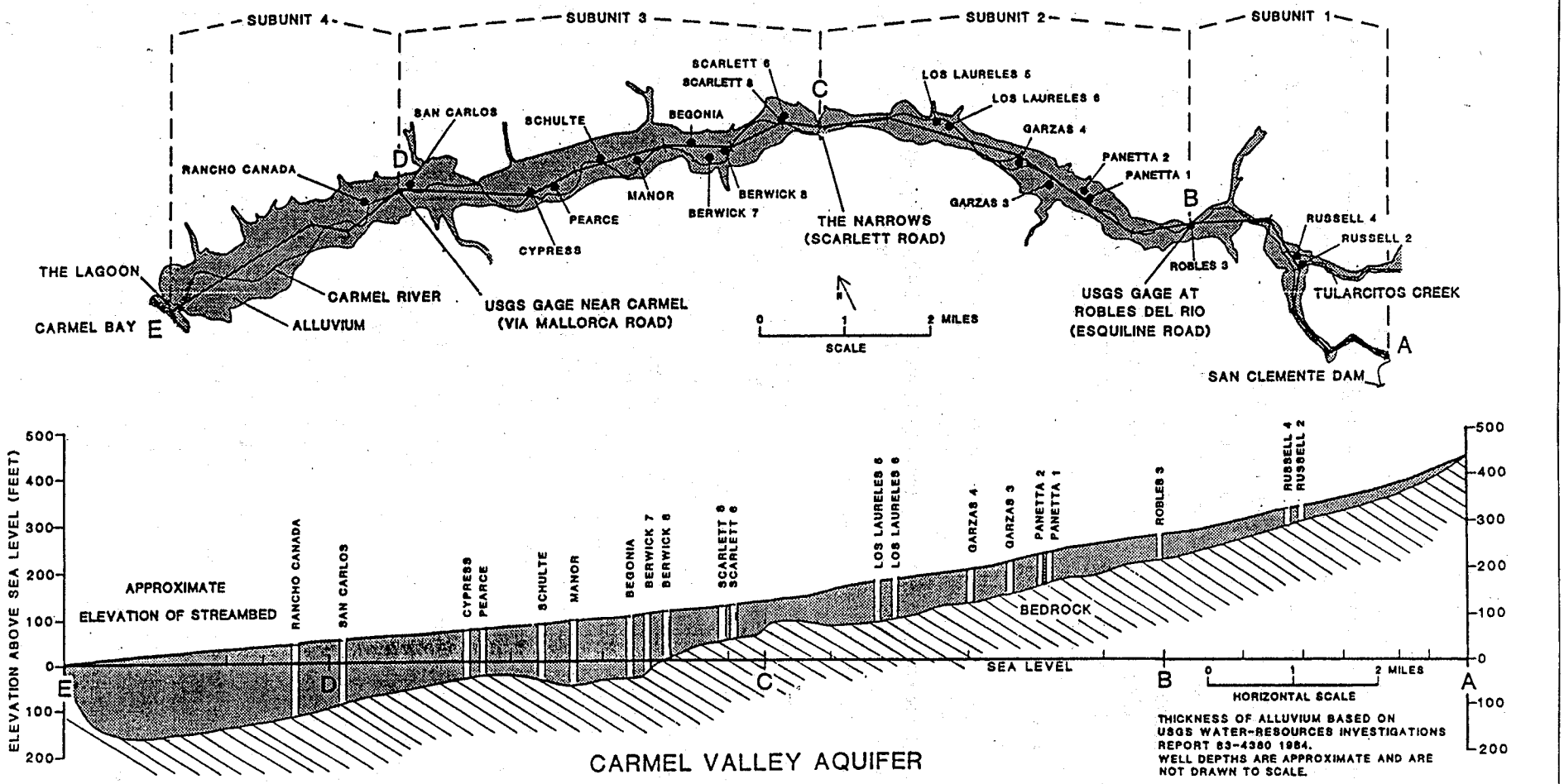
About 85 percent of the water entering the aquifer percolates through the bed of the Carmel River. Additional recharge comes from the tributary drainages, direct infiltration of precipitation, inflow from subsurface bedrock formations and return flow from irrigation and septic systems. Water in the aquifer is primarily lost by ground water pumping; minor sources of loss include discharge into the river, seepage into the ocean, evapotranspiration by riparian vegetation and deep percolation into underlying bedrock formations.

Although riparian vegetation was much more abundant before the valley was developed (and consequently, evapotranspiration was greater), prior to extensive ground water development in the 1960s, the water level in the aquifer in the summer and fall was generally high enough to provide base flow to the river and sustain year-round flow in most years. Upstream diversion of water and large-scale ground water pumping now dry up the river in the lower Carmel Valley during the summer months.

(e) Beaches– Coastal beaches are formed primarily by sediments washed into the ocean by rivers. The Carmel River enters the Pacific Ocean within Carmel Bay. Carmel Bay is enclosed by two rocky headlands: Pescadero Point on the north and Point Lobos on the south. It is approximately 3 miles long and 2.5 miles wide with a shoreline consisting of rocky outcrops interspersed with small sandy coves. The head of a deep submarine canyon, the Carmel Canyon, penetrates the Bay. Examination of aerial photographs taken over the last 32 years indicates that the Carmel Bay beaches are in a state of equilibrium, neither increasing nor decreasing in size.

PROFILE OF ALLUVIAL AQUIFER SHOWING CALIFORNIA - AMERICAN WATER COMPANY PRODUCTION WELLS

FIGURE I-4



SOURCE: MONTEREY PENINSULA WATER MANAGEMENT DISTRICT

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2. *Biologic Setting*

(a) Riparian Corridor – The Carmel River supports a variety of aquatic plants and animals, including several species that have state or federal significance. These include the steelhead salmon, California red-legged frog and the southwestern pond turtle. The extensive riparian corridor supports a variety of bird species, small mammals, reptiles, amphibians and insects. The reader should consult the setting sections in Chapter 8 and Chapter 9, Volume I of the Final EIR/EIS on the Monterey peninsula Water Supply Project (MPWMD, 1994) for detailed information about aquatic and terrestrial plants and wildlife. As described throughout this report, and summarized in Section 2.4, Volume I of the EIR/EIS, the biological resources of the Carmel River have suffered the effects of water extractions to serve the community. Depleted river flows and diminished water tables have resulted in a significantly reduced steelhead population, vegetation stress and die-offs, and resulting habitat loss for creatures dependent on a healthy riparian corridor.

(b) Carmel River Lagoon– A naturally occurring lagoon and wetland area exists at the mouth of the Carmel River, where the river flows to the Pacific Ocean at Carmel Bay (**Figure I-2**). This area represents one of the few remaining estuary/wetland areas in California. About 90 percent of California's wetland acreage has disappeared during historical time due to development encroachment, reduction in water supplies, dredging, etc.

Surface flow from the Carmel River into the lagoon normally recedes after the rainy season in late spring, and ceases between June and August as rates of water extraction from the river and alluvial aquifer exceed baseflow discharge. River flow into the lagoon normally resumes again between November and January with the onset of the rainy season.

The mouth of the lagoon closes when inflow declines to several cubic feet per second (cfs), and a large sandbar builds up on the beach due to wave action during the summer months. When inflow resumes at the onset of the rainy season, the Monterey County Public Works Department must at times manually breach the sandbar prior to when storm flow would naturally breach it, in order to prevent flooding of homes at the northern terminus of the wetland area.

The surface area of the lagoon is usually about six acres during the summer when the mouth is closed, and expands to about 50 acres when the lagoon rises to flood adjacent wetlands, before the sandbar is breached. After the mouth is opened, the surface area of the lagoon varies with the tide, the discharge in the river, and the location of the mouth, but is roughly equivalent to the summertime area except during very high flows.

During the summer and fall, the sandbar at the mouth blocks the connection with the ocean, resulting in a brackish mixture of trapped sea water and fresh water from the river and ground water. A District hydrogeologic study in the coastal portion of the Carmel Valley alluvial aquifer indicates that the lagoon is likely supplied in part by ground water inflow. Some sea water probably seeps through the beach sands during summer, but for the most part the salinity of the lagoon remains low until fall. Usually in September or October, higher tides and surf occur and

the sandbar is overtopped by waves, resulting in an increase in the salinity and surface area of the lagoon.

The lagoon and wetland environment is being impacted in four ways -- (1) water diversion from the Carmel River for community supply reduces fresh water inflow to the lagoon, thereby diminishing habitat value; (2) artificial breaching of the sandbar at the mouth of the lagoon reduces the frequency and duration of flooding that would naturally occur, resulting in more saline waters and reduced feeding area for fish; (3) increased sediment load from upstream areas of the Carmel River affects the quality of fish habitat; and (4) the southern arm of the lagoon has filled with sediment in recent years, thereby reducing steelhead habitat value in this area.

In 1990-1991, the District co-sponsored preparation of the Carmel River Lagoon and Wetlands Enhancement Plan to address the degraded condition of the lagoon. Several of the Plan recommendations are being implemented by the California Department of Transportation (Cal-Trans) as part of a "mitigation banking" project, where environmental restoration is carried out in one area to compensate for future project impacts in another area.

3. Water Supply Setting

(a) Facilities– There are presently two dams on the Carmel River: San Clemente Dam and Los Padres Dam (**Figure I-2**). Both dams are owned and operated by Cal-Am. San Clemente Dam is located near the confluence with San Clemente Creek about 18 miles from the river mouth. The dam is 85 feet high and was completed in 1921. When the dam was built, the reservoir it formed had a capacity of 2,136 acre-feet (AF) which has since been reduced to about 600 AF (flashboards raised) by sediment washing into the reservoir from the upper watershed.

Los Padres Dam, completed in 1949, is 148 feet high and is located about 25 miles from the river mouth. Its original reservoir capacity of 3,030 AF has been reduced to about 2,180 AF by accumulated sediment.

The dams are operated conjunctively to regulate streamflow and to supply water to users in Carmel Valley and the Monterey Peninsula via the Carmel Valley Filter Plant. No flood control storage is allocated in either reservoir, although some minor flood control benefits may be attributable to the dams early in the flood season, when storage space is available as a result of summer drawdown for water supply and instream flow releases. The dams have little effect on peak flows downstream later in the flood season, when the reservoirs are full.

Los Padres Dam is operated by Cal-Am to maintain as much water as possible in San Clemente Reservoir and to meet a streamflow requirement of 5 cfs below Los Padres Dam. San Clemente Dam is operated by Cal-Am in accordance with a Memorandum of Agreement (MOA) that is developed each year by Cal-Am, the District, and the California Department of Fish and Game (CDFG). The MOA is designed to maximize releases from San Clemente Reservoir to maintain rearing habitat for juvenile steelhead in the area downstream of San Clemente Dam.

Cal-Am and others produce water from the coastal area of the Seaside Ground Water Basin. The safe yield for Cal-Am production from this area is estimated at about 4,000 acre-feet per year. Production is maximized in dry years, and minimized in wet years to allow the basin to recharge.

(b) Water Quality – The quality of surface water in the upstream reaches of the Carmel River is considered good because the flow originates from an undeveloped, predominantly granitic watershed. The quality of the water in residence in Los Padres Reservoir can be seasonally low in dissolved oxygen. Small concentrations of dissolved hydrogen sulfide have also been detected near the bottom of the reservoir. This does not affect the suitability of the water for potable consumption, but can affect aquatic life in and below the reservoir. An aeration system installed by Cal-Am operates in the reservoir during summer months to reduce any deleterious water quality effects on aquatic life. No water quality problems have been detected downstream at San Clemente Reservoir, where an aeration system also operates seasonally.

The quality of groundwater in the Carmel Valley aquifer generally reflects that of the river in terms of relative concentration of the major inorganic constituents, but is somewhat more mineralized. This is due to the longer groundwater residence time, which allows for greater chemical dissolution of the aquifer sediments in contact with the groundwater. Groundwater pumped from the aquifer above the Narrows requires no special treatment prior to municipal use. Groundwater pumped from the aquifer down gradient from the Narrows requires minor treatment for excessive iron and manganese concentrations prior to municipal supply use. Ground water pumped from the Seaside Basin also needs similar treatment. Water from pumped from deeper strata in the Seaside basin may also need treatment for hydrogen sulfide and other constituents.

(c) Water Augmentation – Due to lack of an adequate supply for the community as well as the need to restore streamflow in the Carmel River, the District evaluated several dozen long-term water supply alternatives, including dams/reservoirs and different locations, desalination, water importation, additional ground water development, dredging existing reservoirs and others. These efforts are described in detail in the Desalination Project EIR as well as the long-term project EIR for the Monterey Peninsula Water Supply Project. In 1993, a 3 million gallon per day (MGD) desalination plant was brought before the electorate as an interim project, but was not approved. In 1995, state and federal permits for the 24,000 acre-foot New Los Padres Dam and Reservoir Project were obtained, but the project was also not approved by voters. District staff are presently implementing an Action Plan for Water Supply Alternatives (MPWMD, 1996) that focuses again on desalination, an injection/recovery project in the Seaside Basin, and a retrofit/rebate program in addition to ongoing efforts in wastewater reclamation, ground water developments, and other activities. The District Board has directed staff to preserve the viability of the state and federal permits for the New Los Padres Project.

4. Regulatory Setting

Over 80 percent of the water used on the Monterey Peninsula is derived from surface water from the Carmel River and from wells that pump groundwater directly associated with the river. These water sources are public resources controlled by the State of California. In its decisions on water rights, the State Water Resources Control Board (SWRCB) has a legal responsibility to protect

what state law defines as "public trust resources" of the Carmel River. These include the fish, wildlife habitat, recreational and aesthetic values of the river. The SWRCB is also required to strike a "reasonable" balance between municipal and domestic water needs (homes, businesses, industry) and the needs of "public trust resources."

Beginning in 1987, formal complaints were filed by the Carmel River Steelhead Association, Residents Water Committee, Sierra Club, and California Department of Parks & Recreation. The complaints allege that Cal-Am is illegally taking water from the Carmel River system without a water rights permit, and that Cal-Am is causing serious damage to "public trust resources."

The SWRCB agreed to delay action on the complaints against Cal-Am until they could be considered at the same time as the Water District's application for a water rights permit for the New Los Padres Water Supply Project. It was recognized that a premature decision upholding the complaints could have very serious consequences for the Monterey Peninsula if a long-term project that solved the problem was not clearly identified. Extensive testimony presented to the SWRCB in 1992 and 1994 showed that the proposed New Los Padres Water Supply Project would provide adequate water for both the community and the environment.

At hearings in 1992 and 1994 on Carmel River water rights issues, there was no disagreement that significant environmental damage on the Carmel River has already occurred. The steelhead fishery has been reduced to low levels, riverside vegetation has died, and erosion has destabilized the river channel. The amount of water taken from the river basin for delivery to Monterey Peninsula homes and businesses is an important factor contributing to this situation.

The SWRCB, in Order WR 95-10, determined that the water Cal-Am pumps in Carmel Valley is subject to the authority of the State. It determined that Cal-Am does not have a legal right to much of that water (10,730 AF or roughly 70 percent of community supply, based on average water production in the 1980s). It spells out measures that must be taken by Cal-Am to address the situation. These include a requirement that Cal-Am develop an urban and agricultural conservation plan to reduce water use. Starting in the water year beginning in October 1995, Cal-Am is limited to producing 11,990 acre-feet per year from the Carmel River basin. Starting in October 1996, this amount is further reduced to 11,285 acre-feet per year. In the meantime, Cal-Am must secure permits for its water use and address the adverse environmental impacts of pumping from the Carmel River basin. New water supply developed by Cal-Am outside of the Carmel River basin (except for water from the Seaside groundwater basin) must first offset pumping in Carmel Valley on a one-to-one basis before water can be made available for new connections. That is, for every acre-foot of new supply developed, there must be an equal reduction in pumping from the Carmel River basin until the entire 10,730 acre-feet are replaced.

The SWRCB notes that Cal-Am could obtain water rights in Carmel Valley by contracting with the Monterey Peninsula Water Management District for water from the proposed New Los Padres Project, building a similar dam, or developing an alternative project or set of projects. Cal-Am is presently developing a compliance plan that will advise the SWRCB the course of action Cal-Am intends to pursue to rectify this problem.

C. *Organization of Report*

The following sections review and evaluate the major program elements of the Five-Year Mitigation Program. They include hydrologic monitoring, steelhead resource, riparian habitat and lagoon habitat programs (Sections II through V). A summary of costs and recommendations for the next five years are also highlighted in Sections VIII and IX, respectively. In general, each section describes the problems that existed prior the beginning of the Five-Year Mitigation Program, the goals of each program, activities and projects in the 1991-1996 period (as well as pre-existing programs prior to 1991), a summary of costs, an evaluation of effectiveness, and conclusions and recommendations for the future.

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revised October 17, 1996

SECTION II

HYDROLOGIC MONITORING PROGRAM

II. HYDROLOGIC MONITORING PROGRAM

A. Adopted Goals

The 1990 Water Allocation Final EIR did not identify any direct, significant, adverse impacts to hydrologic resources. Rather, specific impacts were discussed in terms of water-dependent resources -- fisheries, riparian, lagoon and wetlands -- which are directly related to the Carmel River hydrologic system. The District Board recognized this linkage and indicated that hydrologic monitoring information is necessary to describe and evaluate impacts to the environment and to monitor the effectiveness of mitigation measures. Therefore, annual implementation of the Five-Year Mitigation Program included specific aspects of the Hydrologic Monitoring Program (HMP).

The HMP is an essential tool for understanding and managing all components of the Five-Year Mitigation Program because it provides basic hydrologic information (i.e., data on precipitation, recharge, runoff and water demand) that is integral to meeting the goals of that program and is generally not available from other sources. In addition to its use as a tool to evaluate the effectiveness of mitigation measures, the HMP also supports other District functions, such as augmenting the water supply and managing available water supplies. Therefore, implementation of the HMP would need to continue regardless of the status of the Mitigation Program. The HMP also allows the District to act as a clearinghouse for local hydrologic data so that the District can be responsive to the public and other agencies' requests for such information. With respect to the Five-Year Mitigation Program, the goal of the HMP can be described as follows:

- To provide basic hydrologic information for developing rational decisions regarding management of the Monterey Peninsula Water Resources System.

B. Description of Activities/Projects, July 1991 - June 1996

The HMP is divided into five hydrologic monitoring elements:

1. Streamflow Monitoring
2. Surface Water Quality Monitoring
3. Ground Water Quantity Monitoring
4. Ground Water Quality Monitoring
5. Weather Station/Flood Warning Monitoring

A description of activities and projects related to each of these HMP elements over the period covered in this report is presented below.

1. Streamflow Monitoring

Since its inception, the District has collected streamflow measurements at approximately 15 mainstem sites on the Carmel River and at 16 Carmel River tributary sites. Due to funding limitations and program modifications to improve efficiency, the District reduced the number of streamflow

measuring sites over time. Currently, the District maintains continuous recording streamflow gaging stations (gaging stations) at three mainstem and eight tributary sites within the Carmel River Basin (**Figure II-1**). In addition, the District collects instantaneous, monthly streamflow measurements on the Carmel River mainstem above Los Padres Reservoir, and on San Jose Creek, which is not a tributary to the Carmel River.

Prior to 1991, streamflow monitoring primarily consisted of instantaneous measurements made by the "current meter" method. Beginning in 1991, a concerted effort was undertaken to upgrade the streamflow monitoring network by gradually replacing instantaneous measurement sites (i.e. sites consisting of a staff gage only) with continuous measurement sites (i.e. sites that include continuous recorders). **Figure II-2** indicates the timing of these program improvements.

During the five-year period, the following gaging stations were installed within the Carmel River Basin:

TRIBUTARY	MAINSTEM
Cachagua Creek	Carmel River at Don Juan Bridge
Pine Creek	Carmel River at Highway 1 Bridge
San Clemente Creek	Carmel River at Sleepy Hollow Weir[1]
Tularcitos Creek	
Hitchcock Creek	
Garzas Creek	
Robinson Creek	
Potrero Creek	

In general, installation activities include: site selection, design, permit acquisition, execution of land owner agreements, budgeting, purchasing and gage installation. The reader is referred to the District Annual Reports of 1991 through 1995 for more specific information regarding the details and timing of improvements to the District's Streamflow Monitoring Program.

Ongoing streamflow monitoring activities fall into two general categories: Operation and Maintenance (O & M) of the gaging stations, and streamflow record processing. Each station is maintained and data processed in a manner consistent with all other stations. In general terms, O & M of the gaging stations include: collection of streamflow measurements on a monthly basis and during high flow periods, elevation surveying, data retrieval, and maintaining gage intakes and power supply. Streamflow record processing procedures include: streamflow measurement calculation, channel rating development, uploading continuous stage data into District office computers, computation of daily streamflow values using specialized software, and management of data and files.

[1]The Carmel River at Sleepy Hollow Weir gaging station was installed in 1989 and has been operated and maintained since that time.

Figur -1

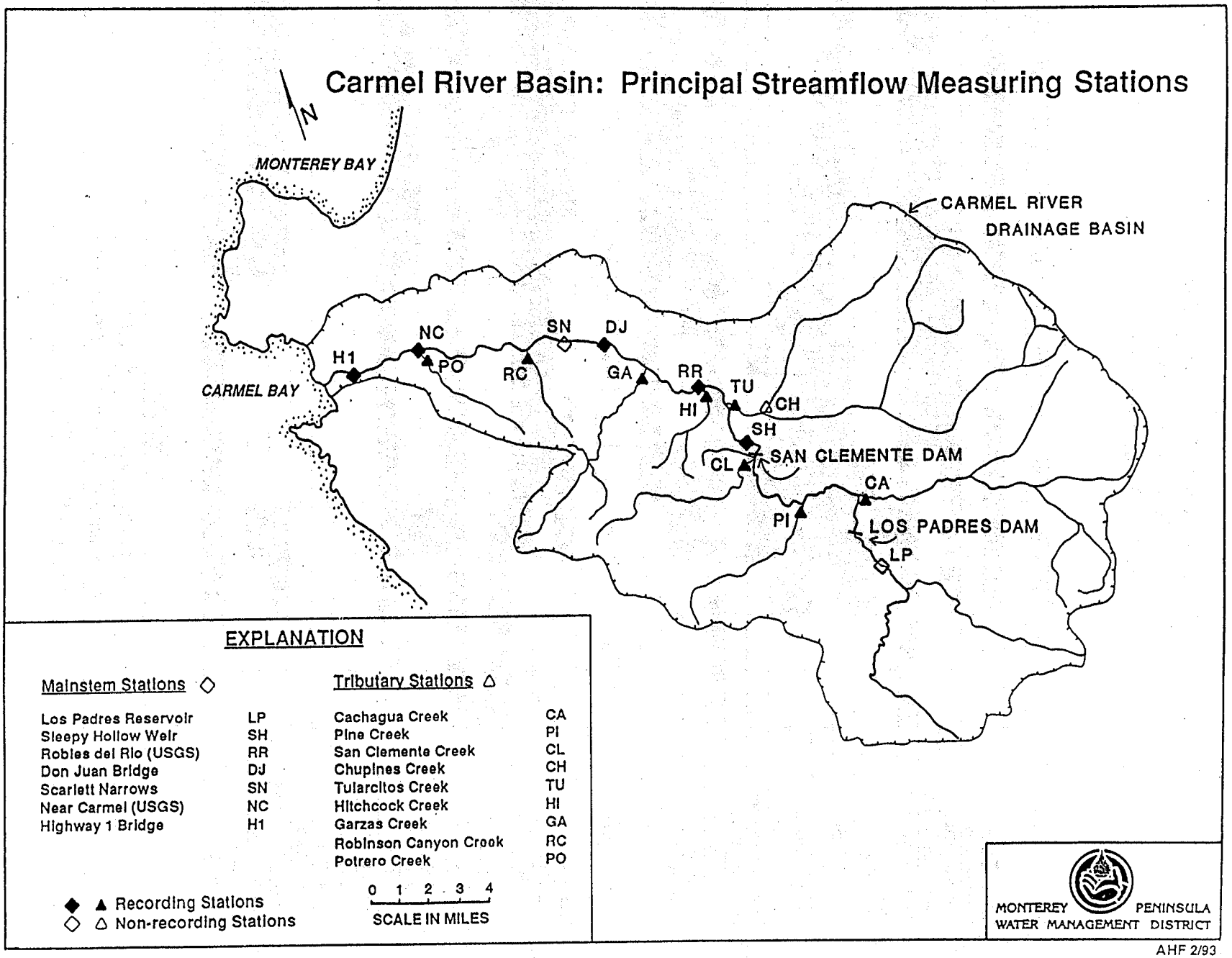
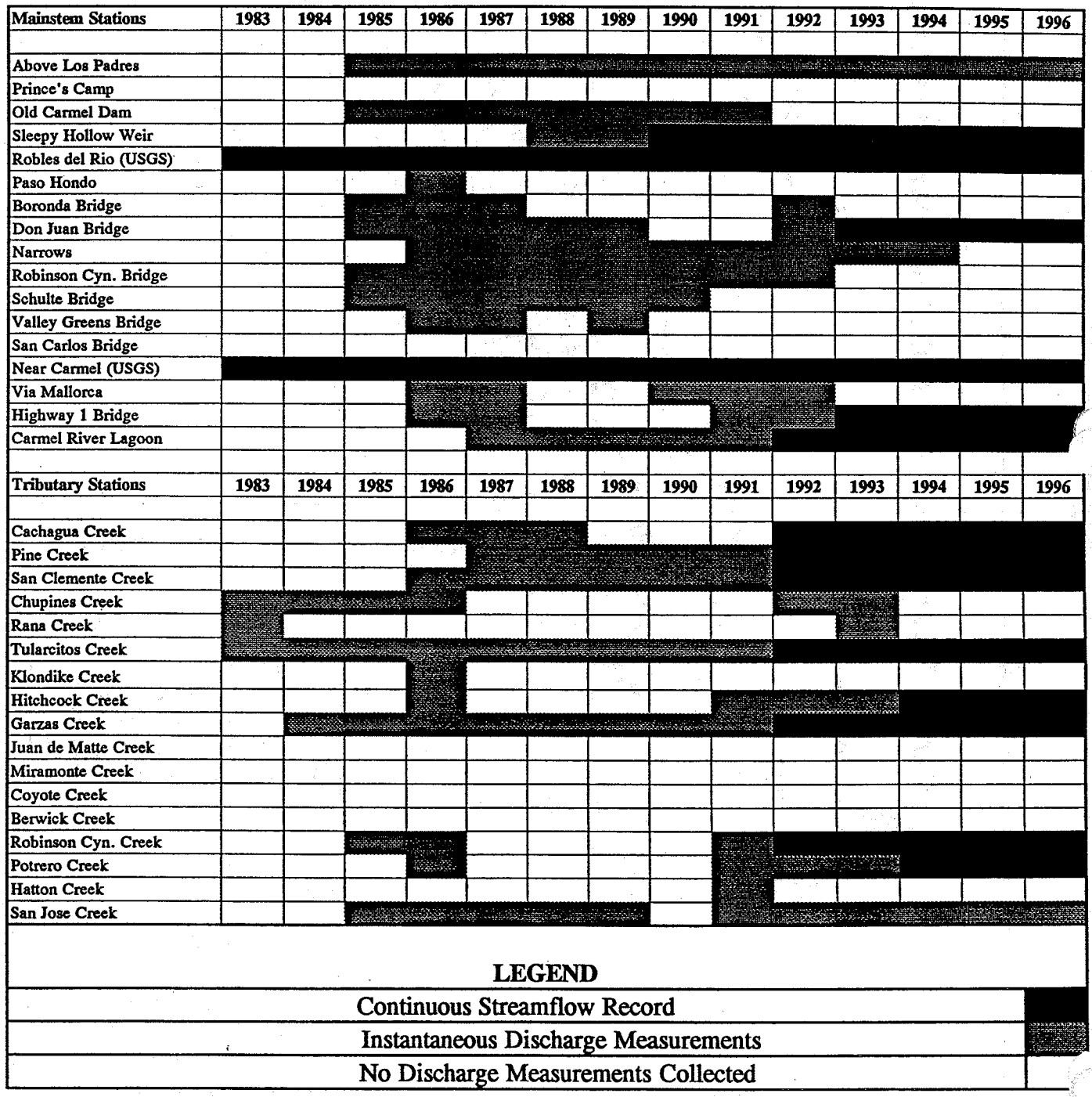

Carmel River Basin: Principal Streamflow Measuring Stations
N
MONTEREY BAY
CARMEL RIVER
DRAINAGE BASIN
CARMEL BAY
H1
NC
PO
RC
SN
DJ
GA
RR
HI
TU
CH
SH
SAN CLEMENTE DAM
CL
CA
PI
LOS PADRES DAM
LP
EXPLANATION
Mainstem Stations ◇
Los Padres Reservoir LP
Sleepy Hollow Weir SH
Robles del Rio (USGS) RR
Don Juan Bridge DJ
Scarlett Narrows SN
Near Carmel (USGS) NC
Highway 1 Bridge H1
Tributary Stations △
Cachagua Creek CA
Pine Creek PI
San Clemente Creek CL
Chupines Creek CH
Tularcitos Creek TU
Hitchcock Creek HI
Garzas Creek GA
Robinson Canyon Creek RC
Potrero Creek PO
◆ ▲ Recording Stations
◇ △ Non-recording Stations
0 1 2 3 4
SCALE IN MILES
MONTEREY PENINSULA
WATER MANAGEMENT DISTRICT
AHF 2/93

Figure II-2

Streamflow Data Collection Activity
Carmel River Basin
Water Years 1983 - 1996



Field and office techniques used by District staff to produce continuous streamflow records are consistent with methods utilized by the United States Geological Survey (USGS). In addition, the computer software program[2] that the District uses to compute its streamflow records, is based on USGS methods.

2. *Surface Water Quality Monitoring*

The District's surface water quality monitoring primarily involves measuring of four parameters -- dissolved oxygen (DO), carbon dioxide (CO_2), temperature, and specific conductance -- that are general indicators of the ability of a water body to sustain a viable population of steelhead. District staff has measured these indicator parameters at three locations along the Carmel River at least twice a year since March 1988. In upstream to downstream order, the locations are:

(1) below Los Padres Reservoir near the dam outlet
(2) below San Clemente Reservoir near the Sleepy Hollow weir
(3) at the Carmel River Lagoon.

Beginning in February 1992, staff began monitoring the above parameters at these stations twice a month. Other parameters, including pH, color, odor, turbidity, ammonia nitrogen, nitrate nitrogen, sodium, alkalinity, and hardness, are periodically sampled. When conditions warrant, such as when the volume of water in the lagoon is depleted in late summer, sampling frequency typically increases to weekly, and more lagoon sites are sampled to better understand variations in water chemistry throughout the lagoon.

Figure II-3 is shown as an example of surface water quality data collected by the District. The graphs show fluctuations in temperature and DO in the lagoon from 1992 through 1995. In winter and spring months, when the river is flowing to the lagoon, temperatures and DO concentrations generally remain at levels sufficient for steelhead survival (i.e. generally below 70 degrees Fahrenheit and DO above about 6 milligrams per liter, respectively). When the mouth of the river is closed and freshwater inflows cease, however, conditions for steelhead rapidly deteriorate. Warm, shallow conditions experienced in the summer and fall stimulate algal blooms that contribute to low DO concentrations in the lagoon. Monitoring these conditions allows District staff to coordinate rescues, thereby preventing potentially devastating fish kills.

3. *Ground Water Quantity Monitoring*

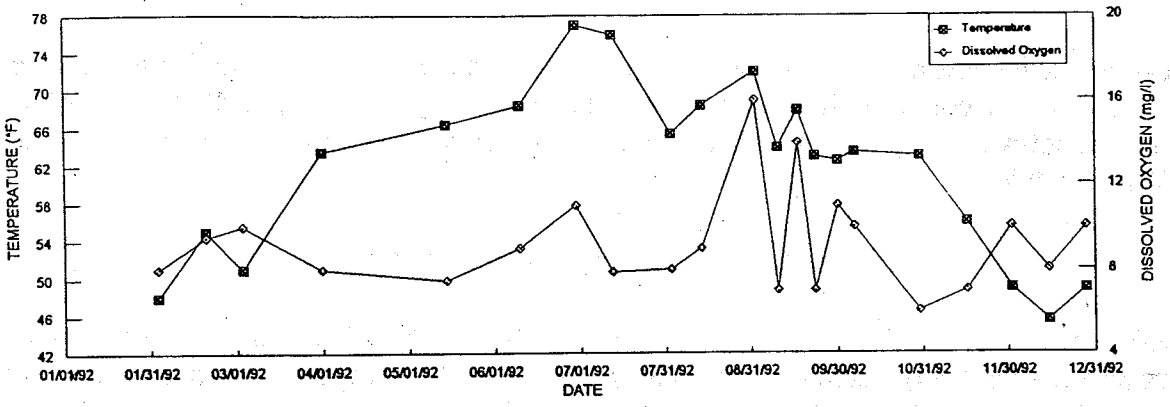
The District's monitoring of ground water quantity is divided into two aspects -- storage and production. Monitoring the quantity of ground water in storage consists of defining the boundaries, characteristics and capacities of aquifers, and then measuring drawdown and recharge in monitor wells to track the amount of storage changes in the aquifers. The District monitors

[2]Program is titled "Western Hydrologic Systems: Computation of Surface Water Records;" Auburn, California.

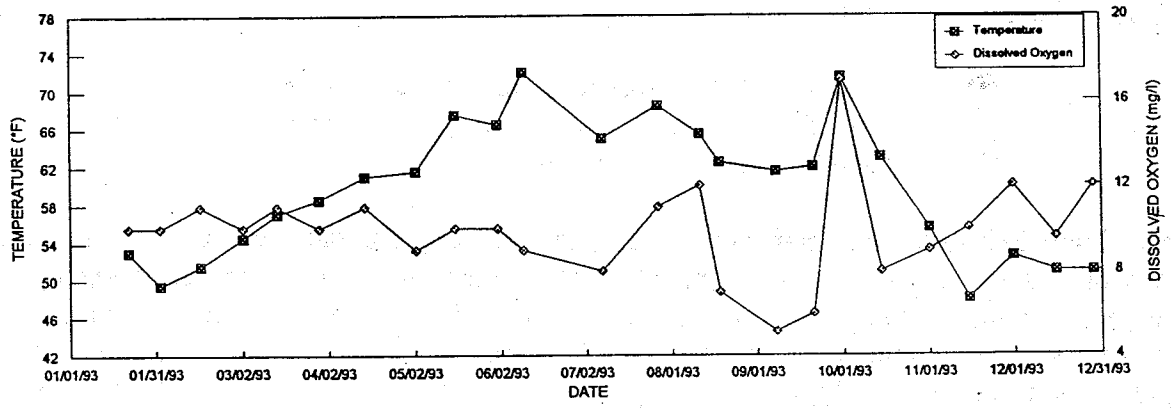
Fluctuations in Carmel River Lagoon Water Quality

FIGURE II-3

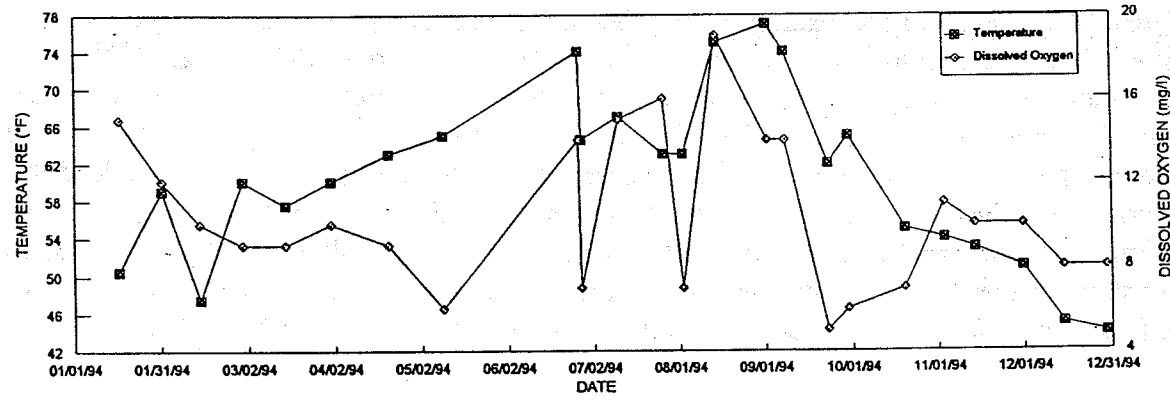
LAGOON 1992



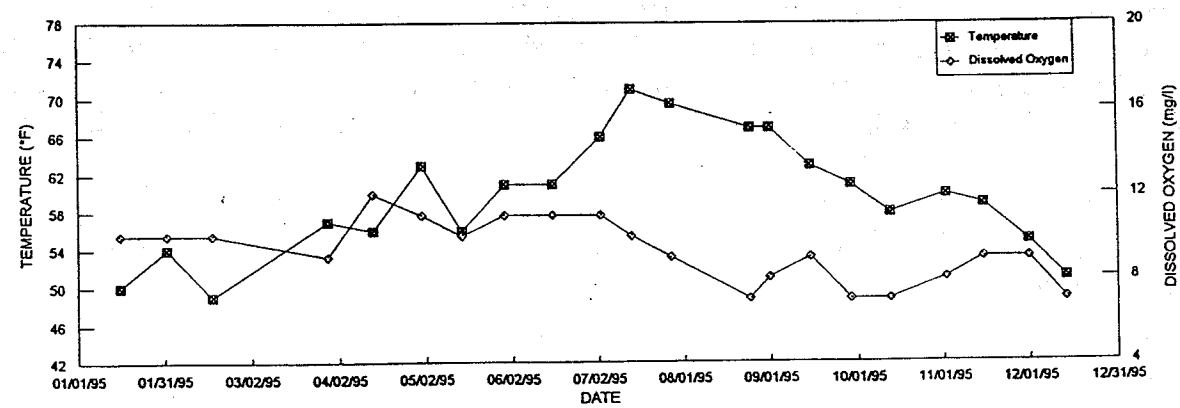
LAGOON 1993



LAGOON 1994



LAGOON 1995



ground water storage in two ground water basins: the Carmel Valley alluvial aquifer, and the coastal subbasins of the Seaside Ground Water Basin. These subsurface storage basins, along with surface water in the Carmel River system, collectively comprise the Monterey Peninsula Water Resource System (MPWRS).

Monitoring ground water production involves tracking the volume of water drawn from each ground water source in the District. This is accomplished by requiring annual reporting of the amount of water produced from all wells within the District, and maintaining monthly water meter readings for the larger production wells (i.e. wells producing over 20 AF/year). In addition to supporting the Five-Year Mitigation Program, production monitoring is an analytical tool, helps resolve water rights quantification issues, and enables the District to more effectively manage the water resources of the Monterey Peninsula area.

Each of these aspects of ground water quantity monitoring is described in more detail below.

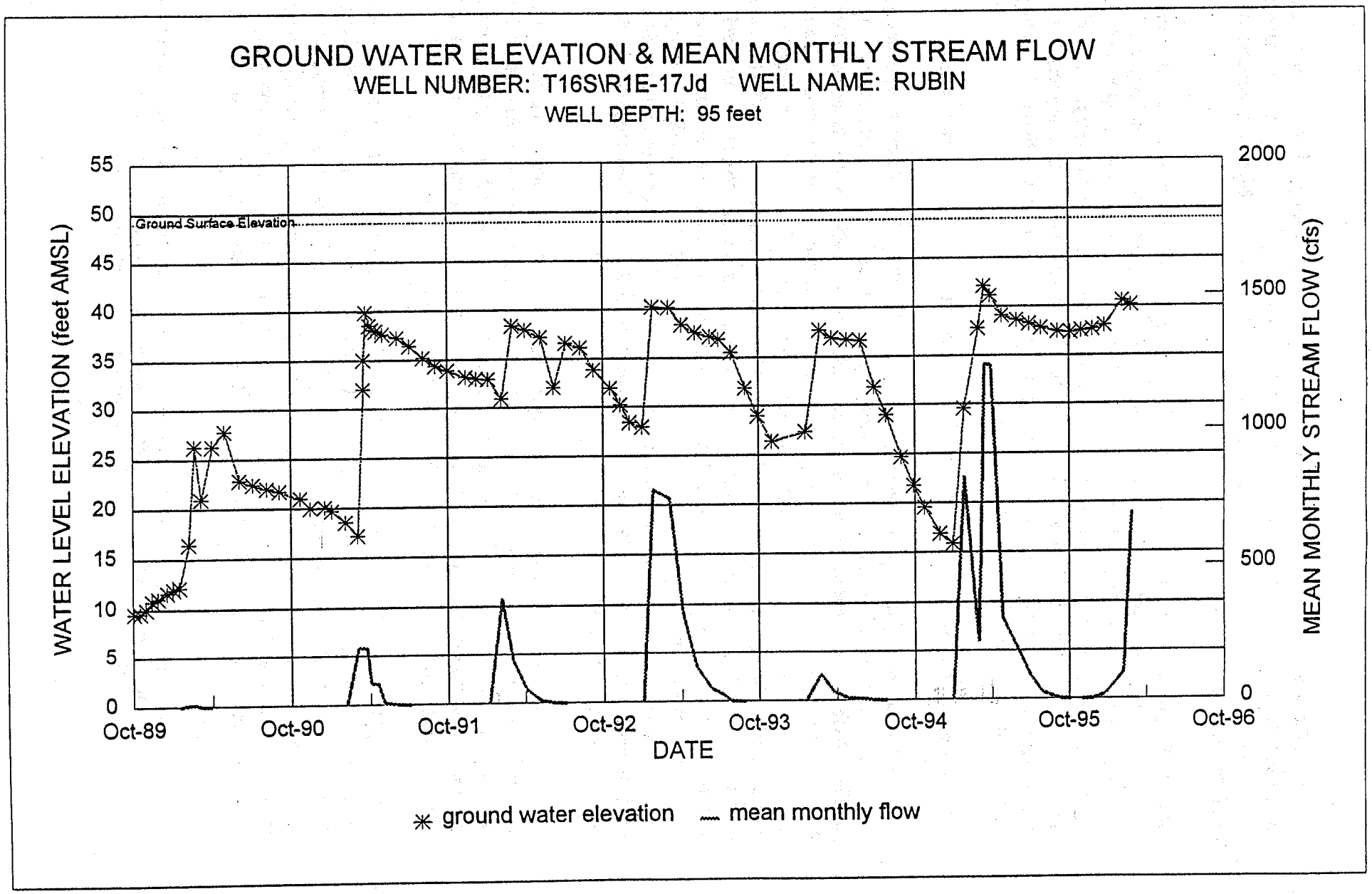
(a) Ground Water Quantity: Storage Monitoring -- Monthly, District staff monitors ground water levels in about 50 wells in Carmel Valley and 10 wells in the Seaside coastal subbasin. Another 12 wells are monitored once per quarter. Most of the wells are dedicated monitor wells that are also used for sampling water quality, and a few are private production wells. The spatial distribution of the wells allows staff to quantify the volume of water in the Seaside coastal subbasin and in the four "sub-units" of the Carmel Valley alluvial aquifer. In an effort to optimize the distribution of monitor wells and reduce areas of inadequate well control, several wells have been added or deleted from the District's network of monitoring sites. For instance, an array of nine water quality monitoring wells were installed in 1989 for a detailed hydrogeologic investigation near the mouth of the Carmel River where monitor well control was lacking. The monitor well data provided an opportunity to better understand the hydrogeology of the most seaward sub-unit of the aquifer.

In 1994, the Monterey County Water Resources Agency curtailed monitoring of 13 wells in Carmel Valley due to budget constraints. Four of those wells have been integrated into the District's monitor well network to maintain continuity of the long-term record for those wells. At times, certain wells are monitored more frequently to track the response of ground water to recharge events (storms) or drawdown during aquifer tests.

As an example of the utility of this type of data collection, **Figure II-4** is a hydrograph showing fluctuations in one monitor well for the period from October 1989 through February 1996 compared with mean monthly streamflow in the Carmel River.[3] This well is located at a point approximately 3.5 miles from the river mouth, about 60 feet from the river channel, adjacent to the USGS "Near Carmel" stream gaging station. The nearest Cal-Am production well, the San Carlos well, is located about 750 feet upstream of this monitor well. The graph shows that ground

[3]Streamflow data on the graph for the period from October 1989 through September 1994 is from the USGS Near Carmel gage. Mean monthly records from October 1994 through February 1996 are from the MPWMD Highway 1 gage because USGS data are not yet available for this period.

Figure II-4


GROUND WATER ELEVATION & MEAN MONTHLY STREAM FLOW
WELL NUMBER: T16S\R1E-17Jd WELL NAME: RUBIN
WELL DEPTH: 95 feet
WATER LEVEL ELEVATION (feet AMSL)
MEAN MONTHLY STREAM FLOW (cfs)
Ground Surface Elevation
55
50
45
40
35
30
25
20
15
10
5
0
2000
1500
1000
500
0
Oct-89
Oct-90
Oct-91
Oct-92
Oct-93
Oct-94
Oct-95
Oct-96
DATE
ground water elevation
mean monthly flow

water levels experience dramatic rises whenever surface flow reaches this area. For example, in early 1995, following a period of steady water level decline that began in mid-1994, the water level in the well recovered to an historic high observation of 42 feet above sea level, an increase of over 26 feet within 75 days. During the middle of the drought, in October 1989, the ground water elevation here was less than 10 feet above sea level.

(b) Ground Water Quantity: Production Monitoring -- Since 1980, all owners of water wells within the District have been required to register and report the amount of water annually produced by their wells. The Reporting Year runs from July 1 through June 30. The results of this program for Reporting Year 1987 were used as baseline values for analysis in the Water Allocation Program Final EIR. District Ordinance No. 48 was adopted in 1990, requiring all owners of large wells (i.e., those producing 20 or more acre-feet per year) to install water meters. In 1991, the District Board adopted Ordinance No. 56, requiring all medium wells (i.e., those producing between five and 20 acre-feet of water per year) to be equipped with water meters to more accurately quantify the amount being produced from wells. As a result, over 98 percent of all water production reported in the District in Reporting Year 1995 was metered. In addition, 93 percent of non-Cal-Am ground water production was metered in Reporting Year 1995, as opposed to 79 percent in Reporting Year 1991.

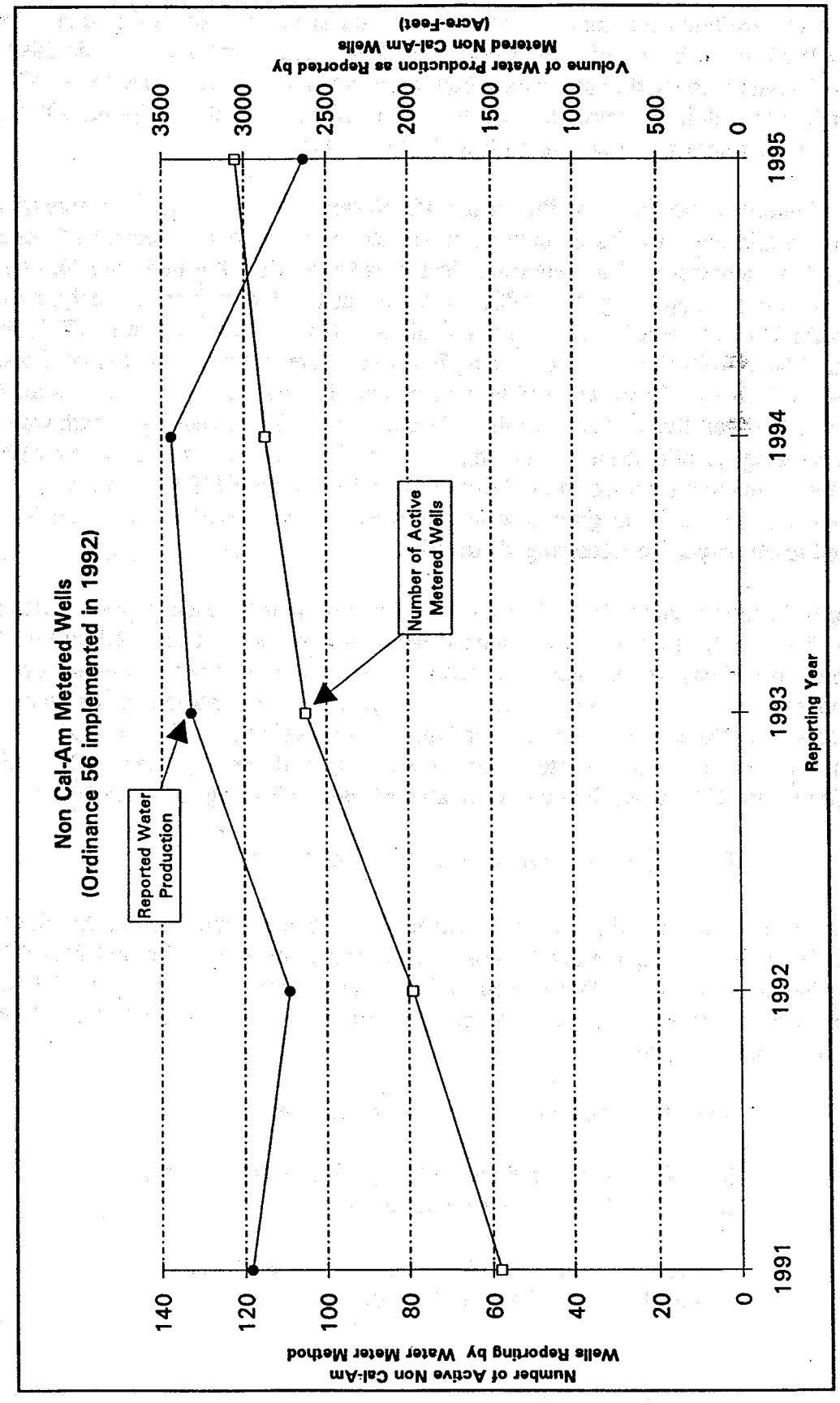
Figure II-5 shows a comparison of metered non Cal-Am wells for each year since Reporting Year 1991. The graph shows that while annual well water production reported by the water meter reporting method has been variable, the number of wells reporting production by the water meter method has steadily increased in the last five years. The variation in the amount of water production reported is in part related to the type of hydrologic year. For example, the significant decline in the volume of reported water production in Reporting Year 1995 as compared to Reporting Year 1994 is attributed to decreased demand following a wet winter.

4. Ground Water Quality Monitoring

As previously discussed, there are two primary sources of ground water within the District: the Carmel Valley alluvial aquifer and the coastal subbasins of the Seaside Ground Water Basin. Each source has unique features that demand diligent monitoring to prevent potential water quality problems from becoming unmanageable. The purposes of the District's ground water quality monitoring activities are to:

- characterize the quality of water in the aquifers,
- detect contamination from septic systems or other sources in the shallow zones of the Carmel Valley alluvial aquifer, and
- monitor sea water intrusion potential in the coastal portions of both the Carmel Valley alluvial aquifer and the Seaside Basin.

Figure II-5


Non Cal-Am Metered Wells
(Ordinance 56 implemented in 1992)
Reported Water Production
Number of Active Metered Wells
Number of Active Non Cal-Am Wells Reporting by Water Meter Method
Volume of Water Production as Reported by Metered Non Cal-Am Wells (Acre-Feet)
Reporting Year
0
20
40
60
80
100
120
140
0
500
1000
1500
2000
2500
3000
3500
1991
1992
1993
1994
1995

Since 1981, ground water quality monitoring activities have been conducted cooperatively between the District, Cal-Am, the Monterey County Water Resources Agency (MCWRA), and the Monterey County Health Department. Water samples are currently collected by the District and are analyzed at the Monterey County Consolidated Chemistry Laboratory in Salinas. Cal-Am also conducts an extensive water quality monitoring program of its water supply sources.

The District has been monitoring ground water quality in Carmel Valley since 1981. Currently, 23 monitor wells in Carmel Valley are sampled semi-annually. Results indicate that ground water in Carmel Valley is significantly below the State drinking water standard for nitrate, which is a key indicator parameter for potential contamination sources, such as septic system effluent. The highly permeable nature of the alluvial aquifer, and the flushing effect of rain and infiltrating surface water have prevented any long-term build-up of contaminants.

The water quality monitoring program in the Seaside Basin began in 1990 and currently includes six monitor wells in the coastal area that are sampled semi-annually. The Seaside Basin wells were installed for specific hydrogeologic investigations, and now serve as monitors of the long-term water quality trends in this basin. Very little change in water quality has occurred since sampling began, and there is no indication of sea water intrusion in the coastal area at this time. Water quality data collected from both Seaside and Carmel Valley are used to detect and prevent problems before they affect the community's water supply.

5. Weather Station/Flood Warning Monitoring

The District's effort to monitor weather and potential flooding is divided into two categories -- District Weather Stations and the ALERT Station. ALERT is an acronym for "Automated Local Evaluation in Real Time". During the period covered in this report, the District operated three continuous recording weather stations located at the following sites:

- Lower Carmel Valley (Carmel Middle School)
- Garland Ranch Park
- Rancho San Carlos.

These stations provide data on precipitation, solar radiation, temperature, humidity, vapor pressure deficit and wind speed. From these parameters, staff calculates reference evapotranspiration to evaluate scheduling and efficiency of irrigation systems. A monthly summary of data from the Lower Carmel Valley station is presented in **Table II-1** as an example of information obtained from District Weather Stations. **Figure II-6** shows a comparison of monthly rainfall records from each of the three stations for one year.

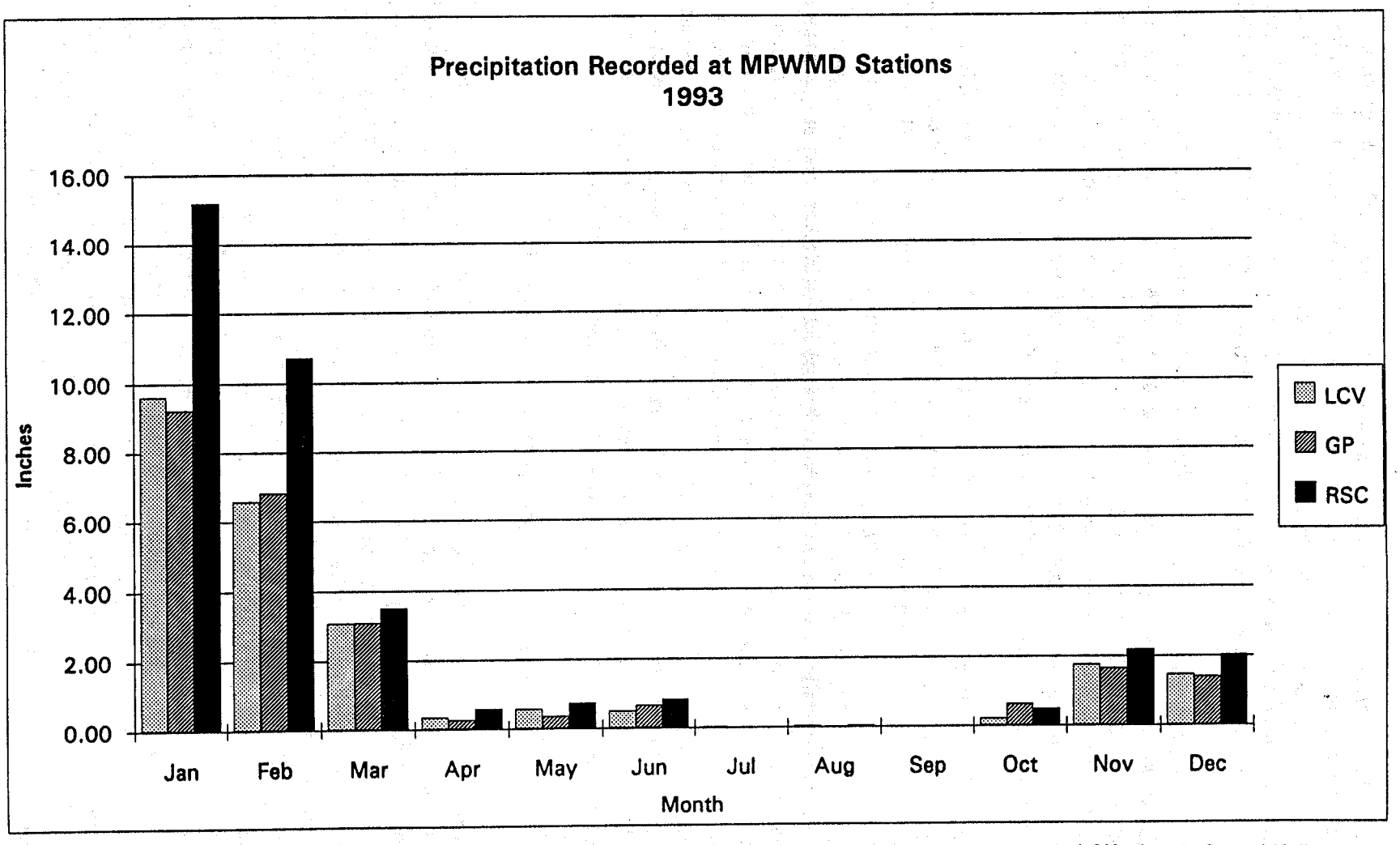
The Lower Carmel Valley station was originally installed in 1984 to assist in scheduling and evaluation of the District's riparian corridor irrigation surrounding the four major Cal-Am wells in the lower Carmel Valley (i.e. aquifer sub-units 3 and 4). The Garland Ranch Park station was added in 1989 to provide data more specific to the riparian corridor farther inland (i.e. aquifer sub-units 1 and 2). Also in 1989, a station was established at Rancho San Carlos. This station

Table II-1

SUMMARY OF WEATHER DATA - LOWER CARMEL VALLEY WEATHER STATION
Monterey Peninsula Water Management District
November 1993

	Radiation (watts/m²)		Air temperature (deg.C)			Relative humidity (%)			Mean vapor pres. def.	Mean wind speed	Ref. ET	Total precip.
date	solar	net	max.	min.	avg.	max.	min.	avg.	(kPa)	(m/s)	(in)	(in)
11- 1	166	80	26.7	9.1	15.9	92	27	64	0.82	2.9	0.17	0.00
11- 2	169	81	28.0	10.3	16.6	60	18	44	1.23	3.1	0.22	0.00
11- 3	164	78	29.3	6.3	15.6	77	12	46	1.14	2.8	0.20	0.00
11- 4	161	76	25.4	5.0	13.4	92	24	65	0.67	2.3	0.14	0.00
11- 5	158	74	23.5	8.2	13.2	93	27	66	0.58	2.7	0.13	0.00
11- 6	155	71	21.1	5.0	12.3	95	30	70	0.45	2.4	0.11	0.00
11- 7	155	71	22.4	5.7	12.1	93	37	72	0.48	2.5	0.12	0.00
11- 8	145	65	20.1	2.8	11.0	93	53	80	0.28	2.2	0.08	0.00
11- 9	140	63	16.9	4.1	10.9	93	75	86	0.20	2.2	0.07	0.00
11-10	101	45	19.6	7.4	12.7	95	62	84	0.28	1.9	0.06	0.87
11-11	67	29	16.2	7.4	11.2	95	80	90	0.15	1.9	0.04	0.32
11-12	141	61	16.9	6.0	10.4	95	61	85	0.23	2.1	0.07	0.36
11-13	149	64	19.2	4.5	10.2	95	35	79	0.38	2.6	0.10	0.00
11-14	150	64	18.9	4.4	11.5	93	19	43	0.89	2.8	0.17	0.00
11-15	150	64	21.2	2.4	9.5	71	15	52	0.72	2.9	0.16	0.00
11-16	131	55	18.3	2.0	9.2	93	39	73	0.37	2.4	0.09	0.00
11-17	90	38	16.8	4.6	10.2	91	64	82	0.26	2.3	0.06	0.00
11-18	134	56	19.7	8.0	12.1	93	57	86	0.33	2.5	0.09	0.00
11-19	142	59	22.2	5.8	12.4	93	38	70	0.53	3.0	0.12	0.00
11-20	115	47	23.3	6.5	11.9	87	25	64	0.61	2.7	0.12	0.00
11-21	41	17	17.1	6.3	11.3	92	48	75	0.34	1.9	0.05	0.00
11-22	84	34	19.1	3.9	11.7	95	70	89	0.17	2.0	0.05	0.00
11-23	139	57	15.0	2.6	7.4	96	38	72	0.37	2.8	0.10	0.00
11-24	139	56	18.2	0.3	7.6	70	17	45	0.71	3.5	0.17	0.00
11-25	135	54	17.5	0.3	8.1	86	24	60	0.48	2.2	0.10	0.00
11-26	129	52	21.0	4.1	10.6	75	21	51	0.72	2.9	0.14	0.00
11-27	53	21	20.9	8.1	12.8	62	19	45	0.85	2.2	0.11	0.00
11-28	95	38	21.1	6.2	14.1	93	39	71	0.45	2.2	0.08	0.02
11-29	100	39	22.8	9.1	13.7	94	55	87	0.25	2.9	0.07	0.20
11-30	101	40	17.5	6.0	12.2	94	65	84	0.25	2.3	0.06	0.00
Avg.	127	55	20.5	5.4	11.7	88	40	69	0.50	2.5	0.11	
Total Monthly Rainfall:												1.77

Figure II-6



LCV: Lower Carmel Valley
GP: Garland Ranch Park
RSC: Rancho San Carlos

was installed to provide data from higher elevations in the watershed. The owners of Rancho San Carlos and the District entered into an agreement that staff would maintain the station for a period of five years. Accordingly, the Rancho San Carlos station was dismantled in 1995. In place of this station, the District now has real-time access to a more reliable precipitation gage on White Rock Ridge, above Rancho San Carlos (see the following description of the ALERT system).

ALERT is a program of the National Weather Service (NWS). In 1989, the District purchased an ALERT system consisting of a personal computer, NWS software, a receiver decoder and an antennae. The ALERT base station at the District offices in Monterey receives rainfall and water level data from remote transmitting units located at various sites within the Carmel River basin. Data is transmitted in real-time, that is, as it is actually happening. This allows evaluation of meteorologic and hydrologic conditions from an office setting.

Through a cooperative agreement with the District, the MCWRA is responsible for maintenance of the ALERT stage and precipitation gages located in the field. This cost-share program was begun in 1992 and continues at an annual cost to the District of $3,000. Following the 1995 Carmel River floods, five additional sensors were installed at the following gage sites: San Clemente Dam, Robles del Rio, Near Carmel, Highway 1 Bridge and the lagoon. The ALERT sensors were installed by the MCWRA with District assistance, and are in response to local citizens' requests to provide improved flood warning along the river. Currently, stations included in the District's ALERT system network are eight precipitation sensors and four Carmel River stage sensors. The data supports a variety of District activities including steelhead resource mitigations (Section III), erosion control (Section IV-B), and hydrologic monitoring. This information is particularly useful to schedule specific field tasks during storm events. In addition, the ALERT system provides a source of public information during storm events. As an example, some data are disseminated over the District's Erosion Potential Hotline.

C. Summary of Expenditures, 1991-1996

Because the HMP was not specifically addressed in the Five-Year Mitigation Plan, a discussion of the amount of funds spent for the HMP and assigned to the Mitigation Program is problematic. Various activities that comprise the HMP, as described in Section II-B, are required to carry out other District functions such as managing available water supplies, new water project planning, and water supply modeling. Nonetheless, attempts have been made to account for the portion of HMP expenditures that were directly attributable to the Mitigation Program over the five-year period. The HMP costs for the Mitigation Program are provided in **Table II-2**. The table indicates that about 93 percent (roughly $337,000) of the $363,000 program total is for personnel costs. The majority of those costs are for data collection services performed by the District's Water Resources Division, and includes staff's total compensation and overhead. Unlike other Mitigation Program activities (i.e., Steelhead, Riparian and Lagoon) no cost estimate for the HMP was made in 1990. Also, for the first two years of the five-year period, no hydrologic data collection services were attributed to the Mitigation Program, although many of the activities described were being conducted during these years. This occurred because the HMP was not initially recognized as a separate component of the Mitigation Program. Because accurate hydrologic data is the cornerstone of effective management

Table II - 2

Hydrologic Monitoring Program Expenditures 1991-1996

Expense Category	1/1/91-12/31/91	1/1/92-12/31/92	1/1/93-12/31/93	1/1/94-6/30/95	7/1/95-6/30/96	Total for 1/1/91-6/30/96
Personnel	$0	$0	$57,247	$166,674	$112,858	$336,779
Projects	$0	$0	$5,180	$6,708	$8,822	$20,711
Fixed Assets	$0	$0	$0	$5,177	$0	$5,177
Program Total	**$0**	**$0**	**$62,427**	**$178,559**	**$121,680**	**$362,667**

Note: In 1991 and 1992 no hydrologic data collection services were attributed to the Mitigation Program, although many of the activities described were being conducted during those years.

of water resources, a hydrologic monitoring program would be in place even if there were no Mitigation Program.

D. Program Effectiveness

The various aspects of the HMP can be evaluated in terms of their application to the Five-Year Mitigation Program. With few exceptions (i.e., monitoring surface flows and water quality in the lagoon, and collection of weather, streamflow and ground water levels that affect riparian resources), the activities of the HMP are not specifically described in the 1990 Five-Year Mitigation Plan. However, the HMP supplies empirical data that are not available from other sources, and in many instances are necessary for the implementation of the Five-Year Mitigation Program. The effectiveness of the individual categories of hydrologic monitoring undertaken by the District are evaluated below.

1. Streamflow Monitoring

- ***Were the District's streamflow activities an effective source of useful information for the Mitigation Program?***

District Streamflow Monitoring activities have provided useful information that supports a number of District functions, including implementation of the Five-Year Mitigation Program. The effectiveness of the Streamflow Monitoring activities can be assessed by examining the data produced in terms of usefulness, cost, availability, and quality.

(a) Uses of the continuous streamflow data -- The uses of streamflow data include but are not limited to the items listed below:

- Defining the general hydrologic conditions in the basin
- Setting flow requirements for meeting aquatic life goals
- Monitoring compliance with minimum flow requirements
- Assessing and scheduling fish rescue activities
- Assessing effectiveness of riparian mitigations
- Evaluating surface and ground water interaction
- Developing and calibrating hydrologic models
- Delineating and managing floodplains

- Evaluating and designing water supply projects
- Providing data for forecasting floods and defining flood recurrence intervals
- Assessing hydrologic impacts from water development projects.

Prior to 1991, streamflow data collected by the District was mostly limited to staff gage readings and instantaneous discharge measurements. The usefulness of this mode of data collection is limited as streamflow conditions between these spot measurements cannot be accurately determined. In 1991, the District hired a hydrologist with formal USGS training in streamflow monitoring to assess and upgrade the District's streamflow monitoring network. The resulting production of continuous streamflow records at 11 sites within the Carmel River Basin has been conducted in a cost effective manner, and these records have directly supported the Five-Year Mitigation Program efforts. **Table II-3** (following page) is an example of a continuous streamflow record which indicates the mean daily flows at the "Carmel River at Don Juan Bridge" gaging station for Water Year 1995. **Table II-4** below illustrates the use of continuous streamflow records to determine relative contributions of flow from major tributaries into the Carmel River.

Table II-4
Carmel River Basin
Major Tributary Inflow to the Carmel River
(Values in Acre-Feet)

TRIBUTARY	DRAINAGE AREA	WY 1992	WY 1993	WY 1994	WY 1995	TOTAL WY 1992 - 1995	TRIBUTARY FLOW AS PERCENTAGE OF NR CARMEL
SAN CLEMENTE CR.	15.6 mi.²	5450	17070	1820	20580	44920	13.0 %
GARZAS CREEK	13.2 mi.²	3700	11170	746	12140	27756	8.1 %
CACHAGUA CREEK	46.3 mi.²	1780	7340	560	16290	25970	7.5 %
PINE CREEK	7.8 mi.²	3750	9800	1230	11110	25890	7.5 %
TULARCITOS CR.	56.3 mi.²	635	3220	444	5100	9399	2.7 %
ROBINSON CREEK	5.4 mi.²	619	2360	89	2230	5298	1.5 %
HITCHCOCK CREEK	4.6 mi.²	*	*	52	1820	1872	1.0 %
POTRERO CREEK	5.2 mi.²	*	*	30	1790	1820	1.0 %
CARMEL RIVER NEAR CARMEL	246 mi.²	35570	123400	8200	177400	344570	

Note: Continuous streamflow data for Hitchcock and Potrero Creeks are not available (*) for Water Years 1992 and 1993. Flow percentages shown for these tributaries are based only on Water Years 1994 and 1995.

TABLE II-3

Continuous Streamflow Record at Don Juan Bridge Station, WY 1995

MONTEREY PENINSULA WATER MANAGEMENT DISTRICT
Carmel River at Don Juan Bridge

Gage located on Don Juan Bridge at Garland Park

DAILY DISCHARGE IN CUBIC FEET PER SECOND WATER YEAR OCT 1994 TO SEP 1995

Day	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.1	1.3	1.9	2.6	462	103	558	281	97	43	14	7.8
2	1.2	1.1	2.0	2.6	401	103	496	242	97	42	14	7.8
3	1.2	1.1	2.1	3.0	354	141	455	216	98	42	14	7.8
4	1.3	1.3	2.1	7.5	315	154	416	198	97	41	13	7.9
5	1.4	.95	2.2	104	285	177	385	190	93	40	12	8.4
6	1.3	.96	2.3	149	262	176	358	196	89	37	12	8.2
7	1.2	1.1	2.4	275	245	159	337	182	86	34	12	8.1
8	1.2	1.2	2.4	280	235	148	324	170	84	34	12	8.1
9	1.2	1.3	2.5	1,020	221	782	299	163	81	32	11	8.1
10	1.3	1.3	2.6	6,100	201	7,630e	282	161	78	30	11	8.2
11	1.3	1.2	2.6	2,160	188	4,960	267	155	77	29	10	8.7
12	1.2	1.3	2.7	1,040	176	2,400	254	150	75	28	10	9.3
13	1.2	1.3	2.7	754	170	1,660	258	179	73	27	9.4	9.3
14	1.2	1.2	2.7	890	220	1,280	245	197	72	25	8.8	9.6
15	1.1	1.3	2.7	1,300	187	1,020	236	210	75	24	8.6	10
16	1.1	1.3	2.7	1,150	171	861	250	199	105	23	8.5	10
17	1.1	1.3	2.7	837	163	736	228	184	98	23	8.4	9.8
18	1.0	1.3	2.6	648	155	638	226	172	82	23	8.9	11
19	1.0	1.3	2.5	518	149	568	212	162	77	23	8.8	10
20	1.0	1.4	2.3	523	142	574	201	154	71	22	9.0	9.1
21	1.0	1.5	2.3	641	135	710	183	148	67	22	9.6	9.3
22	.92	1.5	2.4	591	129	1,300	177	144	64	21	9.7	9.4
23	.94	1.5	2.4	963	123	2,460	168	141	60	20	9.4	9.4
24	.91	1.5	2.8	1,910	118	1,620	162	133	56	20	9.3	9.3
25	.94	1.7	2.8	1,680	115	1,280	156	131	51	20	9.1	9.3
26	1.0	1.9	2.8	1,140	112	1,080	150	123	51	19	8.6	9.4
27	1.1	1.8	2.7	903	107	946	152	117	48	18	8.6	9.3
28	1.2	1.8	2.8	858	105	840	171	111	46	17	8.7	9.4
29	1.2	1.9	2.7	708	------	746	183	108	48	15	8.3	9.4
30	1.2	1.9	2.7	608	------	666	358	103	47	15	7.7	8.9
31	1.1	------	2.5	528	------	602	------	98	------	15	7.8	------
TOTAL	35.11	41.51	77.6	28,293.7	5,646	36,520	8,147	5,118	2,243	824	312.2	270.3
MEAN	1.13	1.38	2.50	913	202	1,178	272	165	74.8	26.6	10.1	9.01
MAX	1.4	1.9	2.8	6,100	462	7,630	558	281	105	43	14	11
MIN	.91	.95	1.9	2.6	105	103	150	98	46	15	7.7	7.8
AC-FT	70	82	154	56,120	11,200	72,440	16,160	10,150	4,450	1,630	619	536

CAL YEAR 1994	TOTAL	6,201.36	MEAN	17.0	MAX	581	MIN	.91	AC-FT	12,300
WTR YEAR 1995	TOTAL	87,528.42	MEAN	240	MAX	7,630	MIN	.91	AC-FT	173,600

e - Estimated

(b) ***Cost Effectiveness*** -- It is estimated that the District maintains a single gaging station for approximately $6,000 per year. This estimate is based on the total compensation for the Assistant Hydrologist responsible for streamflow monitoring activities, and includes estimated overhead and in-house assistance from other District staff. As a cost comparison, using 1996 dollars, the USGS charges $13,300 per year-per station, or more than twice the District cost.

(c) ***Data Availability*** -- Continuous streamflow data at several of the sites within the basin is often required in a timely manner. For example, data collected at the Carmel River at Sleepy Hollow Weir needs to be computed within one week after the previous month has ended, in order to complete the Cal-Am Production Report for monthly presentation to the District Board. In addition, several automated stations along the river supply current data through the ALERT system to support fishery operations and streambank erosion potential reporting. Because the District retains in-house expertise in streamflow monitoring, the potential for supplying streamflow data on a real-time "as needed" basis is enhanced.

(d) ***Data Quality*** -- Streamflow records are reviewed by the Assistant Hydrologist who is responsible for the computations. Data is collected and computed in a manner consistent with USGS methods, which represent the accepted standard in streamflow monitoring. District records compare favorably with records computed by the USGS at the "Carmel River at Robles del Rio" and "Carmel River near Carmel" stations. Because of the close proximity of District staff to the gage sites, staff has the ability to collect more measurements at opportune times (i.e., during high flow events), which adds to the usefulness and applicability of the collected information.

2. *Surface Water Quality Monitoring*

- ***Were the District's activities effective in providing surface water quality data that had applications to the Mitigation Program?***

District Surface Water Quality monitoring activities provided information that was necessary to conduct the Five-Year Mitigation Program. Comprehensive surface water quality information obtained through District activities are not available from other sources. With respect to the Five-Year Mitigation Program, some of the applications of surface water quality data include:

- indicator of habitat status for juvenile and adult steelhead,
- early warning of declining water quality conditions for steelhead and other aquatic life, and
- baseline information for evaluating wetland vegetation's response to water quality changes.

3. *Ground Water Quantity Monitoring*

- ***Have District ground water quantity monitoring efforts provided useful data for management of the Monterey Peninsula Water Resources System?***

Information from the District's Ground Water Quantity monitoring activities has aided in rational management of the area's water resources. At present, there is no other comprehensive source of ground water quantity data for this area. Historically, the MCWRA monitored depths to water in area wells. While the MCWRA data were useful supplements to District data, the infrequency and geographic distribution of MCWRA monitoring precluded making MCWRA data satisfactory for District purposes, which is why the District has a more extensive water level monitoring network. This network includes water level data collected by Cal-Am from their production wells. Regarding non Cal-Am ground water production data, the District is the primary source for these data, other than data that individual well owners may keep. The District's ground water monitoring activities provide information that is necessary for successful implementation of the various sub-programs of the Five-Year Mitigation Program, including:

- early warning of potential drying reaches of the Carmel River, which benefits the Riparian, Aesthetics, and Steelhead Resource Programs;
- evaluation of the effect of ground water withdrawals on lagoon vegetation and wildlife;
- identification of all sources of drawdown and trends in water level declines due to major pumpers that may contribute to localized dewatering;
- establishment of long-term quantified production and water level records for individual well users; and
- compilation of basic hydrogeologic information for other agencies and the public.

4. *Ground Water Quality Monitoring*

- ***Have District ground water quality monitoring activities been effective for management of the Monterey Peninsula Water Resources System?***

The Ground Water Monitoring activities of the District have provided for responsible management of the area's water resources. The District's commitment to monitoring the quality of ground water dates back to 1981. This has been a cooperative effort involving the District, Cal-Am, the Monterey County Health Department, and the Monterey County Water Resources Agency. The information provided allows the District to manage the water resources of the area in such a way as to prevent problems before they occur. For example, ground water quality monitoring serves as an early warning against potential seawater intrusion in the coastal portions of the Carmel

Valley alluvial aquifer and Seaside Subbasin. Although water levels in some wells from both areas have dropped below sea level for short periods, seawater intrusion has not been identified in the District. There is no other comprehensive source of ground water quality data that is specific to the District's goals for this program.

5. *Weather Station/Flood Warning Monitoring*

- ***Did District weather monitoring activities aid the Five-Year Mitigation Program?***

District weather station and flood warning (ALERT) monitoring activities provided basic information used to implement the Five-Year Mitigation Program, including:

- precipitation records from both the upper and lower Carmel Valley Weather Stations assists scheduling of irrigation for sections of the riparian corridor,
- daily calculated reference evapotranspiration from Carmel Valley Weather Stations, which helps optimize irrigation of the riparian corridor, and
- real-time reports of precipitation and stage (elevation) of the river from ALERT gages located within the Carmel River basin, which informs staff of periods when steelhead may be moving and erosion potential may be high.

E. *Conclusions and Recommendations*

1. *Streamflow Monitoring*

The Streamflow Monitoring Program is necessary for the District to account for and monitor the flow of surface water through the Carmel River basin. This program, which has been improved significantly since 1991, now provides continuous records of streamflow at the key locations within the basin. The improved data collection methodology is far superior and more useful that the "spot" measurement methodology previously used. These data currently have many uses, and will be available for future needs.

It is recommended that the Streamflow Monitoring Program continue at its current staffing and funding level. Data collected will become more useful as the length of record collected at the gaging stations increases. The data supports many District functions and serves as a foundation for current and future water resource management decisions.

2. *Surface Water Quality Monitoring*

Due to the successes of the surface water quality monitoring activities, particularly their value to the Steelhead Resources Program, staff recommends continuing the Surface Water Quality

activities in their present form. Future annual expenditures will primarily be for operation and maintenance of the existing program without the need for additional staff..

Planned modifications include the installation of continuous water quality monitoring equipment at the Sleepy Hollow Rearing Facility, which will begin in 1996 when this facility is operating. In addition, four continuous recording water temperature meters will be installed along the river in 1996. These instruments will give a more complete record of river conditions, supplementing instantaneous temperature measurements taken in the course of streamflow measurements.

3. Ground Water Quantity Monitoring

District programs that quantify the amount of ground water storage and production are vital to the ability to responsibly manage the water resources of the Monterey Peninsula area, including the Carmel Valley alluvial aquifer. With respect to the Five-Year Mitigation Program, all sub-programs rely on information generated by monitoring the ground water resources of Carmel Valley. Therefore, staff does not recommend changes to these programs at this time, aside from modifications in specific monitoring sites.

4. Ground Water Quality Monitoring

This activity serves the goals of the Five-Year Mitigation Program indirectly, in that it provides for responsible management of the supply sources within the MPWRS. No recommended changes are proposed to this program at this time. However, it should be noted that it is planned to conduct a comprehensive review of water quality data during the upcoming year. This review will be conducted as a cost-savings measure to determine if the sampling protocols at individual monitoring sites can be modified without compromising the utility of this program.

5. Weather Station/Flood Warning Monitoring

No changes are anticipated or recommended to the ALERT system. However, the two District weather stations are in need of upgrades if they are to be continued at the existing level of effort. The data loggers that were installed at these stations in the 1980s are obsolete and are no longer serviced by the manufacturer. The information obtained with the new data loggers would be useful for a variety of applications, including extending the record of monitoring climate at both stations. It is recommended that both data loggers be upgraded, and that the cost of the upgrade ($4,100 for two CR21X data loggers) be shared by the Capital Projects and Mitigation Program funds. It is also recommended that the District negotiate with the Carmel Unified School District to allow installation of a telephone line on the Lower Carmel Valley Weather Station. This would allow modem access, which is already available for the Garland Park Weather Station, and which would make the data directly accessible by the Riparian Projects Coordinator. Modem access has the added benefit of readily identifying problems occurring with one or more of the sensors from the office. In the past, some data has been lost due to the fact that problems were not recognized

soon enough. Costs associated with installing the phone line are estimated at approximately $1,000.

6. Implementation Plan for 1997-2001

The overall cost of the HMP is expected to be similar for the next five years compared with the preceding five-year period. The precise amount of funds to be spent on the HMP are in part tied to the type of hydrologic conditions that are experienced. In general, more hydrologic monitoring is needed in wet years than in dry years. If a very wet year occurs, some equipment could be damaged and require replacement, as was the case in 1995. Some recommendations, such as upgrades for weather stations, will increase the costs of the HMP regardless of the climatic conditions. Although there are no new stream gaging stations planned in the next five years, there are considerable operation and maintenance activities involved with existing facilities.

The District has prepared a separate document, "Implementation Plan for MPWMD Mitigation Program, Fiscal years 1997-2001." The Plan contains detailed information about anticipated hydrologic monitoring program elements and costs for the next five years.

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revised October 17, 1996

SECTION III

STEELHEAD RESOURCE PROGRAM

III. STEELHEAD RESOURCE PROGRAM

A. Adopted Goals

The findings for Certification of the Water Allocation Program Final EIR identified four mitigation measures to reduce impacts to the Carmel River steelhead population (Findings Nos. 388-A through D). These measures, as well as existing measures included as part of the Interim Relief Program, were adopted by the District in November 1990 and funded beginning with the 1990-91 fiscal year. The four mitigation measures included: (a) expand the program to capture and transport smolts during spring, (b) prevent stranding of early fall and winter migrants, (c) rescue juveniles downstream of Robles del Rio during summer, and (d) implement experiments to assess smolt mortality at Los Padres Dam and recommend solutions. Monitoring of adult returns and juvenile populations provides an indication of the overall success of the steelhead mitigation measures. The following sections briefly describe the purpose of existing measures that began prior to 1990 as well as each of the four mitigation measures identified in the 1990 Five-Year Mitigation Plan.

An overarching goal of the District and other resource agencies is to restore the Carmel River steelhead run to a viable, self-sustaining run. This is especially true in light of the federal designation of California Central Coast steelhead as a proposed threatened or endangered species in July 1996. It should be noted, however, that such restoration is beyond the scope of the Five-Year Mitigation Plan adopted in 1990. It was recognized at the time, and continues to be recognized today, that permanent restoration of the run depends on providing adequate instream flows (as defined by the Interagency Fishery Working Group) to protect the public trust resources of the Carmel River. Such streamflow cannot be provided without a major water upply project or combination of projects. Please refer to the 1994 Final EIR/EIS on the MPWMD long-term water supply project for a detailed discussion of this issue.

1. Continue Interim Relief Program Measures

In November 1988 the District implemented an Interim Relief Program with the goal to reduce the adverse impacts of surface diversions and groundwater pumping on aquatic resources in the Carmel River. This program resulted from a series of meetings of the District's Environmental Advisory Committee. The District formed the committee in response to complaints filed before the State Water Resources Control Board (SWRCB) by the Carmel River Steelhead Association, alleging that Cal-Am was illegally diverting underflow of the Carmel River and that water supply practices result in unacceptable damage to aquatic resources in the Carmel River. The program included measures to rescue juvenile fish as the Carmel River recedes, rescue smolts during critically-dry years, irrigate riparian vegetation, and negotiate streamflow releases from San Clemente Dam. Reviews of District activities under the Interim Relief Program were reported to the SWRCB in five annual reports (1988-89, 1989-90, 1990-91, 1991-92 and 1992-93).

2. *Capture and Transport Emigrating Smolts in Spring*

During spring months, when steelhead smolts are actively emigrating from fresh water to the ocean, the diversion of surface and groundwater from the river often interferes, and in some cases blocks, access to the ocean. In extreme cases, the river dries up during the period when smolts are migrating downstream. This threatens individual fish and significantly reduces the number of smolts that successfully reach the ocean, and indirectly affects the number of adults that eventually return to freshwater. To mitigate this problem, the District monitors streamflow, captures emigrating smolts, and transports them to the ocean, when streamflow is too low to allow natural emigration, or when smolts are at risk of being stranded as the river recedes. The objective of this activity is to avoid disruption of the steelhead life cycle due to current ground water extraction and stream diversion needed to serve the community.

3. *Prevent Stranding of Fall/Winter Juvenile Migrants*

The objective of this activity is to prevent stranding by capturing and transporting juvenile fish during the high-risk period from October through February. As in other central California streams, juvenile steelhead in the Carmel River move downstream into lower reaches of the river well ahead of the peak emigration of smolts. Depending on river conditions and diversions during the previous dry season, there is a risk that pre-smolts and other juvenile steelhead will be stranded following early fall and winter storms, which increase flows and stimulate the fish to move downstream into habitat that is subsequently dewatered after the storm peak passes. This risk occurs primarily during the period from October through February, although in severe droughts, the period may extended into March. Currently, juveniles trapped during Fall/Winter months are transported upstream to viable habitat above the Narrows. In 1998-99, the District plans to construct and operate a facility in mid-Carmel Valley to hold rescued steelhead during the period when fish are at risk; fish will be released when conditions warrant.

4. *Rescue Juveniles Downstream of Robles del Rio in Summer*

The objective of this activity is to transplant juveniles to permanent habitat downstream of San Clemente Dam (if it is available), and to rear young-of-the-year steelhead in a facility below San Clemente Dam in order to maintain viable steelhead populations. Until 1992, about 1.5 miles of juvenile rearing habitat between Boronda Road and Robles del Rio and nine miles of habitat below the Narrows dried up nearly every summer. As a result of SWRCB hearings held in late 1992, operational changes were made to the Cal-Am system that extended the wetted front of the river another two to three miles. At the beginning of each dry season, which typically begins in June, the District rescues juvenile steelhead from habitat in the affected reaches. As part of this activity, the District is responsible for constructing and operating a facility to rear juvenile steelhead. This facility was nearing completion in June 1996; an initial test group of 500 fish was placed in the facility in September 1996.

5. *Assess Smolt Mortality at Los Padres Dam*

No downstream passage facilities were built at Los Padres Dam when it was constructed in 1948. By 1990 several improvements had been made to improve smolt passage, but no tests had been conducted to determine whether the modifications improved conditions. The objective of this activity is to assess how well previous spillway modifications are functioning and to recommend additional modifications or a permanent program to transport smolts around the reservoir.

B. Description of Activities/Projects, 1991-1996

1. *Existing Steelhead Fishery Activities*

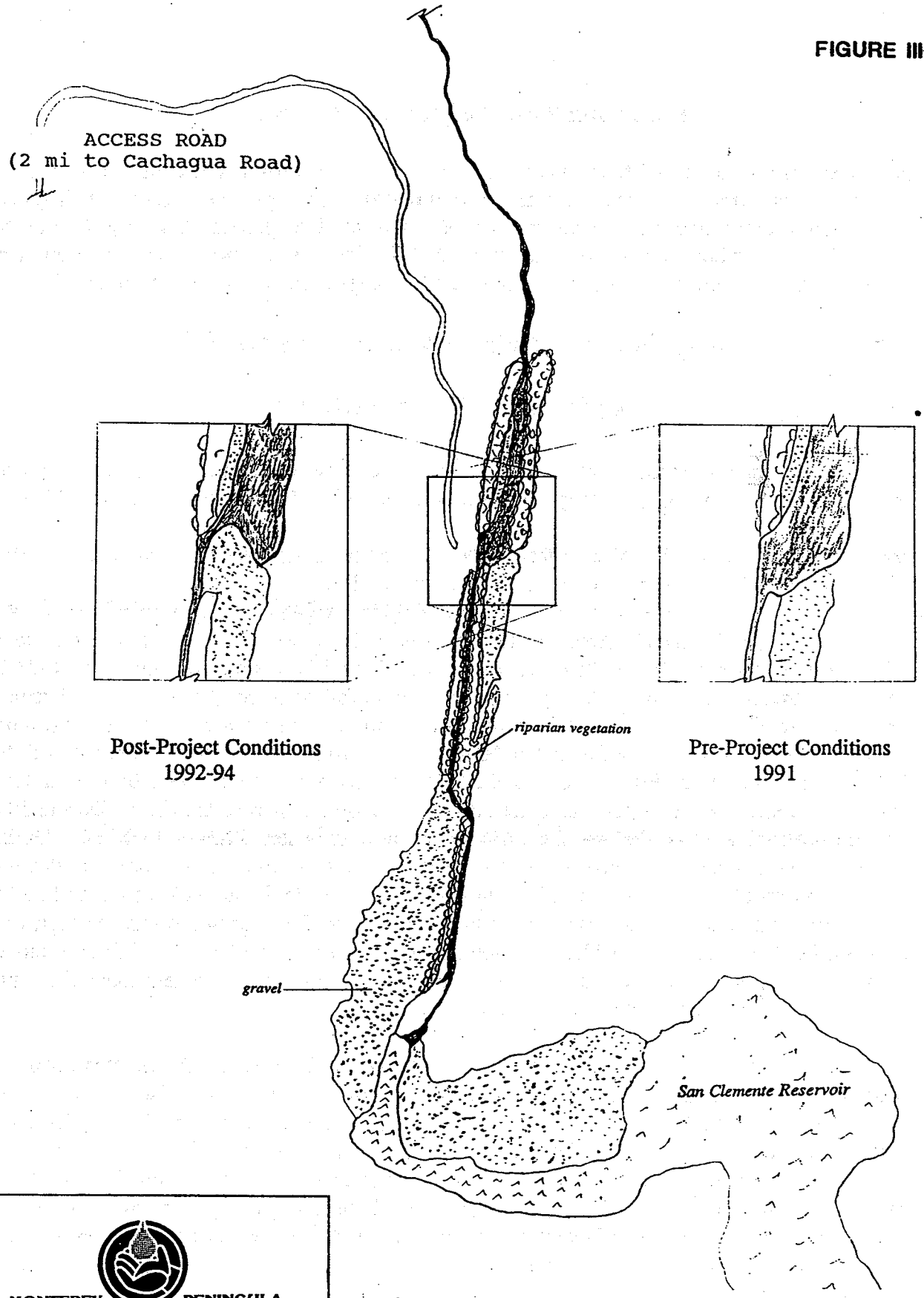
A variety of activities related to preservation of the Carmel River steelhead resource were in place when the Five-Year Mitigation Program was adopted in 1990. Each is briefly described below:

(a) Rehabilitation of critical riffles -- The District has monitored and rehabilitated critical riffles since 1989. A description of the two key areas follows.

Los Compadres Riffle: In 1990 the District began monitoring conditions at a critical riffle located upstream of San Clemente Reservoir. This riffle was created during the 1973-75 period by streambank erosion and deposition of material following construction of an airstrip at the top of a small tributary, located approximately one-half mile upstream of the reservoir (**Figure III-1**). In January 1992, the District obtained a 1601 Stream Alteration Agreement with the California Department of Fish and Game (CDFG), and modified the streambed by placing large boulders to create a series of pools and steps through the steepest part of the riffle. During 1993 no modifications were needed and the work withstood peak winter flows of 4,000 cfs. During February 1994, several trees growing in the middle of the high-flow channel were cut down to route a portion of flood flows around the modifications and additional boulders were placed to maintain the pools and steps. During January 1995, flood flows passed down the high-flow channel, but bypassed the modifications, leaving them intact. The March 1995 flood removed most of the material deposited as a result of the original erosion, scoured a new channel through the reach and improved conditions for steelhead migration.

Pine Creek Critical Riffle: As part of planning for New Los Padres Reservoir, the District identified a critical riffle located approximately 1/4 mile upstream of the confluence with Pine Creek. As part of the planning process, a consultant was retained to model water depth and velocity at streamflows ranging from 10 to 200 cfs, and followed this work with additional empirical measurements of water depth and velocity to determine flows needed for upstream passage of adults and to develop modifications that could be made to allow passage at flows less than 50 cfs. The development of modifications was interrupted by the negative vote on New Los Padres Reservoir, but may be continued by Cal-Am if the Company decides to pursue the New Los Padres Dam project.

FIGURE III-1



MONTEREY PENINSULA
WATER MANAGEMENT DISTRICT

Figure III-1. Critical riffle located upstream of San Clemente Dam

(b) Negotiation of Annual Memorandum of Agreement -- Since 1983, a Memorandum of Agreement (MOA) has been negotiated annually between Cal-Am, CDFG and the District on streamflow releases at San Clemente Dam. In addition to specifying flow releases, the MOA now specifies maximum diversion rates through Cal-Am's Carmel Valley Filter Plant (CVFP) and addresses the operation of Cal-Am's wells in the Carmel Valley aquifer. **Table III-1** lists minimum streamflow releases, maximum diversion rates, and operational constraints for the period 1983-95. Specifics for each reporting year (July 1 through June 30) are as follows:

1991: The 1991 MOA was finalized on June 3, 1991. It specified minimum daily flow releases from San Clemente Reservoir ranging from 25 to 4 cfs and a maximum monthly diversion of 3.5 cfs, unless San Clemente Reservoir was spilling.

1992: The 1992 MOA was finalized on May 19, 1992, and specified minimum daily flow releases from San Clemente Reservoir ranging from 20 to 2.5 cfs and a maximum monthly diversion of 4.0 cfs, unless the reservoir was spilling.

1993-- The 1993 MOA was finalized on June 21, 1993. It addressed several specific issues including:

1. Allocation of inflow to San Clemente Reservoir during the May-June period to release for instream flow below the dam, diversions from the reservoir, and storage in the reservoir. This was done to minimize disruptions to the natural flow recession, maximize opportunities for steelhead emigration through the lower river in May, and ensure that adequate surface water storage was available to maintain steelhead rearing habitat downstream of San Clemente Dam.

2. Specific minimum daily releases of 6.5 cfs, once inflow receded to 10.5 cfs, and maximum diversion of 4.0 cfs, averaged over a monthly period.

3. Constraints on groundwater pumping in the upper and lower Carmel Valley basins. In the upper basin (upstream of the Narrows), the MOA included a schedule for maintenance pumping to minimize impacts of pumping on streamflow. In the lower basin (downstream of the Narrows) the MOA included a guideline that Cal-Am would make "all reasonable effort to operate the lower Carmel Valley production wells in the sequence from the lowermost well and progress upstream as wells are needed and available for production."

1994: The MOA was finalized on May 24, 1994. It addressed allocation of inflow during the April-May period, included special releases to protect steelhead nests during this period and specified releases of 3.5 to 4.0 during summer months, and constraints on groundwater pumping in the Carmel Valley.

1995: The MOA was executed on July 30, 1995. The agreement specified a minimum release of 9.5 cfs in the Carmel River, as measured at the Sleepy Hollow Weir, limited

Table III-1. Minimum flow releases specified in annual Memorandum of Agreeement between California-American Water Company, California Department of Fish and Game, and the Monterey Peninsula Water Management District, May through December, 1984-96.

YEAR	RELEASE AT SAN CLEMENTE DAM		FLOW MEASURED AT SLEEPY HOLLOW		MAXIMUM DIVERSION AT SAN CLEMENTE DAM
	Goal (cfs)	Minimum Goal (cfs)	Goal (cfs)	Requirement (cfs)	(30-day Average) (cfs)
1982	No Memorandum of Agreement or Release Requirements Prior to 1983				not specified
1983		3 to 5	–	–	not specified
1984		3 to 5	–	–	not specified
1985		3 to 5	–	–	not specified
1986		1 to 3	–	–	not specified
1987		3.0	–	–	5.0
1988		4.0	Installed Sept 1988		4.0
1989				2.5	3.5
1990				3	3.5
1991	Varies (4-25 cfs)	4.0	4	3	Varies (3.5-15 cfs)
1992	Varies (5.5-20 cfs)	5.5		4	Varies (4-9 cfs)
1993	Varies (6.5-40 cfs)			6	Varies (4-10 cfs)
1994	Varies (4.0-15 cfs)			3.5-4.0	3.0-3.5
1995	Varies (10-50 cfs)			9.5	Varies (4-11 cfs)
1996	Varies (10-48 cfs)			7.5-8.0	8 cfs (June) & 4 cfs (Jul-Dec)

diversions into the CVFP to 11 cfs in July, 6.0 cfs in August, 5.0 cfs in September and October, and 4.0 cfs in November and December. In addition, the MOA specified the allocation of inflow during the May-October period, including the period after June 30, 1995, when the flashboards were raised.

(c) Long-term Water Supply Alternative -- As directed by Finding No 403-A of the Water Allocation Program EIR, the District pursued construction of a major, long-term water supply alternative during the reporting period. This endeavor required intensive technical work over the last five years including:

- field investigations to determine relationships between streamflow and habitat for adult steelhead migration, adult spawning, and juvenile rearing;
- preparation of EIR/EIS including detailed analysis and assessment of impacts of ten alternative water supply projects on the steelhead population;
- participation in an interagency Fishery Working Group which developed streamflow requirements for the 24,000 AF New Los Padres Project (NLP), as described in the Group's 1994 Completion Report;
- development of specific mitigation measures for 24,000 NLP; and
- expert testimony before the SWRCB for a water rights permit for the proposed dam.

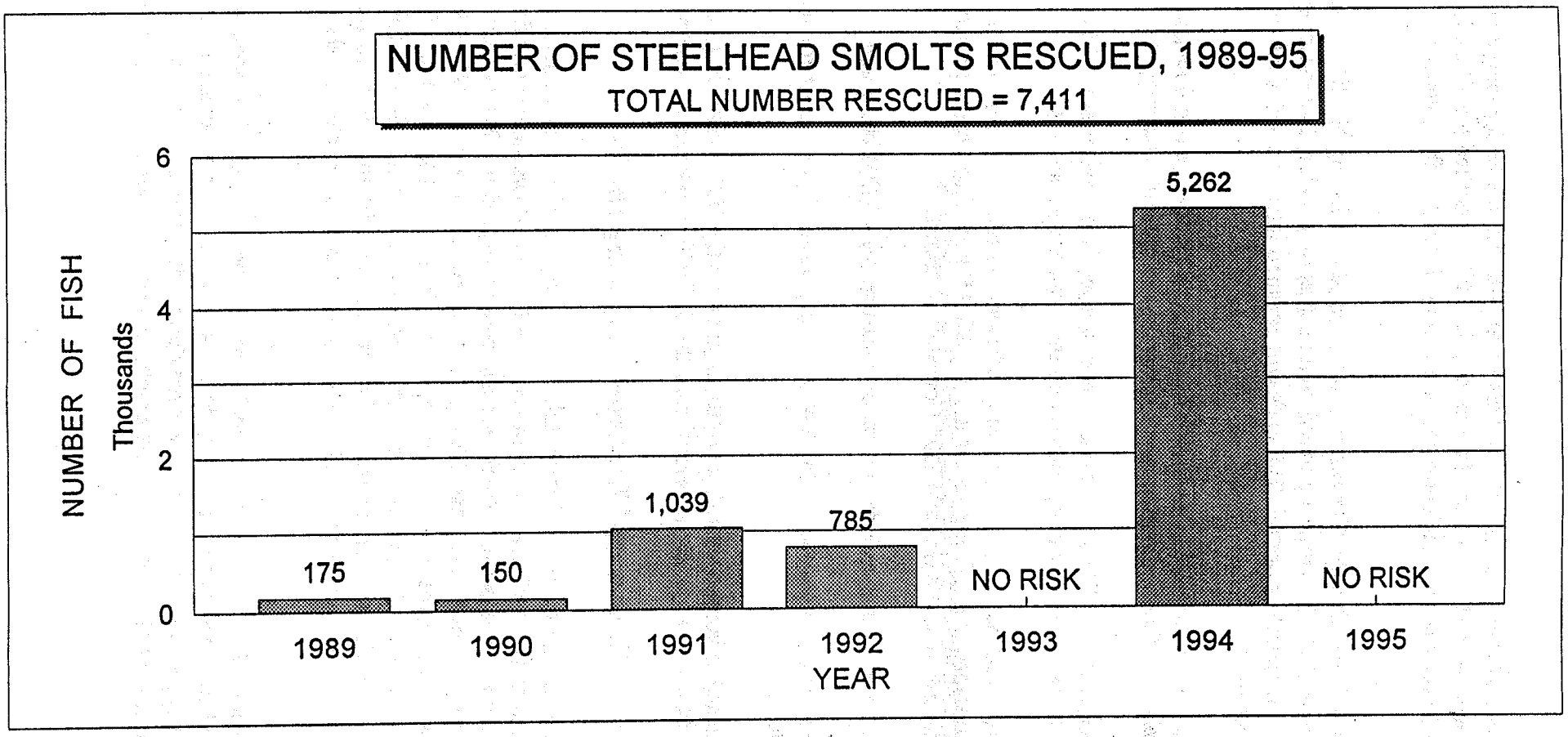
This work culminated in issuance of a Section 404 permit from the U.S. Army Corps of Engineers to construct the dam and water rights permit from the SWRCB to operate the reservoir.

2. *Capture and Transport Emigrating Smolts*

Based on recommendations in the Water Allocation Program EIR, the District rescues and transports steelhead smolts in all years when March, April or May flows are too low for successful natural emigration into the ocean. Smolt rescues were conducted in 1991 (a "dry" hydrologic year), 1992 (a "below normal" year), and 1994 (a "dry" year). Water Years 1993, 1995 and 1996 were normal or wet, and rescues were not needed. Typically, rescues begin with the first seasonal closure of the river mouth and extend until the end of May or early June, when juvenile steelhead begin to revert from their smolt phase back to freshwater, and with the raising of flashboards at San Clemente Dam. Following are highlights of smolt rescues conducted in 1991, 1992, and 1994:

(a) March-July 1991 -- District staff and Carmel River Steelhead Association (CRSA) volunteers rescued pre-smolt and smolts during March as the river initially advanced and retreated, and rescued and trapped smolts as the river receded during late May and early June. During this period a total of 1,039 fish, classified as pre-smolts and smolts, were rescued (**Figure III-2**).

FIGURE III-2


NUMBER OF STEELHEAD SMOLTS RESCUED, 1989-95
TOTAL NUMBER RESCUED = 7,411
NUMBER OF FISH
Thousands
6
4
2
0
175
150
1,039
785
NO RISK
5,262
NO RISK
1989
1990
1991
1992
1993
1994
1995
YEAR

(b) April-May 1992 – The river flowed continuously to the ocean until the third week of May. District and CDFG staff and volunteers from the CRSA rescued a total of 785 smolts, including 209 fish from the lower river as it receded in May, 173 fish from the Lagoon when the river mouth closed, and 403 fish from the Lagoon as water levels dropped to critical levels in August (**Figure III-2**).

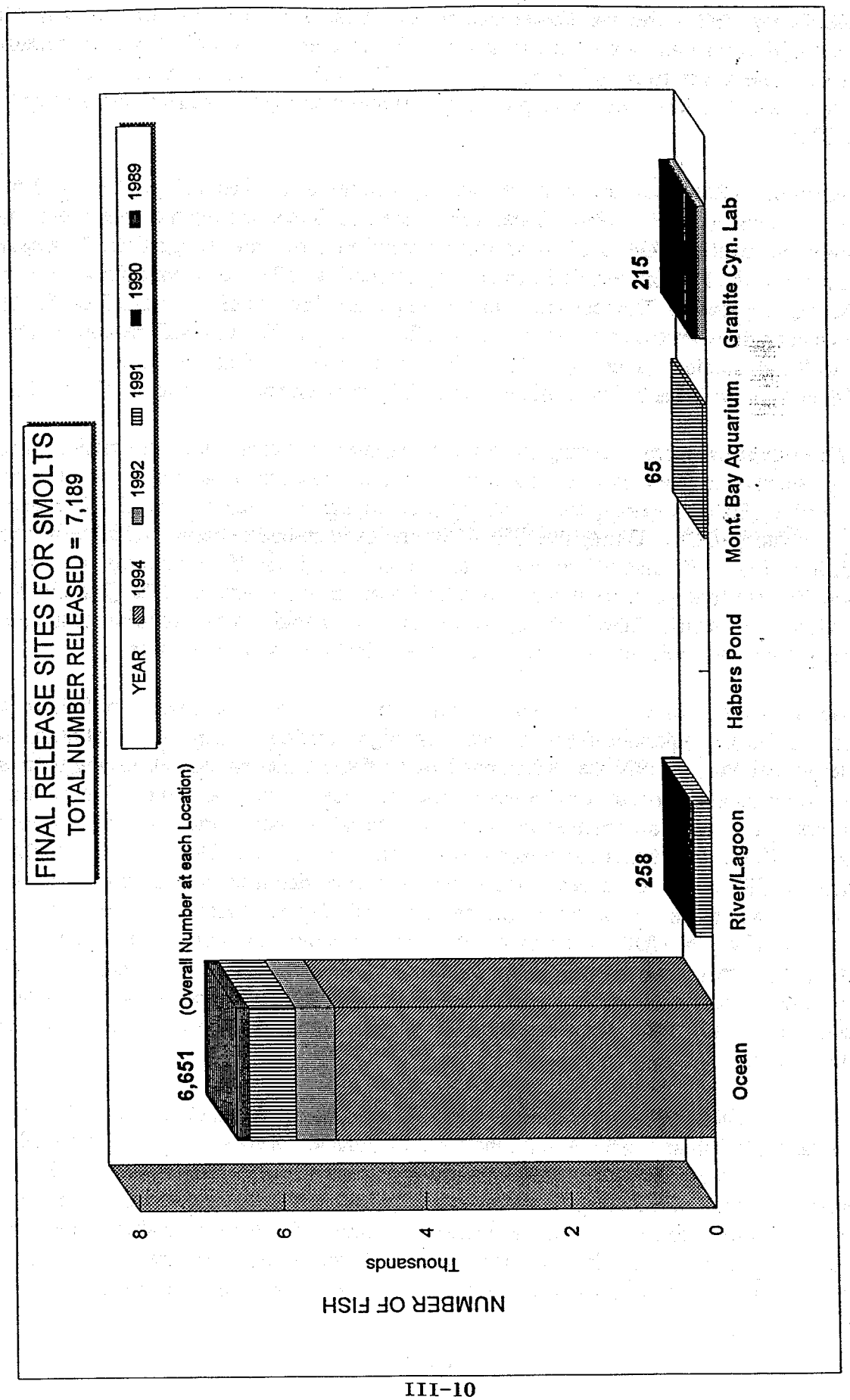
(c) April-May 1994 – Streamflow at the Highway One bridge declined below 20 cfs by March 28, 1994, and 5 cfs by April 7, 1994. These flows were insufficient to keep the river mouth open and it closed on April 1, 1994, well ahead of the normal peak of smolt emigration. In response to this situation, the District installed a smolt trap on April 6, 1994, and started spring rescues below the trapping station. The trap was tended twice per day from April 6 through June 6, 1994, after which operations were suspended due to insufficient flows. District staff rescued a total of 5,262 steelhead smolts, including 1,922 fish seined from the Carmel River Lagoon, 95 electrofished from the lower 5.7 miles of river and 3,245 from the trapping station (**Figure III-2**).

(d) Transplant Locations – During the years that rescues were conducted, the District released the rescued smolts into five locations, including the ocean, the river or lagoon, a private pond in Carmel Valley (Haber's Pond), the Monterey Bay Aquarium (MBA), and CDFG's Granite Canyon Laboratory (GCL). During the 1991, 1992 and 1994 rescue seasons, 7,189 smolts were released, including 6,651 fish (93 percent) into the ocean, 258 fish (four percent) into the river or lagoon, 65 fish (one percent) at MBA, and 215 fish (three percent) at GCL (**Figure III-3**). During March and April, Haber's Pond, located in Quail Meadows Subdivision, was used to temporarily hold pre-smolts and smolts, prior to their final release at other sites.

(e) Acclimation Facility – The gradual acclimation of steelhead smolts to full strength seawater can be an important factor in ensuring high survival during their transition from freshwater to seawater. In 1994 the District purchased a floating net pen, similar in design to pens used for rearing salmon in ocean and bay environments. This pen will be deployed in the lagoon during years when smolts are rescued and acclimated to saline water, prior to their transfer into the ocean. In 1995, the District received a permit from the California Department of Parks and Recreation (CDPR) to operate the pen in the lagoon and to service it via a small boat. However, lagoon outflow was more than sufficient during April and May and there was no need to deploy the net-pen. In 1996, the CDPR decided to not renew the permit for deployment of the net-pen, concluding, "design of the net-pen is not appropriate for the Carmel River Lagoon", where "natural preserves are managed to preserve environmental and ecological integrity and protect scenic and visual unity". This means that other techniques will need to be developed to acclimate smolts to saltwater.

(f) Status of Holding Facility – During years when the lower Carmel River dries up following early storms in late Fall and early Winter, the District plans to construct and operate a facility to hold steelhead pre-smolts during the period prior to spring months when they become smolts. The conceptual plan calls for a facility to be located in the lower Valley, near Garland Park, or the upper end of Aquifer subunit 3, where an acceptable source of water is available. The need for the facility was based on a finding that water supply Option V would induce dewatering of the lower river during the late fall/early winter period. Currently, the District is re-evaluating where

FIGURE III-3


FINAL RELEASE SITES FOR SMOLTS
TOTAL NUMBER RELEASED = 7,189
YEAR
1994
1992
1991
1990
1989
(Overall Number at each Location)
6,651
258
65
215
NUMBER OF FISH
Thousands
8
6
4
2
0
Ocean
River/Lagoon
Habers Pond
Mont. Bay Aquarium
Granite Cyn. Lab

to locate the facility and whether or not it will be needed, given SWRCB Order WR 95-10, which reduces Cal-Am pumping from the lower river. Implementation of the Order may reduce the need for construction and operation of the facility.

3. *Prevent Stranding of Fall/Winter Juvenile Migrants*

The District rescues and transplants steelhead whenever early freshets cause the wetted edge of the lower river to initially advance and then retreat during late fall/winter months. Each year, District staff closely monitors the advance and retreat of the river front on a day-to-day basis, following early storms, and rescues steelhead whenever they are threatened.

(a) Monitoring of River Conditions -- The following paragraphs highlight river conditions that affected the extent of the fish rescue program during early fall and winter months. Please refer to Section II for further details on the District's Hydrologic Monitoring Program.

1990-91: Surface reservoir storage, ground water levels and surface streamflow were at extremely critical levels throughout the period from October 1990 through mid-March 1991. The river front receded throughout the period and by the end of December surface flow ceased at the USGS gaging station at Robles del Rio. With the onset of rains in March, the river advanced rapidly downstream, but then retreated several miles as runoff subsided and the recharge rate to the lower aquifer exceeded surface streamflow.

1991-92: The river advanced gradually during January and February 1992 with the first rains of the year, and then rapidly advanced to fill the lagoon on February 11.

1992-93: During late December 1992, the river advanced rapidly and reached the lagoon on January 2. The sandbar was breached by the Monterey County Department of Public Works on January 7.

1993-94: In response to storms of February 7 and 17, 1994, the riverfront advanced downstream, reached the Highway One Bridge on February 9, filled the lagoon and breached the sandbar on February 17.

1994-95: In response to a major Pacific storm, the riverfront advanced rapidly on January 4, 1995, reached the Highway One Bridge on January 8, and filled the lagoon and breached the sandbar on January 9.

(b) Fish Rescues -- During the five-year reporting period intensive rescues of juvenile steelhead were needed during 1991 (**Figure III-4**). During the period from March 5 to March 15, 1991, the river advanced at rates up to 1,600 feet per hour, but then receded up to 300 feet per hour. In response to this situation, District staff conducted eight rescues in a 3.3 mile-long reach between San Carlos Road Bridge (River Mile 3.8) and near the Cal-Am Manor Well (River Mile 7.1). A total of 268 pre-smolt and smolts were rescued and transported to Haber's Pond and held, prior to their release into the ocean or MBA. This group of fish, although small in absolute number, constituted about one-third of the entire production of smolts from the river in 1991 and

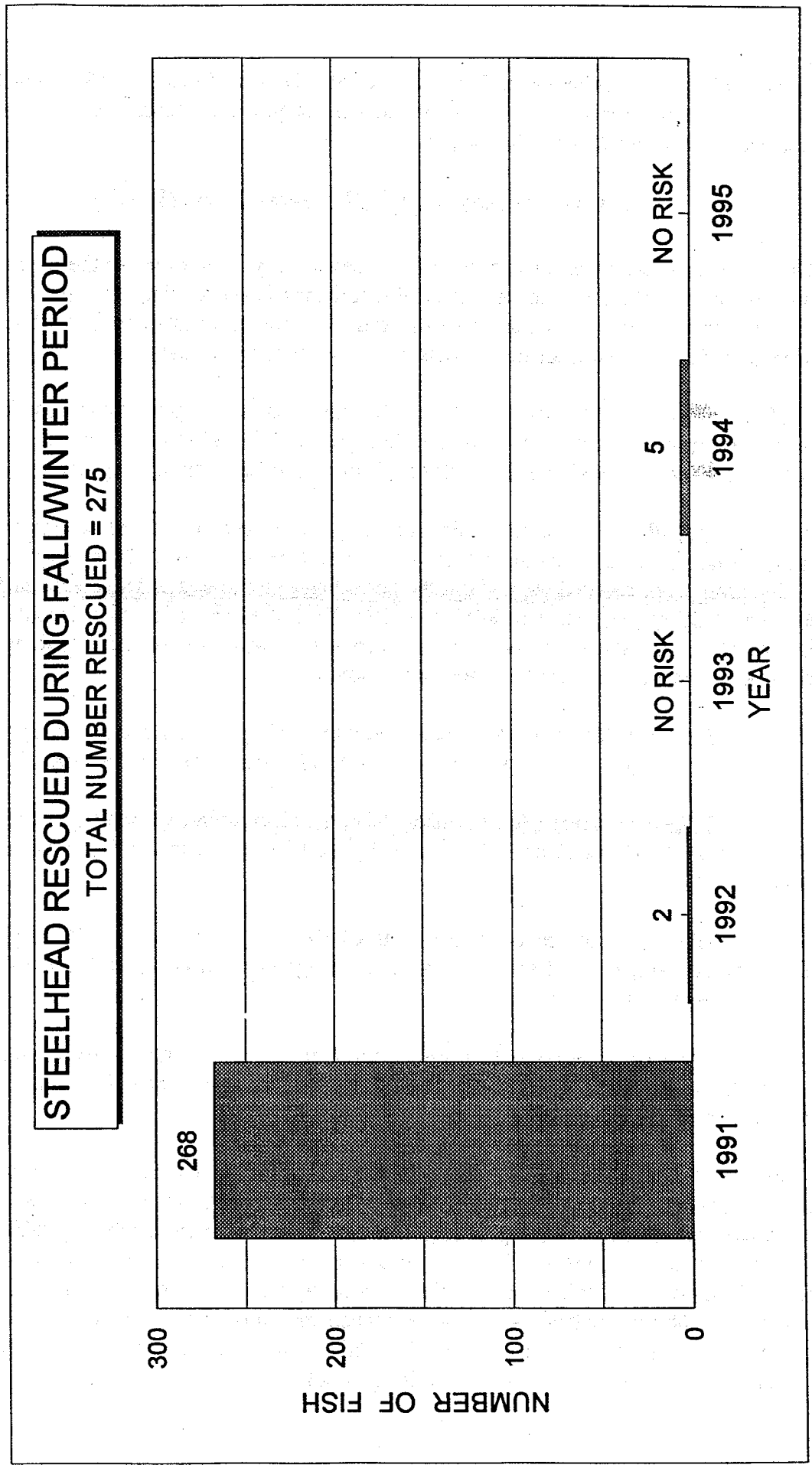

STEELHEAD RESCUED DURING FALL/WINTER PERIOD
TOTAL NUMBER RESCUED = 275
NUMBER OF FISH
300
200
100
0
268
2
NO RISK
5
NO RISK
1991
1992
1993
1994
1995
YEAR

FIGURE III-4

were the nucleus of the fish reared to adult size in CRSA's broodstock program at the GCL facility.

The CRSA broodstock program was implemented during the 1987-91 drought to help offset the loss of the natural production of steelhead. CRSA volunteers cared for adult brood stock that were reared at the CDFG's Granite Canyon Laboratory, south of Carmel. During Winter and Spring, the brood stock were transferred to a hatchery operated by the Monterey Bay Salmon and Trout Project, located on Big Creek in Santa Cruz County, where the adults were spawned. The resulting broods were reared at the hatchery and a grow-out facility located in Scotts Valley and were planted in the Carmel River as young-of-the-year or smolts.

4. Rescue Juveniles Downstream of Robles del Rio in Summer

Under existing conditions, the lower Carmel River usually begins to dry up and recede in June. In response to receding flows and monitoring of river conditions, the District begins dry-season rescues in the vicinity of the Highway One Bridge and proceeds upstream to a point where it is judged that streamflow will remain stable throughout the summer season.

(a) Annual Dry-Season Rescues – A total of 29,284 juvenile steelhead were rescued from the river during the dry seasons of the 1991-95 reporting period, including 13,079 young-of-the-year, 9,536 older juveniles, 6,623 smolts and 46 adults (**Table III-2**). Annual totals ranged from 879 fish in 1991 to 13,949 fish in 1994 (**Figure III-5**). The following accounts briefly summarize river conditions and rescue of juvenile steelhead during each dry season.

1991: The lower river flowed for a total of only 83 days and was dry at the USGS gaging station, near Carmel, on June 8. Dry-season rescues began with electrofishing the lower river on May 2 and installation of a trapping station on May 4. During June, July, August and November, District staff conducted 15 rescues in the reach between Highway One and the Chalk Rock Pools (River Mile 14.0, downstream of Esquiline Road) and rescued a total of 165 juvenile steelhead, including 63 young-of-the-year and 102 older juveniles (**Table III-2**).

1992: The river flowed at the USGS gaging station, near Carmel, until June 10, but had dropped below 10 cfs by May 13. Dry-season rescues began with installation of a trapping station on May 13, 1992, and continued until September 29, 1992, with rescues in the vicinity of the deDampierre Ball Park. The District conducted 28 rescues in the drying sections of the river and rescued a total of 3,670 steelhead, including 2,598 young-of-the-year, 424 older juveniles, 647 smolts and 1 adult (**Table III-2**).

1993: The river flowed at the Highway One Bridge until July 5, but had receded to 5 cfs by the last week of June. The District began rescues on June 30, 1993 and by the end of July the river had receded to the Cal-Am Manor Well, located at river mile 7.2. Following a month at this location, the river retreated further to a point about 800 feet downstream of the Cal-Am Begonia Well (river mile 7.6). During the period from June 30 through October 8, 1993, the District conducted 34 rescues in drying reaches of the river between the Lagoon and Cal-Am's

Table III-2. Steelhead rescued from the mainstem Carmel River, during the dry-season, downstream of Robles del Rio, 1989-95.

Year	Rescue Period	Miles Rescued	NUMBER OF STEELHEAD RESCUED						Brood Index (yoy rescued per mile) *
			Young of the Year	Older Juveniles	Subtotal	Smolts	Adults	Annual Total	
1989	May 24 - Sept 21	12.8	14	141	155	0	0	155	1
1990	Apr 1 - Dec 10	12.2	113	80	193	22	0	215	9
1991	May 2 - Nov 27	10.6	63	102	165	714	0	879	6
1992	May 13 - Sept 29	11.1	2,598	424	3,022	647	1	3,670	234
1993	Jun 30 - Oct 8	7.2	2,053	4,021	6,074	--	0	6,074	285
1994	Apr 6 - Aug 5	9.4	4,630	4,012	8,642	5,262	45	13,949	493
1995	Aug 3 - Dec 8	5.2	3,735	977	4,712	--	0	4,712	718
Totals by Life History Phase:									
	Period								
	(1989-91)	36	190	323	513	736	0	370	5
	(1991-95)	44	13,079	9,536	22,615	6,623	46	29,284	301
							Overall:	29,654	

* Footnote: yoy = young-of-the-year steelhead

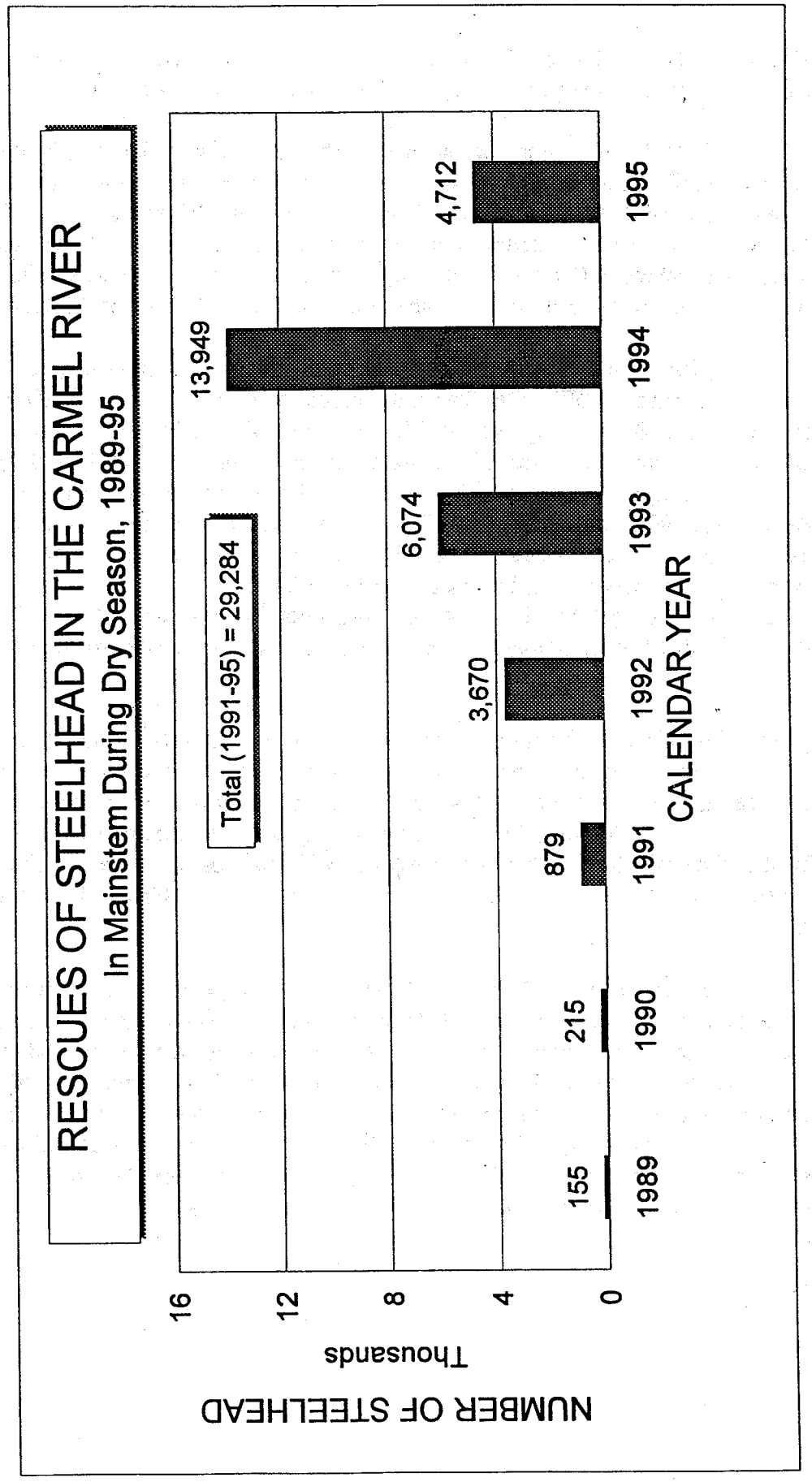

RESCUES OF STEELHEAD IN THE CARMEL RIVER
In Mainstem During Dry Season, 1989-95
Total (1991-95) = 29,284
NUMBER OF STEELHEAD
Thousands
16
12
8
4
0
155
215
879
3,670
6,074
13,949
4,712
1989
1990
1991
1992
1993
1994
1995
CALENDAR YEAR

FIGURE III-5

Begonia Treatment Plant. These efforts yielded a total of 6,047 juvenile steelhead, including an estimated 2,053 young-of-the-year and 4,021 older juveniles (**Table III-2**).

1994: The dry season began early with streamflows reduced to below 1 cfs at the lagoon, during April and May. Due to special releases from San Clemente Dam and small rain storms in late April and May, the river flowed continuously at the Highway One Bridge until June 9. Staff completed rescues of juveniles from the lower 5.4 miles of river by June 9 and proceeded with rescues up to Robinson Canyon Road Bridge (river mile 8.5). This effort yielded a total of 8,642 juveniles, including 4,630 young-of-the-year and 4,012 older juveniles (**Table III-2**).

1995: The lower river did not begin to dry up until mid-August. District staff began rescues on August 3, 1995, after flow had receded to 10 cfs at the MPWMD gaging station at the Highway One Bridge. By August 24, 1995, the District had conducted twenty rescue operations in the lower 5.2 miles of the mainstem and captured a total of 4,712 juveniles, including 3,735 young-of-the-year and 977 older juveniles (**Table III-2**). The lower number of fish rescued during 1995 was not related to fewer numbers of fish in the juvenile population, but was linked to a reduced need for rescuing juvenile steelhead. The river flowed for a longer period of time and only 5.2 miles of habitat was at risk of drying.

It should be noted that Cal-Am changed its operations on several occasions to accomodate the fish rescues.

(b) Rescue Locations -- During the reporting period, the majority (about 55 percent) of the juvenile steelhead were rescued in the 3.3-mile long reach between Robinson Canyon and Valley Greens, where the river usually drys up by the end of July (**Figure III-6**). An exception to this generality occurred in 1995, when the river flowed throughout the year, downstream to Cal-Am's Pearce Well at river mile 5.7. In this year, a total of 3,526 fish, or 75 percent of the total number rescued, were rescued from the 3.7-mile long reach between Valley Greens Bridge and Highway One (**Table III-3**).

(c) Transplant Locations -- During the 1991-95 reporting period, most juvenile steelhead rescued from drying sections were transported upstream into permanent habitat upstream of Robles del Rio, although the reach adjacent to Garland Ranch Regional Park received about 17 percent of the fish, because of the good habitat, excellent access and close proximity of this reach to rescue locations (**Figure III-7**). Ninety-three steelhead were provided to Monterey Bay Aquarium for their exhibits, where the fish that grew to adult or smolt size were eventually released back into the river. One hundred and thirty-seven steelhead were provided to the Carmel River Steelhead Association for their emergency captive broodstock program at CDFG's Granite Canyon Laboratory.

FIGURE III-6

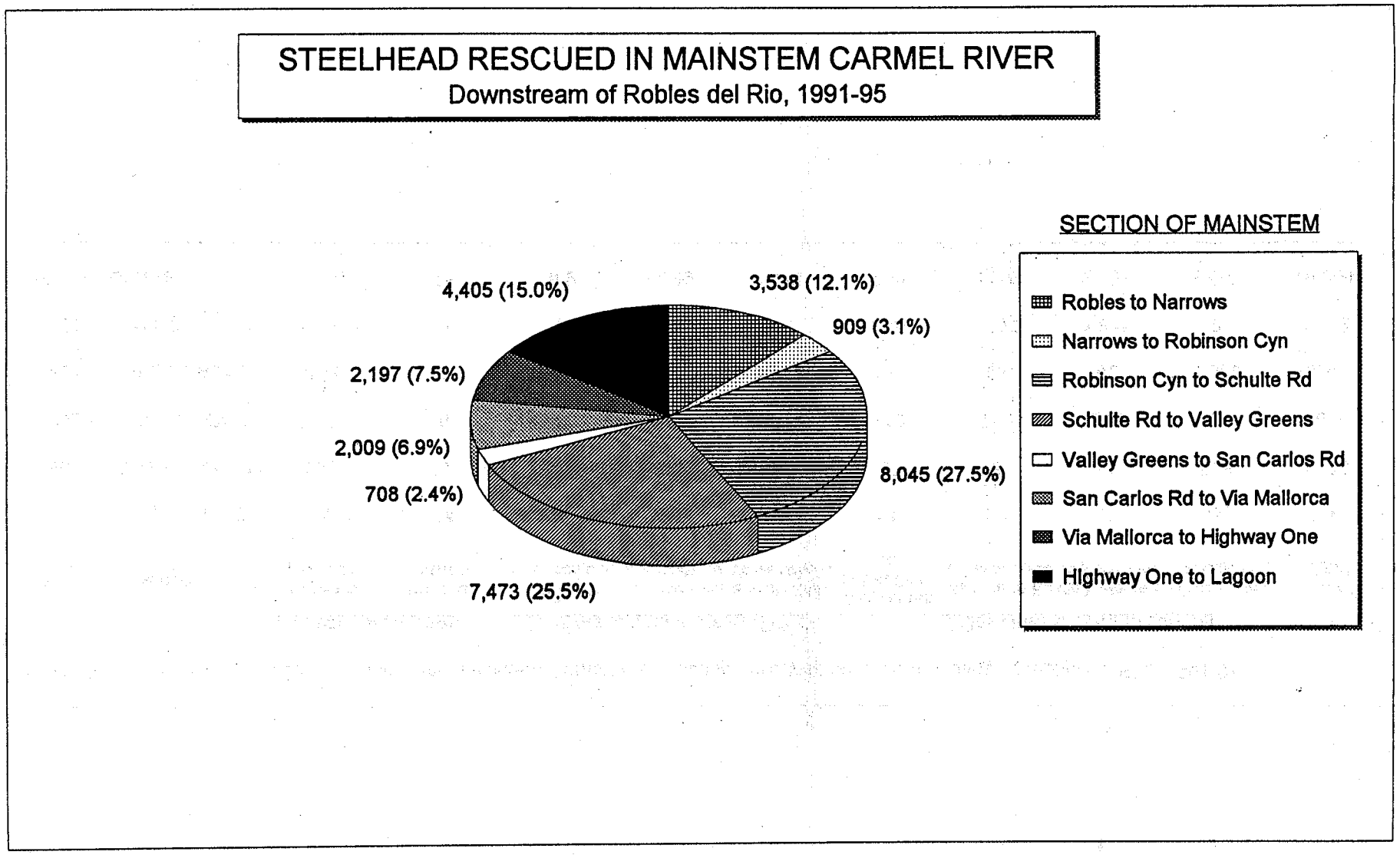
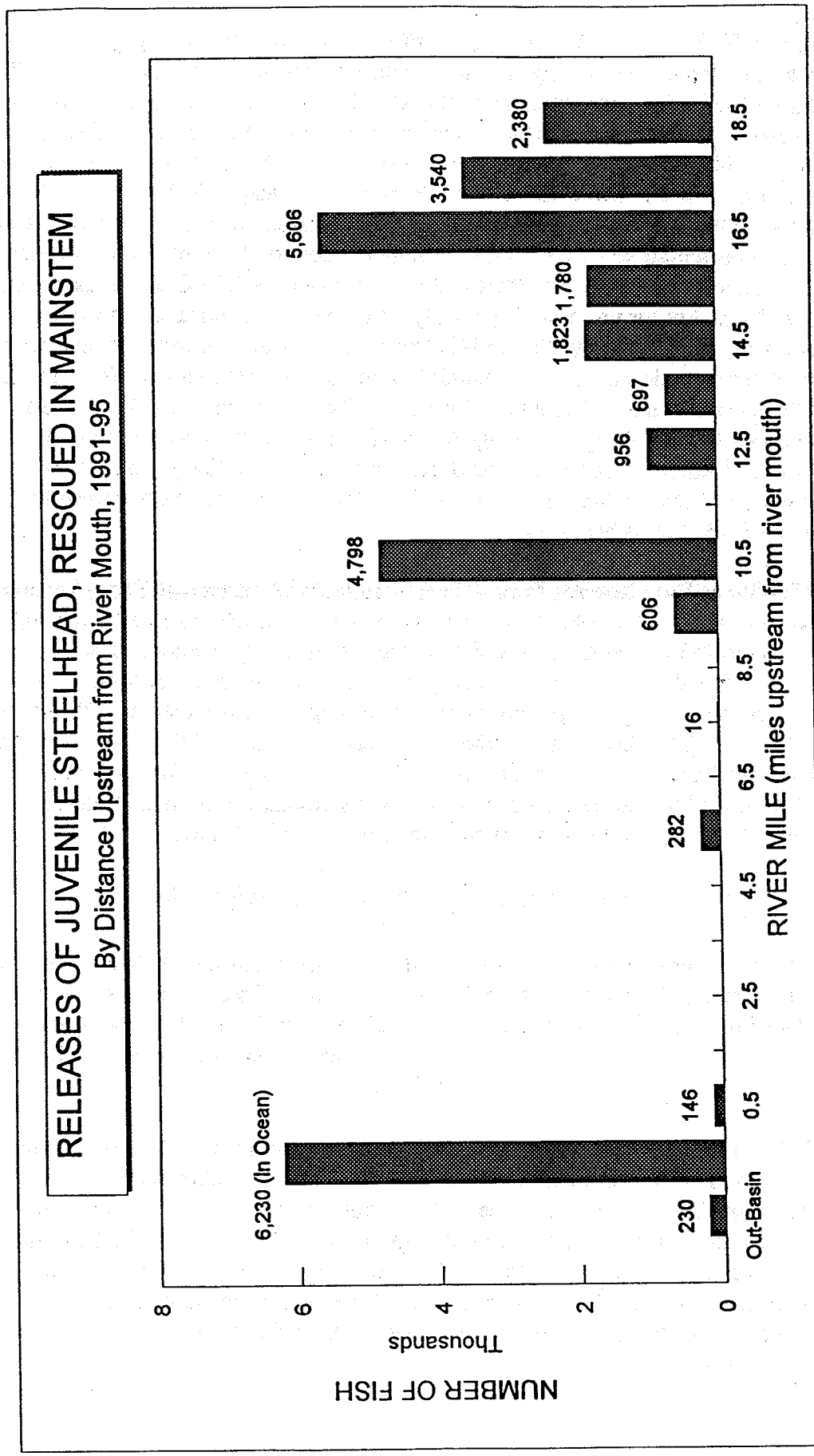

STEELHEAD RESCUED IN MAINSTEM CARMEL RIVER
Downstream of Robles del Rio, 1991-95
4,405 (15.0%)
3,538 (12.1%)
909 (3.1%)
2,197 (7.5%)
2,009 (6.9%)
708 (2.4%)
8,045 (27.5%)
7,473 (25.5%)
SECTION OF MAINSTEM
Robles to Narrows
Narrows to Robinson Cyn
Robinson Cyn to Schulte Rd
Schulte Rd to Valley Greens
Valley Greens to San Carlos Rd
San Carlos Rd to Via Mallorca
Via Mallorca to Highway One
Highway One to Lagoon

Table III-3. Number of steelhead rescued in the mainstem Carmel River, during the dry-season, downstream of Robles del Rio, 1991-95.

		Upstream of Narrows		Narrows to Valley Greens Drive			Valley Greens Drive to Lagoon				
Year	Rescue Period	Robles to Boronda	Boronda to Narrows	Narrows to Robinson Cyn	Robinson Cyn to Schulte Rd	Schulte Rd to Valley Greens	Valley Greens to San Carlos Rd	San Carlos Rd to Via Mallorca	Via Mallorca to Highway One	Highway One to Lagoon	Annual Total
1991	May 2 - Nov 27	61	14	37	24	19	11	315	17	381	879
1992	May 13 - Sep 29	959	0	872	922	86	37	167	51	576	3,670
1993	Jun 30 - Oct 8	1,589	0	0	2,784	1,013	119	259	242	68	6,074
1994	Apr 6 - Aug 5	402	0	0	4,315	5,682	35	93	42	3,380	13,949
1995	Aug 3 - Dec 8	513	0	0	0	673	506	1,175	1,845	0	4,712
Totals by Location		3,524	14	909	8,045	7,473	708	2,009	2,197	4,405	29,284

FIGURE III-7


RELEASES OF JUVENILE STEELHEAD, RESCUED IN MAINSTEM
By Distance Upstream from River Mouth, 1991-95
NUMBER OF FISH
Thousands
8
6
4
2
0
6,230 (In Ocean)
230
146
282
606
4,798
956
697
1,823
1,780
5,606
3,540
2,380
Out-Basin
0.5
2.5
4.5
6.5
8.5
10.5
12.5
14.5
16.5
18.5
RIVER MILE (miles upstream from river mouth)

(d) Sleepy Hollow Steelhead Rearing Facility -- The Five-Year Mitigation Program includes construction of a facility for rearing juvenile steelhead through the summer season. The purpose of the rearing facility is to rear juvenile steelhead, which are rescued from the lower river during the dry season. In 1991, the District began surveys for a site to locate the facility and initiated negotiations with Cal-Am to lease Cal-Am property for the facility, located about one mile downstream of San Clemente Dam, at a site known as Sleepy Hollow. In 1992, the District developed a preliminary design, outlined in an Planning Memorandum, and discussed the project design with representatives of the CDFG, Monterey County Planning Department and Cal-Am. In 1993, the conceptual design was reviewed and approved by CDFG and a lease agreement was finalized with Cal-Am for use of their property. In 1994, final construction plans for the facility were developed, the District applied to Monterey County and recieved a conditional use permit, and applied for a septic permit, four building permits and a grading permit. The CDFG issued a 1601 Streambed Alteration Agreement for the facility in December 1994. In 1995, the District made revisions to final design drawings for the facility, recieved septic, building, and grading permits from Monterey County, prepared bid materials for contracts, and issued four contracts for construction of the facility. By June 30, 1996 the facility was nearly completed. Presently, a test batch of 500 fish is being reared.

(e) Net-Pen at San Clemente Dam -- In July 1994, the Distrist installed a floating net-pen in the plunge pool at San Clemente Dam to test the feasibility of rearing steelhead in water released from San Clemente Reservoir. A total of 140 seven- to ten-inch juveniles of hatchery and natural origin were rescued from the lagoon and placed into the net-pen. A total of 115 fish, or 82 percent, survived during the period form July through mid-November with the average fish growing from 7 to 10 inches long and tripling its weight from 67 to 201 grams by mid-November. The test indicated that water quality conditions below San Clemente Dam are suitable for rearing juvenile steelhead but that care must be taken to ensure that certain individuals do not grow too rapidly, which can inhibit the urge to migrate to the ocean as smolts.

5. Assess Smolt Mortality at Los Padres Dam

As part of a cooperative effort between CDFG, Cal-Am and the District to improve passage conditions, increase the survival of smolts and the returns of sea-run adults to Los Padres Dam, the District implemented a program to measure the mortality of steelhead smolts as they pass through the spillway. The following sections summarize major activities during the reporting period:

(a) 1991 Activities -- The District designed and began construction of a set of low-flow weirs, upstream of the fish barrier gabion below the dam. This weirs allowed unimpeded downstream emigration of smolts at low flows and served as a trapping station for experimental fish that were released at the head of the reservoir, at the top of the spillway, and at the base of the spillway. The District made arrangements with CDFG to receive several small lots of experimental smolts from two groups of Carmel River strain steelhead for experiments planned for 1992. The District designed and constructed a new set of stainless steel fingers for the adult trap below the dam. This replaced an old, rusted unit.

(b) 1992 Experiments at Los Padres Dam -- In April 1992, eight groups of marked smolts were released at Los Padres Dam. Releases were made on four days at flows ranging from 30 to 45 cfs. On each day, one group was released at the top of the spillway and one into the plunge pool below the spillway. For several weeks following the releases, staff monitored passage of the marked fish at the trapping station, constructed in 1991, tallied the number of marked fish from each group, and noted any injuries to the fish. Based on retrievals of marked fish, the mortality of smolts passing through the spillway averaged 27 percent and ranged from zero to 50 percent. (Hanna and Dettman, 1993) On average, the natural mortality over an equivalent length of stream would be about 0.3 percent, so the average of 27 percent was about two orders of magnitude higher than natural mortality. This led the CDFG and the National Marine Fisheries Service (NMFS) to consider designing improvements to mitigate the existing situation.

(c) Survey of Spillway and Plunge Pool -- In November and December 1992, as part of the design phase for improvements at the spillway, and at the request of the CDFG and NMFS, the District surveyed the spillway, falls and plunge pool and provided the agencies with a cross-section and plan view of the spillway.

(d) CDFG Modifications -- During 1993, the CDFG initiated a project to make two modifications to the dam, including cutting of a notch at the top of the spillway and removal of additional rock and/or extension of the ramp at the bottom of the spillway. The notch was completed in December 1993 and blasting of additional rock at the head of the plunge pool, below the spillway, was completed in August 1995.

(e) Experiments Planned for 1995 -- Experiments to test the effectiveness of the notch and transporting steelhead around Los Padres Reservoir were canceled in late April 1995, due to safety concerns and lack of experimental fish. The District had planned to procure experimental fish by installing a trapping station upstream of the reservoir. As a result of the March 1995 flood, safe passage to the upper end of the reservoir was blocked by an extensive floating raft of logs and debris.

(f) 1996 Experiments -- Experiments were implemented during Spring 1996 to test the effectiveness of the notch and modifications to the base of the spillway. In late March, the District installed a rotating screw-trap below the spillway and a box trap upstream of the reservoir. The District marked five groups of smolts and released them in the river at the head of the reservoir, into the forebay above the spillway, into the spillway below the crest, into the plunge pool at the base of the spillway, and into a control area. The experiment extended through the last week of May 1996 and a report on the findings is being prepared for release in November.

6. Additional Activities

The District carried out several activities that were not specifically part of the Allocation Mitigation Program, but improved habitat conditions or helped restore the steelhead population. Following is a brief accounting of these activities:

(a) Spawning Habitat Restoration Project -- In 1990, the District applied for and in 1991 received a grant from the California Wildlife Conservation Board (CWCB) restore spawning habitat in a 7.4-mile long reach between Los Padres Dam and the Sleepy Hollow area below San Clemente Dam (**Figure III-8**). Existing dams have blocked the flow of gravel from the upper watershed for 75 years at San Clemente Dam and 48 years at Los Padres Dam and severely reduced available spawning habitat throughout the reach. The contract with the CWCB called for placing gravel into selected spawning sites and maintaining the sites over a ten-year period. The District acquired a Section 404 permit from the U. S. Army Corps of Engineers (No. 19958S09, dated May 26, 1993), which extends for five years and allows the District to add gravel below each dam for maintenance of spawning habitat. Following is an accounting of activities for each reporting year.

1991: The District received grant funding and authorization to proceed with the project in May.

1992: The project was delayed because it required a Section 404 Permit from the Corps of Engineers. The District applied for the Section 404 permit in September 1992.

1993: District received 1601 Streambed Alteration Agreement from CDFG in January 1993, a Waiver of Water Quality Certification from the Regional Water Quality Control Board in February 1993, and Section 404 Permit from the Army Corps in May . In June 1993, the District completed the initial phase of the project by placing a total of 580 cubic yards (cy) of washed, river-run gravel into 28 sites using a Sikorsky T58 helicopter and a system of air pumps powered by a diesel semi-truck/trailer rig.

1994: During January 1994, the District began periodic surveys of the restoration sites. Nine sites below San Clemente Dam were surveyed once every two weeks during the period from January 28 through April 7, 1994.

1995: The January and March floods severely damaged the restoration sites by scouring gravel, leaving only a remnant of the gravel for use by adult steelhead. In response to this situation, the District applied to the FEMA for funds to repair the project and received authorization to expend $72,000 for repairs.

As part of its contract with the CWCB, the District is required to add gravel to the river downstream of San Clemente and Los Padres Dams. In May 1995, the District placed a total of 270 cubic yards of gravel below the dams, including 210 cy below Los Padres Dam, 20 cy just upstream of Sleepy Hollow (San Clemente) Ford, and 40 cy at Old Carmel Dam, located downsteam of San Clemente Dam.

1996: As of this report, the District had injected the 1996 allotment of gravel, including 120 cy below Los Padres Dam and 100 cy below San Clemente Dam. FEMA approved the District's application to repair the original work, the District prepared a request for bids in June 1996, and awarded a contract with ERS Industrial Services, Inc to place 540 cy of spawning gravel. This work was completed during late July 1996.

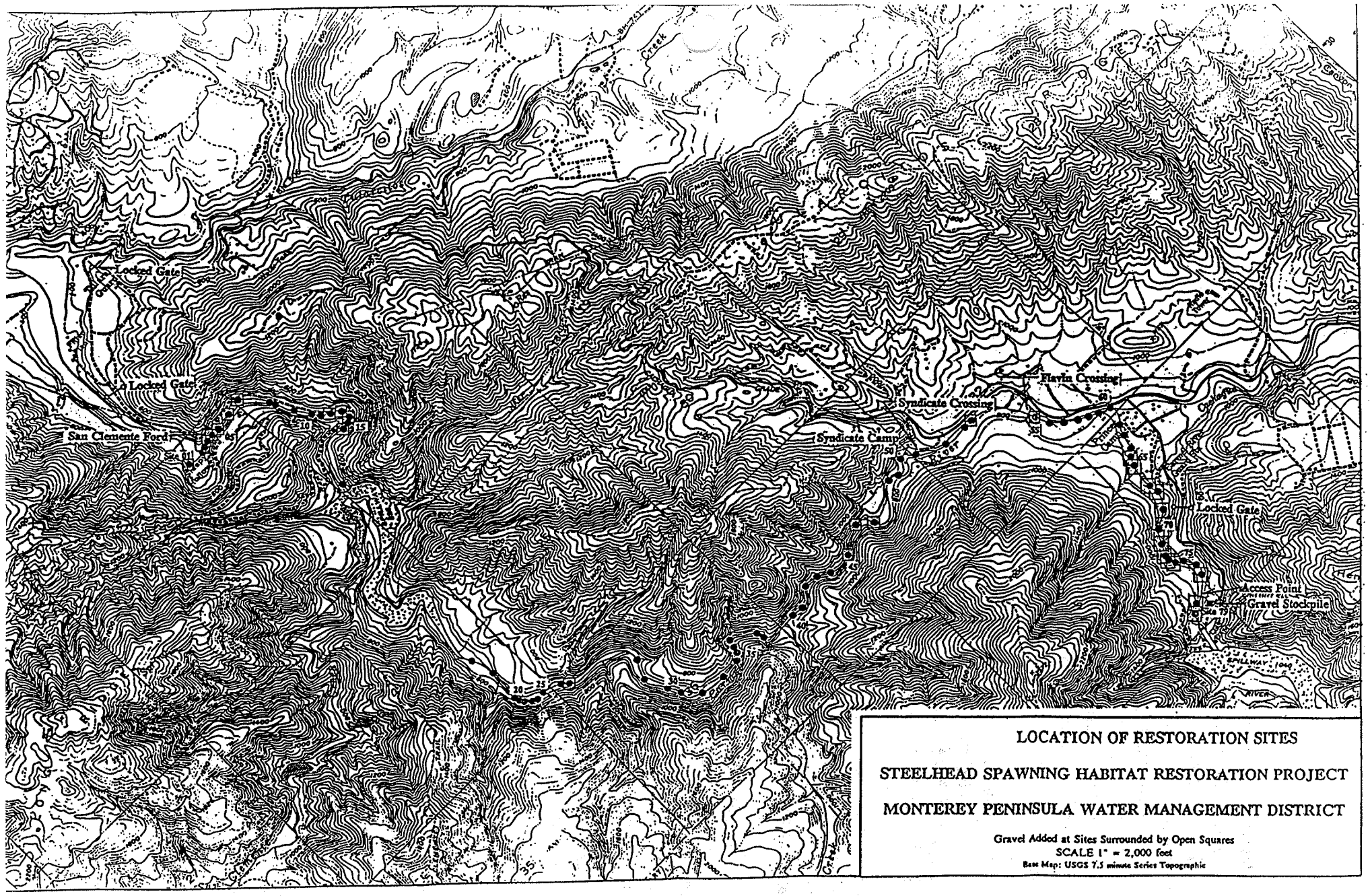


Figure III-8. Location of restored spawning habitat sites in the Carmel River between Los Padres Dam and Sleepy Hollow Area

(b) Rescue and Downstream Transport of Kelts – Kelts, defined as adult steelhead which spawned during the January through March period, begin to migrate back to the ocean in late spring and early summer. Under existing conditions, these fish are threatened by receding flows in most years, especially when the upstream migration of adults is delayed, due to late season storms. During the reporting period, the District conducted numerous rescues of kelts that were threatened by receding flows. In 1994, a total of 43 steelhead kelts were rescued and transported to the lagoon or ocean. This compares to totals of twelve in 1993 and one in 1992 (**Figure III-9**). Of the total kelts rescued in 1994, 37 fish (86 percent) were captured in the reach between Highway One and Robinson Canyon and six fish (14 percent) were captured in the lagoon.

(c) Adult Fish Counts at San Clemente Dam -- Since 1991, the District with assistance from Cal-Am, has counted the number of adult steelhead, passing San Clemente Dam during the winter migration period from December through April. Prior to 1994, counts were made once per day by turning off the flow into the fish ladder and tallying the number of adult steelhead. In 1994, the District constructed and installed a new fish counter to track all upstream migrants that pass through the fish ladder. The counter mechanism is patterned after one on the North Fork of the Clackamas River in central Oregon. It records the date and time of fish passage. In 1995, the District installed a camera at the counting station, but was unable to sort out technical problems in synchronizing the camera shutter with the counter.

(d) Emergency Broodstock Program – In 1990, the CRSA inititated an emergency broodstock program under agreement with the CDFG and the Monterey Bay Salmon and Trout Project (MBSTP). During the period from 1990 through 1993, the District assisted the program by providing smolts for broodstock, transporting broodstock to and from the CDFG GCL below Soberanes Point and MBSTP's Big Creek Hatchery in Santa Cruz County, and planting progeny of the program in the Carmel River. Under agreement with the CDFG, the District transported a total of 60,552 juvenile steelhead, including 10,570 smolts from the 1991 brood, 42,800 fry and fingerlings and 982 smolts from the 1992 brood, and 6,200 fingerlings from the the 1993 brood.

C. Summary of Expenditures, 1991-1996

During the 1991-1996 period, a total of $1,436,500 was spent on the steelhead element of the Five-Year Mitigation Program (**Table III-4**), representing 28 percent of the total program expenditures (see **Table VIII-1** in section VIII of this report). As shown in **Table III-4**, 53 percent of the fishery expenditure was for personnel, 22 percent was for project construction and operation expenses, and 25 percent was for fixed assets over the five-year period. During the five-year period, no expenditures were made for the Mid-Valley Fish Holding Facility, which was included in the original Five-Year Mitigation Plan. Also, the Sleepy Hollow Steelhead Rearing Facility did not become operational until September 1996. Thus, expenditures for the steelhead program over the period were about $44,700 (three percent) less than the costs estimated in 1990 (roughly $1.48 million). The actual expenditures would have been greater than the 1990 estimates if these two capital projects were completed as originally planned.

FIGURE III-9

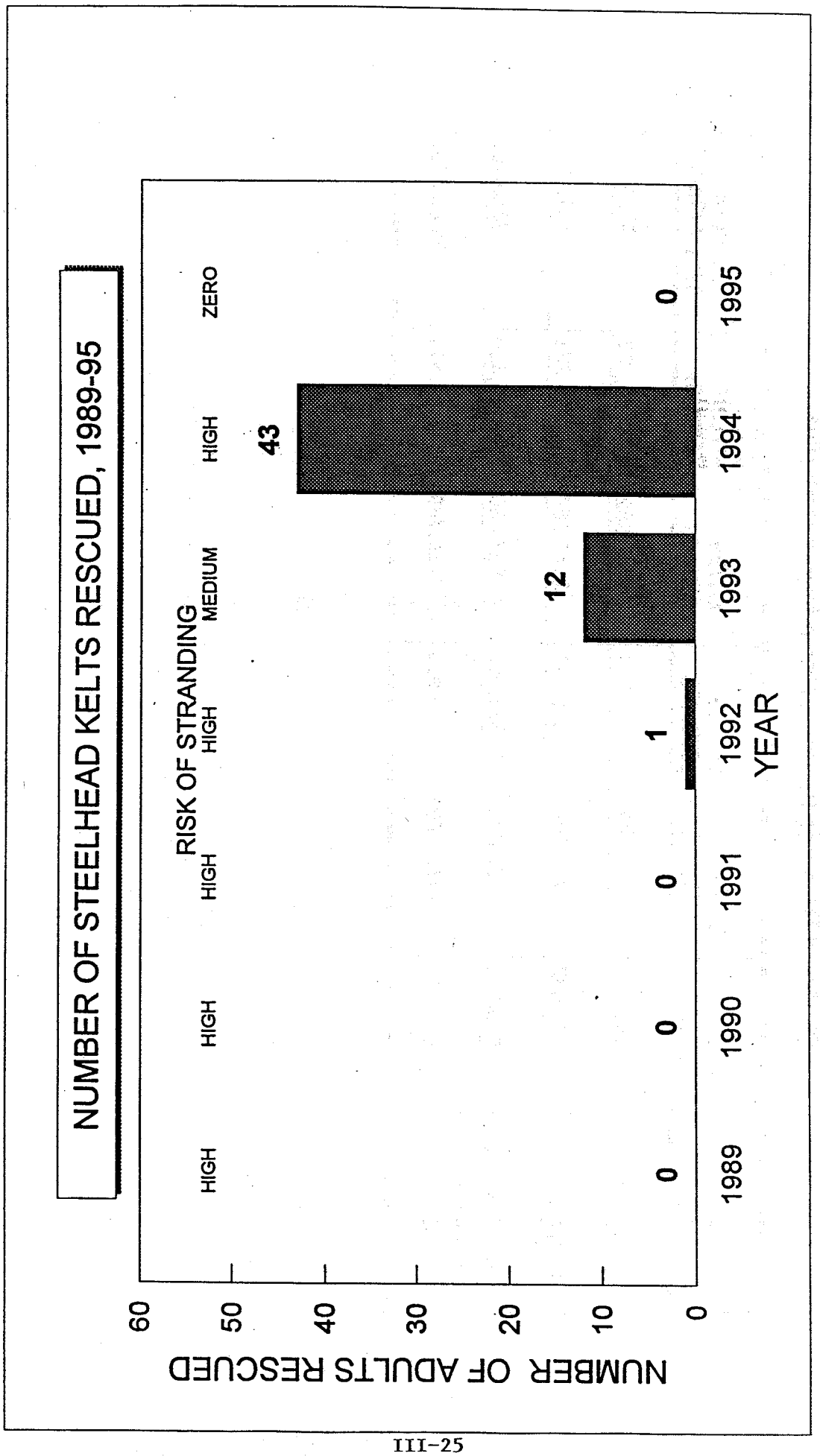

NUMBER OF STEELHEAD KELTS RESCUED, 1989-95
NUMBER OF ADULTS RESCUED
60
50
40
30
20
10
0
RISK OF STRANDING
HIGH
HIGH
HIGH
HIGH
MEDIUM
HIGH
ZERO
0
0
0
1
12
43
0
1989
1990
1991
1992
1993
1994
1995
YEAR

Table III - 4

Steelhead Resource Program Expenditures 1991-1996

Expense Category	1/1/91-12/31/91	1/1/92-12/31/92	1/1/93-12/31/93	1/1/94-6/30/95	7/1/95-6/30/96	Total for 1/1/91-6/30/96
Personnel	$61,021	$102,775	$123,631	$266,982	$209,703	$764,112
Projects	$7,082	$51,309	$75,269	$145,287	$38,283	$317,230
Fixed Assets	$10,500	$2,805	$21,055	$27,480	$293,325	$355,165
Program Total	**$78,603**	**$156,889**	**$219,955**	**$439,749**	**$541,311**	**$1,436,507**

A major capital project planned for the 1991-1996 period was construction of the Sleepy Hollow Steelhead Rearing Facility (SHSRF) as described in Section III-B.4(d). The District issued contracts for the construction of SHSRF in June 1995, but began acquiring equipment for the facility in FY 1991-92 (**Table III-5**). Expenditures for this facility totaled $406,000 during the reporting period, with $101,900 in fixed asset purchases and $304,100 in project expenses. As of June 1996, the contractors has completed 77 percent of the construction of the facility. By the end of construction, the capital cost is projected to total $510,000, or three times the initial estimated cost of $173,100 in the 1990 Five-Year Mitigation Plan. The large difference in cost is due to inflation, changes to the project during final design, unforseen costs in the original estimate, and the fact that the District is required to go out-to-bid for capital projects costing more than $5,000. Of the total project capital expense of $510,000, $411,000, or 81 percent, was allocated to construction contracts for the diversion, pipelines, rearing tank bases, electrical system, office/lab/shop building, and rearing channel. The remaining $99,000 was allocated to purchase supplies and miscellaneous capital assests and to pay for electrical engineering consultants and permits.

D. Program Effectiveness

In 1991, at the beginning of the reporting period, the adult sea-run population of steelhead was nearly extirpated from the Carmel River Basin. Four years of record-breaking drought conditions during the 1987-91 period, and the diversion of surface and subsurface flow prevented the river from reaching the ocean. The lack of surface flow blocked the upstream migration of adult steelhead in four sequential years, stranded smolts during their downstream emigration, interfered with migration of adults and juveniles past Los Padres and San Clemente Dams, and resulted in a population that can best be described as on the "verge of being extirpated", or threatened with extinction.

The following sections summarize the current status of the population and address whether the mitigation program, implemented during the last five years, has been effective in improving environmental conditions, increasing the population of steelhead, and reducing the risk that steelhead could be extirpated from the basin. The section begins with a description of the juvenile steelhead population, because this life stage provides a measure of the population's response to habitat improvements and other environmental conditions. The section continues with an examination of the current status of the adult steelhead population, as indexed by adult returns to San Clemente and Los Padres Dams and by the use of restored steelhead habitat. It continues with an examination of additional juvenile production in the reach below Scarlett Narrows and an assessment of the effectiveness of fish rescues, and ends with a summary on the prognosis for future populations.

Table III-5. Fixed Assets and Project Expenses for Sleepy Hollow Steelhead Rearing Facility, 1991-1996.

Fiscal year	Fixed Assets	Project Expenses	Annual Total
1991-92	$16,779	$89	$16,868
1992-93	$0	$0	$0
1993-94	$49,391	$1,533	$50,924
1994-95	$25,052	$16,743	$41,795
1995-96	$10,649	$285,779	$296,428
Overall 1991-96	$101,871	$304,144	$406,015

1. *Status of Juvenile Steelhead Population*

- ***Did the District's efforts to regulate flows and rescue steelhead help to restore populations of juvenile steelhead?***

This question can be answered by examining trends in the density and abundance of the juvenile population. The production of juvenile steelhead is one of the most direct measures of whether activities implemented as part of the mitigation program were effective in restoring the steelhead population in the Carmel River.

(a) Population Density -- Since Fall 1990 the District has surveyed the juvenile steelhead population in the reach downstream of Los Padres Dam. This information is crucial to assess the success of adult reproduction and whether freshwater habitat is fully saturated with juveniles. During the reporting period the density of the juvenile population averaged 4,049 fish per mile of stream and ranged from a low of 2,038 fish in 1990 to a high of 5,660 fish in 1995 (**Table III-6**). The population density increased steadily during the period, except in 1994, which was a dry year with less available rearing habitat and fewer spawning adults (see Sections III-C.2 and 3).

(b) Comparison to Historical Data -- The CDFG surveyed juvenile steelhead in the reach downstream of Los Padres Dam in 1973 and 1974, and in the reach below San Clemente Dam in 1983 and 1985-87 (Snider 1983, and CDFG office files). Lineal density for the period prior to the drought averaged 6,032 fish per mile and ranged from a low of 3,648 fish/mi in 1974 to 9,307 fish/mi in 1986. Population density declined during the drought years of 1987-1990, averaging 2,389 fish/mi and dropping to a low of 22 fish/mi in 1989 (**Table III-6**). The low population density was indicative of insufficient spawning adults and juveniles that were trapped in small freshwater refuges during the drought years. Based on a comparison of recent and historical data, it appears that the juvenile population is rapidly recovering from low numbers extant during the 1987-91 drought, and is approaching levels that were common in the 1970s and early 1980s (**Figure III-10**).

(c) Comparison to Coastwide, Regional and Local Data -- The density of the juvenile population in the Carmel River can be compared to levels in other steelhead streams in California.

Statewide Comparison: Recently, the Association of California Water Agencies commissioned a review of the status of steelhead stocks in California, as part of a study to develop recommendations for the National Marine Fisheries Service regarding the Service's biological assessment and listing of steelhead under the Endangered Species Act (Cramer *et al.*, 1995). This review included a compilation of available data on juvenile steelhead population along the coast of California from the Oregon border, south to Ventura County. Population data from a wide variety of streams should be compared on a unit area basis to compensate for the effect of stream size. The density of the juvenile population in the Carmel was similar, or slightly higher, to northern California streams, prior to 1987, but ranged well below levels in other streams during the 1987-91 drought (**Figure III-11**). Subsequent to the drought years, the population in the Carmel River increased, but still ranges about 50 percent below the levels in northern California,

Table III-6. Density of juvenile steelhead population in the Carmel River, 1973-95 with a comparison to selected northern California Streams. Source: CDFG file reports, MPWMD files and Cramer, et al. 1995)

	Lineal Density			Aerial Density		North Coast Streams
Year	(no/mi)	(no/100ft)	(no/meter)	(no/sqft)	(no/sqm)	(no/sqm)
1973	6,121	116.4	0.355	0.0486	0.523	
1974	3,648	69.4	0.212	0.0290	0.312	
1983	6,116	116.3	0.355	0.0468	0.503	0.430
1984						0.800
1985	4,966	94.4	0.288	0.0544	0.585	0.550
1986	9,307	177.0	0.540	0.1037	1.116	0.930
1987	5,107	97.1	0.296	0.0492	0.529	0.840
1988						0.810
1989	22	0.4	0.001		0.000	0.800
1990	2,038	19.6	0.060	0.0185	0.199	0.690
1991	2,978	39.2	0.120	0.0148	0.159	0.590
1992	3,333	58.7	0.179	0.0313	0.337	0.630
1993	5,174	98.0	0.299	0.0524	0.564	1.110
1994	3,100	58.7	0.179	0.0291	0.313	0.590
1995	5,660	107.0	0.326	0.0529	0.569	
Averages:						
1973, 74, 83, 85-86	6,032	114.7	0.350	0.0565	0.608	0.678
1987,89,90	2,389	39.0	0.119	0.0339	0.243	0.785
1991-95	4,049	72.3	0.220	0.0361	0.388	0.730

FIGURE III-10

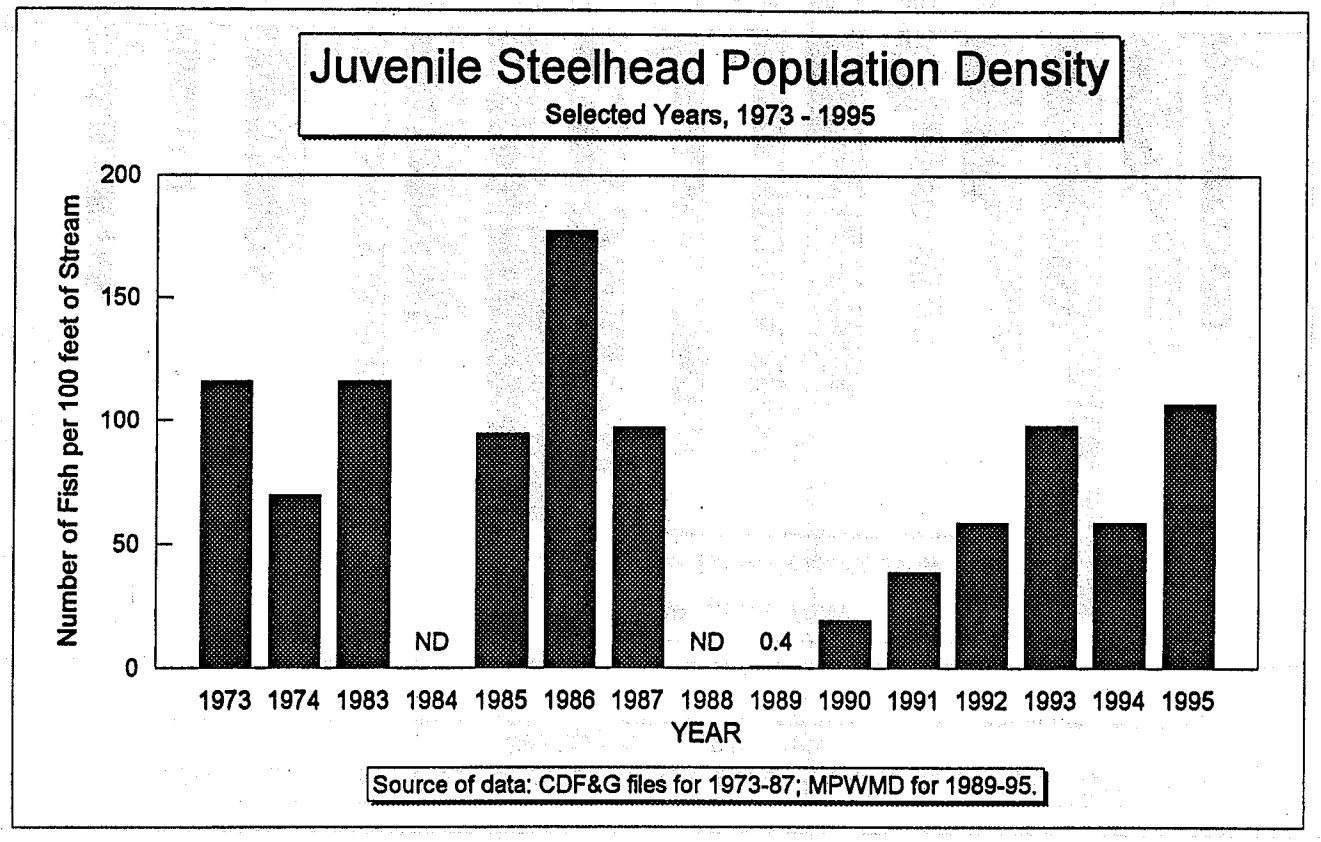
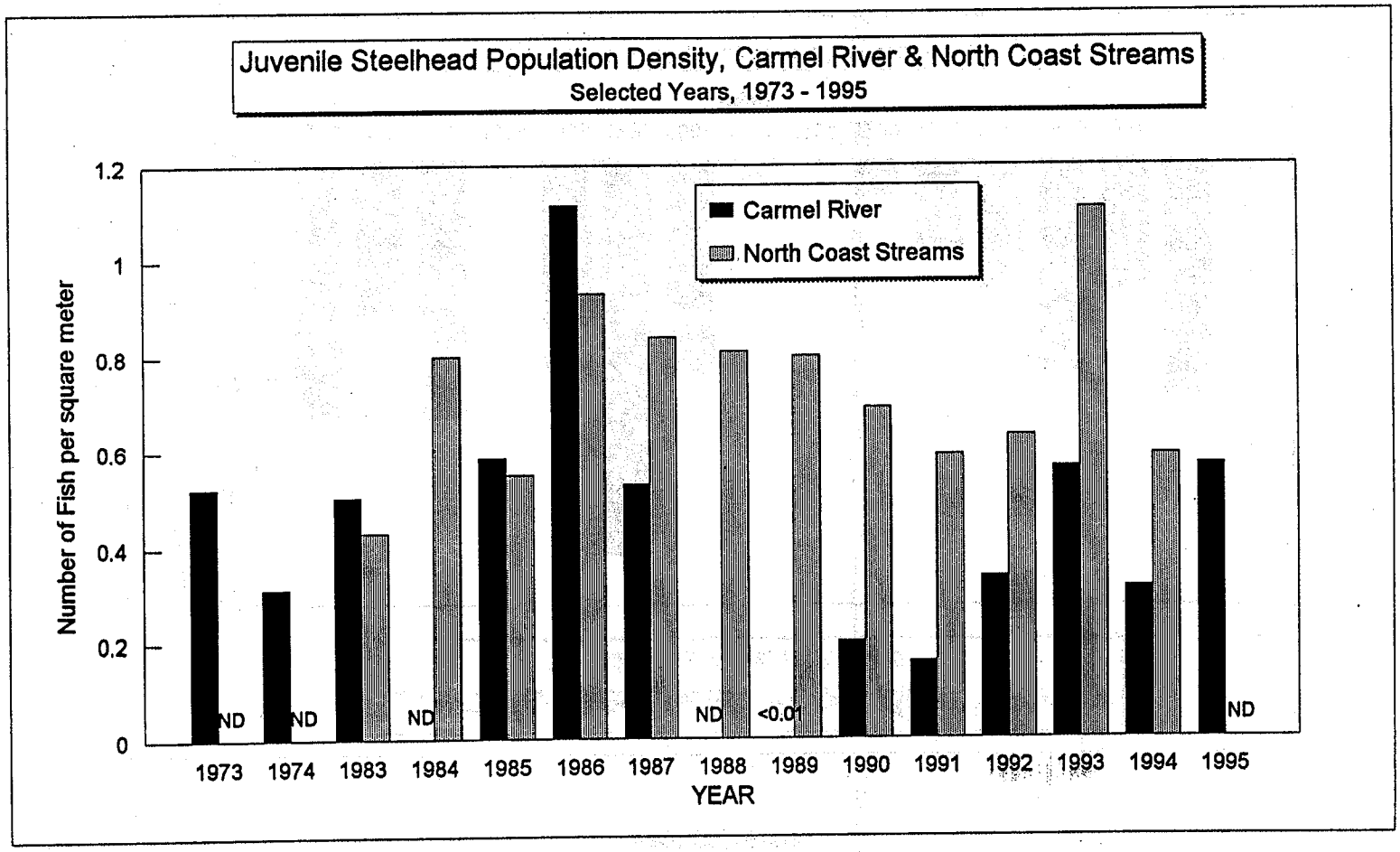


FIGURE III-11



where numbers remained relatively consistent during the drought years and post-drought years (**Table III-6**).

Regional Comparison: Trihey and Associates (1995) recently compiled population survey data from Lagunitas Creek in Marin County during the period from 1970 through 1995. Based on a comparison of selected years, when comparable data is available from the Carmel River, it appears population densities in the Carmel were once approximately double those in Lagunitas Creek, but this pattern broke down during the 1987-91 drought. Since the end of the drought, no clear relation has developed, but during two out of the last three years, population density in the Carmel River exceeded levels in Lagunitas Creek (**Figure III-12**).

Local Comparison: More locally, D. W. Alley and Associates (1995) surveyed steelhead population densities at eighteen stations in the San Lorenzo River basin in 1981, 1994, and 1995. Population density in the lower portion of the San Lorenzo River, where the stream is similar in size to the Carmel River, averaged 52.1 fish per 100 feet of stream in 1994 and 81.3 fish/100 feet in 1995. Average population density was similar, but slightly higher, in the Carmel River, equaling 58.7 fish/100 feet in 1994 and 107 fish/100 in 1995 (**Figure III-13**).

(d) ***Population Abundance*** – Estimates of population density can be expanded to estimate the abundance of juvenile steelhead in specific reaches, represented by sampling stations. **Table III-7** is a compilation and expansion of population densities into abundance estimates for seven reaches between Los Padres Dam and the downstream edge of viable habitat. Overall abundance averaged 50,400 fish during the reporting period and ranged from 21,200 fish in 1991 to 90,300 fish in 1995. Population abundance was consistently higher in the reach between the dams, except in 1995 when abundance was only one-third of levels below San Clemente Dam (**Figure III-14**). This was caused by the poor to fair substrate conditions in the reach between the dams. High concentrations of fine sediment from Cachagua Creek impaired rearing habitat throughout the reach downstream of the confluence with Cachagua Creek, thereby reducing the quality of rearing habitat and number of juvenile steelhead reared during the summer and fall months.

(e) ***Comparison to Basin Potential*** – Kelley, Dettman and Rueter (1987) estimated the capacity of the Carmel River to rear juvenile steelhead in the reach between the Narrows and Los Padres Dam. The total equaled 101,000 juveniles, including 94,000 young-of-the-year, 6,000 yearlings, and 1,000 2-year and older juveniles. A comparison of estimated total abundance to rearing capacity during the reporting period indicates that the abundance of juvenile steelhead in the mainstem of the Carmel River ranged from 20 to 90 percent of the capacity. This is remarkable, considering the abundance had been reduced to below 1,000 fish, or one percent of the rearing capacity, as recently as 1989.

The trends noted in the above sections are evidence that the combined effect of the District's efforts to regulate streamflow releases from San Clemente Dam and rescue juvenile steelhead have contributed to the recovery of the juvenile population. Other contributing parties include CDFG, CRSA, Cal-Am and the Monterey Bay Trout and Salmon Project.

FIGURE III-12

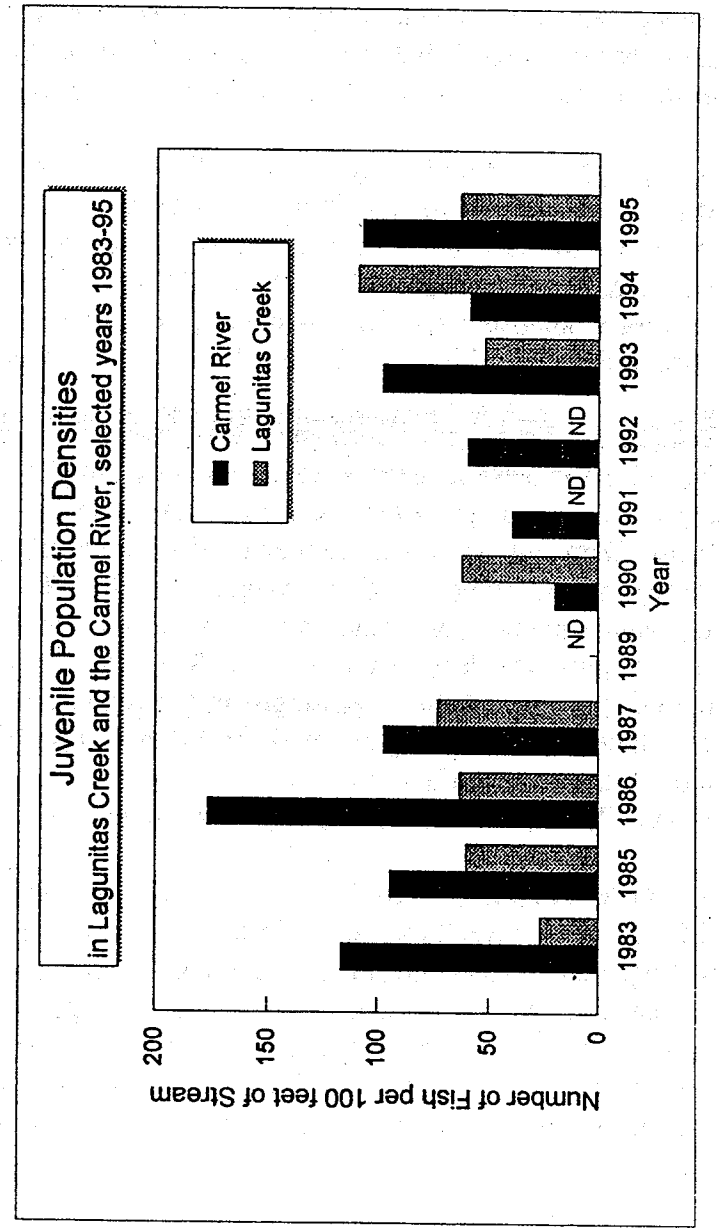


FIGURE III-13

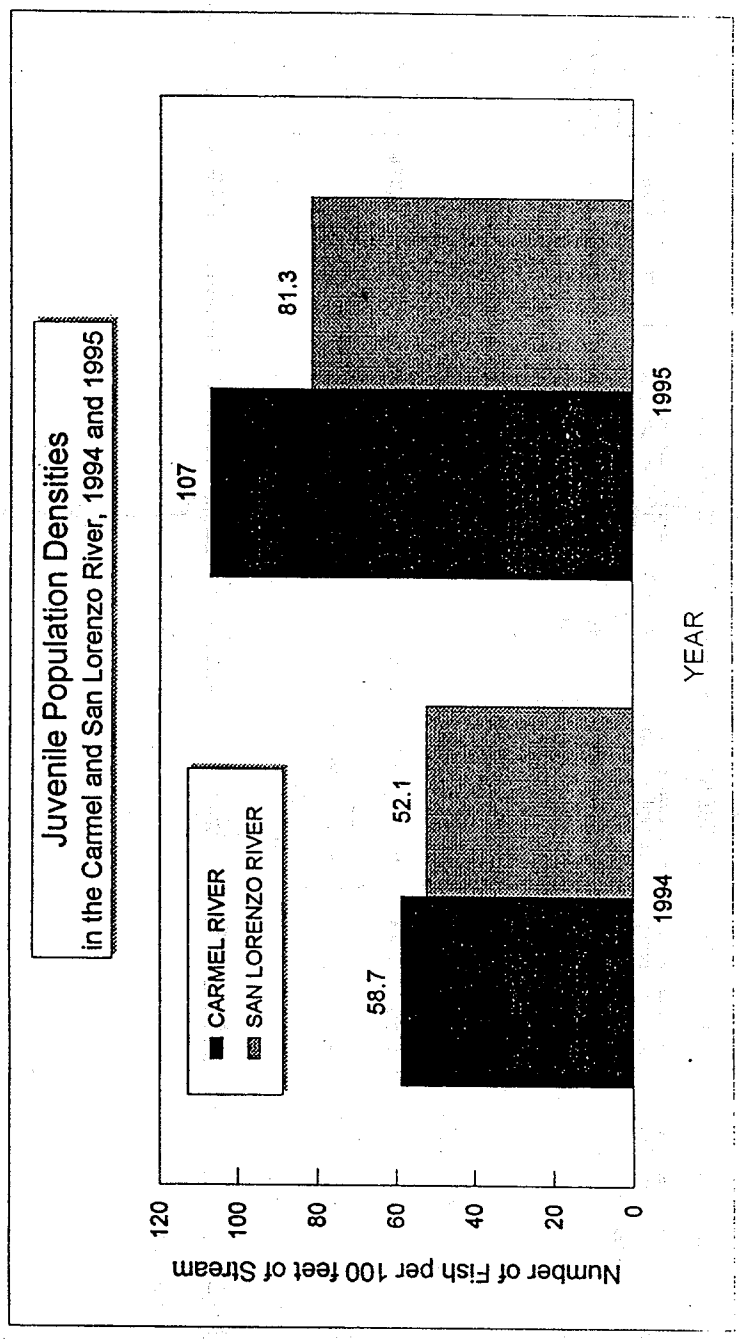


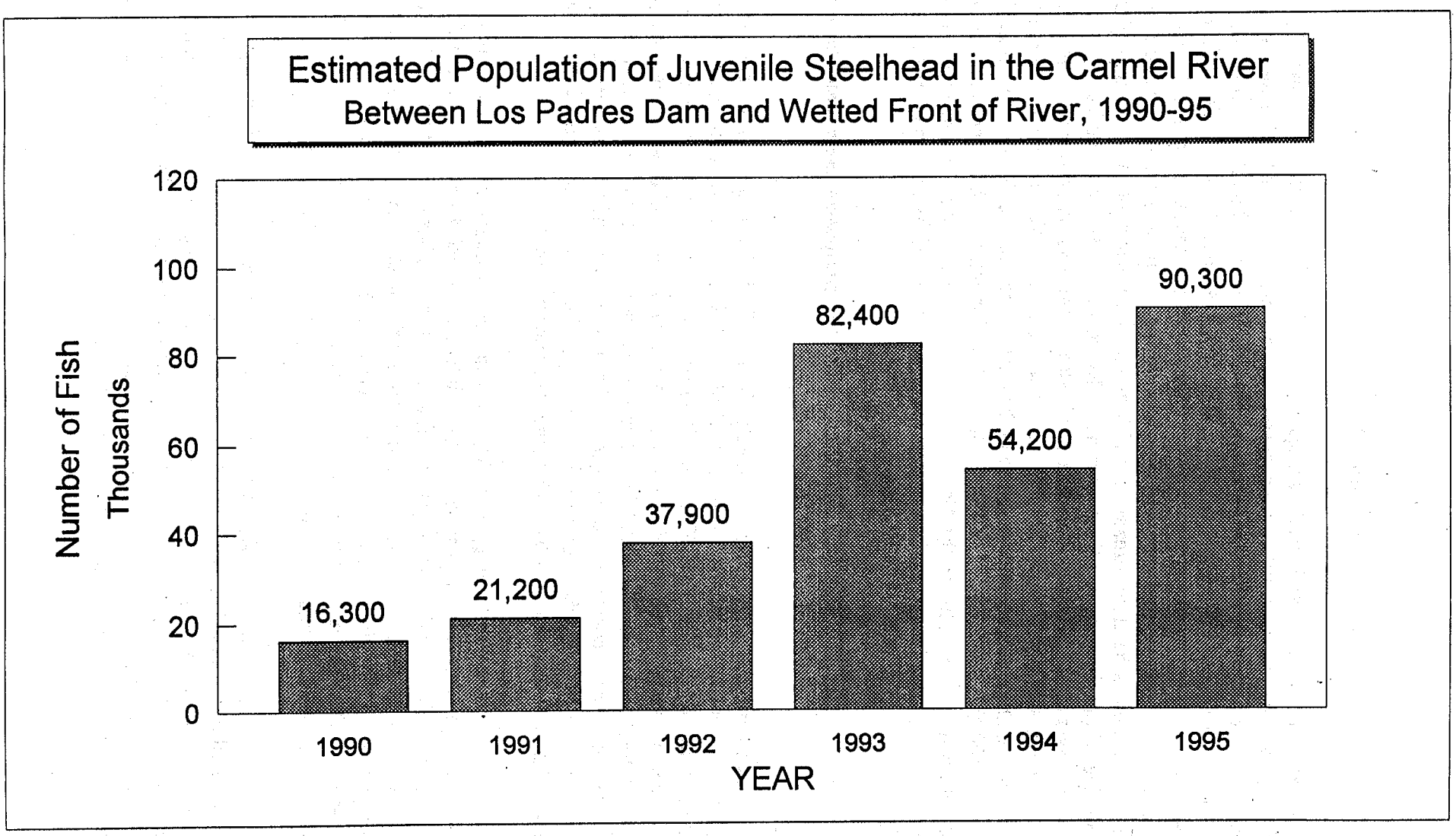
Table III-7. Estimated fall population of juvenile steelhead in the mainstem of the Carmel River, between the river front and Los Padres Dam, October 1990 to 1995. Based on annual population surveys conducted by the Monterey Peninsula Water Management District and estimated length of viable habitat in each reach.

ESTIMATED ABUNDANCE OF JUVENILE STEELHEAD BY STREAM REACH

	Scarlett Narrows (RM 8.7)		Garland Park (RM 10.8)		Boronda Bridge (RM 12.7)		Stonepine Resort (RM 15.8)		Sleepy Hollow (RM 17.5)		Los Compadres (RM 19.7)		Stonehouse (RM 24.7)		ANNUAL TOTALS		
															Downstream San Clemente to		
YEAR	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	Density (No./ft)	Pop. (Nos.)	San Clemente (Nos.)	Los Padres (Nos.)	Overall (Nos.)
1990	--	--	--	--	--		0.50	5,099	0.27	3,920	0.26	5,874	0.22	1,380	9,019	7,254	16,273
1991	--	--	0.12	1,299	0.12	811	0.74	7,502	0.39	5,683	0.09	2,002	0.62	3,906	15,295	5,909	21,204
1992	--	--	0.67	7,252	0.36	2,433	0.96	9,732	0.30	4,372	0.40	8,900	0.83	5,229	23,789	14,129	37,918
1993	0.62	4,256	0.91	9,850	0.92	13,504	0.84	8,516	0.52	7,578	1.22	27,145	1.84	11,592	43,703	38,737	82,440
1994	0.44	1,487	0.23	2,490	0.43	2,906	0.50	5,069	0.29	4,226	1.51	33,597	0.710	4,473	16,177	38,070	54,248
1995	0.57	9,932	1.01	10,932	1.61	23,632	1.42	14,395	0.69	10,055	0.50	11,125	1.630	10,269	68,947	21,394	90,341

RM; indicates miles from rivermouth

FIGURE III-14



2. *Adult Steelhead Returns*

Ultimately, the success and effectiveness of the District's efforts to restore the steelhead population will be measured by the abundance of sea-run adults. Estimates of the capacity of the basin to produce adult steelhead have ranged from 4,100 to 4,200 adults, with habitat similar to conditions in 1975 and 1982 (Snider, 1983, and Kelley, Dettman, Rueter, 1987). These estimates were made assuming steelhead were provided unhampered access to all available rearing habitat in the basin, had unrestricted access to the ocean during smolt emigration, and could rear during summer months as far downstream as the Narrows. Establishment of a goal of 4,000 adults is reasonable, if the above assumptions were true. However, the first assumption has not been met for many years due to passage problems at Los Padres Dam, so it is unreasonable to expect in the short term that 4,000 fish would be produced from the basin. With impaired passage conditions at Los Padres Dam, it is reasonable to expect the total production would equal about 2,600 adults, including 500 fish upstream of Los Padres Dam, 1,200 fish from the basin between the dams, and 800 fish from habitat between the Narrows and San Clemente Dam. These expectations can be used as a benchmark for comparison to gage the effectiveness of restoration efforts and to answer the following question:

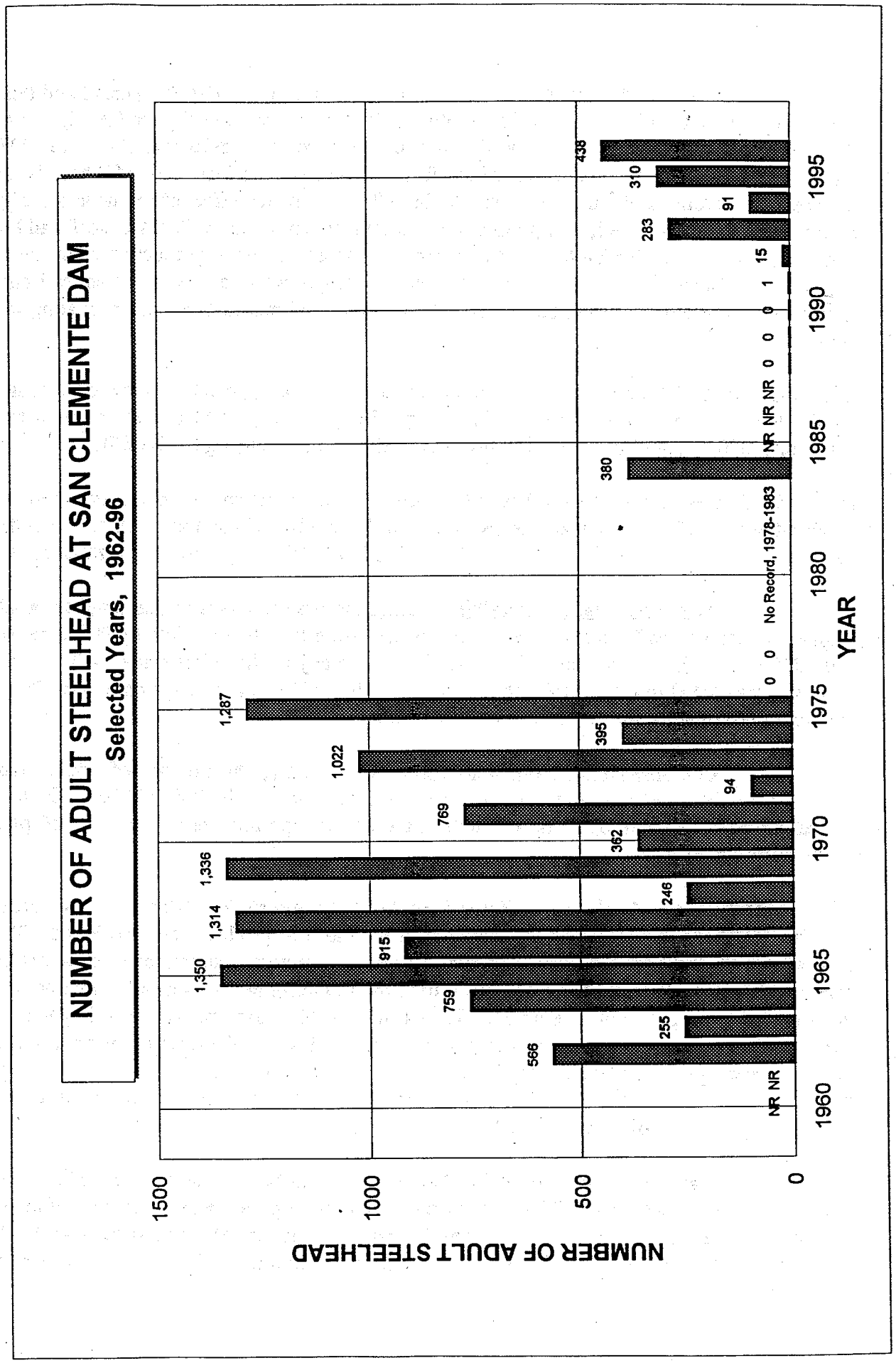
- ***Did the District's activities under the mitigation plan help to restore the population of adult steelhead?***

(a) San Clemente Dam -- As described in Section III-B.6.(c), the District has counted adult steelhead at San Clemente Dam since 1991. Prior to 1991, counts of adult steelhead passing the dam are available for 1984 and 1975; since 1963, visual counts of fish in the ladder are available for selected years. These visual counts were made by turning off flow through the ladder and counting adult fish in it. As such, the visual counts are an index of the run, and may be biased due to under- or over-counting. Nonetheless, visual counts are valuable as a relative measure of the run prior to 1975 and the counts in 1975, 1984, and since 1991 provide accurate estimates of the run size, not including fish taken by legal and illegal fishing.

Five-Year Trend (1991-96): During the reporting period, the number of adults counted at San Clemente Dam averaged 140 adults and ranged from one fish in 1991 to 438 in 1996, with a clear upward trend (**Figure III-15**). The number counted was only 91 in 1994, which was a dry year. In 1994, streamflow during the latter half of the migration season was inadequate for adult migration and probably influenced the number of adults which successfully migrated past San Clemente Dam. This is supported by observations of fish holed-up in the lower river and spawning in marginal habitat downstream of Via Mallorca Bridge.

Comparison to Historical Data: During the period from 1962 through 1975, visual counts of adult steelhead at San Clemente Dam averaged 780 fish and ranged from a low of 94 fish in 1972 to 1,350 fish in 1965. While not directly comparable to actual counts from the reporting period, the index from the 1962-75 period was six times the average count during the reporting period. Based on this comparison, it appears recent returns of adults have not reached levels that were common prior to the 1976-77 drought.

FIGURE III-15



No adult sea-run steelhead migrated upstream of the dam during the 1987-90 period and this led to critically low populations of juvenile fish during 1990 and 1991 (see **Figure III-14**). In turn, these low juvenile populations produced low numbers of sea-run adults in 1994. The 1995-96 returns represent improved production of juvenile steelhead from the 1991 and 1992 broods, good to excellent conditions for survival of smolts in 1993, the postive effect of rescue and transport of almost all smolts in 1994, and production of steelhead smolts from CRSA's steelhead brood stock program. It is important to note the majority of natural juvenile production from the 1991 and 1992 broods was due to stream-maturing steelhead, which were rescued as juveniles from the lower river, transported upstream to permanent habitat and matured without migrating to the ocean.

The 1993 and 1995 counts, as well as counts to date in 1996, indicate the steelhead resource is recovering from the impacts of the 1987-91 drought, but it has not recovered to the historical levels of 1,000 to 1,400 fish observed during the 1962-75 period (**Figure III-15**).

(b) Los Padres Dam -- Cal-Am Water Company operates a trap and truck facility to pass adult steelhead over Los Padres Dam and keeps records of the number of fish transported. Records are available for the years 1949-51, 1962, 1963, 1964, 1975-1978, 1982-86, and 1988-present.

Five-Year Trend (1991-96): During the reporting period, the number of adults trapped at Los Padres Dam averaged 13 and ranged from zero fish in 1991 to 94 fish in 1996. The 1996 amount (considered provisional) is higher than any of the tallies since 1983, when 171 fish were trapped (**Figure III-16**). The trend in number of fish trapped at Los Padres Dam has clearly increased since the end of the 1987-91 drought.

Comparison to Historical Data: Historically, the number of adults trapped averaged 86 fish, and ranged from zero in several years to 558 in 1962 (**Figure III-16**). In comparison to historical trapping data, numbers during the reporting period are about 10 percent of the historical average.

(c) Comparison of Adult Run to Basin Potential & Prognosis for Future -- The current run of adult steelhead is well under the potential of the basin to produce adult steelhead. This is particularly apparent for the portion of run utilizing headwaters upstream of Los Padres Dam, where the average return of adult steelhead during the reporting period was only three percent of the projected basin potential (**Figure III-17**). The under-utilization was related to impacts of the 1987-91 drought, water withdrawals from the lower Carmel River, degradation of rearing habitat in the lower river, inadequate facilities to pass adults upstream and juveniles and adults downstream past the dam, removal of adults from the lower river during winter angling season, and possibly removal of juvenile steelhead by anglers during summer months.

The portion of the run downstream of Los Padres Dam is in better condition, as indexed by the statistic that the average run of 127 adults during the reporting period was 10 percent of the basin potential, upstream of San Clemente Dam (discounting the run at Los Padres Dam). Most recently in 1996, the returns to San Clemente and Los Padres Dams indicate that 26 percent of

FIGURE III-16

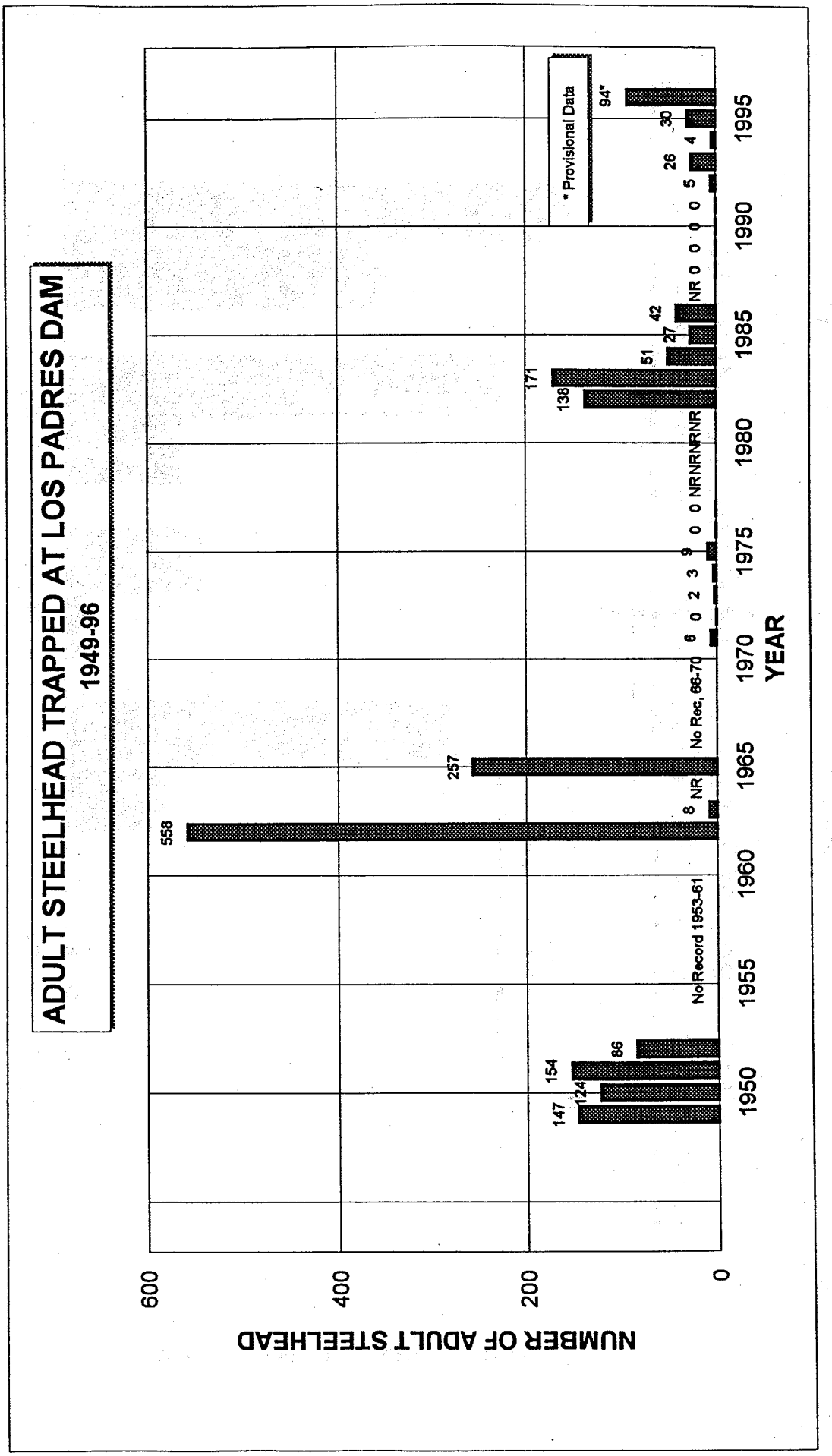
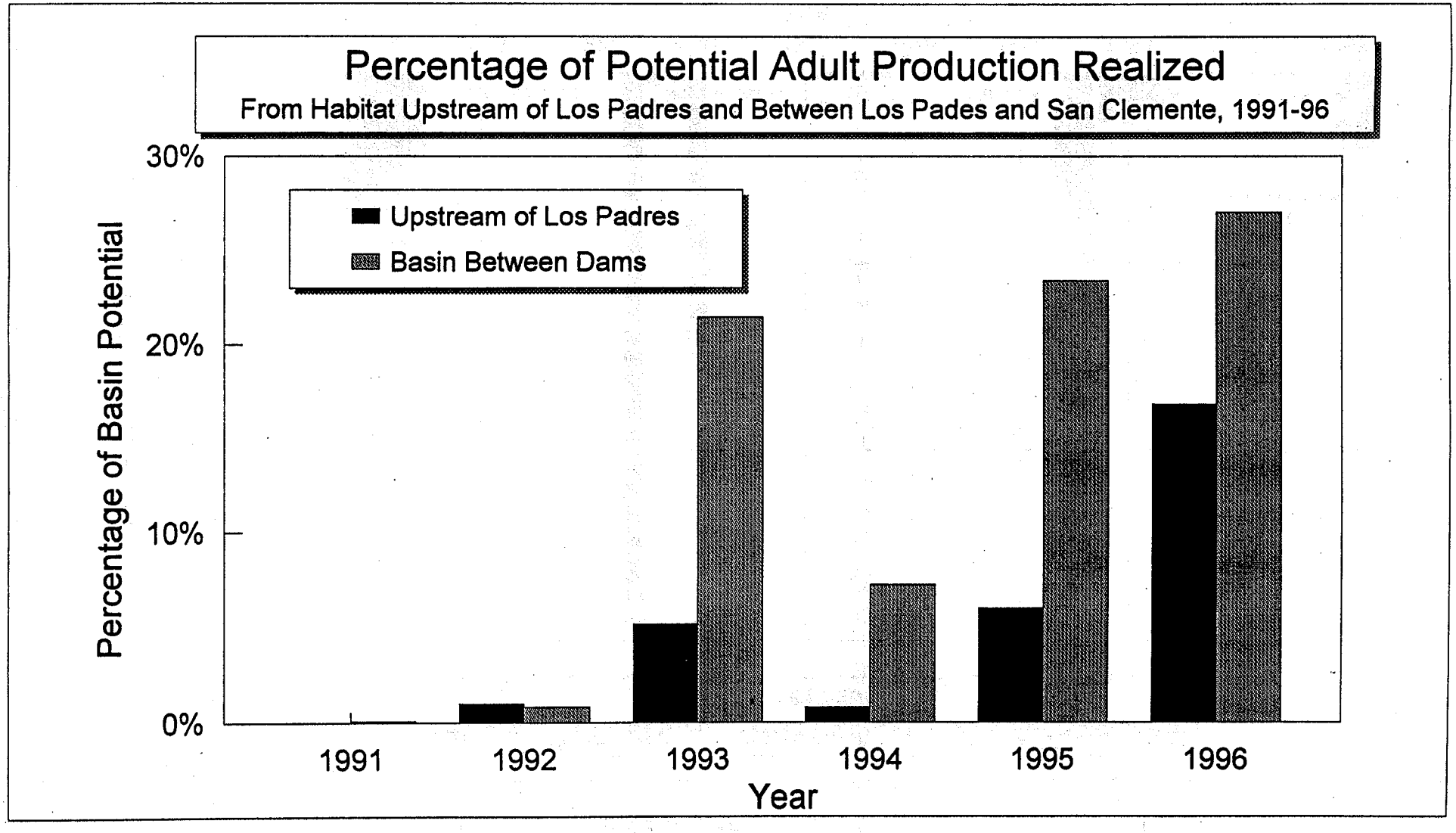


FIGURE III-17



the basin potential has been met at San Clemente Dam and 17 percent at Los Padres Dam (**Figure III-17**).

Currently, several problems that limit the production of adults are being addressed by activities within the District's Mitigation Program. The District's activities to limit diversions and increase releases at San Clemente Dam, to rescue juvenile steelhead when they are stranded in the lower river, to regulate the operation of Cal-Am during spring months when smolts are emigrating to the ocean, and to restore riparian vegetation along the river downstream of Robles del Rio, have contributed to the increasing trend of adult counts at Los Padres and San Clemente Dams. The CDFG, the District, and Cal-Am's efforts to improve passage conditions at Los Padres Dam are crucial to restoration of the run upstream of Los Padres Dam. As described in section III-B.5, the recent removal of rock outcrops may significantly improve survival of smolts migrating down the spillway and have a lasting beneficial effect on the run upstream of Los Padres Dam. Recent changes to angling regulations, upstream of Los Padres Dam, may improve production by limiting the number of smolts taken by angling during the general trout season.

Based on recent surveys of juvenile steelhead (see **Figure III-14**), which indicate the population of juvenile fish has increased substantially, and the recent above normal rainfall and runoff patterns, which have provided good to excellent opportunities for smolt emigration, the prognosis for realizing the basin potential for adult production is good. However, due to the variable nature of seasonal flows in the basin and the 3- to 4-year generation time of steelhead, attainment of the potential will not be immediate and may take several generations. However, in the short term there is strong evidence that mitigation efforts are working and the population of adults is recovering.

3. *Effectiveness of Steelhead Rescues*

The use of rescues to mitigate for the lack of surface flows in coastal California streams is controversial. On one hand, evidence from the Carmel River supports the use of rescues. On the other, the CDFG and other resource agencies have adopted policies which prohibit or discourage rescues, because it may discourage the restoration of streamflow in degraded streams and does not address impacts on other public trust resources. In addition, they are concerned that the effectiveness of rescues has not been thoroughly evaluated. The District's Five-Year Mitigation Plan included activities to evaluate the effectiveness of rescues by measuring the survival rate of rescued steelhead that were to be marked with coded-wire tags. To date, the District has not marked sufficient numbers of wild fish to develop estimates of survival through adulthood, because this requires operation of the Sleepy Hollow Steelhead rearing Facility (SHSRF), which is scheduled to begin in the summer of 1996. In the future, the District intends to mark large numbers of rescued steelhead and evaluate their return as adults. But for now, an evaluation of the effectiveness of rescues must rely on other information gathered during the last five years.

- ***What information is available to judge the effectiveness of the District's program to rescue juvenile steelhead and does it indicate that rescued fish survive at higher rates than if they had been left alone?***

The District has tracked the survival of all rescued fish over the short-term periods (4 to 24 hours) and the survival of several captive groups over long-term periods (24 hours to 1 year).

(a) Short-term Survival -- District staff keeps detailed records of the number of fish that are rescued, transported and released into permanent habitat. Any mortalities that occur during transport or at the time of release are recorded. Based on this information, the mortality of captured and transported fish is estimated each year. During the reporting period, short-term mortality of rescued fish averaged 0.46 percent and ranged from 0.00 to 0.97 percent (**Figure III-18**). These levels are well within standards accepted by fish management agencies, especially considering the nature of the rescue operations. In many circumstances, fish are rescued from marginal habitat under conditions of high temperatures, low dissolved oxygen and high carbon dioxide levels. Given these circumstances, and the immediate alternative which is a mortality rate of 100 percent by suffocation, the observed short-term mortality rates are extremely low.

(b) Long-term Survival of Captive Groups of Rescued Steelhead -- In several cases, the District has been able to follow the long-term survival of groups of rescued fish that were reared for special projects or demonstrations.

1990: During the period from February 23 through April 19, 1990, District staff and CRSA volunteers caught or trapped 134 pre-smolts, which were transplanted to Haber's Pond, with the intent of holding them prior to release into the ocean. Two groups of these fish, 75 fish on March 29, 1990 and 32 fish on May 30, 1990, were transported to the Monterey Bay Aquarium for acclimation to seawater over a two-week period. Following acclimation at MBA, a total of 98 smolts were transported to CDFG's, Granite Canyon Laboratory, to form the core group of fish used by CRSA and the Monterey Bay Salmon and Trout Project (MBSTP) to produce the first progeny from the emergency broodstock program. The survival of fish between the time they were trapped or rescued and when they were released into tanks at Granite Canyon was 73 percent, including 80 percent survival at Haber's Pond and 92 percent survival during the acclimation period at MBA (**Table III-8**). Most mortality for the first group of fish occurred in Haber's Pond where the population was reduced from 96 to 75 fish, a 22 percent loss. Mortality for the second group in Haber's Pond was only 11 percent with the population declining from 38 to 34 fish. Lower mortality for the second group was not expected because they were held at significantly higher temperatures. Mortality during the acclimation period occurred when eight smolts jumped out of the holding tanks at MBA.

1991: During the period from December 10, 1990 through March 15, 1991, a total of 323 juveniles and pre-smolts were temporarily transported to Haber' Pond. Of this total, 275 fish, or 85 percent, survived to become smolts between March 19 and April 23, 1991 (**Table III-7**). On March 29, 1991 forty smolts from Haber's Pond were transported to MBA for acclimation prior to their transplant to Granite Canyon. Although they were in excellent conditions when released at MBA, all 40 of the fish died within 36 hours on their arrival. The cause of the complete mortality was never determined but was thought to be related to osmotic and thermal stress during acclimation, water quality problems, or perhaps disease.

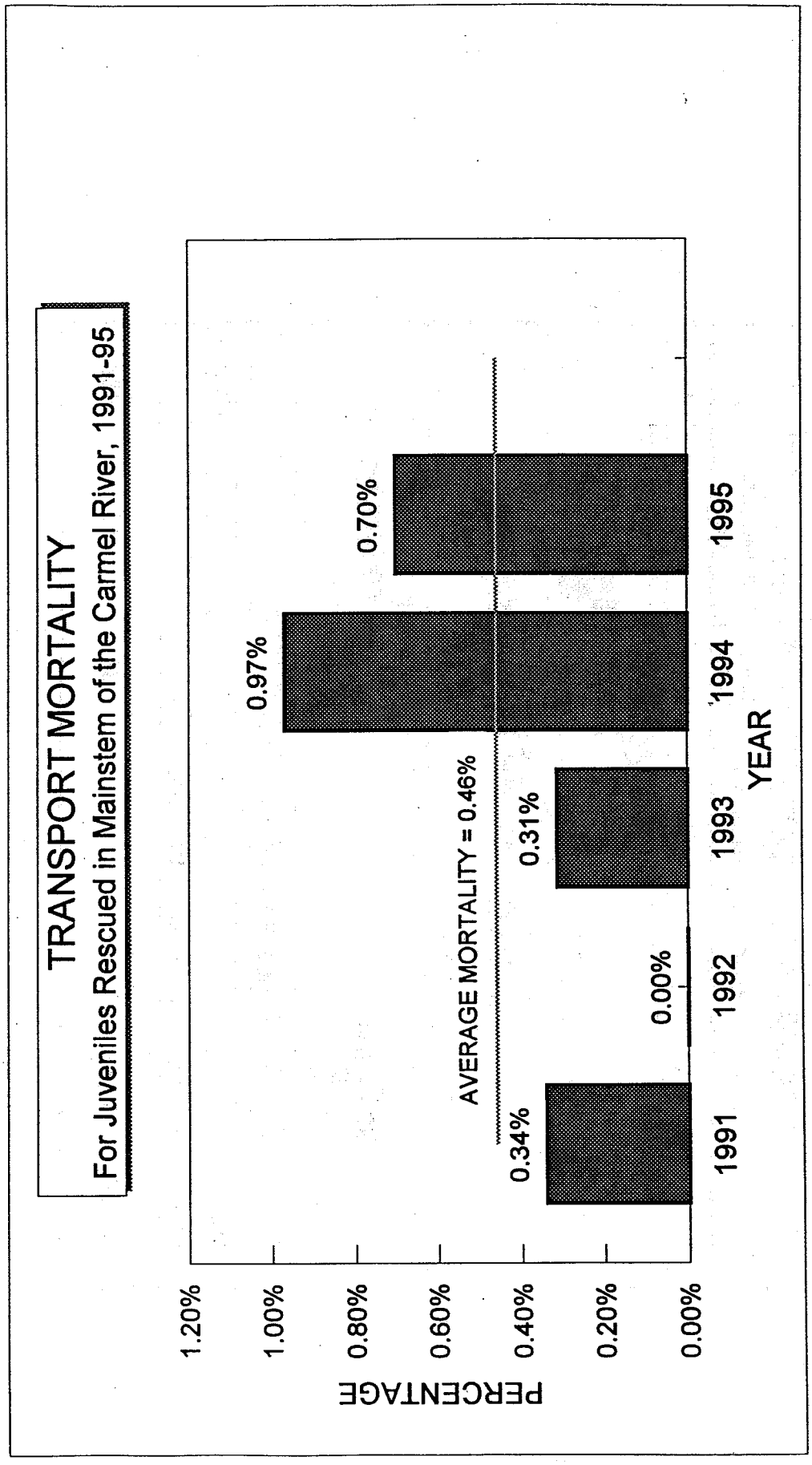


FIGURE III-18

Table III-8. Transplantation sites and destination of steelhead pre-smolts and smolts, rescued from the Carmel River and released during the period from 1989 through 1995.

YEAR	TRANSPLANT SITE OR DESTINATION OF SMOLTS Ocean	River/Lagoon	Habers Pond	Mont. Bay Aquarium	Granite Cyn. Lab	Total
1989	175					175
1990	4	12	134 (80% survival)	107 (92% survival)	98	114
1991	658	246 11	323 (85% survival)	65 25 (0% survival)	22 0	991
1992	552 382	170		265 (100% survival)	95	647
1993	NO RESCUES NEEDED -- ADEQUATE FLOW					
1994	5,262					5,262
1995	NO RESCUES NEEDED -- ADEQUATE FLOW					
Overall	**6,651**	**258**		**65**	**215**	**7,189**

On May 5, 1991, ten smolts trapped at the USGS gage, near Carmel, were transferred to Granite Canyon Laboratory. All of these fish survived their first week in the tanks to become part of the brood stock.

On June 13, 1991, seven smolts, who had reverted to a non-smolt appearance, were transferred to Granite Canyon Laboratory and challenged to increasing salinity over a 2-hour period. After five days all of these fish survived to become smolts and were transferred to the brood stock tanks.

During Summer/Fall 1991, a total of 25 juvenile steelhead were transferred to MBA to become part of the exhibits. All of these fish survived rescue, transport, were reared to a large size over the next year, and finally released back into the Carmel River as freshwater maturing adults.

1992: In mid-June, two groups of steelhead, including one adult and 36 smolt-reverts, were rescued from the fish ladder at San Clemente Dam, held overnight in a 400-gallon tank, transported to Granite Canyon and acclimated to seawater over extended 2-day periods. All but one of these fish survived through the end of June and became part of the brood stock at Granite Canyon.

On August 4, a total of 265 steelhead were rescued from the Carmel River lagoon and transported to MBA for gradual acclimation to seawater over a two-day period. Following acclimation, 100 percent of the smolts survived with 95 fish transferred to Granite Canyon and 170 fish released into the ocean **(Table III-8)**.

1993: On July 4, a total of 27 young-of-the-year steelhead were transported to MBA for rearing and eventual display in a special exhibit. All of these fish survived and grew to normal juvenile size by December, when they went on display for several months.

1994: In May, two groups of smolts (12 fish on May14 and 40 fish on May 21) rescued from the lagoon were transported for acclimation and display at MBA. After several days, 25 percent of the first group had died, but mortality in the second group was zero.

In July, a total of 140 seven- to ten-inch juveniles of hatchery and natural origin were rescued from the lagoon and placed into a net-pen in the plunge pool below San Clemente Dam. A total of 115 fish, or 82 percent, survived their four-month residence in the pen and grew from an average of three inches in length and tripled their weight from 67 to 201 grams.

1995: In September, 35 juvenile fish were captured for a display at the open house for Monterey Bay Sanctuary, and then transferred to MBA for display. All of these fish survived and by December had grown from an average of 5.0 inches to 7.5 inches long.

In general, the data on rescued fish indicates survival rates are very high, except in certain cases where smolts are rescued and acclimated to seawater over a short period of time. This information shows that great care must be exercised in capturing, transporting and acclimating rescued smolts prior to their final release in the ocean. In all cases, the rescues of steelhead parr, where fish are removed from drying reaches and transferred to freshwater, were very effective,

as evidenced by very low mortality during the rescue operation and high survival rates in those cases where the fish were held at MBA, Haber's Pond and the net-pen at San Clemente Dam. It is speculative whether "semi-reared" wild fish, once released, fare better or worse than their "pure wild" counterparts in the open ocean, as no definitive studies have been carried out.

4. Use of Restored Spawning Habitat

As described in section III-B.6 the District has restored spawning habitat in the Carmel River under a contract with the California Wildlife Conservation Board. The California Department of Fish and Game (Snider, 1995) developed a list of criteria to evaluate the effectiveness of this type of work, leading to the following questions:

- ***Is the gravel where it should be from a channel morphology standpoint (e.g. at transition areas where accumulation allows sufficient subsurface flow to accommodate spawning?***

- ***Does the gravel maintain its integrity during the period of spawning, relative to gravels distributed via "natural" processes?***

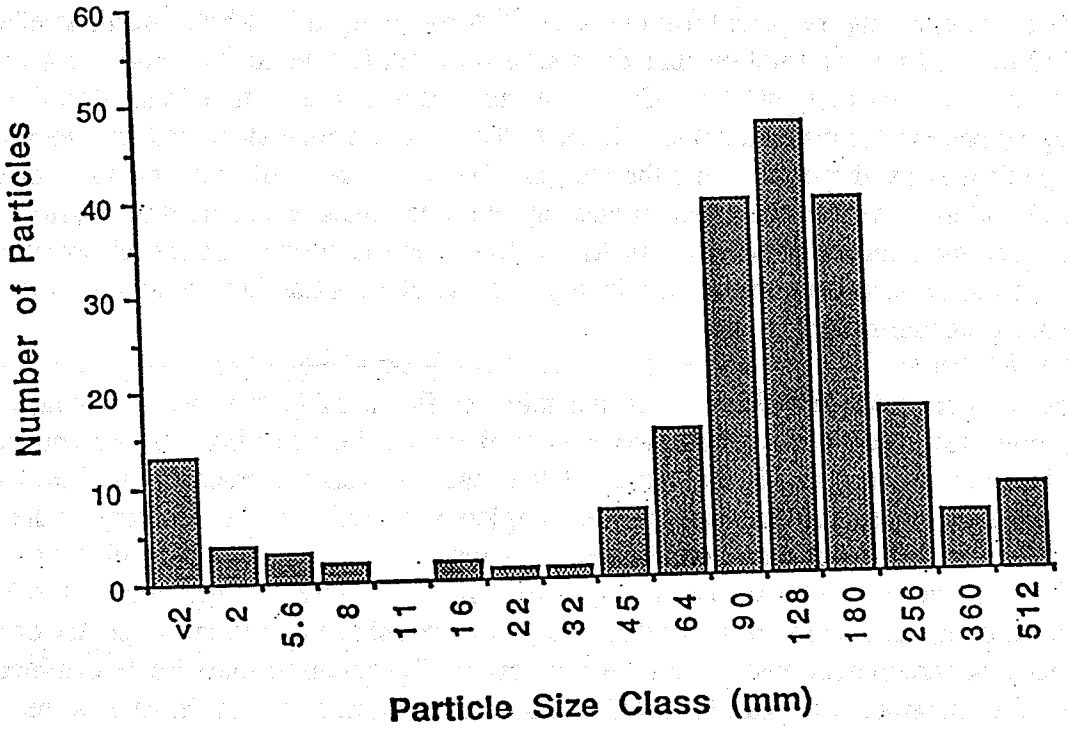
- ***Does the properly located gravel maintain its location under typical, high flow events (annual, bankfull flow)?***

- ***Is the gravel used successfully by the targeted lifestages?***

(a) Pre-project Conditions -- Prior to implementation of the spawning habitat restoration project, the river channel downstream of San Clemente Dam and between San Clemente Reservoir and Los Padres Dam had been scoured of spawning-sized gravel for many years. Normally, as evidenced by channel morphology in the reach upstream of Los Padres Dam, spawning gravels are concentrated most heavily at the transition zones between the tail of pools (where it is scoured at high flows) and the head of riffles (where it is deposited as flows decline). This transition zone, commonly refered to as "glide" habitat is the prefered, or "critical" habitat for spawning adult steelhead. Prior to the project, glide habitats in the above reaches were virtually devoid of spawning-sized material, which in the Carmel River typically ranges from 11 mm (1/2 inch) gravel to 127 mm (5 inch) cobble (Dettman and Kelley, 1986). Although steelhead are capable of spawning in cobble size material (5 inch), the majority of the spawning material (about 75 percent) is gravel ranging from 22 mm (1 inch) to 64 mm (2.5 inch). A comprehensive survey of 79 spawning sites in the general project area indicated material meeting this criterion was scarce. Pebble counts in individual spawning glides provided a clear picture of this problem at specific sites (**Figure III-19**) from Dettman and Hanna (1991). Although, hydraulic parameters of depth and velocity would be suitable within a wide range of flows, the lack of gravel severely limited spawning habitat and the number of nests that could be successfully built, without adjacent fish superimposing one nest on top of another.

(b) Restored Conditions (1993) -- Following placement of 580 cubic yards (cy) of gravel in 27 spawning sites, the material was well distributed across the width of the each glide, in a one-

FIGURE III-19



Size class composition of substrate mixture at spawning glide station number SG-1 Carmel River, CA. The median diameter of the gravel was measured at approximately 1 foot intervals along a X-shaped transect placed 25 feet upstream of the glide-riffle break.

foot deep layer, just upstream of the glide-riffle break. It was placed directly in the transition zone to facilitate use during the following winter of 1994. Following the restoration project, the amount of spawning habitat in the treated sites increased from about 1,500 to 12,400 square feet. In the context of the entire reach with 79 potential sites, habitat increased from about 9,900 to 20,800 square feet, or about doubled as compared to pre-project conditions (MPWMD, 1993).

(c) Use of Spawning Habitat (1994) -- Streamflow conditions in 1994, a dry year, were ideal for evaluating the effectiveness of the project in terms of habitat use. During January 1994, the District began surveys of sites located downstream of San Clemente Dam, which were examined once every two weeks during the period from January 28 through April 7, 1994. Adult steelhead were observed over all nine restoration sites downstream of San Clemente Dam and constructed a total of at least 31 nests in eight of the sites. During several surveys, female steelhead were observed digging nests in the restored gravel. Later in the season, young steelhead fry were seen in the vicinity of the nests, dispersed along the margin of channel. Also of note was the fact that spawning steelhead used the restored gravel exclusively; no other nests were found throughout the reach during a complete survey of the reach in April. Based on the above data and observations, it appears that the restoration project was highly successful in attracting spawning fish and producing young steelhead fry.

(d) Flood Impacts (March 1995) -- Unfortunately, the floods of 1995 severely damaged all of the restoration sites. Most of the gravel was scoured from the sites, leaving only a remnant of the material in the original locations. Some of the material was dispersed downstream and deposited in other glides, so the material was not completely wasted, but the intensity of the 50- to 100-year storm caused major damage. This information indicates that similar projects cannot be expected to survive such intense events. However, flows of a lower magnitude, in the 5- to 10-year recurrence level, should not be as damaging. Determining the normal longevity of this type of project will take annual observations over a period of years and cannot be determined in the sequence of an extremely dry year, followed by one of the wettest and most intense on record.

(e) Project Maintenance -- Maintaining the supply of gravel in restoration projects, particularily below dams, is crucial to ensure the continued benefits to the fish population. As part of the maintenance and monitoring agreement with the CDFG, the District is required to add gravel to the river downstream of San Clemente and Los Padres Dams. During maintenance activities in May 1995, the District placed a total of 270 cy of spawning gravel, including 20 cy just upstream of Sleepy Hollow Ford, 40 cy at Old Carmel Dam, and 210 cy below Los Padres Dam. This material moved during Winter 1995, but was not scoured completely out of the low-flow channel. For example, the material placed below Los Padres Dam has moved about 100 feet downstream and been deposited in the first glide below the dam. Adult steelhead spawned in this material, as evidenced by the production of large numbers of swim-up fry, which are appearing in the District's smolt emigration trap, located below in the pool below this glide.

Based on the increase in available habitat, its use by adult steelhead in 1994, and the presence of steelhead fry in the immediate vicinity of the restored habitat, it appears that the project was successful. However, as evidenced by the impacts of severe floods in 1995, it is obvious that this type of project can not be expected to last indefinitely, without significant maintenance costs.

5. *Additional Production below Scarlett Narrows*

During the 1992 SWRCB hearings on complaints against Cal-Am diversions from the Carmel River, testimony was presented that outlined the potential benefits of a modified way of managing the sequence of pumping from Cal-Am well fields in the Carmel Valley Aquifer. Pursuant to Condition No. 5, SWRCB Order WR 95-10, Cal-Am was ordered to operate its Carmel Valley production wells beginning with the most downsteam well, and moving upstream to other wells as needed to meet demand. The goal of this order is to maximize the length of viable stream and aquatic habitat in the lower valley.

- ***What impact has this operation had on juvenile steelhead populations in the Carmel River?***

During the reporting period this mode of operation and flow releases from San Clemente Reservoir resulted in the additional production of 9,900 juveniles in 1995, 1,500 fish in 1994 and 4,300 fish in 1993 (**Figure III-20**). These increases represent 10 to 14 percent of the total juvenile population below San Clemente Dam and are especially significant because fish in these restored sections were larger than those upstream. Juvenile steelhead which are larger survive at higher rates and return in larger numbers as adults. The production of larger juveniles and smolts could be an important factor in restoring the run of adult steelhead in the Carmel River.

E. Conclusions and Recommendations

During the last five years, the District successfully rescued about 29,300 steelhead from drying reaches of the Carmel River and transplanted them to permanent habitat in the reach between San Clemente Dam and the Narrows. During this period the population of juvenile fish rebounded from a low of 9,000 in 1990, the middle of the 1987-91 drought, to a high of 69,000 in 1995. This population response can be attributed to several activities, including the rescue of juvenile steelhead that would have otherwise perished, transport of emigrating smolts from drying reaches to the ocean, improvements to streamflow and riparian habitat in the reach downstream of San Clemente Dam, restoration of spawning habitat below Los Padres and San Clemente Dams, restrictions on steelhead angling, and implementation of a emergency brood stock program. While it is impossible to sort out the relative contribution of each activity, the net effect has been a remarkable resurgence of the adult steelhead population. The adult run increased from near extinction levels of zero or one fish in four consecutive years (1988-91) to 438 adults in 1996. The adults returning to habitat between San Clemente and Los Padres Dams in 1993, 1995, and 1996 represented 22 to 27 percent of the basin potential for adult production. While the current returns are not up to the basin's full potential for adult production, the increases indicate that the population is recovering.

To encourage full recovery of the population and help ensure the population remains above "threatened" or "endangered" levels, District staff recommends implementation of the following activities during the next five years (1997-2001).

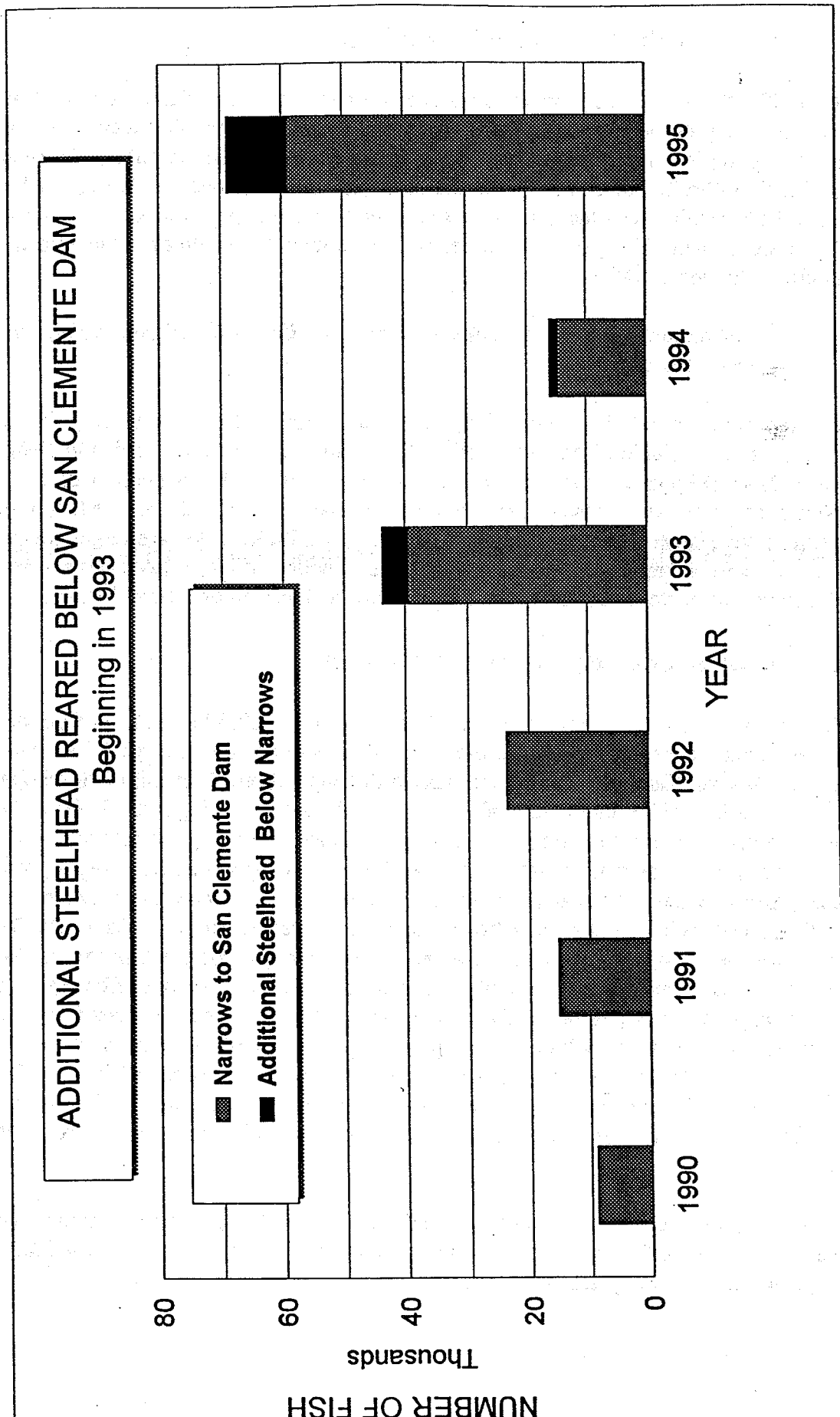


FIGURE III-20

1. *Continue Existing Rescue Activities*

The District should continue to rescue all juvenile steelhead that are threatened by unnatural recession of streamflow in the lower Carmel River (i.e., where ground water pumping combined with insufficient streamflow causes the river to retreat or dry up prematurely). Depending on their life cycle phase, juvenile steelhead should be transplanted upstream to surplus habitat or acclimated to seawater, prior to their release into the ocean. If no surplus habitat is available, rescued fish should be reared at the Sleepy Hollow Steelhead Rearing Facility through the dry season and released into the river, after flows are reestablished in the lower river during late Fall or early Winter.

2. *Defer "Permanent" Mid-Valley Holding Facility*

The construction of a permanent facility to hold juveniles was recommended as part of the original Five-Year Mitigation Plan. This recommendation was based on a finding that a Cal-Am production limit of 17,600 acre-feet would have significant impacts on the migration of juvenile steelhead during late Fall and early Winter. Given the ramifications of Order No. WR 95-10 by the SWRCB (which will result in yet-to-be-quanified reduced diversions from the Carmel River), this finding may need to be revised, and could affect the need to build and operate a holding facility. Construction of a permanent facility has been deferred until 1998-99, as described in a separate MPWMD Implementation Plan for mitigation program over the next five years. If the SWRCB establishes an allowable level of diversion and this level results in significant risk to juveniles during Fall and Winter, then a permanent facility should be constructed to hold juveniles during winter months. Until such time, the juveniles that are at risk during Fall/Winter months should be transported upstream to permanent habitat, held at SHSRF, or possibly a portable facility.

3. *Spawning Habitat Restoration Project*

As specified under contract with the State of California, the District should maintain and monitor the spawning habitat restoration project. Given the relatively high cost of obtaining suitable gravel for maintenance activities ($28/ton in 1996), the District should consider, and if feasible, implement a program to extract suitable gravel from the inundation zones of San Clemente and Los Padres Reservoirs.

4. *Downstream Passage of Kelts*

During the last five years, the District has rescued steelhead kelts stranded in the lower river, reacclimated and transported them back to the ocean. The District should continue this activity and research current techniques, procedures, and equipment needed to ensure high survival of the fish during the acclimation phase.

5. *Fish Passage at Cal-Am Facilities*

In cooperation with CDFG and Cal-Am, the District should continue to evaluate the need for modifications at Cal-Am facilities to ensure safe passage of steelhead adults, smolts and kelts. Where appropriate, District staff should assist CDFG and Cal-Am in implementing projects to improve fish passage by applying for grants administered by CDFG or other agencies. These projects may include, but are not limited to the following:

(a) Kelt Passage at Los Padres Dam -- Currently, smolts and kelts must pass down the spillway at Los Padres Dam. While it is possible to improve conditions for smolt passage at Los Padres Dam, the passage of kelts down and over falls at the bottom of the spillway is unsafe under any condition due to the height (30 feet) of the falls. Alternatives should be considered and one implemented to provide safe passage for kelts.

(b) Old Carmel Dam -- The Old Carmel Dam, at river mile 18.3, is an impediment to adult steelhead migration at flows in the range of about 200 to 800 cfs. The notch through the dam abutment along the right bank often plugs with debris or water velocity is too high for migration. Cal-Am and CDFG should develop a project to provide good passage conditions throughout the range of winter migration flows. If grant funds are available, the District could also contribute to this effort.

(c) Smolt Passage through Los Padres Reservoir -- Under drought or low flow conditions, Los Padres Reservoir or the relic channel below elevation 1040 feet may delay, impede or block the normal migration of pre-smolts and smolts. The resultant delay may impair successful migration of smolts between the headwaters and the ocean. Alternatives should be considered and implemented to reduce the migration delay or reduce predation in the inundation zone and reservoir.

(d) San Clemente Fish Ladder -- The steps in the San Clemente fish ladder are beyond accepted standards for new ladders. Several of the steps are 2-3 feet in height. In order for steelhead to negotiate the extreme steps and be attracted to the ladder, high flows must be passed down it. This increases energy expended by migrating adults and may be detrimental. To mitigate this situation, the steps in the ladder should be modified so passage is possible with less flow, but additional flow should be routed into the lowermost bay of the ladder to increase its attractiveness to migrating adults. The District should provide technical assistance tot CDFG and Cal-Am in surveys, design and implementation of a project to modify the ladder.

6. *Monitoring the Steelhead Population*

During the last five years, the District expanded monitoring activities to include annual surveys of the juvenile population and instantaneous counts of steelhead passing San Clemente Dam. The District should continue these activities:

(a) Juvenile Population -- The District should continue to monitor the juvenile steelhead population downstream of Los Padres Dam at seven stations. Special attention should be directed

to the lower nine miles of the river, where management of Cal-Am pumping has resulted in additional habitat. In cooperation with CDFG, USFWS, NMFS and USFS, the District should expand the monitoring program to include annual surveys of the steelhead population and habitat upstream of Los Padres Reservoir.

(b) Adult Population – The District should continue counts of adult steelhead migrating past San Clemente Dam by operating the fish counter in the fish ladder. Staff should continue efforts to install and operate a camera for photographing adults as they pass the counting station.

7. Acclimation Facility

In lieu of the California Department of Parks and Recreation's decision in 1996 to not renew a permit for operation of an acclimation facility in the lagoon, the District should investigate alternative locations, facilities, and techniques for acclimating smolts and kelts to saline/ocean water, prior to their release into the ocean. If feasible alternatives are identified, the District should develop an implementation plan during the next two years and implement the plan during the following three years. If no feasible alternatives are identified, the District should re-evaluate the feasibility of continuing to transport and release of smolts and kelts into the ocean. If no feasible alternatives are identified, the District should re-examine the impacts on emigrating smolts and may need to issue a "Statement of Overriding Consideration" in a supplement to the Water Allocation Program EIR.

8. Implementation Plan for 1997-2001

The District has preapred a separate document, "Implementation Plan for MPWMD Mitigation Program, Fiscal Years 1997-2001," which contains detailed information about steelhead resource activities planned in the next five years. The Plan assumes current staffing level of three full-time personnel and part-time help from other staff positions, as itemized in the 1996-97 MPWMD budget. Cost estimates for annual maintenance of facilities such as the Sleepy Hollow Steelhead Rearing Facility are based on average years. Actual costs could be higher or lower, reflecting the variable nature of seasonal flows and the requirement to operate the facility over periods ranging from three to nine months.

SECTION IV

RIPARIAN VEGETATION AND WILDLIFE PROGRAM

IV. RIPARIAN VEGETATION AND WILDLIFE PROGRAM

A. Adopted Program Goals

The Water Allocation Program Final EIR found that all water supply options, including the 16,744 acre-foot Cal-Am production limit (Option V) that was adopted by the MPWMD Board of Directors in 1990, would have impacts to riparian resources along the Carmel River. Without mitigations, Option V was projected to result in significant adverse impacts over large areas of the Carmel River alluvial aquifer, particularly aquifer subunits 3 and 4 and a few localized areas of aquifer subunit 2 (see **Figure I-2** in Section I of this report).

Significant adverse impacts were projected to occur if riparian vegetation was subjected to a ground water drawdown rate of two feet per week, or a seasonal ground water drawdown of eight feet or greater in the root zone. The primary impacts associated with ground water drawdown include mortality of vegetation, and reduced seed dispersal and seedling establishment resulting from a lack of streamflow. Secondary, long-term impacts from vegetation mortality and a reduction in plant recruitment include: changes in riparian community age class, structure, species composition and productivity; a reduction in wildlife habitat; destabilization of streambanks; channel migration; property loss; flood hazards; and degradation of aquatic habitat. In recognition of the impacts due to water extraction practices, the Water Management District adopted the following goals for managing the water supply, protecting property, and protecting the natural resources of the Carmel River:

- Integrate the management of the riparian corridor by coordinating channel clearing, erosion protection projects, vegetation enhancement, and irrigation activities;
- Reduce property loss and stabilize banks against erosion during moderate (one-in-10-year) flows;
- Evaluate and improve irrigation techniques to minimize water use while maximizing protection and enhancement of riparian vegetation;
- Reintroduce native riparian species at District-sponsored projects to diversify and enhance revegetated areas;
- Prevent degradation of existing riparian vegetation and wildlife habitat;
- Enhance the aesthetics of the riparian corridor;
- Provide recreational opportunities; and
- Enhance the anadromous fishery.

The Findings of Adoption of the 1990 Water Allocation Program Final EIR identified four categories of mitigation measures to reduce impacts to the Carmel River riparian corridor, including wildlife that is dependent on streamside habitat (Findings Nos. 389-A through D, and 391). The mitigations adopted in the Five-Year Mitigation Plan for Option V are:

- Conservation and Water Distribution Management to Retain Water in the River
- Prepare and Oversee Riparian Corridor Management Plan
- Implement Riparian Corridor Management Program
- Expand Monitoring Programs for Soil Moisture and Vegetative Stress.

The Board-approved mitigations, in addition to continuing the existing riparian programs, were designed to reduce impacts of Water Supply Option V to the riparian corridor. However, the EIR determined that there was no definitive method to ascertain whether impacts would be reduced to a less than significant level. Thus, despite activities undertaken in the District's mitigation program for Option V, the EIR concluded that the 16,744 acre-foot Cal-Am production limit could result in potentially significant impacts to riparian vegetation and associated wildlife.

B. Description of Activities/Projects, July 1991 - June 1996

1. Pre-Existing Programs (up to 1991)

Integrated management of Carmel River resources was initiated by the District in the early 1980s. The District recognized that the increase in bank erosion, degradation of the steelhead fishery, and decline in health of riparian vegetation in the lower Carmel Valley were related not only to droughts and floods, but also to human disruption of natural processes in the watershed. The Five-Year Mitigation Plan called for the continuation of ongoing programs in 1990 to address the restoration and protection of channel stability, aquatic resources, and riparian habitat, as well as the enhancement of aesthetic values and recreational opportunities. Programs included:

- Hydrologic Monitoring
- Carmel River Management Program (primarily erosion protection and riparian habitat restoration projects)
- Irrigation of Riparian Vegetation
- Monitoring of Soil Moisture and Riparian Plant Stress
- Water Conservation and Management Programs to Reduce Impacts on River.

(a) Hydrologic Monitoring – See Section II for a description of on-going activities which support a variety of District functions, including activities related to the riparian corridor.

(b) Carmel River Management Program (CRMP) – This section explains the District's river restoration program and describes several projects that the District completed between 1984 and 1991. For information about the Districts' erosion protection activities during the Five-Year Mitigation Program, please see Section IV-B.4(b), "Erosion Protection and Restoration Projects."

A severe drought in 1976 and 1977 and high river flows between 1978 and 1983 contributed to significant vegetation die-off and stream bank erosion along the Carmel River between Camp Steffani and the lagoon. The loss of tens of acres of property and degradation of several miles of the river was the culmination of a series of man made and natural events. Two mainstem dams constructed on the upper Carmel River in 1921 and 1948 cut off 90% of the supply of sediment to the river. This resulted in entrenchment of the river in the alluvial portion of Carmel Valley beginning at Camp Steffani. In the early 1960s, increased water extraction from the Carmel Valley groundwater basin for a variety of uses led to significant impacts to channel and streambank stability, riparian vegetation, and wildlife. These impacts are summarized as follows:

- Reduced streamflow and inadequate soil moisture during the latter portion of the dry season prevent or significantly slow natural recovery of riparian vegetation on streambanks and leads to loss of existing vegetation.
- Denuded streambanks made of unconsolidated material (sand and cobble) are highly unstable, even during moderate flows.
- Formations of gravel bars (collections of sand, gravel, and cobble) downstream of unstable areas lead to additional bank erosion by constricting the channel and focusing flow into adjacent streambanks (the "water nozzle" effect).
- Emergency works initiated by individual property owners to repair unstable streambanks during high flows are often ineffective and result in transferring problems to other areas of the river.
- Unstable banks often contain debris, trash, and deleterious material that can be washed into the main channel during high flows. This material is unsightly and can damage aquatic habitat.
- Reduced cover and riparian vegetation in the riparian corridor reduces the value of aquatic and wildlife habitat.

After the wettest winter on record in 1982-83 caused significant loss of riverfront property, concerned citizens requested that the District start a program to restore the health and stability of the Carmel River. In November 1983, property owners along the river overwhelmingly voted to tax themselves and to start the Carmel River Management Program (CRMP). The citizenry was not only concerned about property damage, but also about the long-term degradation of the river.

In 1984, MPWMD developed and published the Carmel River Management Plan (MPWMD, April 1984), which was designed to be a comprehensive guide to solving the problems along the river. The preferred solution was formulated with the goal of maximizing public benefits and minimizing public costs, yet still provide for comprehensive river management and natural resource protection.

The CRMP listed five primary goals, which have been incorporated into the District's management of the river under the Five-Year Mitigation Program:

1. Reduce bank erosion and maintain sediment transport capability in the main stem
2. Enhance fishery habitat
3. Enhance riparian vegetation and wildlife habitat
4. Provide recreation
5. Improve aesthetic values.

The Carmel River Management Plan contained recommendations to restore eight miles of the river. At the time that the District started the CRMP, it was thought that work could be completed in ten years. Thus, a sunset clause was included in the District ordinances that set up the CRMP. Basic activities of the program included:

- Installation of structural protection such as post-and-wire revetments and rip-rap at key areas along the streambanks in restoration project areas;

- Channel realignment and gravel bar removal to increase sediment transport, improve flow characteristics, and reduce the potential for bank erosion;

- Revegetation of newly created streambanks and terraces with native riparian species as well as installation of irrigation systems to augment natural soil moisture;

- Maintenance of structural protection after installation to allow vegetation to mature and anchor the structural portion of the installation to the river bank (over time, these types of installations will resist even the highest of flows);

- Provide expertise to private property owners who want to carry out river restoration and erosion protection projects (addressed situation during the early 1980s when there was a lack of consistency in following accepted standards and a lack of overall planning to reduce channel instability; the District developed the Carmel River Management Plan to address these problems);

- Enforcement of ordinances designed to protect the riparian corridor from further degradation due to clearing and/or trimming;

- Snag removal at bridges and other key locations.

Between 1984 and 1991, the District completed several projects that comprised about 8,800 lineal feet of river restoration. These projects focused on stabilizing the main channel, providing fish passage during low flows, and restoring riparian vegetation. Although providing recreation was not a goal of these projects, river restoration projects have provided additional recreation opportunities and have helped control access into the main channel, thus reducing erosion. In addition to completing intensive restoration projects in aquifer subunits 3 and 4 (AQ3 and AQ4), MPWMD began working with Cal-Am to increase flow in aquifer subunits 1 and 2 (AQ1 and AQ2, between the San Clemente Reservoir and the Narrows). Beginning in 1984, the flow release schedule from the San Clemente Reservoir was altered to provide more flow during the dry season. In addition, ground water pumping in that reach was restricted. These two actions helped portions of this reach to recover without intensive restoration efforts.

In June 1993, CRMP river management activities and a portion of the funding for the CRMP were subsumed into the Mitigation Program (a small assessment levied on river-front property was discontinued at this time). For additional information on the CRMP, see the "Ten Year Review of the Carmel River Management Program" (MPWMD 1993) which contains a detailed description of each project, program costs, and recommended projects to complete the restoration of the Carmel River.

*(c) **Irrigation Activities*** -- The District's long-standing commitment to irrigation of riparian vegetation is based on research that documented the relationship between ground water drawdown and the degradation of riparian habitat along the Carmel River. Documentation provided by Zinke (1971), Lee (1976), Woodhouse (1980, 1983, 1984, 1985), Groeneveld and Griepentrog (1985), Kondolf (1982), and McNiesh (1986, 1988, 1989, 1991a, 1991b) demonstrated a close connection between municipal groundwater pumping, the decline in the health and extent of riparian vegetation, and an associated increase in channel instability.

Four-Well Irrigation Program: In 1978, Cal-Am proposed four new production wells in Carmel Valley, the Pearce, Cypress, San Carlos and Cañada wells. In 1980, Monterey County granted Cal-Am a use permit for the new wells after several public hearings and the preparation of an EIR. The County placed conditions on Cal-Am's project permit that required irrigation of riparian vegetation around each new well to mitigate for damages to vegetation associated with the extraction of groundwater. In January 1981, the District and Cal-Am entered into an agreement pursuant to the maintenance of the riparian corridor for the areas affected by the new production wells. The objective of the Four-Well Irrigation Program was to maintain riparian vegetation with irrigation during the dry season for 2,000 feet upstream and downstream of the Cal-Am Pearce, Cypress, San Carlos and Cañada production wells in order to mitigate for impacts associated with groundwater extraction.

Beginning in the summer of 1985, the District operated large sprinklers (" water cannons") to irrigate the Four-Well area and the streamside corridor at various locations along the dry river channel. The water cannons were mounted on a trailer and moved along the channel bottom with a truck. Efforts were concentrated along the bank areas in the vicinity of the Cal-Am Pearce, Cypress and San Carlos Wells, where seasonal ground water drawdown and associated riparian vegetation degradation was most pronounced. Irrigation was not undertaken by the District

around the Cañada Well because of the overlap with turf irrigation along the streambanks through the Rancho Cañada Golf Resort. Cal-Am initially spent $90,000 to purchase the equipment necessary to implement the Four-Well Irrigation Program. Cal-Am has also contributed $7,000 per year toward this program and provided Four-Well irrigation water to the District free of charge as a condition of its permit.

To optimize water application and effectively mitigate the physiological needs of the moisture-stressed vegetation, the District contracted with consulting agronomist Charles McNiesh to develop an irrigation schedule. Irrigation scheduling and application recommendations were forwarded to the District by McNiesh (1986, 1988, 1991a), who conducted extensive sampling of plant stress parameters, soil water availability, and depth to groundwater in the riparian corridor adjacent to the effected wells. He assisted District staff with the development of a soil moisture and vegetative stress monitoring program using neutron probe tests for soil moisture and the Scholander pressure chamber to assess leaf water potential. As a result of his plant physiological and soil water availability investigations, McNiesh suggested that before a decision to irrigate vegetation near one of the new wells was made, four criteria should be documented: (1) the presence of a dry river channel, (2) a drop in the water table greater than 1 foot per week, (3) unacceptable soil moisture levels, as measured with the neutron probe, and (4) unacceptable vegetative stress, as measured with the pressure chamber. The District's on-going monitoring program is summarized below in Sections IV-B.1(d), and IV-B.4(e).

The water cannon sprinklers were operated in 1985, 1986, 1987 and 1988. In 1988, a drip irrigation system was designed and installed around the Pearce Well (Meadows Irrigation System) as a pilot program to test the potential for water conservation with drip techniques as compared to the water cannon method. Cal-Am paid for the materials required to install the Meadows drip irrigation system around the Pearce Well. The program proved so successful that the Cypress and San Carlos irrigation systems were converted to drip in 1989. Drip irrigation was conservative in the application of supplemental water to the riparian vegetation and, in addition, individual trees some distance from the channel bank could be uniquely addressed with the careful placement of lateral lines. The water cannon sprinklers applied a high-volume spray of water from the center of the channel, but were unable to penetrate into dense riparian vegetation some distance from the river banks. Water losses due to evaporation on windy and hot days were minimized when the water cannons were replaced with drip irrigation.

The Four-Well irrigation and monitoring activities were maintained throughout the duration of the Five-Year Mitigation Program as part of a group of activities known as the Riparian Corridor Management Program. The extent of water application to riparian vegetation varied from year-to-year depending on streamflow and aquifer storage levels. Pumping and well repair schedules at each location also affected the need for applying supplemental moisture to riparian habitat. The irrigation system in the vicinity of the Cypress Well was modified in 1993 to provide water to the restoration plantings at the Valley Hills Erosion Protection Project.

Interim Relief Program - Emergency Irrigation: In 1988, the District developed a program to address the environmental impacts of water extraction from the Carmel River basin pending a long-term solution. The program was characterized as "interim relief" in recognition

of the need to improve current environmental conditions while a future water supply project was pursued. The Interim Relief Program focused on the rescue and transplant of fish, the irrigation of riparian vegetation, and the controlled release of water from San Clemente Reservoir. The Interim Relief Program was superseded by the adoption and implementation of the Five-Year Mitigation Program.

The Emergency Irrigation component of the Interim Relief Program was designed to provide emergency irrigation water to riparian vegetation in an effort to reduce vegetative stress during the 1988-1991 drought years. The goal of the Emergency Irrigation Program was to maintain existing riparian vegetation and the integrity of the riparian corridor by diminishing plant moisture stress levels. Maintaining a healthy riparian corridor was key to reducing erosion, channel instability, property loss, habitat degradation, and future sedimentation and erosion problems downstream.

After an environmental review and the filing of a negative declaration, the Emergency Irrigation project was approved by the MPWMD Board of Directors on July 11, 1988. The Board authorized a budget of $234,000, and adopted an ordinance increasing the user fees by 0.875 percent to pay for the project. In 1988 and 1989, approximately 250,000 feet of drip tubing was installed in nine reaches of the river to irrigate all the substantial areas of existing riparian vegetation between Via Mallorca and Scarlett Road. The District's secured water sources, obtained property owner permission, installed drip irrigation materials, and operated the systems on 4.2 miles of riverbank.

The emergency irrigation network installed and operated by the District included the Robinson, Big Berwick, Begonia, Schulte Well, Valley Greens Bridge, and Valley Greens irrigation systems. The District also purchased irrigation materials that were installed by staff, but operated by property owners at several locations along the river. The irrigation systems that were privately operated included the Lemos, Egg Ranch, Carmel Valley Golf and Country Club (CVGCC), Hacienda, and Rancho Cañada installations (see **Figure IV-1**).

In addition to the establishment and operation of the emergency irrigation network designed to supplement soil moisture during the drought, the District operated the Schulte, Scarlett, Little Berwick, Pryor and Manor irrigation systems already in place for the Carmel River Management Program bank protection projects, as well as the Meadows, Cypress and San Carlos irrigation systems operated under the Cal-Am Four-Well program.

Because of prolonged drought, the Emergency Irrigation Program was expanded during the Spring of 1990. District ground water monitoring in 1988 and 1989 had documented a drop in the water table of approximately eight feet in the vicinity of the Highway 1 Bridge. Riparian vegetation displayed high stress levels, with estimates of up to 20 percent mortality of mature cottonwood and willow trees. On March 26, 1990, the MPWMD Board of Directors approved the augmentation of the emergency irrigation network by extending the area of District irrigation efforts to include both the north and south banks of the river from the Rancho Cañada Golf Resort to the Lagoon. The District targeted 20 parcels, and installed approximately 130,000 feet of drip line along 2.2 miles of river channel. The expansion project included the Rancho Canada,

FIGURE IV-1a

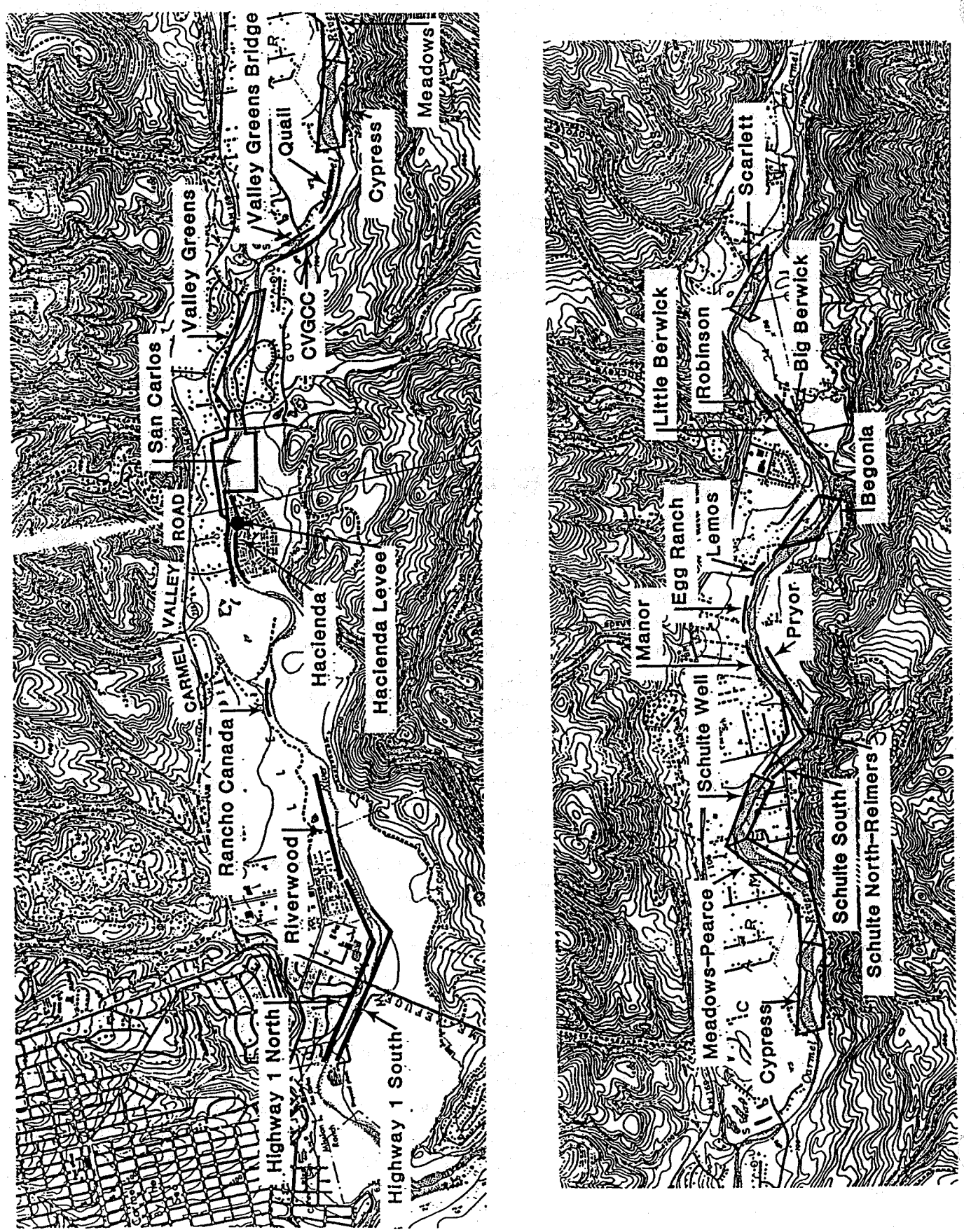
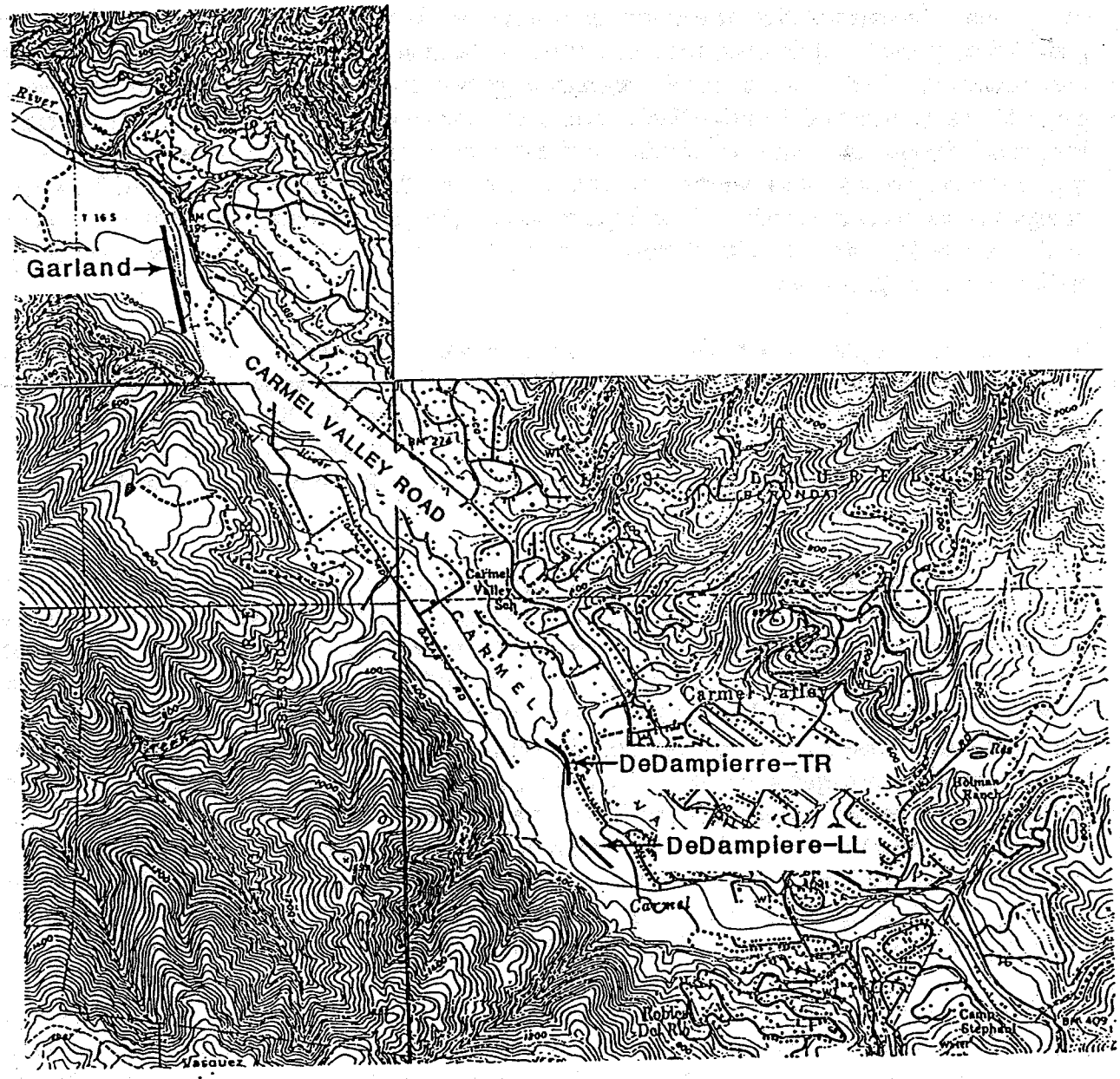

MPWMD RIPARIAN IRRIGATION SYSTEMS
San Carlos
Valley Greens
Valley Greens Bridge
Quail
CVGCC
Cypress
Meadows
VALLEY ROAD
CARMEL
Rancho Canada
Riverwood
Hacienda
Hacienda Levee
Highway 1 North
Highway 1 South
Little Berwick
Robinson
Scarlett
Big Berwick
Manor
Egg Ranch
Lemos
Schulte Well
Pryor
Begonia
Meadows-Pearce
Cypress
Schulte South
Schulte North-Reimers

FIGURE IV-1b


Garland
CARMEL VALLEY ROAD
CARMEL
Carmel Valley
DeDampierre-TR
DeDampiere-LL
Carmel
Holman Ranch
Robles Del Rio
Camp Stephens
BM 409
Vasquez

Riverwood, Highway 1 North, and Highway 1 South irrigation systems. Four seasonal employees were hired in 1990 to assist with implementation of the emergency irrigation expansion project.

(d) Monitoring of Soil Moisture and Riparian Vegetation -- Prior to the initiation of the Five-Year Mitigation Program, the District's riparian monitoring efforts focused on assessing soil moisture and plant water stress to identify how streamside vegetation was affected by ground water pumping. Monitoring activities were associated with specific studies coordinated by District consultants. The interpretation of monitoring data resulted in management efforts to mitigate for plant water stress by optimizing irrigation water application. Soil moisture parameters, direct measurements of plant water stress, vegetation growth rates, and climatological data were evaluated as elements of the Four-Well, Emergency Irrigation, and Carmel River Management Program irrigation activities. In addition to direct measurements of soil and plants, the District monitored evaporation rates, weather conditions, and overall riparian habitat vigor with canopy ratings and photo documentation. Hydrologic monitoring of ground water levels was also critical to the successful interpretation of vegetation moisture stress indicators and the appropriate application of irrigation water.

Soil moisture and plant water stress monitoring generally followed the sampling conventions developed by Woodhouse (1983) and McNiesh (1986) during the early years of the Cal-Am Four-Well Program. To sample soil moisture and available soil water, the District operated a neutron probe instrument and a series of gypsum blocks. The neutron probe was used at several Carmel Valley locations between 1984 and mid-1992, while gypsum blocks were monitored in the vicinity of the San Carlos Well between 1984 and 1986.

Soil Monitoring: District staff used a neutron probe (Campbell Pacific Nuclear Hydroprobe Model 503) to measure soil water content at one-foot intervals at 30 access tubes located between the mid-Carmel Valley area and the vicinity of the Carmel Area Wastewater District treatment facility. Access tubes varied in depth from 6 to 13 feet and were often distributed along transects either parallel to municipal wells, or perpendicular to the edge of the streambank at increasing distances away from the wells. The neutron probe device emits neutrons which bounce off hydrogen atoms in the soil and are registered with a sensor. These are measured as "thermalized" neutrons, essentially providing a measurement of the relative amount of hydrogen (contained in water) at each station. Neutron probe data were collected infrequently because of equipment malfunctions, problems associated with the maintenance of access tubes, and the difficulty in calibrating the instrument. After the start of the Five-Year Mitigation Program, the neutron probe was used on only one day in 1992 to measure soil moisture at four sites.

The District also measured soil moisture with gypsum blocks, which were used for indirect measurements of soil water content because their porosity allows them to saturate at rates similar to the surrounding ambient soil. The electrical resistance of dry gypsum is nearly infinite and when permeated with water, the electrical conductivity of gypsum block "potentiometers" approximates that of the surrounding soil at the same water content. A series of gypsum block profiles was installed at seven sites near the San Carlos Well in 1985. Blocks in each profile were buried at depths of 2, 4, 6, 8, 10 and 12 feet in the soil column. Gypsum blocks were monitored until 1986, when they began to naturally deteriorate.

Vegetation Monitoring: Monitoring of the growth and water relations of willows and cottonwoods was initiated by the District in 1981 as an element of the Cal-Am Four-Well irrigation program. Investigations conducted by several consultants to the District between 1981 and 1991 provided baseline data, guidelines on critical thresholds of plant stress, and recommendations on irrigation water application amounts and scheduling. District staff and consultants measured indicators of vegetative moisture stress, including qualitative canopy rating (defoliation), stomatal resistance, and leaf water potential at dawn. In addition to vegetation sampling, an annual photograph (slide) collection was begun in 1986 to chronicle vegetation, streambank and riverbed conditions along the river in the vicinity of the San Carlos Well and the Highway 1 Bridge.

Key to the plant moisture stress investigations conducted by District staff and consultants was the use of a Scholander pressure chamber to assess leaf water potential, or the ability of the plant to pull water out of the soil. During the day when a plant is actively photosynthesizing, plant water loss through transpiration exceeds water uptake. Because vegetation loses relatively little moisture at night and water in the plants tends to equilibrate with water in the soil, leaf water potential is sampled before dawn and the onset of photosynthesis. Measured in bars, leaf water potential is an indicator of how much water is available to the plant in the root zone. Essentially, leaf water potential values provide an index of plant water deficit conditions.

Laboratory studies helped to determine approximate values for Carmel River cottonwood and willow leaf water potential values indicative of critical water deficit conditions. Staff and consultants assessed local evapotranspiration (ET) rates with reference ET values and by monitoring evaporation in open pans, and used visual indicators of moisture stress (canopy evaluations and sequential photographs) to assist in interpreting trends in the pressure chamber data. Ideally, irrigation was initiated before critical water deficit thresholds were reached and certain physiological processes, such as photosynthesis, were impaired.

Soil moisture and plant water stress monitoring activities conducted before the inception of the Five-Year Mitigation Program were performed irregularly at various locations in lower Carmel Valley. Existing riparian habitat areas with established vegetation were sampled in the vicinity of the large municipal production wells. Monitoring information summaries and raw data were included as appendices to consultant reports, and pressure chamber data for the years 1986-1989 were consolidated into a separate data set by District staff. A comprehensive summary of "Basic Water Resources Data" was prepared for Water Year 1986, but other than this document and individual consultant reports, no comprehensive monitoring reports were prepared that presented raw data or summarized the results of the collective monitoring efforts.

Several of the soil moisture and vegetation monitoring activities begun in the early and mid-1980s were continued in the Five-Year Mitigation Program, although there was some change in the location of sampling sites. Gypsum block soil moisture sampling, pressure chamber measurements of dawn leaf water potential, and photo-documentation efforts were continued with the Mitigation Program. These monitoring activities, as well as others begun with the Mitigation Program, are further described in Section IV-B.4(e).

(e) Implement Conservation and Management Programs to Reduce Impacts -- Since the early 1980s, a variety of conservation and management activities have been carried out by the District, in cooperation with Cal-Am Water Company, in order reduce the effect of the community's demand for water on the Carmel River. Major activities are summarized below.

Water Supply Budget and Strategy -- In July of 1983, the District, Cal-Am and the California Department of Fish and Game (CDFG) developed a Memorandum of Agreement (MOA) to balance the requirements of the CDFG to conserve and protect the fish and wildlife resources of the Carmel River with Cal-Am's responsibility to supply water to communities of the Monterey Peninsula. The MOA has been modified each year to reflect aquifer storage conditions and inflow projections at the Los Padres and San Clemente Reservoirs. The MOA addresses the release of water from San Clemente Dam and was originally designed to maximize surface flow to the Narrows during the low-flow season. In addition to specifying minimum flow releases from San Clemente Dam, the MOA limits Cal-Am diversions from San Clemente Dam to the Carmel Valley Filter Plant. Typically, the specifics of the MOA are negotiated in May and remain in force until the end of December. The agreement may be modified or extended by mutual consent of the parties. See Section III-B.1(6) for a summary of activities during Mitigation Program.

MPWMD Ordinances Nos. 19 and 41 -- Ordinance No. 19 was adopted by the MPWMD Board of Directors in December 1984. Ordinance 19 required that the District develop an annual water supply strategy. This strategy includes estimates of projected demands and proposed production goals for the Cal-Am system. The ordinance also limited Cal-Am surface water diversions from the Carmel River to no more than 35 percent of total Cal-Am production. Based on the annual strategy developed by District staff, Cal-Am developed an annual water supply budget specifying monthly production goals.

The annual water supply budget was changed to a quarterly process with the adoption of Ordinance No. 41 in March 1989. Ordinance No. 41 also specified that Cal-Am's surface water diversions should be targeted at no more than 29 percent of total production. The percentage of total production for surface diversion was set as a goal, rather than an absolute standard, to allow greater operational flexibility during wet and above-normal water years.

Currently, the quarterly strategy and water supply budget values are developed jointly by Cal-Am, CDFG and the District in conformance with the annual MOA. The strategy is designed to maximize the long-term production potential and protect the environmental quality of the Carmel Valley and Seaside basins. The quarterly strategies and budgets are developed in December, March, June, and September of each year.

District Water Conservation Plan -- One of the six Goals and Objectives adopted by the MPWMD Board of Directors for budget planning in the early 1980s was to "promote water conservation and education regarding water issues." Since 1987, the District has carried out a comprehensive water conservation program with water conservation ordinances, the distribution of water-saving kits, periodic seminars, public education, and participation in reclamation projects. The District has a long-term goal of a 15 percent permanent reduction in projected water use by the year 2020. See Section VII of this report for further discussion.

2. *Conservation and Water Distribution Management to Retain Water in the River (1991-1996)*

The purpose of this mitigation was to reduce pumping impacts on riparian vegetation, particularly in the region of Aquifer Subunit 2 (Scarlett Narrows to Carmel Valley Village). The Five-Year Mitigation Program continued the conservation and management activities described immediately above Section IV-B.1(e) and in Section VII. For more detailed information on these activities in recent years, consult the annual reports for the Five Year Mitigation Program.

3. *Prepare and Oversee Riparian Corridor Management Plan*

One of the mitigations directed by the Five-Year Mitigation Program was the preparation of a comprehensive river management plan that integrates the various erosion protection, irrigation, and monitoring activities into one inclusive program. The essential goal of the Riparian Corridor Management Program is the coordination of mitigation activities and staff efforts to stabilize and enhance the Carmel River riparian corridor. Under the directive of the Five-Year Mitigation Plan, riparian corridor activities were geared to reduce adverse impacts to the riparian corridor associated with the extraction of ground water.

To facilitate the preparation and development of the Riparian Corridor Management Plan, the District created a new position and hired a Riparian Projects Coordinator in June 1991. An Administrative Draft of the Riparian Corridor Management Plan was prepared in early 1993. Because the various river management activities consolidated under the Five-Year Mitigation Program were operating efficiently, the completion of the final planning document was deferred until the close of the Five-Year Mitigation Program. The purpose of the Riparian Corridor Management Plan is to coordinate the many riparian activities of the District so that they can be implemented in an orderly, cost-effective manner. It is recognized that the plan will likely change in the future with the implementation of a long-term water supply project and the resolution of directives from the State Water Resources Control Board for Cal-Am to reduce pumping from the Carmel River aquifer. The Riparian Corridor Management Plan is currently reflected in the recommendations found in Section IV-E of this report as well as the separate MPWMD "Implementation Plan for Mitigation Program, Fiscal Years 1997-2001."

4. *Implement Riparian Corridor Management Program*

At the start of the Five-Year Mitigation Program, all erosion protection and riparian habitat management activities were integrated into the Riparian Corridor Management Program (RCMP). Carmel River projects were undertaken with complementary erosion protection, riparian habitat enhancement, and fisheries objectives. Maintaining channel stability and enhancing the natural resources of the Carmel River are primary goals of the RCMP, while improving aesthetic values and recreational opportunities are secondary objectives of the program.

The RCMP incorporates the following river management activities:

- Hydrologic Monitoring
- Erosion Protection and Restoration Projects
- Irrigation Activities
- Channel Clearing
- Monitoring of Soil, Vegetation and Wildlife
- Riparian Restoration Planting
- Public Information and Technical Assistance
- Ordinance Enforcement
- FEMA Flood Disaster Grant Management

*(a) **Hydrologic Monitoring*** -- Ground water and streamflow monitoring data are vital for effectively implementing both irrigation and erosion protection projects. Refer to Section II for more detail on program activities.

*(b) **Erosion Protection and Restoration Projects*** - For background information on the District's erosion protection activities, please see Section IV-B.1(b), "Carmel River Management Program," in this document or refer to the District's "Ten Year Review of the Carmel River Management Program" (MPWMD, April 1993).

Between July 1991 and June 1996, the District completed major restoration projects at four sites totaling almost 8,000 lineal feet of the river. Except for heavy construction tasks, MPWMD staff completed all project activities. The project areas included the most unstable areas in the river. In addition to those projects sponsored solely by MPWMD under the Mitigation Program, the District cooperated with the Monterey County Water Resources Agency (MCWRA) to complete two emergency streambank restoration projects in 1995 along 1,200 lineal feet of the river. **Table IV-1** lists those projects and **Figure IV-2** shows the locations of the projects. The following section describes the District's projects.

Hacienda Carmel Project: Staff and contractors completed repairs in November 1994 to 200 lineal feet of the Hacienda Carmel Retirement Community levee on the main stem at River Mile 3.3. High flows in January 1993 heavily damaged a short portion of the levee and left a nearly 20-foot tall vertical sand bank. Repairs consisted of installation of 600 tons of rip-rap structural protection, 600 cubic yards of channel realignment and gravel bar removal, and installation of native vegetation and an irrigation system. The project area suffered minor damage

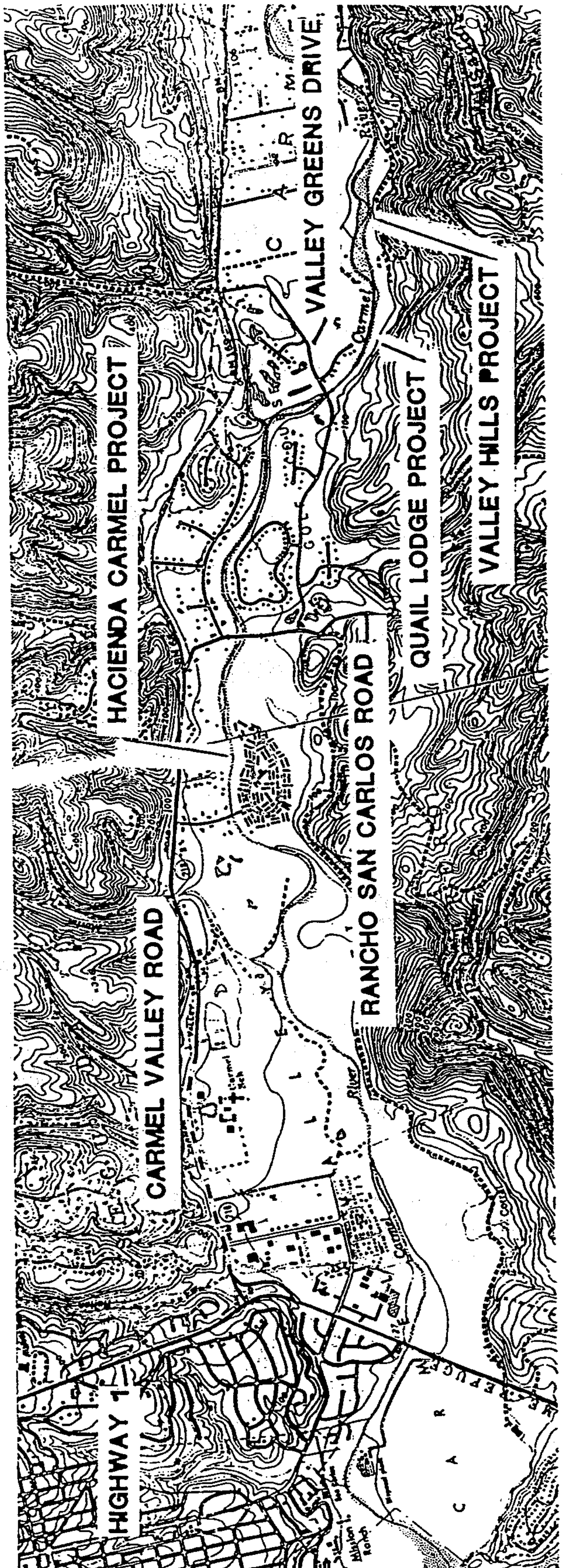
TABLE IV-1 CARMEL RIVER PROJECTS

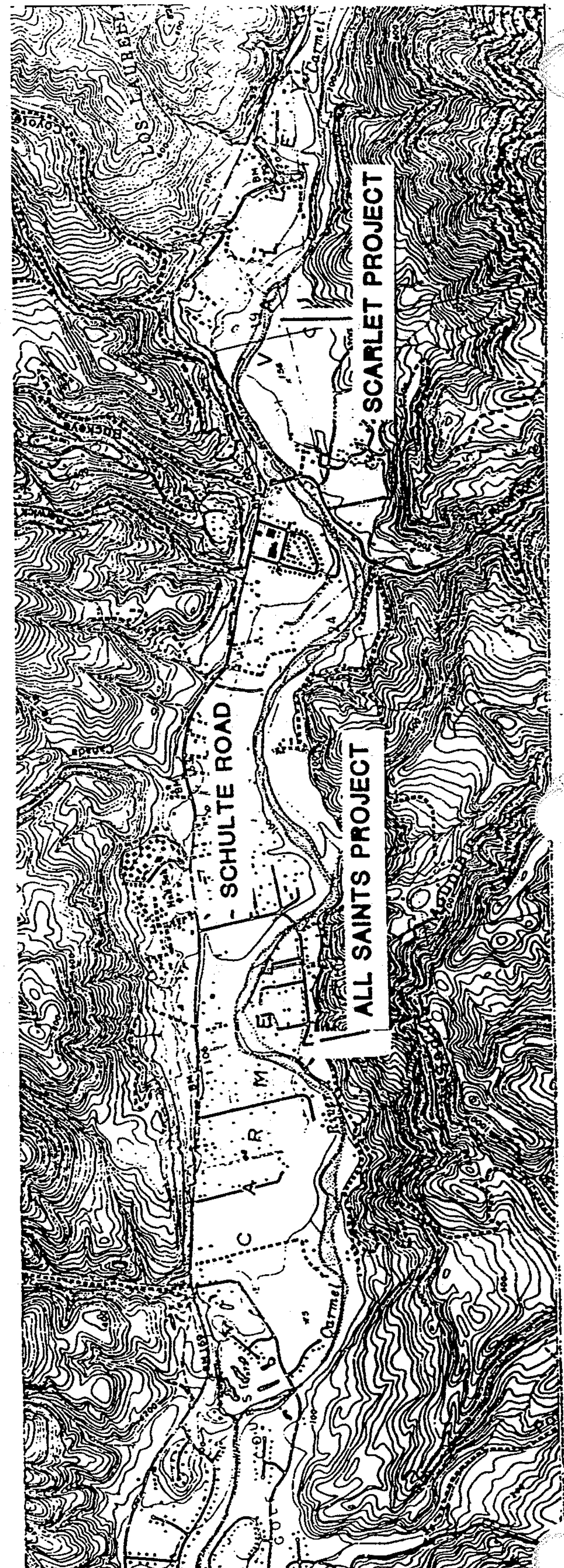
PROJECT	LOCATION (RIVER MILE)	LENGTH (FEET)	CONST. COST	ADMIN. COST	TOTAL COST	COST/ FT.
MPWMD-SPONSORED PROJECTS						
Valley Hills	5.2-5.5	1,500	$140,000	staff	$140,000	$93
deDampierre	13-14	5,500	$248,000	staff	$248,000	$45
Quail Lodge	5.1-5.2	500	$40,000	staff	$40,000	$80
Hacienda Carmel	3.1	200	$33,000	staff	$33,000	$165
MPWMD TOTAL		7,700	$461,000	staff	$461,000	$60
OTHER PROJECTS						
All Saints[1]	6	450	$216,000	$13,500	$229,500	$510
deDampierre (River House)[1]	14	700	$254,000	$13,500	$267,500	$382
Rancho San Carlos Bridge and Rosie's Bridge[2]	4&15	1,300	$92,000	$58,000	$150,000	$115
OTHER PROJECTS TOTAL		2,450	$562,000	$85,000	$647,000	$264

1. A majority of the funding for the emergency streambank repairs at the All Saints and deDampierre (River House) projects was provided by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) and the California Office of Emergency Services. The Monterey County Water Resources Agency (MCWRA) sponsored the projects and provided approximately $4,000 of in-kind services. MPWMD provided technical expertise and construction in-kind services totaling approximately $19,000 (these costs included MPWMD overhead). The NRCS provided about $4,000 of in-kind services for survey work. Cost figures for these two projects were provided by MPWMD and by MCWRA.

2. Stream maintenance projects at the Rancho San Carlos and Rosie's Bridges were funded by a small increase in Monterey County's Community Service Area No. 74 and were sponsored by the MCWRA. MPWMD was a permitting agency and provided in-kind services for revegetation of streambanks. The cost of MPWMD's services were not included in the construction figures, but were approximately $1,000. Costs shown in the table for these two projects were provided by MCWRA.

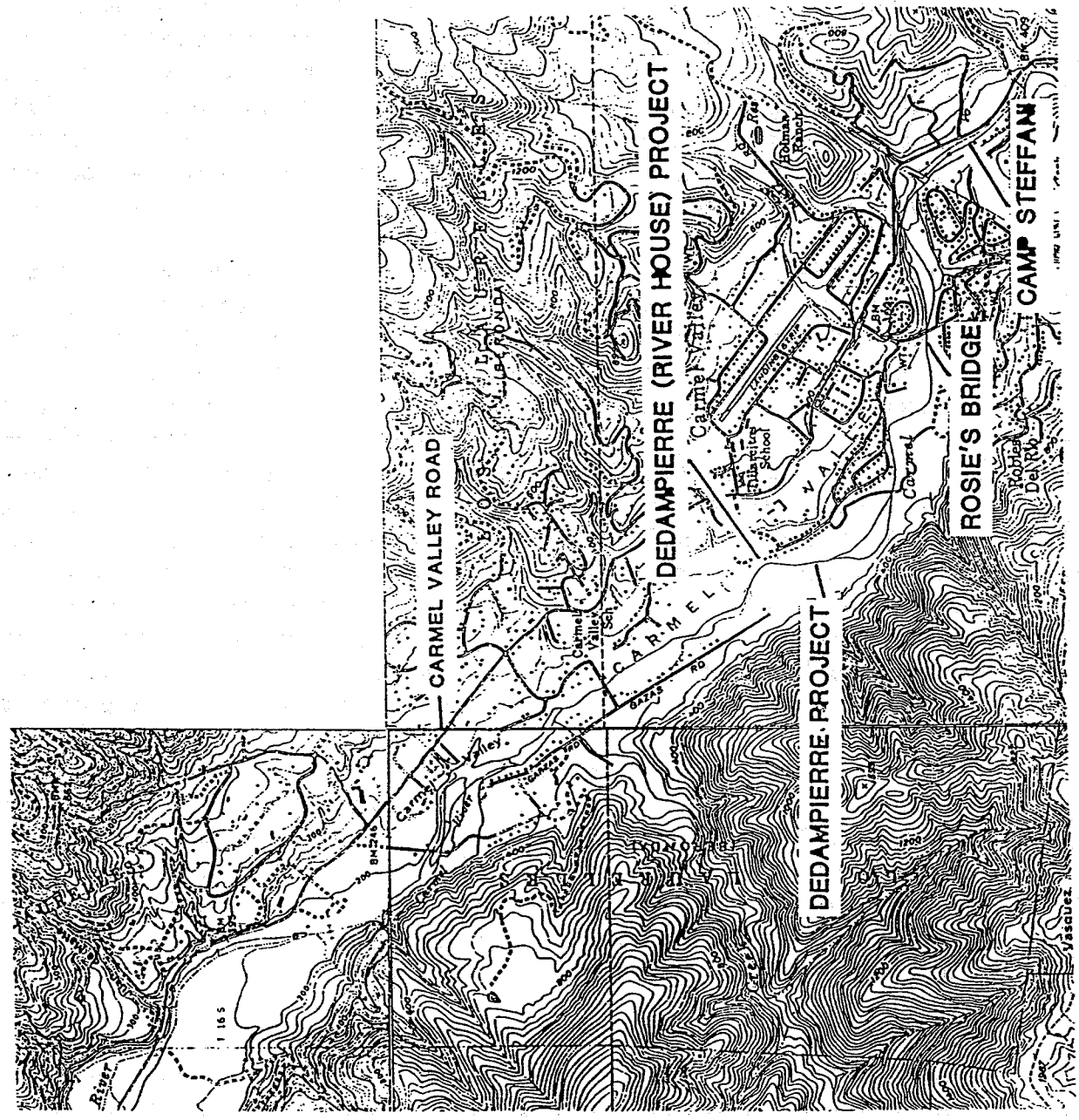
FIGURE IV-2a





CARMEL RIVER EROSION PROTECTION PROJECTS

FIGURE IV-2b


CARMEL RIVER EROSION PROTECTION PROJECTS
CARMEL VALLEY ROAD
DEDAMPIERRE (RIVER HOUSE) PROJECT
DEDAMPIERRE PROJECT
ROSIE'S BRIDGE
CAMP STEFFAN
CARMEL VALLEY RD
Carmel Valley
Palma Ranch
Pollard Del Rio

during high flow in January 1995. A District contractor subsequently repaired the damage by installing an additional 60 tons of rip-rap before the March 1995 high flow.

Valley Hills and Quail Lodge Projects: - Approximately 1,500 lineal feet were restored in the fall of 1992 in an area immediately upstream of the Quail Lodge Golf Resort at River Mile 5.2. Project work included realignment of the channel into the 1966 configuration, which had been dynamically stable (i.e., a state of equilibrium in which the river neither aggrades nor degrades, despite large fluctuations in sediment flow). Repairs consisted of 20,000 cubic yards of grading to remove gravel bars and realign the channel, installation of 300 lineal feet of post and wire structural protection, installation of 1,000 tons of rip-rap to create a rock grade control structure, and installation of vegetation and an irrigation system to water more than three acres of riparian vegetation.

In January 1993, a flow of 5,000 cfs eroded portions of this project and eroded a portion of the north streambank near the Quail Lodge Golf Resort maintenance buildings. The District agreed to extend the Valley Hills Project approximately 500 lineal feet to restore streambanks in this area. Bank repairs and restoration work were completed in November 1993. District staff modified the design of post and wire revetments by including the use of rip-rap at the Quail Lodge Project.

***deDampierre Project*:** The District restored approximately 5,500 lineal feet in and adjacent to the deDampierre Addition to Garland Park between River Mile 13 and 14. More than 40,000 cubic yards of grading was completed to excavate several gravel bars, realign the channel, and create appropriate terraces. About 2,600 lineal feet of post and wire revetments were installed to protect streambanks from erosion. Nearly 10,000 willow and cottonwood cuttings were used to revegetate streambanks and terraces. Two irrigation wells were installed to provide water during the dry season. In July 1993, approximately 1,000 lineal feet of post and wire were repaired and strengthened after high flows in January 1993 eroded portions of the project.

***Emergency Streambank Protection Projects*:** Extensive streambank erosion occurred in many locations because of the March 1995 floods. The U.S. Department of Agriculture Natural Resources Conservation Service (formerly the Soil Conservation Service) and the California Office of Emergency Services agreed to fund 93% of the costs associated with two emergency streambank stabilization projects. The projects were located downstream of Schulte Bridge at River Mile 6.2 and at the deDampierre Project at River Mile 13.5. At both project locations, there were homes in danger of being swept into the river during the next high flow.

MCWRA agreed to sponsor each project, which entailed contracting for and administrating the repair works. District staff performed topographic surveys and construction staking, designed and completed construction drawings, secured permits, performed construction management, inspected for proposed endangered species (red-legged frog and southwestern pond turtle), relocated steelhead, and designed and installed revegetation and irrigation.

Nearby gravel bars at each project site were removed and used to rebuild eroded slopes. Nearly 8,000 tons of rip-rap were placed to protect finished slopes (boulders placed at the river bottom weighed more than five tons). A low-flow fish passage channel was graded and armored with

cobbles. District staff revegetated newly created slopes with riparian species and an irrigation system was installed to water plantings during the dry season.

(c) Irrigation Activities – The long-term objective of the District's irrigation efforts along the Carmel River is the maintenance and enhancement of riparian vegetation. This has been accomplished with the irrigation of established vegetation in areas affected by ground water extraction, and by the irrigation of restoration plantings integral to the District's biotechnical erosion protection methods.

Ample rain in March 1991 and a relatively cool summer helped relieve moisture-related stress for riparian vegetation after the drought years that preceded the Five-Year Mitigation Program. Historic irrigation projects were maintained and supplemented during the Five-Year Program with the addition of irrigation systems, development of irrigation wells, testing of water treatment techniques, scheduling trials, and experimentation with irrigation materials and application methods. The severity of drought conditions experienced during 1987-1991 was not repeated during the Five-Year Mitigation Program, although 1991 and 1994 were considered dry years. Significant supplemental watering around the Cal-Am production wells (Pearce, Cypress and San Carlos Wells) and emergency irrigation was not required to maintain existing, mature riparian vegetation in most years of the mitigation program because of adequate precipitation, streamflow, and aquifer storage levels.

Each summer, the need for supplemental irrigation was assessed based on vegetation conditions, precipitation figures, sreamflow totals, and aquifer levels measured during the winter and spring season immediately preceding the typical summer irrigation period. No definitive values for precipitation, streamflow, or ground water elevation were used to define the need for irrigation; a qualitative assessment of all factors influencing the health of the riparian corridor was used to review the need for supplemental watering. For both established stands of riparian vegetation and restoration plantings, the maturity of plants (and potential root development), elevation above the summer water table, leaf water potential data, soil moisture, prevailing weather conditions, and streamflow were assessed before irrigation systems were activated.

Emergency and Four-Well Irrigation: Although the emergency irrigation program materials remained in-place throughout most of the Five-Year Mitigation Program, the extensive network of emergency irrigation systems installed between 1988 and 1990 was not utilized significantly after 1991. The floods of January and March 1995 caused severe damage to the entire emergency irrigation network, rendering most main lines and all lateral lines useless. At this time (Spring 1996), the emergency irrigation network is not functional and the replacement of the numerous systems would require a substantial capital outlay. It is estimated that the material and labor cost to replace the emergency irrigation network would be approximately $230,000. These funds have been committed to the District by the Federal Emergency Management Agency (FEMA) as a portion of the District's flood disaster repair grant program (refer to Section IV-B.4(i)). The District has applied to FEMA for a 30-month extension for completing repairs to the emergency irrigation systems because repairs will not be needed until conditions are dry or critically dry for one or more years, and aquifer storage levels decline to critically low levels. Emergency irrigation would go into effect in situations where ground water levels fall several feet

within a period of a few weeks and are predicted to continue falling, and if leaf water potential and soil moisture monitoring data indicate severe moisture stress of riparian vegetation.

March 1995 flooding also caused severe damage to the irrigation systems in the Cal-Am Four-Well Program. The Cypress Well irrigation network was rebuilt following the March 1995 event in order to irrigate restoration plantings at the adjacent Valley Hills Project. Irrigation networks will be reconstructed around the Pearce Well (Meadows Irrigation System) and the San Carlos Well when poor flow conditions and low water table elevations in the early spring season trigger concern for potential vegetation moisture stress during the summer dry season. As a condition of its original Monterey County Use Permit, Cal-Am continues to provide irrigation water free of charge for the San Carlos, Cypress and Pearce (Meadows) irrigation systems, and contributes $7,000 per year to the District for the maintenance of riparian vegetation around its production wells.

District Erosion Protection and Restoration Projects: The success of the District's erosion protection projects implemented under the Riparian Corridor Management Program (and its precursor, the Carmel River Management Program) is dependent on the planting and maintenance of native riparian vegetation. Most restoration plantings require supplemental irrigation, particularly during an initial establishment period. Some planting sites (for example, the Scarlett Project) can gradually be cut off from irrigation after the establishment period when root development penetrates to where perennial summer streamflow maintains the water table at relatively high elevations. Without persistent high water table levels, several restoration locations (for example the Schulte and Valley Hills sites), will likely require supplemental irrigation in perpetuity unless historic ground water extraction practices and the associated seasonal dewatering of the river is discontinued.

Please refer to **Figure IV-1** for the locations of irrigations systems installed between 1991 and 1996, as well as those in-place at the start of the Five-Year Mitigation Program. **Table IV-2** outlines each of the irrigation systems designed and installed by the District and notes which program funded the installation, the water source, and responsibility for operation. **Table IV-3** presents irrigation water use data for all irrigation systems designed, installed and operated by the District between 1988 and 1995.

Irrigation techniques and the design of the irrigation system varied from project-to-project, with irrigation application methods designed to accommodate planting locations, type of plant propagule, water pressure from the point of connection, and whether irrigation water was raw or potable. Generally, a combination of drip emitters and low-volume sprinkler heads was used. Flood irrigation in large, shallow basins was successful at a few sites where finer soil textures prevented the rapid permeability generally associated with streambank and terrace soils. Irrigation usually followed a watering schedule of two short duration applications, followed by a longer period of deep watering to encourage the movement of water through the soil and promote deep root extension.

TABLE IV-2

BASIC IRRIGATION INFORMATION

System Name	Program	Installation Year	Water Source	Operator
De Dampierre (L.L.)	CRMP	1994	MPWMD Well	MPWMD
De Dampierre (T.R.)	CRMP	1994	Private Well	MPWMD
Garland	CRMP	1987	Cal-Am	MPRPD
Scarlett	CRMP	1989	Cal-Am	MPWMD
Robinson	EI	1989	Cal-Am	MPWMD
Little Berwick	CRMP	1987	Cal-Am	MPWMD
Big Berwick	EI	1989	Cal-Am	MPWMD
Begonia	EI	1989	Cal-Am	MPWMD
Lemos	EI	1989	Private Well	owner
Egg Ranch	EI	1989	Private Well	owner
Pryor	CRMP	1988	MPWMD Well	MPWMD
Manor	CRMP	1988	Cal-Am	MPWMD
Reimers Well	CRMP	1990	Private Well	MPWMD
Schulte North	CRMP	1988	Cal-Am	MPWMD
Schulte South	CRMP	1988	Cal-Am	MPWMD
Schulte Well	EI	1988	Cal-Am	MPWMD
Meadows (Pearce well)	4-WELL	1988	Cal-Am	MPWMD
Cypress	4-WELL	1989	Cal-Am	MPWMD
CVGCC	EI	1988	Private Well	owner
Quail	CRMP	1994	Private Well	owner
Valley Greens Bridge	EI	1989	Cal-Am	MPWMD
Valley Greens	EI	1989	Cal-Am	MPWMD
San Carlos	4-WELL	1989	Cal-Am	MPWMD
Hacienda Carmel	EI	1988	Private Well	owner
Hacienda Levee	CRMP	1994	Private Well	owner
Rancho Canada	4-WELL	1989	Private Well	owner
Riverwood	EI	1990	Cal-Am	MPWMD
Highway 1 South	EI	1990	Cal-Am	MPWMD
Highway 1 North	EI	1990	Cal-Am	MPWMD

Notes:
CRMP = Carmel River Management Program
EI = Emergency Irrigation Program
4-Well = California-American 4-Well Irrigation Program
MPRPD = Monterey Peninsula Regional Park District

TABLE IV-3

ANNUAL SUMMARY OF IRRIGATION WATER USE 1988-1995

All values are in acre-feet

Irrigation System	88	89	90	91	92	93	94	95
De Dampierre (L.L.)							0.90	0.35
De Dampierre (T.R.)							0.76	
Scarlett			3.33	5.43	4.39	5.64	4.57	
Robinson		1.44	4.00	0.32				
Little Berwick	2.87	1.11	2.93	1.42	1.10	0.48	0.07	
Big Berwick	3.04	2.98	7.49	6.53	3.83			
Begonia			6.54	2.99	2.63			
Pryor	0.49	1.63	5.52	2.77	2.08	1.53	0.66	
Manor	2.12	1.16						
Schulte North	9.39	9.64	22.79	19.63	19.24	18.68	20.54	1.84
Schulte South	1.57	1.98	2.39	2.04	3.69	3.44	4.25	
Schulte Well	10.02	1.53		0.03				
Meadows	19.62	10.24	24.87	13.63	16.49			
Cypress	10.55	4.28	11.07	1.36	9.31	9.28	14.56	2.01
Quail							1.54	0.37
Valley Greens Bridge			6.15	2.76				
Valley Greens	4.30	10.62	28.12	9.01	0.03			
San Carlos	20.00	5.75	28.35	11.14	2.46		3.22	
Riverwood			9.12					
Highway 1 South			20.65	0.73				
Highway 1 North			12.21					
Annual Total	83.97	52.36	195.53	79.79	65.25	39.05	51.07	4.57

One of the objectives of the Riparian Corridor Management Program (RCMP) is the drilling of new District wells to replace the use of Cal-Am water to irrigate established streamside vegetation and restoration plantings. At the beginning of the Five-Year Program, the District owned and operated four irrigation wells (Little League, Scarlett Vault, Pryor, Reimers). The Pryor Well was drilled in 1986, Scarlett and Little League in 1988, and Reimers in 1990. Under the RCMP, a well was drilled in 1994 at the Trail and Saddle Club to water plantings on the south bank of the deDampierre Project. In 1995, the Reimers Well was relocated and deepened for better production results. The District was also successful in negotiating a Well Use Agreement with John Gardiner's Tennis Ranch for the use of water to irrigate restoration plantings in a portion of the deDampierre Project situated on the Gardiner's property.

General maintenance of irrigation systems included pump tests, flushing lines, cleaning emitters and replacing polytubing damaged by wildlife. Vandalism of District irrigation material and restoration plantings occurred, but losses were minor and easily repaired.

Iron Treatment: The use of untreated groundwater with high levels of iron and manganese resulted in elevated maintenance needs because of the severe clogging of screen filters, lateral lines and emitters at several locations. The San Carlos, Cypress, Reimers (Schulte North), and Pryor irrigation systems incurred high maintenance costs and reduced efficiency because high iron contents in the untreated groundwater support a sheathed bacteria that utilizes iron during its metabolic process. This iron-loving bacteria is typical of many Carmel Valley water systems that pump from certain levels in the alluvial aquifer. The metabolic by-product produced by the bacteria is an orange sludge that coats the inside of all plumbing fixtures, gradually reducing their ability to transport water.

To address the iron contamination problem, in 1995 the District initiated a pilot water treatment program at the Cypress Well. With the assistance of Advanced Water Systems, Inc. of Santa Cruz, District staff installed an electric metering device that injected a measured amount of a polyphosphate chemical into the mainline of the irrigation system. The non-hazardous polyphosphate maintains iron and manganese in solution and unavailable for the bacteria to metabolize. During the 1995 irrigation season, there was a marked reduction in maintenance needs at the Valley Hills Project (Cypress Well) associated with the cleaning of emitters and lateral lines. Because of the success of the water treatment program at the Cypress Well, similar treatment systems will be considered at other sites with problematic iron contamination levels.

(d) Channel Clearing -- Channel clearing projects along the Carmel River were a significant component of the District's river management program. Since the fall of 1990, the District has mobilized hand crews and equipment to remove woody vegetation and debris from the active channel bottom of the Carmel River. The primary objective of the District's clearing effort was to keep the center of the channel clear of obstructions to river flow in order to reduce erosion hazards and maintain bank stability. The District carefully preserved riparian vegetation on the channel banks to promote channel stability, provide wildlife habitat, and enhance both aquatic habitat values for steelhead and the visual aesthetics of the riparian corridor.

District counsel determined that the District had the legal authority to undertake channel clearing tasks within its entire jurisdictional area, from the center of the channel to the limit of the 10-year flood elevation. However, as a courtesy to property owners along the river, access permission was requested prior to vegetation removal. During each year of the Five-Year Mitigation Program, the District assumed regular channel clearing responsibilities along fifteen miles of the Carmel River between Stonepine Resort and the river mouth at the Lagoon. Generally, the District received property owner support of these efforts.

The Water Management District found that along the Carmel River, streambank erosion occurred when woody vegetation or debris in the river channel bottom collected flood debris or created water diversions that deflected river flows against unstable riverbanks. Streambank erosion can result in property loss, riparian habitat degradation and localized flooding. Besides the bank protection benefits provided by the District's channel clearing program, removal of vegetation from the center of the channel increases channel capacity, reduces safety hazards for river recreationists, and improves the aesthetic qualities of the riparian corridor by disposing of undesirable trash. Cutting debris and downed trees also reduced the potential for the accumulation of large debris-jams on bridge pilings during high flow events.

Because of its well-documented bank protection and habitat benefits, live riparian vegetation on the streambanks was carefully preserved, and live vegetation and natural debris utilized by wildlife was removed from the center of the channel only if it posed a bank erosion and/or flood threat. Trees that leaned over the channel and large woody plants that shaded important pools in the river were trimmed if they posed an erosion or flood hazard. Generally, small-stemmed vegetation growing at the toe of the channel banks was left in place if it could be bent or forced to the side of the channel when storm flows raised the river level. Vegetation that is pushed against the streambanks deflects water back into the center of the channel, thus further offering protection to the riverbanks.

Removal of woody debris and vegetation that offers cover to aquatic species conflicts with the protection and enhancement of riparian and fishery resources along the Carmel River. The Carmel River and its riparian corridor support a potentially threatened run of anadromous steelhead fish and many aquatic and terrestrial species that depend on streamside vegetation and woody debris in the river channel. By evaluating each reach of the river and assessing habitat values, potential erosion problem areas, as well as areas where increased channel capacity offer possible erosion and flood relief, the District can prioritize channel clearing needs and attempt to balance the resource needs of wildlife with the removal of material from the center of the channel. The District obtained a Streambed Alteration Agreement from the California Department of Fish and Game (CDFG) and an Emergency River Work Permit from the County of Monterey Water Resources Agency each year the channel clearing project was implemented. For regular maintenance tasks throughout the year, the District negotiated a Memorandum of Understanding with the CDFG that permitted channel clearing in dry reaches of the river without securing a Streambed Alteration Agreement.

District staff was assisted in channel clearing efforts by the California Conservation Corps (CCC), the California Department of Forestry (CDF), and other sources of semi-skilled labor that are available to public agencies. The District has an agreement with the CCC for up to a yearly total of 1040 hours of labor provided at an annual cost of $6,500. The regular CCC hourly wage is currently $11.75 per hour. CDF provides crews of 15 to 18 workers at no charge to the District.

After the floods of 1995, in addition to the regular CCC and CDF crews, the District was successful in securing a second crew of CCC laborers and a small crew from the Monterey County Joblink program at no cost. During its 17-week channel clearing campaign in 1995, the District utilized 11,640 man-hours provided by various labor crews at a cost to the District of only $6,500 (the negotiated annual cost of the CCC crew).

The hand crews supervised by District staff trimmed vegetation, cut dead material and collected inorganic waste. Independent backhoe operators were contracted to remove more massive debris jams blocking the channel. Cut vegetation was chipped with the District's brush chipper, or burned after regional and local burn permits were obtained. Larger material was cut into 2-foot rounds and left in the river bottom to be carried by high flows out to sea. Inorganic debris was hauled out of the river channel and properly disposed of. In 1995, more than 300 vehicular tires were recycled and 250 cubic yards of waste were disposed.

Where feasible, rootballs of willows that are readily accessible to heavy equipment were removed with a backhoe and replanted in areas that benefitted from additional vegetative growth. In 1995, District staff also experimented with the application of "Rodeo", a broadleaf herbicide acceptable for use adjacent to aquatic environments. Aerial spraying was not considered due to the sensitive nature of the aquatic species in the Carmel River. To apply "Rodeo", tree stumps were first cut by hand then immediately painted with a concentrated solution of the herbicide in an effort to control the resprouting of hardy willow growth.

The annual operating budget for the District's channel clearing activities averaged approximately $14,000, which included the $6,500 charge for CCC work crews. Operating expenses do not cover staff time, which is factored into the general Mitigation Program budget. In the aftermath of the storms of 1995, the channel clearing budget was $21,500, which included the CCC labor costs. Costs for rental of a brush chipper were eliminated in late 1993, when the District purchased a chipper for use during channel clearing projects.

(e) Monitoring of Vegetation, Soil, and Wildlife – A vital component of the District's river management activities related to mitigating the impacts of ground water extraction was the regular monitoring of vegetation, soil and wildlife. Consistent and repeated monitoring chronicled changes in habitat conditions in the riparian corridor and documented trends in the vigor of riparian vegetation, the variability of soil moisture levels, and the presence of wildlife. Several of the vegetation and soil moisture sampling techniques used prior to 1991 were continued during the Five-Year Mitigation Program, and a few new monitoring activities were implemented.

Vegetation Monitoring: The District collected and analyzed quantitative and qualitative data on vegetation with the primary goal of providing information to trigger riparian corridor management actions. Specifically, plant moisture stress indicators were sampled in order to identify irrigation needs. A secondary goal of vegetation monitoring was to collect empirical data to assess whether the management practices employed by the District were effective. Monitoring efforts were geared towards applied management functions, rather than for research purposes.

Background: The Water Allocation Program EIR stated that without mitigation, the extraction of ground water under the 16,744 acre-foot Option V Allocation would have significant adverse impacts on riparian vegetation, particularly in the lower Carmel Valley in aquifer subunit 3 (AQ3) and aquifer subunit 4 (AQ4). Significant adverse impacts were also projected for several acres in aquifer subunit 2 (AQ2) in extremely dry years. Significant impacts were anticipated when vegetation was subjected to an eight-foot or greater ground water drawdown in the root zone. To characterize the magnitude of the projected impacts, water stress models were developed by McNiesh (1988, 1989) and riparian vegetation maps were used in conjunction with computer-based models that simulated aquifer storage and drawdown caused by well production. The vegetation impact analysis provided an estimate of the acreage of riparian habitat that would be affected during a typical water year, a critically dry year and an extremely dry year. **Table IV-4** outlines the affected areas of the Carmel River riparian corridor projected to suffer significant adverse impacts under the adopted Allocation Option V.

Table IV-4
Affected Areas of Riparian Vegetation,
Water Allocation Option V

Aquifer Subunit	Typical Water Year*		Critically Dry Water Year		Extremely Dry Water Year	
	Acres Affected	Percent of Total Area	Acres Affected	Percent of Total Area	Acres Affected	Percent of Total Area
AQ1						
AQ2			Localized decline on channel banks near Laureles Wells		3.5 acres	5%
AQ3	41.0 acres	48%	83.2 acres	98%	84.9 acres	100%
AQ4	17.2 acres	22%	19.1 acres	24%	24.3 acres	31%

* Note, water year definitions were developed by the consultant and differ from those of MPWMD. Definitions are based on exceedence probability. A typical year is composed of river flows that are equalled or exceeded up to 50% of the time.

The acreage estimates represent riparian vegetation subjected to an eight-foot or greater seasonal drawdown and susceptible to severe water stress that could cause direct mortality or a gradual decline in vigor. As soil water declines in the root zone of riparian plants, McNiesh's plant water stress model predicted that severe moisture deficiency generally occurs if the water table drawdown rate exceeds two feet in any seven-day period, or if total seasonal drawdown exceeds eight feet below the elevation of the winter water table and the area of permanent root development. Mild water stress often occurs if the drawdown rate exceeds one to two feet in any week, or if seasonal drawdown is between four and eight feet below the winter water table. These rates were considered sufficient to induce damage to riparian vegetation, particularly if repeated from year to year. Under the Option V allocation, riparian vegetation in AQ 1 was not projected to experience damaging soil moisture levels. Vegetation in AQ2 was estimated to suffer stress and

some mortality only along the channel bottom in the immediate vicinity of the two Laureles Wells, where shallow rooted plants are not able to penetrate to deeper soil moisture at the same pace as ground water drawdown.

The negative impacts associated with ground water drawdown include direct mortality of vegetation, and reduced seed dispersal and seedling establishment resulting from the lack of streamflow. Over time, the reduction in seedling dispersal and germination potential could alter riparian plant community structure and species composition, and could decrease habitat productivity (vigor).

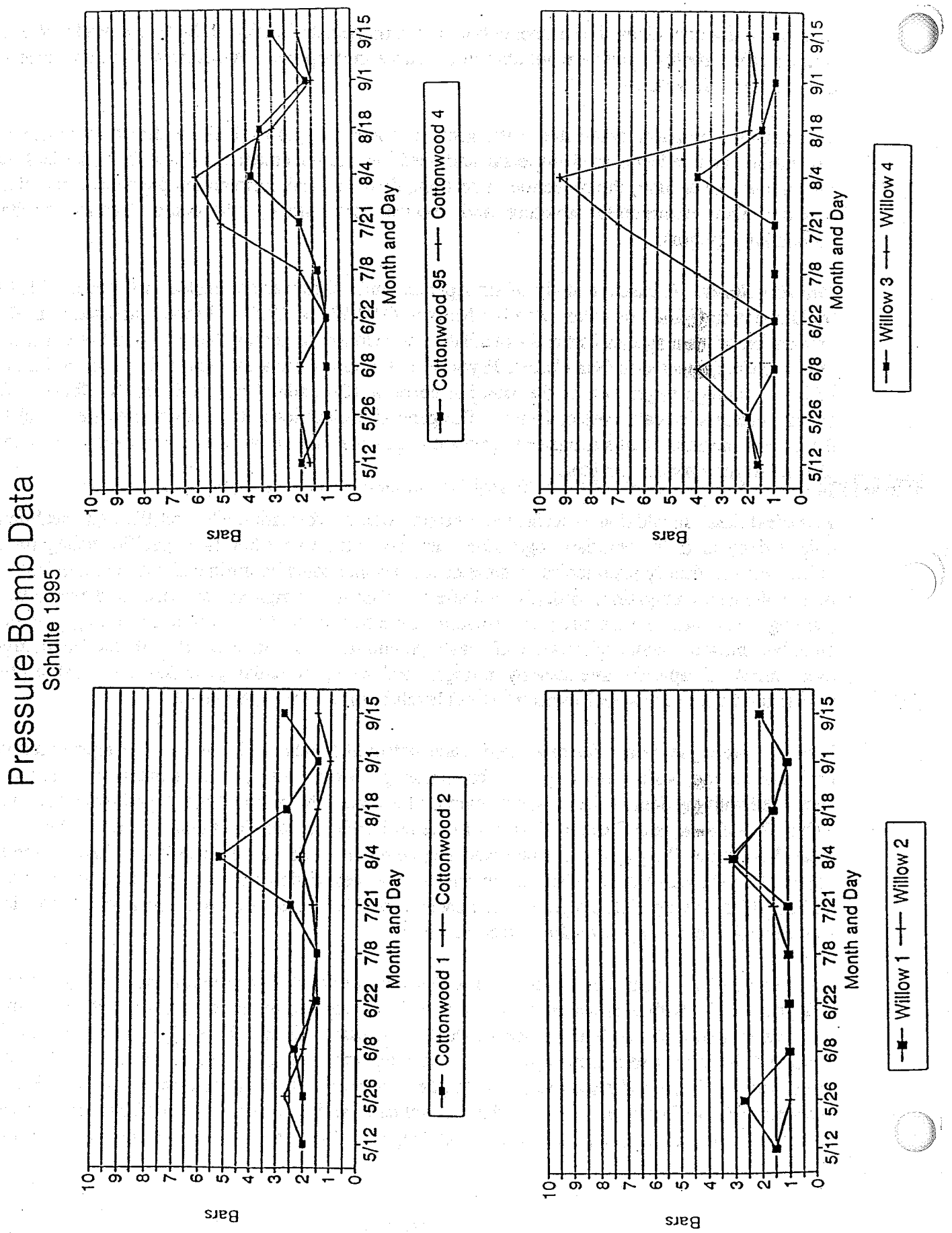
Baseline Study: A baseline study of six riparian study sites was conducted in October of 1991 by District staff and consultant Randall Morgan (MPWMD, 1992). Morgan assisted with the preparation of plant species lists and a qualitative description of general habitat conditions at three District management sites (San Carlos, Pryor, Schulte) and three areas where the District did not actively manage vegetation in the riparian corridor (Boronda, Oxbow, Camp Steffani). No specific quantitative data were collected. The general descriptions of the study sites are useful in that they demonstrate that streamside vegetation and habitat conditions vary significantly along the Carmel River riparian corridor.

Empirical Data: In addition to surface and ground water information (Section II), empirical data collected by staff for riparian vegetation were collected to further two specific management objectives: (1) identify plant moisture stress conditions that could be mitigated with the application of supplemental irrigation, and (2) evaluate the District's irrigation practices and restoration planting techniques. To identify plant moisture stress trends, staff focused on compiling pressure chamber measurements of dawn leaf water potential. Used in concert with the qualitative assessment of riparian tree canopy ratings, leaf water potential provided the most useful information about the actual moisture stress levels plants were experiencing.

Four sites were monitored for dawn leaf water potential trends, with a total of 32 representative cottonwood and willow trees chosen for sampling. Leaf water potential measurements were conducted with the Scholander pressure chamber following the protocol developed by consultants Robert Woodhouse and Charles McNiesh in the mid-1980's. Regular sampling during the Five-Year Mitigation Program was conducted beginning in 1992 in the established riparian forest adjacent to the San Carlos Well and at the Schulte Restoration Project, and since 1993 at the Valley Hills and Scarlett Projects. In general, the leaf water potential information provided representative data on plant water stress conditions.

An example of a seasonal data set for two willows at the Schulte Restoration Project is presented in **Figure IV-3**. Both willows were planted in 1988 as cuttings in the Schulte Project. Note that leaf water potential centibar values gradually increased during the early summer of 1995, indicating that it became increasingly difficult for the plant roots to absorb moisture from the soil. Note also the increased moisture stress (higher centibar values) for willow 4. Willow 3 was approximately 50 feet from the top of the channel bank and willow 4 was over 300 feet from the streambank, where depth to ground water was deeper. In early August repairs were completed to

FIGURE IV-3


Pressure Bomb Data
Schulte 1995
Bars
Month and Day
5/12 5/26 6/8 6/22 7/8 7/21 8/4 8/18 9/1 9/15
0 1 2 3 4 5 6 7 8 9 10
Cottonwood 95
Cottonwood 4
Cottonwood 1
Cottonwood 2
Willow 3
Willow 4
Willow 1
Willow 2

the Schulte irrigation system after it incurred damage during the March 1995 flood. Plant moisture stress gradually decreased when regular irrigation was initiated for restoration plantings at the Schulte Project. Complete leaf water potential data for the San Carlos, Valley Hills, Schulte and Scarlett sample sites are available at the District's Carmel Valley Field Office.

Data were also collected between 1992 and 1995 to document trends in the height and growth (diameter at breast height, or DBH) of the same trees monitored for dawn leaf water potential. When the effects of natural flood damage and occasional broken limbs are factored into the analysis, trees in irrigated areas managed by the District with supplemental irrigation display increases in height and growth **(Figure IV-4)**.

Growth of restoration plantings at District project sites was been excellent, with some trees tripling in height. **Table IV-5** presents growth rate information for several species planted in portions of the deDampierre Project. Intensive monitoring efforts during the initial establishment period documented survival and the height of each planting in eleven sample plots at the deDampierre Project. Staff systematically monitored restoration planting mortality and growth at the Valley Hills Project. Restoration plantings were not empirically monitored at the Hacienda Project or emergency bank repair sites, where District staff performed visual inspections and reported problematic conditions directly to the parties responsible for long-term maintenance.

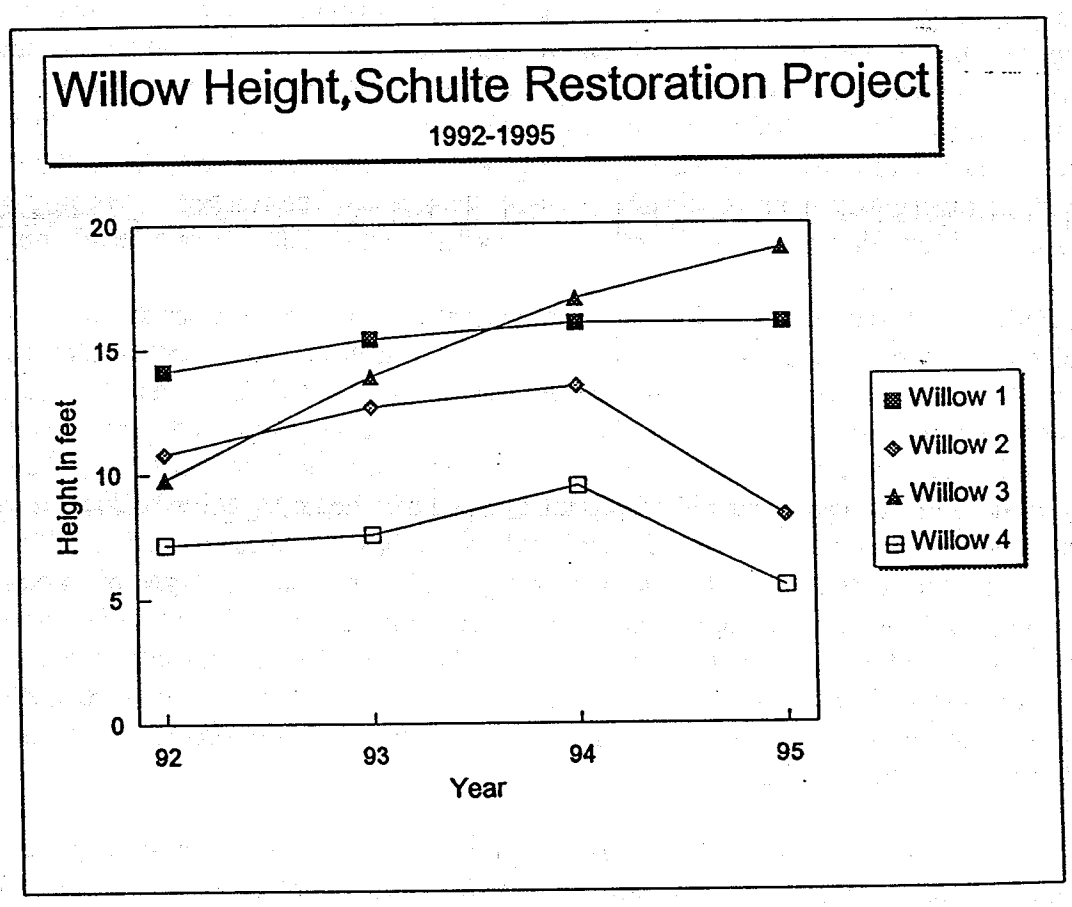
Descriptive Data: Because dawn leaf water potential measurements were conducted on a relatively small representative sample of monitoring trees, visual indicators of moisture stress throughout riparian habitat areas were also qualitatively analyzed. Canopy defoliation and leaf yellowing are physical manifestations of moisture deficiency and these vegetation attributes were regularly assessed in seasonally dewatered reaches of the river during the Five-Year Mitigation Program. Canopy defoliation was measured with a rating scale developed by MPWMD in the late 1980s; ratings of one through ten where correlated to canopy conditions ranging from complete defoliation and obvious mortality, to lush foliage and commensurate high soil moisture. Leaf yellowing and general canopy conditions were also chronicled with photographic slide documentation at regular monitoring stations. Photo monitoring was conducted at the same stations in the vicinity of the Highway 1 Bridge and the San Carlos Well since 1986. Regular photographic monitoring was also a standard practice at all the erosion protection projects implemented by the District.

Soil Moisture Monitoring: Soil moisture monitoring was been an element of the District's regular monitoring program since before the inception of the Cal-Am Four-Well Irrigation Program in the early 1980s. Soil moisture monitoring occurred during the Five-Year Mitigation Program in both established riparian habitat areas and in District restoration projects. Techniques used for measurement of soil moisture included the use of the neutron probe, tenisometers, and gypsum blocks. As described previously in Section IV.B.1(d), use of the neutron probe was discontinued shortly after the beginning of the Five-Year Mitigation Program because of equipment malfunctions, problems associated with the maintenance of access tubes, and the difficulty in calibrating the instrument.

FIGURE IV-4

TOTAL HEIGHT OF PRESSURE BOMB TREES AT SCHULTE RESTORATION PROJECT
1992-1995

	92 Height (ft)	93 Height (ft)	94 Height (ft)	95 Height (ft)
Willow 1	14.1	15.4	16.0	16.0
Willow 2	10.8	12.7	13.5	8.3
Willow 3	9.8	13.9	17.0	19.0
Willow 4	7.2	7.6	9.5	5.5



Note: During the March 1995 flood event, the entire Schulte Restoraton Project was under 5 to 10 feet of water and several of the sampling trees were bent by flood debris. Although the tree heights of willow 2 and 4 decreased, these trees suffered no permanent damage, and continued to increase in height throughout the 1995 growing season.

DE DAMPIERRE RESTORATION PROJECT
Growth Information for Three Common Restoration Species
March 1994 (Planting Date) to September 1995

Basin	Cottonwood			Willow			Sycamore		
	Number of Trees Planted	Average Height Increase	Mortality Number	Number of Trees Planted	Average Height Increase	Mortality Number	Number of Trees Planted	Average Height Increase	Mortality Number
1	18	256%	1	2	85%	0	3	22%	0
2	5	289%	0	4	164%	0	2	422%	0
3	5	403%	0	8	352%	0	1	86%	0
4	7	508%	1	7	248%	0	2	155%	1
5	4	647%	0	5	260%	0	1	317%	0
6	5	290%	0	12	198%	0	2	82%	0
7	10	205%	0	12	95%	1	2	15%	0
8	8	240%	0	10	130%	1	2	153%	0
9	5	228%	1	12	111%	2	2	114%	0
10	11	310%	1	10	43%	1	1	22%	0
11	1	269%	0	5	83%	0	1	300%	0
Total	79		4	87		5	19		1

Average Height Increase for Cottonwoods for all Basins = 331%
Average Height Increase for Willows for all Basins = 161%
Average Height Increase for Sycamores for all Basins = 153%

TABLE IV-5

In 1992, District staff installed arrays of tensiometers in the vicinity of the San Carlos Well and at the Schulte Project. Two tensiometers were installed at the Schulte Project in graduated distances away from the streambank, and six instruments were placed in two groups at the San Carlos site (three instruments on each side of the river at different depths and increasing distance away from the San Carlos Well). After the winter 1995 flood events, damaged tensiometers were replaced at Schulte and on the north bank of the San Carlos site and an additional monitoring site was added at Schulte. However, the array on the south bank of the river at San Carlos was not replaced due to the thickness of the vegetation and the abundance of poison oak. In 1995, the original tensiometers were replaced by 18-inch and 36-inch instruments, in addition to a series of three gypsum blocks (2, 18 and 36 inches deep) placed at the same monitoring location.

Tensiometers are closed plastic tubes with a vacuum gage at the top and a porous ceramic tip sealed at the bottom. The tube is filled with water and the ceramic tip is buried in the soil at the depth to be monitored. The working principle of the tensiometer is based on the equilibrium between the porous tip of the instrument and the surrounding ambient soil; water will permeate through the porous tip from wetter areas to drier conditions until equilibrium is reached. Gage readings are usually displayed in centibars and the tensiometers register the suction of moisture into the soil (as well as the ability of plants to pull water from the soil) until the instrument becomes totally dry at about 80 centibars.

Wildlife Monitoring: Since the spring of 1992, the District has contracted with consulting wildlife biologist Dr. David Mullen for the sampling of avian (bird) wildlife along the Carmel River and the evaluation of Species Diversity Index trends. Dr. Mullen has systematically monitored nine locations during the spring and summer seasons (1993 sampling was conducted in the winter and summer seasons) with a repeatable sampling protocol providing data used in developing a Shannon-Weaver Index of General Diversity. Monitoring sites included several District restoration projects, areas with perennial river flow, as well as reaches typically dewatered during the summer and fall dry seasons. The objective of Species Diversity Index (SDI) sampling along the Carmel River was to investigate and correlate the effects of ground water extraction and mitigation efforts on riparian vegetation and wildlife habitat in the riparian corridor (EIP 1993; Mullen 1993, 1994, 1995). Avifauna (birds) were used as an indicator of the relative quality of riparian sites because streamside habitats provide a variety of food resources and structural microhabitats that tend to support large numbers of avian species.

Species Diversity Index sampling is a commonly used biological survey technique that involves the analysis of ratios between the number of species at a site and the "importance value" (numbers, biomass, productivity) of the individuals within each species. Species diversity tends to be high in older, well-established natural communities and low in newly established or disturbed ecosystems. Ecological literature indicates that SDI values below 2.00 usually characterize areas with poor habitat values, or sites that are highly disturbed. SDI values near 3.00 or above are associated with more ecologically diverse, environmentally stable habitats.

Data collected by Dr. Mullen at each location were statistically analyzed and compared to other sites in the sample. SDI values from the Carmel River avian monitoring program are presented in **Table IV-6**. The data-set of relatively high SDI numbers indicates a rich avifauna throughout

TABLE IV-6

AVIAN MONITORING
Carmel River Riparian Corridor

Species Diversity Index Values

Transect #	1992 Spring	1992 Summer	1993 Winter	1993 Summer	1994 Spring	1994 Summer	1995 Spring	1995 Summer
2A*	3.13	2.76	2.54	2.97	3.04	2.50	3.14	2.41
2B	3.12	2.75	2.55	2.80	2.74	2.76	3.18	2.21
2C*	3.24	2.87	2.60	3.04	3.04	2.93	3.13	2.41
3A	3.11	2.89	2.49	2.80	3.04	2.85	3.06	2.90
3B*	2.98	2.67	2.74	2.54	2.68	2.52	2.71	2.55
3C*	3.21	2.74	2.54	3.00	2.88	2.73	3.07	2.50
4A	3.24	2.83	2.68	2.88	3.00	2.65	3.55	3.02
4B	3.37	2.72	2.62	2.44	2.88	2.77	3.20	2.79
4C	3.27	2.13	2.85	2.08	3.09	2.34	3.19	2.53

* District Bank Protection Projects

Transect Locations:

2A* = De Dampierre Park, west from eastern park boundary, 1750' along south bank (De Dampierre restoration project).
2B = Garland Park, west from Carmel River bridge 1750' along south bank.
2C* = Carmel Valley Ranch Golf Club, west from eastern propery limits, 3300' along south bank (Scarlett restoration project).
3A = Robinson Canyon Road, east from barns area for 2000' along south bank.
3B* = Schulte Road Bridge, west for 1375' along south bank (small portion of Schulte restoration project).
3C* = Valley Greens Drive Bridge, east for 2200' along south bank (small portion of Valley Hills restoration project).
4A = San Carlos Ranch Road Bridge, west for 1250' along south bank.
4B = Riverwood, west for 2500' from eastern property boundary along north bank.
4C = U.S. Highway 101 Bridge, west for 2250' along south bank.

Species Diversity Index (SDI) values from annual Carmel River Riparian Corridor Wildlife Habitat Monitoring Program reports,1992-1995. Prepared by Dr. David A. Mullen, Environment Consultant, Berkeley, CA . Reports on file at MPWMD.

the Carmel River riparian corridor. SDI values generally declined from their peak during the spring breeding season because many birds used riparian habitats only for nesting and then migrated out of the central coastal region. The seasonal decline between spring and summer was accentuated when SDI values from perennial reaches of the river were compared with those obtained from dry areas.

Although avian monitoring was conducted for only a few years, trends emerge from the data that demonstrate increased habitat occupation by birds in riparian areas where surface water is present in the river. Species diversity values for all reaches of the river in lower Carmel Valley show little variation during the spring breeding season each year. By contrast, **Table IV-7** demonstrates that summer SDI values from sites in typically dry portions of the river were significantly lower than SDI numbers in the upper valley where perennial flow is maintained. This pattern is supported by the summer 1995 data, which were collected when the river still flowed continuously to the lagoon. SDI values obtained during the summer sampling period at the downstream monitoring locations showed an average increase of 8.5 percent over those in the upper river. The presence of summer stream flow in the lower valley in 1995 led to richer riparian habitat qualities for birds.

As Dr. Mullen suggests in his 1995 monitoring report, the summer 1995 SDI information and the ability to compare it to previous years when data were collected under drier stream flow conditions, provides the first empirical evidence of the wildlife habitat benefits that could be anticipated if surface flow was maintained in the lower Carmel River. Continued SDI sampling will document patterns of avian use and associated habitat quality along perennial and seasonally dry reaches of the river.

(f) Riparian Restoration Planting -- During the Five-Year Mitigation Program, the District experimented with several different techniques for establishing restoration plantings. Riparian plantings were installed as an integral component of erosion protection projects, where willows in particular contributed to the overall stability of bank restoration efforts. Supplemental plantings were also established at older District restoration sites in an effort to diversify the original planting palette and position various native riparian species to augment appropriate streamside microhabitats. Planting activities were undertaken with two primary objectives: (1) increase bank stability, and (2) enhance the diversity of District restoration efforts and overall habitat qualities of the riparian corridor. Restoration plantings have also increased general aesthetics along the river and have contributed to habitat values for aquatic species and the steelhead fishery.

Each erosion protection project undertaken by the District incorporated native riparian vegetation as an integral component of bank stabilization. The District's "biotechnical" approach to bank stabilization is described in Section IV-B.4(b). In addition to planting willows for erosion protection benefits at District projects, the District provided thousands of willow cuttings and hundreds of riparian tree seedlings to private landowners who undertook private bank restoration projects.

The District experimented with diverse planting techniques for both cuttings and rooted seedlings. Where irrigation was available and bank or terrace topography was appropriate, willow and

TABLE IV-7

SPECIES DIVERSITY OF BIRDS
UTILIZING LOWER CARMEL RIVER RIPARIAN CORRIDOR HABITATS

Spring	Perennially Watered Reaches Transects 2A-3A	Seasonally Dry Reaches Transects 3B-4C	Percent Difference
1992	3.15	3.21	+1.9
1994	2.96	2.91	-1.8
1995	3.13	3.14	+0.3
Mean (3 Yrs)	3.08	3.09	+1.3
Summer			
1992	2.81	2.62	-6.8
1993	2.90	2.59	-10.7
1994	2.76	2.60	-5.6
1995	2.48	2.69	+8.4
Mean (4 Yrs)	2.73	2.62	-4.0

Notes:
1. 1993 Winter monitoring results not included.
2. 1994 considered a critically dry year.

cottonwood cuttings between 3 and 5 feet in height and 0.75 to 2 inches in diameter were placed in 4-foot trenches constructed with a ditchwitch or backhoe. When conditions permitted, these "bank cuttings" were manually pounded several feet deep into channel bank and terrace substrates.

Cuttings in unirrigated areas, where perennial streamflow maintains ground water at generally high elevations, were placed in deep holes excavated with a backhoe to intersect the water table. "Pot holes" were excavated up to 10 feet in depth. Depending on the size of the "pot hole" excavation, up to 12-foot long cuttings were placed in scattered configurations in each hole. An additional unirrigated planting method that proved very successful along river reaches with perennial flow was the channel bank "mattress" technique. The "mattress" method involved trenching to the water table at the toe of the streambank and placing a long willow cutting directly on the surface of the bank. With the bottom end of the cutting in the deepest portion of the trench and all but the tip of the cutting covered with native material, adventitious root development occurred along the entire length of the propagule. It is estimated that the District has planted more than 50,000 willow and cottonwood cuttings along the Carmel River between 1984 and 1996.

Rooted seedlings and entire rootballs of several different native riparian trees were placed in areas where irrigation provided supplemental moisture. The District contracted with several local nurseries for the propagation and growth of native riparian trees grown from seeds and cuttings collected from along the Carmel River. District staff also transplanted seedlings and rootballs salvaged from riparian areas where they were slated to be removed for channel clearing purposes. An attempt was made in 1992 to plant salvaged cottonwood seedlings at the Pryor Project in a nursery for eventual outplanting in the riparian corridor. After the seedlings were placed directly in the ground at the nursery and then outplanted after a few months, it appeared that the trees were stressed by the two consecutive episodes of transplanting as they did not exhibit growth rates indicative of healthy juvenile cottonwoods. The nursery project was abandoned after its one-year trial period.

In addition to planting seedlings grown by local nurseries or salvaged from channel areas, the District was successful in obtaining a $19,800 grant for tree planting from the Federal Small Business Administration (SBA). The SBA grant provided for the propagation and planting of 1,200 seedlings at the Schulte Restoration Project. The 1995 SBA planting effort resulted in supplementing the willow-dominated Schulte site with 400 sycamore, 400 boxelder and 400 elderberry trees. Diversifying the District's traditional willow and cottonwood restoration plantings, particularly on terrace areas where protection along channel margins was accomplished with willows, resulted in the installation of approximately 900 sycamore, 600 boxelder, and 480 elderberry trees throughout the riparian corridor during the Five-Year Mitigation Program.

The District's planting palette reflected what native species were appropriate for riparian micro-habitat locations on channel banks and terraces. Tree species were situated in sites that approximated, as closely as possible, the natural distribution for those species in the Carmel River riparian corridor. The District's planting palette included the species listed in **Table IV-8** at the planting locations outlined.

TABLE IV-8

District Restoration Planting Selections

Common Name	Scientific Name	Planting Location		
		Lower Bank	Upper Bank	Flood-plain
Boxelder	Acer negundo		x	x
Buckeye	Aesculus californica			x
Alder	Alnus rhombifolia	x		
Mugwort	Artemisia douglasiana		x	x
Slough sedge	Carex obnupta	x	x	x
Creek dogwood	Cornus sericea		x	x
Monkey flower	Mimulus aurantiacus			x
Sycamore	Platanus racemosa			x
Cottonwood	Populus balsamifera		x	x
Valley oak	Quercus lobata			x
Coast live oak	Quercus agrifolia			x
Coffeeberry	Rhamnus californica			x
Golden currant	Ribes aureum			x
Fuchsia-flowered gooseberry	Ribes speciosum			x
Sandbar willow	Salix hindsiana	x	x	
Red willow	Salix laevigata	x	x	x
Arroyo willow	Salix lasiolepis	x	x	
Elderberry	Sambucus mexicana			x

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Several different planting and irrigation techniques were also tried at District restoration projects during the Five-Year Mitigation Program. Plantings were watered with drip irrigation or low overhead sprinklers, or were flood irrigated in large, shallow basins. Flood irrigation was attempted at the deDampierre and Valley Hills Projects, where shallow basins averaging 35' x 15' in size were constructed. Restoration plantings were placed inside the shallow basins. Flood irrigation proved successful at the Valley Hills Project in areas with relatively fine soil that permitted ponding prior to infiltration. The flood watering method encouraged the establishment of typical native riparian understory species, but also the proliferation of weeds, so the technique was discontinued after two growing seasons. Flood irrigation was not successful at the deDampierre Project because of the large size of the cobbles and gravel that characterize the majority of the project area.

(g) ***Public Information and Technical Assistance*** -- Staff activities included:

- Distributed a river care guide to river-front property owners and prepared a willow planting guide;
- Provided technical expertise to property owners regarding bank repair and stabilization;
- Assisted property owners with securing permits from local, state, and federal agencies for bank repair and river restoration projects;
- Provided technical expertise regarding revegetation techniques and irrigation system installation, operation, and maintenance;
- Provided river-front property owners with willow and cottonwood cuttings and sycamore and box elder seedlings to revegetate streambanks and terraces;
- Contacted river-front property owners to inform them about the District's channel clearing program;
- Conducted public meetings to inform river-front property owners about restoration activities;
- Maintained an Erosion Potential Hotline (call 408/649-1993) for the Carmel River during winter/spring flows;
- Acted as staff for the Carmel River Advisory Committee;
- Guest lectured at University of California at Berkeley short course workshops in the Carmel River and at the Association of Environmental Professionals' annual meeting; and
- Led informative hikes and interpretive programs for several environmental groups.

Staff prepared two informational brochures designed for residents and property owners along the Carmel River. The "Carmel River Protection and Enhancement" brochure describes general river ecology and suggests activities for river-front residents to effectively manage their streamside resources. The Protection and Enhancement brochure provides information to property owners on how to enhance the riparian habitat vital for the maintenance of a healthy stream. District staff also prepared a small pamphlet describing appropriate techniques for installing willow cuttings and seedlings for bank stabilization and habitat enhancement.

Before the March 1995 flood event, staff provided assistance upon request to property owners who wished to carry out river works; however, after the 1995 floods, staff was overwhelmed by requests for technical assistance. Detailed service for all property owners was not possible. Instead, staff concentrated on providing information that helped property owners obtain permits and complete repairs on their own or with the help of contractors. Staff met with and advised most property owners who required repairs. Staff also cooperated with MCWRA to obtain a permit from the U.S. Army Corps of Engineers to repair streambanks for all properties along the lower Carmel River. As in the aftermath of the 1982/83 storm season, privately sponsored streambank repair projects varied in work quality from excellent to poor. To help property owners revegetate newly repaired slopes, the District gave many property owners willow and cottonwood cuttings and box elder and sycamore seedlings. Staff also gave technical advice and assistance with the installation of irrigation systems to water cuttings and seedlings during the dry season.

Prior to starting either channel clearing or restoration work in the river, the District obtained written permission from each property owner. For channel clearing activities, the District annually sent access permission forms to each property owner. If a property owner had concerns or questions about the program, a staff member contacted the owner to address those concerns. Besides written permission for channel clearing projects, the District secured the written permission of all property owners within the limits of restoration projects. Before the start of construction at the deDampierre Project, staff conducted a public meeting to inform property owners of the District's proposed work and to ask for their cooperation to complete the project.

When the river flowed to the ocean, staff operated the Carmel River Erosion Potential Hotline (649-1993). Instantaneous flow information at Rosie's Bridge and Highway 1 was recorded and updated as conditions warranted. Staff also recorded reports about bank erosion and gave information about the potential for additional bank erosion.

Staff met periodically with the Carmel River Advisory Committee (CRAC) to discuss river management issues. The CRAC is a volunteer citizen committee made up of appointees from each of the seven Board members and advised the Board on matters pertaining to the Carmel River.

On several occasions, staff acted as guest lecturers for the University of California at Berkeley short courses in River and Stream Restoration. The District's river restoration program is recognized as a leading program in California and has attracted researchers, resource managers, regulators, planners, and ecologists to several of the project sites.

Staff conducted occasional informative hikes and interpretive programs for environmental groups such as the California Native Plant Society and the Pacific Grove Eco-Corps. The hikes occurred at District restoration sites, where planting techniques, river ecology, and erosion protection objectives were discussed.

(h) Ordinance Enforcement - - In 1983, the District enacted several ordinances to protect the riparian corridor from further degradation. District Rules 124 through 127 were enacted to regulate many activities in the riparian corridor including grading, alteration and removal of vegetation, installation of drainage facilities, and the operation of motorized vehicles. The District also set up a process to review and approve applications for River Work Permits.

Between July 1991 and June 1996, staff observed 38 violations of the District's ordinances including dumping of deleterious materials onto streambanks, clear-cutting of riparian areas, illegal grading activities, and illegal operation of motorized vehicles in the river bottom. Due to staff work load, only the most serious violations were followed up on. Usually, staff contacted property owners personally to request that an illegal activity cease. Staff was usually able to educate property owners about the District's ordinances and obtain their cooperation to repair damages or cease an activity. In a few cases, property owners did not cooperate and continued to violate District ordinances. Staff followed up on these types of violations with written requirements to cease and desist and to repair damage to the riparian corridor. Seven violations were either resolved or are currently being pursued by staff.

(i) FEMA Flood Disaster Grant Management – After flood disasters in January and March 1995, the District assessed damages at all sites where MPWMD river management activities had occurred since the inception of the Carmel River Management Program in 1983. Most of the District's erosion protection projects suffered only minor damages, with a few notable exceptions at the deDampierre Project and the upstream portion of the Schulte Project. Approximately 85% of all irrigation materials were damaged throughout the Carmel River riparian corridor and all of the District soil moisture monitoring equipment was lost. In addition to erosion damages and loss of irrigation program equipment, the District also lost three stream gages, facilities at the deDampierre Well, and gravels placed during the steelhead spawning gravel restoration work undertaken in 1993.

A total of 18 applications were made to the Federal Emergency Management Agency (FEMA) for disaster grant funding to replace and repair District facilities (**Table IV-9**). The District's total funding request was approximately $1.8 million, and included several petitions for enhancement, where it was clear that previous erosion protection measures were inadequate. These FEMA-funded repairs are for District projects originally implemented because of historic ground water extraction practices and the associated degradation suffered in the riparian corridor. FEMA supported the District's mission to address environmental damages induced by ground water pumping practices and to date, the District has received approximately $660,000 for project repair work. Repairs and enhancements to District erosion protection and irrigation facilities are expected to be completed in 1998.

January and March 1995 Flood Disaster Repair Claims filed with the Federal Emergency Management Agency (FEMA) and the state Office of Emergency Services (OES) 7/9/96

PROJECT	MPWMD ACCT. #	DSR #	AMOUNT REQUESTED	AMOUNT APPROVED	COMPLETE IN FISCAL YEAR	STAFF TIME FUNDED IN DSR GRANT	25% OES SHARE/ADMIN. OBLIGATED	90% of OES SHARE RCVD. NO ADMIN.	75% FEMA SHARE/ADMIN. RECEIVED	MATERIAL COSTS TO DATE
Hacienda levee	4-7896.01	29957	$6,724	*$5,524	1994-95	0			$4,143/$166	$6,554.07
Spawning gravel	4-7896.02	12286	$98,458	*$70,047	1996-97	$5,373	$17,512/$700		0/$2,101	0
Berwick irrigation	4-7896.03	73438	$2,093	$2,093	1995-96	$1,700	$563/$22		$1,570/$62	$1,115.00
Debris removal	4-7896.04	73405	$46,312	*0						$11,070.17
deDampierre	4-7896.05	73532	$794,994	**68,938	1998-99	$23,478 + $6,761'	$17,235/689		0/$1,379	$5,738.94
deDampierre well	4-7896.06	73404	$10,142	$10,089	1995-96	$634	$2,522/$101		$7,567/$304	$6,104.26
Emergency irrigation	4-7896.07	73454	$229,363	$229,363	1998-99	unspecified	$57,341/2,294		0/$4,587	0
Manor well	4-7896.08	73533	$212,244	*$33,060	1996-97	$2,147 + $1,592'	$8,265/330		$24,795/$661	0
Pryor	4-7896.09	73515	$153,541	$151,289	1996-97	$7,920 + $11,749'	$37,822/1,513		0/$3,026	0
Quail irrigation	4-7896.10	73439	$1,307	$1,307	1995-96	$1,107	$353/$14		$980/$39	$279.87
San Carlos ramp	4-7896.11	73437	$4,459	$4,419	1995-96	$906	$1,176/47		$3,314/$118	$1,296.90
Scarlett	4-7896.12	73436	$48,140	*$25,140	1997-98	$1,700	$6,415/257		$18,855/$754	$4,091.54
Schulte	4-7896.13	73447	$96,840	*$20,254	1996-97	$8,376 + 590'	$5,064/202		$15,190/$544	$10,711.74
Cachagua gage	4-7896.14	73413	$3,667	$3,667	1995-96	$1,681	$1,068/$42	$961	$2,750/$110	$1,750.94
Hitchcock gage	4-7896.15	21941	$3,705	$3,705	1995-96	$1,720	$939/$38		$2,779/$111	$2,279.26
Highway 1 gage	4-7896.16	21942	$5,595	$6,391	1995-96	$2,970	$1,872/$75	$1,685	$4,793/$192	$2,510.18
Valley Hills	4-7896.17	73450	$53,106	**$13,226	1997-98	$7,193 + $1,276'	$3,307/132		$9,919/$356	$1,211.44
Los Padres weir	4-7896.18	18736	$15,384	$15,224	1997-98	$384	$3,806/$152		$11,418/$456	0
Barrett Consulting	4-7896.20			($17,000)'	1995-96					
TOTAL			$1,786,074	$663,736		$66,655 + $21,968'	$165,260/6,608	$2,646	$108,073/$14,966	$53,832

1 Amount approved by MPWMD Board. Not included in column total.

Appeals filed with FEMA, ** Appeals WILL BE FILED with FEMA

Specified for survey, design,construction management, permitting, engineering.

5. *Expand Monitoring Programs for Soil Moisture and Vegetative Stress*

One of the riparian vegetation mitigation measures specified for Allocation Option V was the expansion of monitoring programs for soil moisture and vegetative stress. Please refer to Section IV-B.4(e) above for a description of the soil and vegetation monitoring activities incorporated into the Riparian Corridor Management Program.

C. *Summary of Expenditures, 1991 - 1996*

1. *Overall Cost of Program*

As shown in **Table IV-10** the five-year total cost associated with the Riparian Vegetation and Wildlife Program is about $1.76 million, which is about 15 percent less than the $2.08 million cost estimate made in 1990. During the five-year period, the largest expenditure (roughly $956,000) was associated with personnel costs for the District's numerous erosion protection, irrigation and riparian projects. District staff performed all tasks relating to the installation, operation and maintenance of the extensive irrigation program; all survey, design, contracting, construction management, irrigation and planting associated with erosion protection projects; all coordination and supervision of channel clearing, as well as provision of lead workers for the project; most restoration plantings; all soil and vegetation monitoring; most tasks associated with developing public information material; significant technical advice to property owners for bank protection and vegetation enhancement; and all tasks associated with ordinance enforcement and FEMA flood disaster grant management.

The second largest total expenditure in the Five-Year Mitigation Program (roughly $689,000) was connected with project expenses, which included the installation of the erosion protection projects, most irrigation costs, channel clearing, monitoring, public information materials, restoration planting, and other various riparian projects.

2. *Breakdown of Costs*

(a) Irrigation Expenses – **Table IV-11** presents cost figures for the District's extensive irrigation program during the five-year period. Irrigation expenses were reduced during the first year of the Mitigation Program because of rainfall amounts that exceeded drought year precipitation. No personnel costs for installation, operation, maintenance and administration of the irrigation program are included in **Table IV-11.** The purchase of irrigation water from Cal-Am is the single largest expense during the Five-Year Program, with water purchase costs reflecting the extent of irrigation needs due to overall annual precipitation and streamflow conditions. Maintenance expenses rose dramatically during the two last years of the program, when repairs to flood damaged irrigation systems were made.

Table IV - 10

Riparian Vegetation and Wildlife Program Expenditures 1991-1996

Expense Category	1/1/91-12/31/91	1/1/92-12/31/92	1/1/93-12/31/93	1/1/94-6/30/95	7/1/95-6/30/96	Total for 1/1/91-6/30/96
Personnel	$86,455	$129,167	$187,653	$333,536	$218,935	$955,745
Projects	$52,499	$117,276	$260,085	$92,706	$166,306	$688,873
Fixed Assets	$7,831	$2,805	$9,212	$61,481	$32,832	$114,160
Program Total	**$146,784**	**$249,248**	**$456,950**	**$487,723**	**$418,074**	**$1,758,778**

Table IV-11
Irrigation Program Costs

FIVE-YEAR PROGRAM COSTS			
FISCAL YEAR	CAL-AM WATER PURCHASE	MAINTENANCE ON ALL IRRIGATION SYSTEMS	WELL INSTALLATION
7/91 - 6/92	$36,362	$5,649	$0
7/92 - 6/93	$18,011	$3,754	$0
7/93 - 6/94	$26,361	$2,298	$2,900*
7/94 - 6/95	$23,315	$11,766	$0
7/95 - 6/96	$3,695	$29,522	$27,730
TOTAL	$107,744	$52,989	$30,630

* Well drilling costs funded by the Trail and Saddle Club; District pressure tank salvaged from old Reimers Well; District 3hp pump salvaged from abandoned Scarlett Well. Program costs do not include personnel.

(b) Carmel River Erosion Protection Activities - - **Table IV-1** in Section IV-B.4(b) lists major river projects completed during the Five-Year Mitigation Program. The right-hand column lists the approximate cost per foot. Costs of District-sponsored projects ranged from $45/foot for the deDampierre Project to $165/foot at Hacienda Carmel. Costs of stabilizing the Hacienda Carmel levee were fairly typical for traditional engineering solutions in confined streams where substantial quantities of rip-rap or similar materials are often used. The Valley Hills and Quail Lodge projects at about $80-$90/foot were more typical of costs for District-sponsored projects. In these areas, rip-rap was combined with post and wire and extensively revegetated to stabilize banks. Large quantities of rip-rap were used to rebuild and stabilize banks at the All Saints and deDampierre (River House) projects sponsored by the NRCS. These projects were the most expensive to construct at up to $500/foot. Work at Rancho San Carlos Road and at Esquiline Road consisted primarily of gravel bar removal and the installation of rip-rap downstream of Rosie's Bridge. Flood control was the primary goal of work at these two locations.

(c) Other Riparian Programs – Channel clearing, restoration planting, monitoring, and public information costs during the Five-Year Mitigation Program are presented in **Table IV-12.** Similar to the financial information presented above, no personnel costs are factored into this summary table of expenditures. Annual channel clearing expenses included the cost of contracting with the California Conservation Corps. In the 1993-1994 Fiscal Year, the District purchased a brush chipper for $12,000, which reduced rental charges for this piece of equipment. Channel clearing expenses rose in the 1995-1996 Fiscal Year because of the dramatic increase in debris and damaged vegetation removed from the channel after the March 1995 flood event. The 1995-1996 expenditure for "Monitoring and Other Projects" increased because of the preparation, printing and mailing of the Carmel River Protection and Enhancement Guide.

Table IV-12
Riparian Maintenance and Restoration Program Costs

FIVE-YEAR PROGRAM COSTS			
FISCAL YEAR	CHANNEL CLEARING	RESTORATION PLANTING	MONITORING & OTHER PROJECTS
7/91 - 6/92	$4,108	$1,786	$1,324
7/92 - 6/93	$21,208	$443	$8,888
7/93 - 6/94	$20,595	$6,209	$4,530
7/94 - 6/95	$8,969	$7,903	$9,964
7/95 - 6/96	$23,480	$23,376*	$20,658
TOTAL	$78,360	$39,717	$45,364

* Restoration planting costs reimbursed $19,100 by Small Business Administration grant. Program costs do not include personnel.

D. Program Effectiveness

The riparian and wildlife activities implemented during the Five-Year Mitigation Program were designed to reduce the negative effects of ground water pumping on riparian habitat and channel stability. As described previously, the EIR determined that the Option V allocation of 16,744 acre-feet would result in significant adverse impacts to riparian resources. The specific, primary impacts to vegetation were projected to include direct mortality and a reduction in plant recruitment. In addition, secondary impacts resulting from a weakened riparian corridor were forecast. Secondary impacts include: changes in riparian plant community age class, structure, species composition and vigor; a reduction in wildlife habitat; destabilization of streambanks; channel migration; property loss; flood hazards; and degradation of aquatic habitat.

Using computer models and vegetation maps, acreage estimates were developed to predict the amount of riparian habitat affected by the 16,744 acre-foot Cal-Am production limit. Although impacts to vegetation were forecast to be significant, particularly in the lower Carmel Valley, the EIR determined that even with the implementation of mitigation measures, there was no definitive method to ascertain whether the adverse impacts associated with ground water extraction could be reduced to a less than significant level. The EIR noted that plant water stress became severe when certain pumping levels were achieved, but no criteria were established to evaluate to what degree vegetation actually suffered damage consequent to ground water withdrawal. The EIR concluded that despite executing the mitigation activities recommended to retain water in the river and protect the riparian corridor, the 16,744 acre-foot Cal-Am pumping limit could result in potentially significant impacts to riparian vegetation and associated wildlife.

Four mitigation measures were developed to reduce riparian corridor impacts associated with ground water extraction:

- Conservation and Water Distribution to Retain Water in the River
- Prepare and Oversee Riparian Corridor Management Plan
- Implement Riparian Corridor Management Program
- Expand Monitoring Program for Soil Moisture and Vegetative Stress

The activities associated with Conservation and Water Distribution are described in Section IV-B.2. The remaining three mitigation measures were consolidated into the Riparian Corridor Management Program, which incorporated all river management efforts directed at protecting and enhancing riparian resources and channel stability. Collectively, the mitigation measures addressed the direct impact of ground water pumping on riparian vegetation mortality, and the secondary impacts associated with degraded streamside conditions resulting from a loss in vegetation vigor.

The combined Five-Year Mitigation Program riparian corridor management activities were successful in reducing, but not eliminating environmental impacts associated with ground water extraction. Conservation and water distribution management maximized the amount and duration of surface flow in the river, and the District's irrigation efforts maintained vegetation around the large Cal-Am production wells. The District's river management activities were effective in improving stream bank stability, maintaining sediment transport, reducing erosion hazards, and generally protecting habitat values throughout the riparian corridor.

1. Conservation and Water Distribution Management

As described previously in Section IV-B.1(e) and also in Section VII of this report, a variety of conservation and water management activities have been carried out by the District, in cooperation with Cal-Am, in order to reduce the adverse effects of the community's need for water on the Carmel River.

- ***Has the District's water conservation efforts resulted in permanent reductions in demand as compared to water consumption in the 1980s?***

As described in Section VII, water consumption (Cal-Am use per connection) in the 1992-1995 period is about 25 percent less than that in the 1980-1988 period. This indicates that the District's conservation ordinances, which require installation of water-saving fixtures for new contruction, remodels and changes in commercial use, along with cooperative educational efforts by the Water Awareness Committee of Monterey County (of which the District is an active member) have had positive results within the District. The Pebble Beach Wastewater Reclamation Project, for which the District serves as the financing entity, also contributes to the conservation effort by providing up to 800 acre-feet of treated wastewater for golf irrigation rather than drinking water. The

reduced demand resulting from these combined efforts means fewer acre-feet must be pumped from the Carmel River basin to serve the community.

- ***Have management actions to reduce impacts of water extractions on the river resulted in improved environmental conditions for river-dependent wildlife?***

The District, Cal-Am and the California Department of Fish and Game have met at least quarterly throughout the 1991-1996 period to develop a water supply production strategy and budget that meets the needs of the community while minimizing adverse environmental effects to the degree feasible. As described in the 1994-1995 Annual Report for the Five-Year Mitigation Program (Section III-A) as well as Section III-D.5 (Steelhead Resource) of this report, efforts to minimize disruption of the natural streamflow recession, provide sufficient streamflow to protect steelhead nests during incubation, and ensure that adequate water storage is available in reservoirs to maintain steelhead rearing habitat below San Clemente Dam during the dry season did result in improved environmental conditions. For example, during 1994, which was a dry year, flow was maintained to a point near Cal-Am's Begonia Wells, approximately 1.3 miles downstream of the Narrows (the point at which streamflow had stopped in previous similar years). This resulted in an additional 0.7 miles of steelhead habitat and supported about 1,500 steelhead, or equivalent to 10 percent of the population in the reach downstream of San Clemente Dam. Riparian vegetation and dependent wildlife also benefited from the increased length of the river.

2. *Riparian Corridor Management Program*

The Water Allocation Program EIR cited vegetation acreage figures projected to suffer significant adverse impacts unless mitigation activities were implemented to reduce the negative effects of ground water pumping on riparian habitat (**Table IV-4**). No criteria were suggested to establish whether mitigation activities successfully reduced the significant adverse impacts to potentially significant or less than significant levels. In order to determine whether riparian corridor management activities were effective, the goals of each component of the management effort must be reviewed.

(a) ***Hydrologic Monitoring*** – Please refer to Section II of this report.

(b) ***Carmel River Erosion Protection Activities*** - - At the time of adoption of the Mitigation Program, no specific success criteria were set to judge the effectiveness or success of channel restoration projects; however, the goals outlined for the CRMP are appropriate for use in reviewing the effectiveness of the District's erosion protection activities.

- ***Did the District's activities reduce bank erosion and maintain sediment transport capability in the Carmel River?***

The onset of heavy rains in March 1991 ("Miracle March") began a different era for the District's erosion protection program. Until that time, none of the District's projects had weathered a large flow. It is interesting that river-front property owners' attitudes toward river restoration work changed from being quite skeptical about the District's projects in 1991 to requesting that the

District perform restoration and repair activities to the channel in 1995. Staff worked diligently to inform property owners about District projects; more importantly, the projects spoke for themselves by doing what they were supposed to do -- reduce erosion and enhance the riparian corridor. Also, it is likely that the presence of unstable areas became painfully clear to many property owners in the winter of 1995.

Staff designed restoration projects to withstand flows of up to a one-in-10-year runoff event. These criteria were developed after property owners incurred substantial erosion at moderate flows between 1978 and 1983 (flows with a magnitude of less than the ten-year runoff event). Flows in January and March 1995 were larger than anytime since the early part of this century and greatly exceeded the District's design criteria. A peak flow of about 16,000 cfs at Rosie's Bridge, or a 40-year event, in March 1995 caused widespread flooding and bank erosion along an estimated 25% of the river. However, during January 1995, when the river peaked at about 10,000 cfs (a 20-year event), property loss from bank erosion occurred only in a few isolated areas. About one acre of land was eroded in three separate reaches during the January 1995 event. This compares with an estimated loss of 30 to 40 acres of property over an eight-mile reach of the river during the 1970's and early 1980's. The peak flow during this period was 8,360 cfs in 1983, or a 15-year event, at Rosie's Bridge.

Staff estimated that total property losses between 1984 and January 1995 amounted to between two and three acres along less than one-half mile. Clearly, the restoration projects and the District's river management program helped to reduce the instability present in the Carmel River during that period. The March 1995 event was powerful enough to move 200-year-old oak and sycamores weighing several tons and dislodged one to two ton boulders from the banks. This flow was the type of event that "resets" the riparian corridor by eroding large portions of the riverbanks and redefining the low-flow channel. While these events are quite destructive to private property, they provide the foundation for renewal of the riparian corridor.

With one exception, the District's projects held up well to the March 1995 flood. River bank damage was sustained at several projects; however, in many areas, the erosion was superficial and not significant enough to require repair work. Typically, a small amount of streambank erosion is acceptable, since some revegetation will occur naturally. In areas where there was significant erosion (more than 50 lineal feet), repairs are needed to maintain a stable stream. In retrospect, drought conditions between 1988 and 1991 provided an ideal environment for the establishment of willows at the river's edge, where the greatest amount of stress is placed on the banks. Areas where willows had been established the longest suffered the least damage. With a longer establishment period, it is likely that erosion would have been less at many projects.

The exception to the overall success of the bank restoration program was the deDampierre Project where the channel migrated up to 250 feet during the March 1995 flood and aggraded up to eight feet adjacent to the Carmel Valley Trail and Saddle Club. Stream power, which is a measure of the erosive capacity of a river, was much greater than originally thought in the deDampierre reach. Nearly 80% of the streambanks in this reach were eroded. It should be noted that every property along the river upstream of this project through Camp Steffani suffered bank erosion and/or flooding of some degree. In addition, many properties downstream of this project suffered

flooding and erosion damage. To stabilize this reach, more structural protection must be used or a longer period between project installation and vegetation maturation is required.

Aerial photographs from 1994 and 1995 show that for all of the projects (except deDampierre), the basic meander pattern remained essentially the same. **Table IV-13** shows that sinuosity (a measure of how much the river meanders in comparison to the valley length) remained virtually the same after the March flood. Although considerable scour and pool development occurred in project areas, the location of the main channel did not change significantly because of the flood.

Table IV-13
Sinuosity at Carmel River Projects

PROJECT	LOCATION (RIVER MILE)	LENGTH (FEET)	1939	1966	1992	1993	1995
Valley Hills/Quail Lodge	5.1-5.5	1,500	1.21	1.12	1.15	1.07	1.09
Schulte	6.5-7.2	3,500	1.37	1.41	1.37	1.37	—
deDampierre	13-14	5,500	1.15	1.16	1.20	1.12	1.25

Profiles of the river bottom have been performed periodically, usually after major changes in the river have occurred. **Figure IV-5** shows profiles from 1978, 1984 and 1994 between the Carmel River lagoon and Valley Greens Drive. Despite significant bank erosion between 1978 and 1984 that produced a large bedload, the river bottom changed little. Between 1984 and 1994, banks were more stable and the 1994 profile shows that the river bottom was scoured out during this period. Sediment transport data **(Table IV-14)** show an overall decline in sediment transported through this reach between the early 1980s and 1992. **Figure IV-6** shows that the river bottom coarsened between December 1991 (curve at far left) and February 1994 (curve at far right). This figure shows a reduction in the percentage of sand sized material (0.062 mm to 2.00 mm) at the surface from 70% in 1991 to less than 25% in 1994. This data, in conjunction with river bottom profiles, clearly demonstrates a winnowing out of smaller material associated with a reduction in sediment supply. Some reduction in sediment supply can be attributed to restoration and stabilization of upstream streambanks.

FIGURE IV-5

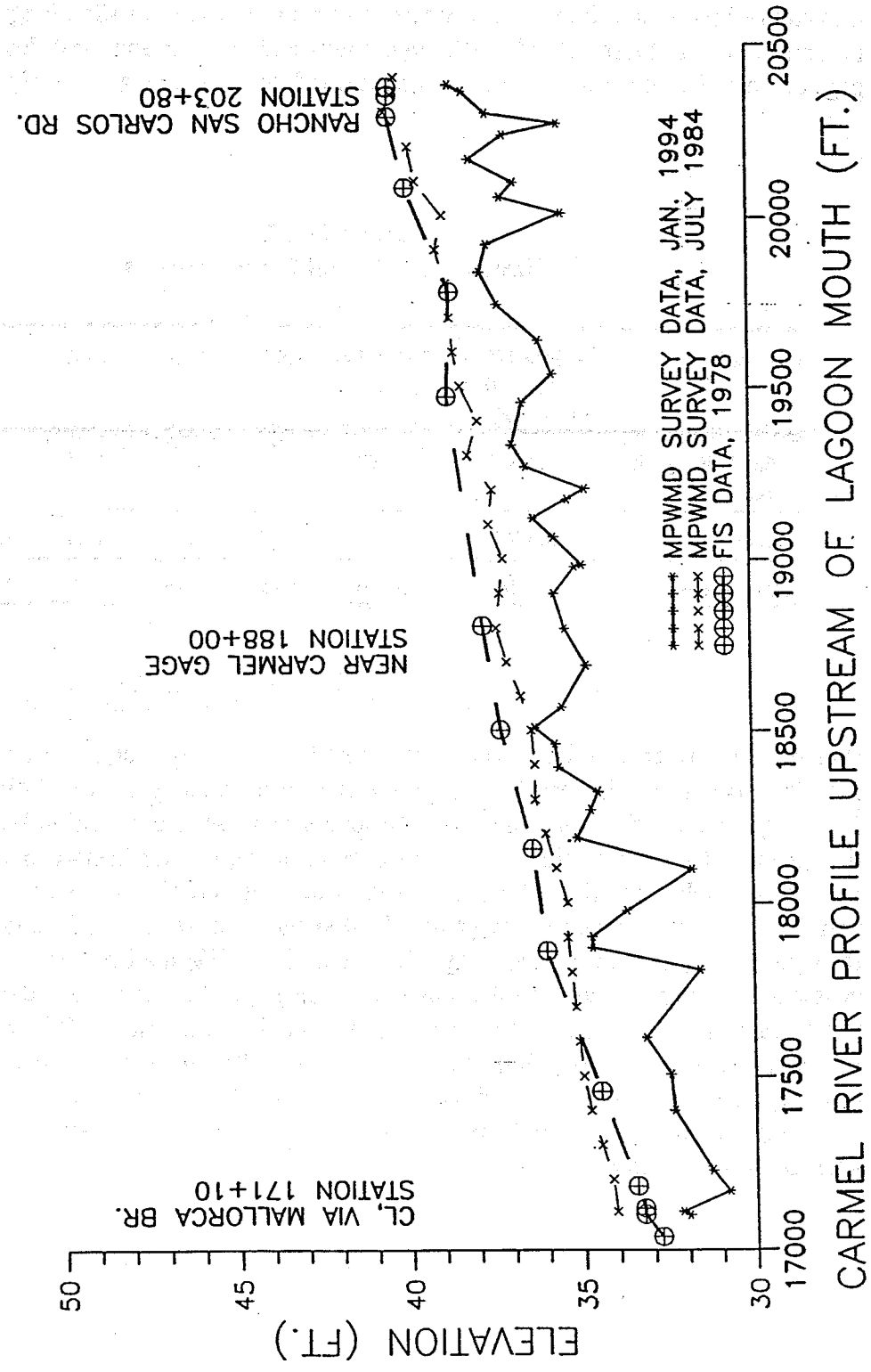

CARMEL RIVER PROFILE UPSTREAM OF LAGOON MOUTH (FT.)
ELEVATION (FT.)
50
45
40
35
30
17000
17500
18000
18500
19000
19500
20000
20500
MPWMD SURVEY DATA, JAN. 1994
MPWMD SURVEY DATA, JULY 1984
FIS DATA, 1978
CL. VIA MALLORCA BR.
STATION 171+10
NEAR CARMEL GAGE
STATION 188+00
RANCHO SAN CARLOS RD.
STATION 203+80

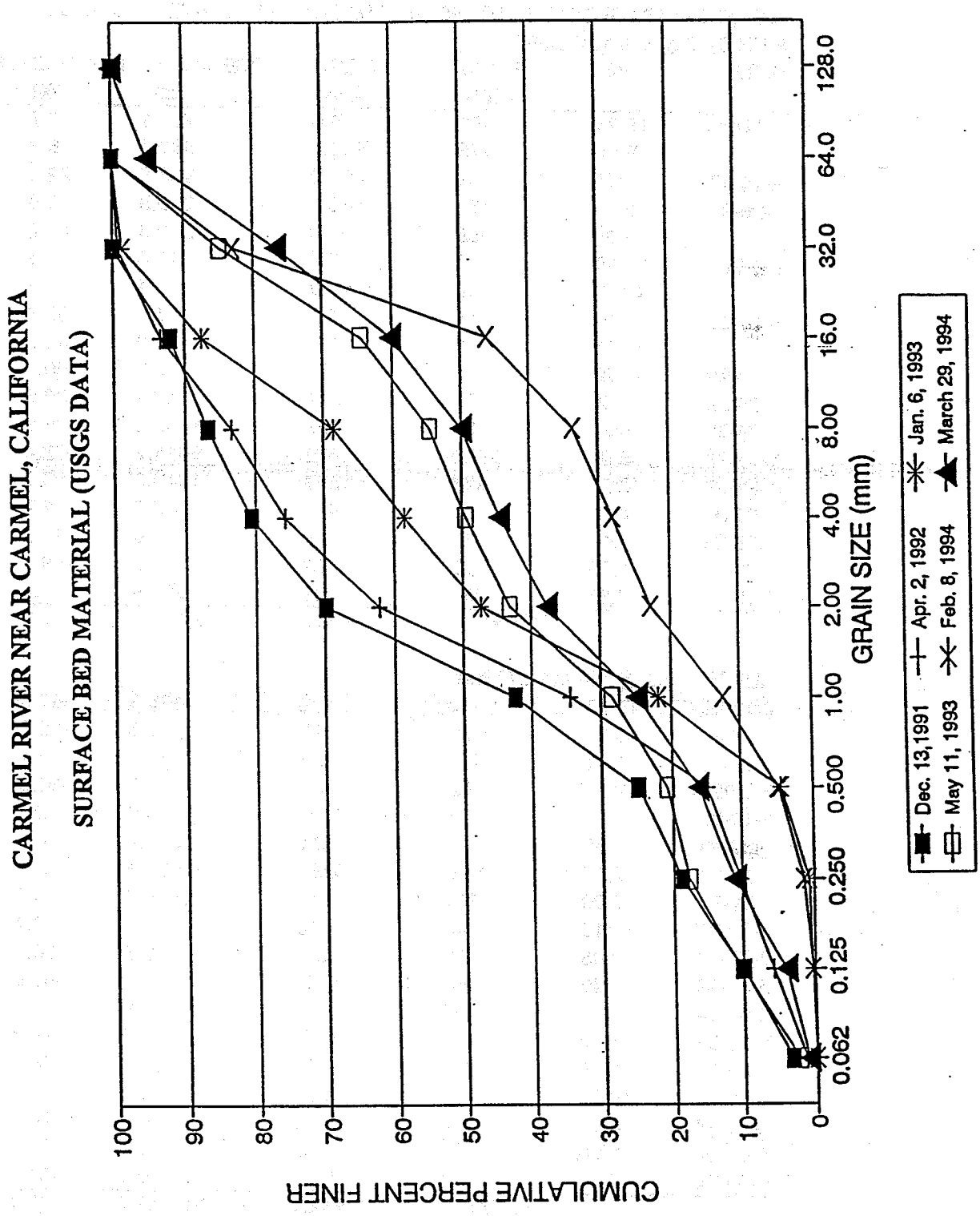
TABLE IV-14

1992,1993,1994 SEDIMENT TRANSPORT DATA,CARMEL RIVER (U.S.G.S.)

DATE	TIME	FLOW (CFS)	USGS (t/day)	PREDICTED (t/day)	DIFFERENCE (%)
BEDLOAD @ VIA MALLORCA					
2/11/92	18:25	452	776.0	701.1	10.7
	18:50	445	869.0	688.7	26.2
2-14-92	13:45	581	724.0	935.8	-22.6
2-28-92	16:05	159	188.0	210.9	-10.8
	16:20	159	181.0	210.9	-14.2
4-2-92	13:10	92	12.0	112.4	-89.3
	13:30	92	16.0	112.4	-85.8
4-16-92	11:00	51	0.4	57.0	-99.3
	11:15	51	0.6	57.0	-99.0
5-18-92	11:20	5	NIL	3.9	-100.0
1-06-93	13:45	27	0.14	27.4	-99.5
1-08-93	15:50	700	698	1159.5	-39.8
1-13-93	16:00	2930	2260	6015.7	-62.4
1-21-93	16:20	948	3210	1643.3	95.3
3-03-93	14:50	651	616	1066.6	-42.2
3-25-93	12:40	64	61	74.0	-17.6
2-08-94	11:30	63	0.16	72.7	-99.8
2-18-94	13:35	234	22	328.8	-93.3
		TOTAL	9,634.3	13,478.3	-28.5
SUSPENDED @ VIA MALLORCA					
2/11/92	17:55	463	169	496.3	-65.9
2-14-92	13:15	581	97	821.5	-88.2
2-28-92	15:50	159	2.6	46.3	-94.4
4-2-92	12:30	92	1.2	13.7	-91.3
5-18-92		5	0.01	0.0	-53.2
1-08-93	14:50	713	121	1294.2	-90.7
1-13-93	17:25	2690	6830	24671.8	-72.3
1-21-93	16:00	953	1110	2464.5	-55.0
3-03-93	14:15	646	110	1039.6	-89.4
3-25-93	12:05	198	2.7	75.3	-96.4
5-11-93	13:40	64	0.52	6.1	-91.5
2-08-94	11:30	63	5.1	5.9	-13.9
2-11-94	15:40	50	0.13	3.5	-96.3
2-18-94	13:15	234	13	109.1	-88.1
3-29-94	10:35	15	0.04	0.2	-83.7
4-20-94	14:55	4.4	0.02	0.0	24.3
5-03-94	10:20	5.1	0.03	0.0	34.3
5-18-94	14:15	8.7	0.05	0.1	-31.6
		TOTAL	8,462.4	31,048.4	-72.7

BEDLOAD EQUATION: lb = 0.62 X Q ^ 1.15 (Q IN cfs, lb IN t/day)
SUSPENDED LOAD : ls = (6.0 x 10^(-4)) x Q^2.22 (Q IN cfs, ls t/day)
EQUATIONS BASED ON DATA FROM 1980-1983

FIGURE IV-6


CARMEL RIVER NEAR CARMEL, CALIFORNIA
SURFACE BED MATERIAL (USGS DATA)
CUMULATIVE PERCENT FINER
100
90
80
70
60
50
40
30
20
10
0
0.062
0.125
0.250
0.500
1.00
2.00
4.00
8.00
16.0
32.0
64.0
128.0
GRAIN SIZE (mm)
Dec. 13,1991
Apr. 2, 1992
Jan. 6, 1993
May 11, 1993
Feb. 8, 1994
March 29, 1994

- ***Did the District's erosion protection activities enhance fishery habitat?***

Data are limited, but there are two important observations about the District's projects. First, in August 1992 prior to the start of the deDampierre Project, District personnel removed all steelhead from the project area (5,500 lineal feet) to areas of the river with perennial flow. In December 1992, work completed at this project resulted in the creation of an entirely new channel bottom that was virtually devoid of aquatic organisms and cover (the new channel was created by a Caterpillar D-9 bulldozer and 950B loader); however, channel rearmoring activities included placement of several hundred boulders in the low-flow channel by backhoe and hand labor. A flow of 5,000 cfs occurred in January 1993, two weeks after completion of the project. In August 1993, District staff counted more than 700 young-of-the-year in three separate pools at the deDampierre project (not all of the pools were surveyed).

The second observation is that established projects provided shade and contributed to pool/riffle development. By 1993, vegetation at the Scarlet, Berwick, and Schulte Projects was mature enough to provide significant shade and cover when there was adequate flow through the project areas. At the Schulte Project, locations of eight pools that were created during project construction in 1988 were generally in the same locations as the design, despite large flows in 1995. Riparian plantings were cited as a factor in pool development at this project (Schroeder, 1995). Scour on the outside of bends can destabilize a streambank by eroding supporting material at the base of the bank. This results in the collapse of bank material above the highest level of flow, especially as flow recedes and soil water pressure acts perpendicular to the direction of river flow. Mature vegetation can prevent loss of this base material and allow river flows to form a pool adjacent to the vegetation, rather than meander into terrace deposits.

For additional information about fishery enhancement activities, please see Section III-D.

- ***Did the District's projects enhance existing riparian vegetation and wildlife habitat?***

For information about this topic, please see section IV-B.4(f) "Riparian Restoration Planting."

- ***Did the District's projects provide additional recreation opportunities?***

Restoration projects provided enhanced bird watching opportunities by increasing the amount and diversity of wildlife habitat. Grading and channel clearing associated with restoration projects provided a safer environment for boaters during winter flows. Newly created terraces and cleared river bottom areas provided summer recreation for hikers, horseback riders, and off-road cyclists.

The District's restoration projects provided additional habitat for steelhead. If the steelhead run returns to its former vigor and if CDFG opens the Carmel River to fishing in the future, then the District's restoration projects may provide opportunities for anglers.

- ***Did the District's restoration projects improve aesthetic values?***

Aesthetics are subjective; however, most people will agree that such items as car tires, household appliances, trash, construction debris, and other deleterious material degrade the Carmel River environment and reduce its aesthetic value. Annually, District crews remove this type of material (see Section IV-B.4(d) for more on channel clearing). Besides the annual clearing program, deleterious material excavated during restoration project construction was hauled off for proper disposal. For example, more than 1,000 car tires that were used as a revetment in the 1970's to stabilize a streambank at the Valley Hills Project were hauled off by a tire recycler in 1992. Several truckloads of metal, car tires, household objects, and garbage were hauled away from the deDampierre Project.

Between 1991 and 1994, about 18 acres of streambanks and terraces were revegetated with native species. Before restoration, much of the area within each project site was severely degraded. Large gravel bars and terrace areas built up in the early 1980's were thinly colonized (mostly by baccharis, broom, and annual non-native grasses). Restoration work included installation of several native species of riparian trees at degraded areas and the removal of non-native species. Although the lower Carmel River is an urbanized river and less capable of riparian corridor regeneration than a natural stream system, riparian vegetation introduced into degraded areas helps replace some functions lost due to water extraction practices. Floods in 1995 damaged portions of the planted areas, but with normal rains and irrigation, it is likely that these areas will recover within the next few years.

(c) Irrigation -- Under the Riparian Corridor Management Program, the District consolidated all irrigation efforts into one comprehensive program. Irrigation methods and objectives for the Cal-Am Four-Well, Emergency Irrigation and Restoration Project sites were standardized. New techniques for water application, scheduling and conservation were tested and implemented. Quantitative and qualitative vegetation sampling information complemented data derived from soil, hydrologic and climatic monitoring, thereby allowing more comprehensive evaluations of factors influencing riparian plant moisture stress conditions. Monitoring information supported management actions regarding the appropriate application of irrigation water to remedy plant moisture stress conditions observed in the riparian corridor.

- ***Did the District's irrigation program reduce adverse impacts to riparian vegetation?***

Irrigation successfully reduced unnatural or accelerated riparian vegetation mortality due to drought or ground water extraction, but it did not simulate the seed dispersal and seedling establishment environments created with natural streamflow. Irrigation sustained riparian vegetation growth (as demonstrated by height and growth rate data), but it did not provide all ecological conditions necessary for natural riparian plant recruitment. Therefore, the District's irrigation program successfully maintained streamside vegetation and restoration plantings free of physiological moisture stress in reaches that were seasonally dewatered, but it did not address long-term changes in riparian community age class, structure, species composition and vigor.

Riparian vegetation dynamics can not be maintained over the long-term unless aggressive restoration planting is implemented.

While riparian trees can adapt to moderate seasonal variations in the water table, there are limits to the amount and duration of drawdown that streamside plants can tolerate. As pointed out in several of the McNiesh investigations (1986, 1989), the concept of a uniform threshold of critical ground water drawdown is appealing analytically, but in reality there are many individual plant attributes and general site conditions that can influence physiological stress, other than limited water availability. Riparian vegetation will likely be weakened over the long-term by repeated fluctuations in the watertable that are exacerbated by ground water withdrawal. The District's irrigation program reduced short-term impacts to riparian vegetation, but over the course of several years of repeated plant stress, potential adverse impacts to vegetation may occur. Long-term monitoring of riparian plant community attributes will be necessary to document gradual changes in habitat characteristics. It is evident that as long as ground water extraction practices are continued, irrigation mitigation activities will be required to sustain riparian habitat, support wildlife, and maintain the stability of the Carmel River channel.

(d) Channel Clearing -- Channel clearing efforts have focused on the removal of vegetation and debris in the river channel bottom in order to eliminate obstructions to flow and reduce potential erosion hazards resulting from water being deflected onto adjacent streambanks. Staff conducted annual inspections of 15 miles of the channel between the mouth of the river at the lagoon and the Stonepine Resort and targeted reaches of the river where hand crews selectively removed downed trees, debris and live vegetation that encroached into the active channel of the river. Riparian vegetation on the banks of the river was carefully preserved to promote channel bank stability and provide wildlife habitat.

- ***Did the District's channel clearing program reduce erosion hazards and assist in the maintenance of bank stability?***

During the Five-Year Mitigation Program, channel clearing was a regular river management activity that successfully maintained the channel bottom clear of obstructions to flow. Since the inception of channel clearing in 1990, minimal localized flooding and streambank erosion caused by material collecting and deflecting flows was experienced in all but the March 1995 flood event. In March 1995, tremendous flows scoured mature vegetation and carried debris from the upper watershed, developed floodplain areas, and higher streambanks. The massive debris load carried by the river in March 1995 will likely not be repeated for many years, as the collection of material at elevations above normal streamflow takes time to accumulate. Staff noted during river inspections in early 1996 that significant deadfall or deleterious material did not collect on bridge pilings and no debris-induced streambank erosion occurred after February 1996 flows of up to 4,000 cfs.

In addition to eliminating obstructions to flow, channel clearing increased channel capacity and reduced hazards for river recreationists. Removing undesirable trash and debris improved aesthetics in the riparian corridor and reduced the potential for the accumulation of large debris-jams on bridge pilings. Annual clearing efforts were supplemented by inspections during storm

events when additional debris and downed vegetation was identified for removal. In combination with erosion protection projects where gravel bars that deflect river currents into banks were graded into more stable configurations, channel clearing proved to be a very effective technique for lessening localized erosion hazards.

Channel clearing work with hand tools is labor intensive and meticulous, but the techniques employed by the District were effective in removing channel obstructions in the most environmentally sound, cost-effective manner. Unique debris or snag situations were addressed by hand crews and habitat conditions affected by proposed vegetation removal were evaluated in the context of adjacent habitat values. When appropriate, mechanized equipment was used to remove large debris piles and heavy rootballs.

Although channel clearing efforts were demonstrably effective at reducing erosion hazards, increasing channel capacity and increasing recreation safety, removal of woody debris from the active river channel impacted wildlife, particularly steelhead and aquatic species. Removal of vegetation and woody debris eliminated valuable steelhead habitat and cover, and caused open surface water to heat. The District's careful site-by-site review of channel clearing needs attempted to minimize impacts to fishery and aquatic resources, but it should be noted that there were occasions when removal of erosion hazards resulted in a negative impact to wildlife and fishery resources.

(e) Monitoring of Vegetation, Soil and Wildlife – Monitoring of vegetation and soil attributes along the Carmel River riparian corridor provided the District with quantitative and qualitative information that assisted in directing management activities. Wildlife monitoring data confirm that avian species diversity increased in reaches of the river where surface flow benefits riparian habitat quality.

- ***Did the District's vegetation monitoring program provide the information necessary to determine if ground water extraction practices were adequately mitigated?***

Monitoring activities undertaken by the District were useful to determine vegetative response to declining soil water availability and commensurate remedial irrigation requirements necessary to maintain riparian plants. Vegetation moisture stress data and visual indicators of water deficiency provided practical information about the condition of riparian vegetation in areas subjected to ground water withdrawal and how that vegetation responded to supplemental irrigation. Growth data corroborated the success of the irrigation efforts to reduce mortality and sustain both existing riparian vegetation and restoration plantings. Vegetation monitoring of leaf water potential, height, growth and mortality was effective in evaluating responses of riparian plants to management practices designed to reduce ground water pumping impacts to riparian vegetation.

In the early years of the Five-Year Mitigation Program, the District's vegetation monitoring effort did not establish baseline conditions for statistically valid comparisons of riparian habitat conditions over time. No comprehensive riparian community sampling was performed in irrigated and non-irrigated areas to assess whether ground water extraction practices and irrigation

mitigation activities affected streamside habitat age class, structure, species composition or productivity. These secondary impacts to riparian vegetation result from long-term stress to riparian habitat and the reduction in natural streamflow necessary for appropriate seedling recruitment. The District did not quantitatively inventory habitat conditions at the start of the Mitigation Program so that subsequent measurements could document whether changes occurred over time. The Mitigation Program for Option V also did not establish success criteria to determine whether mitigation activities adequately addressed vegetation impacts.

The Final EIR for the Water Allocation Program outlined riparian habitat acreage that would suffer adverse impacts without mitigation (please refer to **Table IV-4**). The District's monitoring efforts did not include measurement of acreage values at the start of the Five-Year Mitigation Program and changes in area at the close of the program. Without clear performance standards to determine whether mitigation activities reduced the level of impact from significant to less than significant, comparing acreage figures was ineffectual. At the start of the Five-Year Mitigation Program, baseline sampling should have documented critical vegetation attributes, including density, structure, age class, species diversity and vigor. These vegetation attributes may have been altered at accelerated rates due to vegetation stress and the reduction of natural seedling recruitment. Acreage values of streamside vegetation may actually not have changed because of ground water extraction practices, because vegetated acreage could have been affected by natural flood events that scour river banks, human development, illegal vegetation removal, disease infestation, and the District's restoration planting efforts.

- ***Was the District's soil moisture monitoring program effective in assessing soil water content and relating it to vegetation moisture stress?***

Prior to the Five-Year Mitigation Program, the District assessed soil moisture with neutron probe measurements and gypsum blocks at sites scattered from the mid-Carmel Valley area to the river mouth at the lagoon. Extensive tests conducted by consultants led to the development of a correlation between gypsum block readings and leaf water potential values. The intent of soil moisture monitoring was to associate soil data and plant water stress information to assess the need for supplemental irrigation. Because the neutron probe proved problematic to operate and maintain, the District discontinued its use early in Five-Year Mitigation Program. Rigorous soil moisture monitoring was attempted with tensiometers, and later with gypsum blocks.

District staff found that the conventional tensiometer and gypsum block soil moisture monitoring techniques were developed for commercial agricultural applications where soil types, root depths and water needs over large areas are relatively consistent. Soils in riparian habitats are highly variable in both horizonal and vertical structure over very small areas. Moisture holding capacity in streamside settings can vary radically from site-to-site because of the presence of coarse or fine sediments, organic materials, shade provided by vegetation, and depth to ground water.

Tensiometers were able to measure the relative ability of plants to pull water out of the soil at different specific sampling locations, but they did not provide an adequate assessment of soil moisture availability for surrounding local vegetation. Numerous environmental factors contribute to a plant's ability to pull water out of the soil, including the variable water holding capacity of

the soil at various depths below the actual plant, permanent root depth, and health of vegetation. In addition to being better suited to relatively homogeneous soil conditions, tensiometers stop registering the "suction" required by plants to pull water out of the soil as the summer season progresses and substrates became drier. The greatest need for adequately assessing soil moisture occurs during the summer and fall dry seasons, and this is precisely when tensiometers become less effective in registering soil water content.

Gypsum blocks are relatively inexpensive and easy to sample, but substantial soil disturbance is required to install gypsum blocks at depths greater than a few feet below the soil surface. Gypsum blocks operate effectively for up to two years, then they begin to decompose and must be replaced. In summary, during the Five-Year Mitigation Program, District staff conducted rigorous tests of different soil moisture monitoring equipment, but conclusive water content data was obtained only for particular sampling location depths and soil types where instruments were placed. Inconclusive data were obtained from the tensiometers during late season monitoring efforts. However, trends in soil moisture content were readily observed and soil moisture information was used in concert with ground water level data, qualitative vegetation information, and leaf water potential values to produce an overall evaluation of soil and vegetation conditions at monitoring stations.

- ***Did the District's wildlife monitoring program chronicle changes in riparian habitat conditions that influence avian diversity?***

Species Diversity Index (SDI) monitoring conducted by District consultant Dr. David Mullen provided seasonal information about the numbers and types of birds that visit riparian habitat sampling areas in both District restoration sites and established habitat stands. The SDI figure assigns a habitat quality value to the sampling site, with values of 2.00 and lower indicative of locations with poor habitat quality, and values near 3.00 and above typically characteristic of richer, more diverse sites. Dr. Mullen's work demonstrated trends of increased occupation by birds in riparian habitats where surface water was present in the river. Dr. Mullen's work suggests that SDI values indicating relative habitat values for wildlife were lower during dry seasons in areas that experienced dewatering of the river due to pumping practices. When surface flow returned to these river reaches, SDI values were elevated, indicating higher habitat values for wildlife. The results of wildlife monitoring imply that returning surface flow to seasonally dewatered reaches of the river will have substantial benefits for bird species and other wildlife dependent on streamside vegetation.

(f) Restoration Plantings – Planting activities along the Carmel River were undertaken with two primary objectives: (1) increase bank stability, and (2) enhance the diversity of District restoration efforts and the overall habitat qualities of the riparian corridor. Vegetation incorporated into the biotechnical approach to erosion protection was a vital component of all the District's restoration work since the first river projects were undertaken the mid-1980s. During the Five-Year Mitigation Program, willow planting in bank stabilization projects was continued and various restoration planting techniques were tested. Plantings were also diversified with several different native riparian species to enhance habitat values.

- ***Did the District's restoration plantings increase bank stability?***

As described in Section IV.D.2(b), Erosion Protection, the District's restoration projects generally performed well during the large flow events in January and March 1995. Bank stabilization willow plantings that were able to complete several seasons of growth and establish substantial networks of roots withstood high velocity flows in all restoration sites except the deDampierre Project.

- ***Did the District's planting efforts diversify restoration projects and the overall habitat quality of the riparian corridor?***

The District completed the revegetation of about 18 acres of streambanks and terraces between 1991 and 1995. Following the guidelines first promulgated in the 1984 Carmel River Management Plan, willow vegetation was consistently used to complement bank stabilization projects. During the Five-Year Mitigation Program, the District supplemented willow plantings on an additional 16 acres of floodplain terrace areas and higher banks with a variety of native riparian species propagated from seeds and cuttings collected along the Carmel River. As mentioned in Section IV.B.4(f), 480 elderberry, 600 boxelder and 900 sycamore seedlings were added to District restoration sites, as well as several thousand cottonwood cuttings and numerous understory seedlings typical of the Carmel River riparian corridor (please refer to **Table IV-8**). The District's planting efforts were augmented by the award of a $19,800 grant for tree planting from the Federal Small Business Administration.

Planting native riparian tree and understory species where ecologically appropriate, and augmenting willow plantings with numerous other native riparian species definitely has diversified the District's restoration projects and increased the overall habitat quality of the riparian corridor. The addition of restoration plantings to the willow-dominated erosion protection sites augmented vegetation species diversity and ultimately the quality of riparian habitat for wildlife.

(g) Public Information and Technical Assistance

- ***Did the District provide adequate technical assistance to property owners?***

Much of the technical assistance rendered by the District between 1991 and 1996 was concentrated in a short period after the floods of 1995. Under normal circumstances (i.e., non flood years), staff worked closely with property owners during the design and construction phases of river projects to assist property owners with meeting the District's standards. However, due to the inordinate number of river work projects completed during 1995, staff was unable to work closely with every property owner. Some works completed in 1995 by individual property owners did not meet the District's standards and have become unstable or resulted in damage to other properties. It is unknown what long-term impact there may be to channel stability from work that did not meet the District's standards for revegetation.

(h) Riparian Ordinance Enforcement

- ***Was the District's riparian ordinance enforcement adequate to protect riparian resources?***

As of January 1995, staff had observed 38 violations of District ordinances designed to protect riparian resources. These infractions ranged from dumping yard waste over the riverbanks to clear-cutting of the banks and terraces. Due to other priorities, MPWMD did not follow up on all violations observed. There has been a significant loss of riparian vegetation and cover for wildlife due to vegetation removal by property owners. In two cases, it appeared that the actions of property owners to remove significant quantities of streamside vegetation contributed to bank erosion at those properties and immediately downstream of the vegetation removal. In other cases, replanting could not mitigate the short-term damage to the riparian corridor. The only mitigation for removal of riparian vegetation is to plant more, but this process is time consuming. In some areas, it takes up to ten years to replace whole trees cut down by property owners.

The District began to educate property owners about vegetation management by publishing a river care guide and by discussing vegetation management with individual property owners; however, if this program does not achieve satisfactory results, an effective enforcement effort may be necessary.

- ***Was the District's River Work Permit process effective for carrying out a comprehensive solution to river problems?***

One of the most difficult ideas for property owners along the river to understand is the need to obtain permits from several agencies to do works on their property in the Carmel River. The District initiated the River Work Permit process to help property owners put in place well-constructed works to protect property, enhance the riparian corridor, and not adversely affect other property owners. Often, an application to the District is the first contact a property owner has with agencies that regulate the Carmel River including the U.S. Army Corps of Engineers, Monterey County, California Department of Fish and Game, and MPWMD.

While other agencies regulate certain aspects of river management (e.g., the Monterey County Water Resources Agency focuses on activities that would change 100-year flood elevations), the District's permit process encompasses a wide range of river management concerns including flood elevations, channel stability, riparian habitat, and aquatic habitat. MPWMD's River Work Permit process is not unduly complicared. The process was designed to encourage river-front property owners to work with District staff to develop the best possible solution to river problems.

Both MCWRA and the U.S. Army Corps permit processes are lengthy due to extended responsibilities. Obtaining a permit for river work from other agencies can be both expensive and time-consuming. District staff provided river front property owners as much help and guidance as possible with obtaining permits. In some situations (e.g., District-sponsored projects) MPWMD applied for permits as the owner's representative.

In 1995, when several property owners proceeded to obtain river work permits from many agencies, District staff received several suggestions to streamline the permitting process for river work. One suggestion was to have a single application to one agency to obtain permits for work. Another suggestion was to create an agency review board that meets regularly to review and approve applications. Although there is no streamlined process such as was suggested, District staff provides detailed information to property owners about permit processes at other agencies.

Recently, CDFG and the Army Corps of Engineers expressed an interest in entering into long-term agreements for river work that would replace permitting on a case-by-case basis. There may be opportunities in the future to streamline the permit process for routine maintenance such as channel clearing, repair of structural protection, maintenance of irrigation systems and access ramps, and revegetation of eroded streambanks.

(i) FEMA Flood Disaster Grant Management – After the January and March 1995 flood disasters, Federal Emergency Management Agency (FEMA) and California Office of Emergency Services (OES) investigators evaluated damages to District erosion protection and riparian projects. All District projects qualified as public facilities and were eligible for public assistance funding for repairs. FEMA supported the District's mission to restore and stabilize the Carmel River, as well as the District's work to mitigate for environmental damages associated with ground water extraction. **Table IV-8** presents information on the District's grant applications for repair and enhancement work after winter 1995 floods. The FEMA grant program has been very effective at procuring funding for repair work. The District's appeals to FEMA determinations have generally been successful at reinstating funding for project items necessary to bring repairs up to the standards of the Carmel River Management Plan. Most FEMA appeals address technical issues that were not adequately understood by the federal grant application reviewers.

E. Conclusions and Recommendations

1. 1991-1996 Mitigation Program

It is difficult to balance the competing interests of supplying more than 100,000 people with water from Carmel Valley and maintaining a healthy riparian corridor in the Carmel River. Between 1991 and 1996, the District's riparian programs to mitigate impacts to the Carmel River environment noticeably improved several degraded areas of the river and reduced most impacts from water extraction to a less than significant level. However, until water extraction practices in the Carmel Valley are altered to increase summer and fall river flows, impacts to the riparian corridor from a reduction in plant recruitment in AQ3 and AQ4 remain potentially significant and unavoidable at this time.

District programs conducted between 1991 and 1996 reduced short-term impacts to channel stability, riparian community age class, structure, species composition, and vigor to a less than significant level. These activities included:

- restoration of 18 acres of riparian habitat with native riparian vegetation;
- enhancement of 16 acres of riparian habitat by introducing native trees such as box elder, sycamore, cottonwood and various understory species;
- streambank restoration along 9,000 lineal feet of the Carmel River; and
- irrigation of vegetation in seasonally dewatered reaches of the Carmel River.

District-sponsored irrigation projects in AQ2, AQ3, and AQ4 reduced the impact to plant mortality to a less than significant level within project areas, especially near Rancho San Carlos Road and in the vicinity of large Cal-Am production wells. At these project areas, secondary impacts to channel stability were also reduced to a less than significant level. It appeared that some irrigation systems maintained by private property owners may not have functioned properly, which was a factor that may have led to bank failure and instability in those areas (i.e., at Hacienda Carmel and at the Quail Lodge Resort).

In many areas of the river, the District's activities to restore streambanks and terraces reduced channel instability and property loss due to bank erosion. District restoration efforts also enhanced fishery habitat. Before the March 1995 floods, more than three miles of the Carmel River remained unstable or severely degraded. Most of the degraded areas were in AQ3. Staff estimates that an additional two miles were destabilized because of the March 1995 flood. Newly damaged areas are concentrated in the reach between Valley Greens Drive and Highway 1 in AQ4 and in the reach between Rosie's Bridge and Boronda Road in AQ1. Reaches with perennial flow in AQ1 and AQ2 should recover with a minimum of revegetation work. Areas without perennial flow in AQ1 (i.e., deDampierre reach), localized areas in AQ2 and reaches in AQ3 and AQ4 may not recover without intensive restoration efforts.

Staff recommends continuing the river management activities implemented under the Five-Year Mitigation Program for the period July 1996 through June 2001 with the following additions or changes:

(a) Hydrologic Monitoring -- Baseline hydrologic surveys should be updated after major changes occur in the river. This information should be used to help assess the effectiveness of District activities. A significant amount of data has been collected by the District, but not all data have been analyzed due to staff workload. This information should be made available to staff in a timely manner for decision making. Staff should upgrade weather data collection by installing automatic, continuous recorders (data loggers). To improve irrigation effectiveness, the data from these recording stations could be telemetered to the Carmel Valley field office. See section II for more detailed information.

(b) Erosion Protection Activities -- Update the District's erosion protection standards by incorporating new bio-technical erosion protection methods and by using a 50-year return interval flow design to protect against erosion at critical locations (e.g., bridges, bends, constricted areas). In many areas, this would require more extensive use of structural-type protection to protect banks

during large flow events. Over the long term, capital and maintenance costs for a ten-year design installation exceeds the capital and maintenance costs of using a higher design standard. New standards should be adopted by the District Board. The District should continue the restoration of unstable reaches of the river. Instability in the river usually translates downstream and can destabilize areas that have been stable.

Consider expanding the District's river management zone to include areas within the watershed that contribute sediment to the main stem. The District should explore techniques to reduce sediment input from tributaries, particularly grazed areas along Tularcitos Creek and developed areas along Cachagua Creek. These areas are currently outside the District's boundaries.

*(c) **Vegetation Irrigation*** -- The District's Emergency Irrigation Systems between Highway 1 and Robinson Canyon Road should be rebuilt when the next drought occurs and monitoring data indicate that there is stress on riparian vegetation due to ground water extraction. The Four-Well system should be annually maintained and operated for the benefit of vegetation and wildlife in the surrounding areas. Systems at District restoration projects should be operated and maintained as needed to insure success of the restoration projects.

*(d) **Channel Clearing*** -- Identify and mitigate impacts to aquatic and riparian habitat, especially impacts to steelhead, red-legged frog, and southwestern pond turtle. This would likely require an addendum to the District's existing EIR for the Carmel River Management Plan. Work with the California Department of Fish and Game and Monterey County to draft Memorandums of Understanding (MOUs) to replace annual permits. Develop written guidelines in cooperation with responsible agencies for carrying out channel clearing (width, methods, and type of vegetation removal).

Obtain long-term agreements (i.e., five to ten years) with property owners for access to complete channel clearing activities. Expand the District's river management zone to include Hitchcock, Garzas, Robinson Canyon and Potrero Creeks for channel clearing (primarily for debris removal).

*(e) **Vegetation, Soil, and Wildlife Monitoring*** -- Develop a comprehensive, expanded monitoring program. Testing of soil monitoring equipment should be continued to develop better soil moisture assessments. Staff should develop statistically valid vegetation sampling protocol at permanent transects or quadrats to document long-term changes. Monitoring locations should be chosen to integrate hydrologic and topographic data. A baseline survey should be completed in 1996. MPWMD should develop a Geographic Information System (GIS) to assist with data analysis and management decisions. Useful information in such a system could include:

- well locations and capacity
- riparian vegetation by type and density
- fishery information (e.g., locations of pool-riffle sequences and fish counts)
- locations of erosion protection projects

- wildlife survey data by location
- historic river channel location
- property line information
- channel clearing project locations
- prominent features (geography, topography, geology).

Consider adding a permanent staff position or contractor for riparian corridor monitoring, data collection, and data analysis and to maintain a GIS database.

(f) Restoration Planting – Success criteria for each District project should be established before projects are carried out. A sampling program should be developed to assess performance of District-sponsored projects during the initial establishment period and over the long term. Project performance should be compared with success criteria to determine if remedial action is necessary to meet success criteria.

To mitigate for the loss of surface flows, permanent watering sites should be created in dry reaches of the river for wildlife. This could be accomplished by installing these facilities in areas that are irrigated by the District.

(g) Public Information and Technical Assistance – Identify opportunities for public education and for volunteers to participate in restoration and monitoring projects. Implement a program to educate riverfront property owners about the value of proper streambank and channel maintenance. Property owners could be encouraged to plant and irrigate native riparain species. Information about prohibited actions, such as driving in the riverbottom and dumping deleterious material, should be widely distributed.

Consider augmenting staff (temporary staff or contractor) to meet the demand for technical assistance after flood emergencies. Consider forming a committee of agency representatives (MPWMD, USACE, MCWRA, MCPBID, CDFG) to review applications for river work. Also consider the possibility of MPWMD acting as lead agency in securing river-wide permits from various agencies (CDFG, USACE, Monterey County) that would allow routine maintenance work in the river.

(h) Ordinance Enforcement – Aggressively pursue riparian ordinance violations. This could be done by adding enforcement staff or contracting with the County of Monterey for assistance.

(i) FEMA Flood Disaster Grant Management – Continue to work with FEMA and the OES to obtain funding to repair District projects. Repair work should be completed by mid-1998.

(j) Review and Update the CRMP Documents – The Carmel River Management Plan and the associated EIR were adopted by the MPWMD Board in 1984. Much has been accomplished and learned in the succeeding years. These two documents should be updated to reflect current conditions and management techniques.

(k) Other Agencies – In addition to modifications to the existing Five-Year Mitigation Program, staff recommends that the Monterey County Board of Supervisors and the California Department of Fish and Game be asked to review and adopt the proposed Riparian Corridor Management Plan and a revised Carmel River Management Plan. Currently, County agencies focus on flood control and preservation of riparian vegetation. CDFG focuses on impacts to steelhead. At times, it appears to permittees and the public that there may be conflicts or overlapping areas among the agencies. A common document may serve to reduce potential conflicts and overlapping jurisdictions and would lead to further understanding between the agencies of respective goals and responsibilities.

2. *Implementation Plan for 1997-2001*

The District has prepared a separate document, "Implementation Plan for MPWMD Mitigation Program, Fiscal Years 1997-2001," which describes riparian program activities that are planned over the next five years, and provides estimated costs. These planned actions are based on the recommendations discussed above. Please refer to the Implementation Plan for detailed information.

3. *Long-Term Perspective*

Though District efforts have reduced unnatural or accelerated riparian vegetation mortality, they have not and cannot simulate the seed dispersal and seedling establishment environments created with natural streamflow. In the short-term (five to ten years), irrigation can maintain existing vegetation and can sustain growth rates, but it cannot provide the ecological conditions necessary for natural plant recruitment. Over the long term (more than ten years), it is not likely that impacts to the riparian corridor resulting from a reduction in plant recruitment can be reduced to a less than significant level by activities such as those carried out under the Five-Year Mitigation Program. Plant recruitment that sustains dynamic riparian habitat is dependent on maintaining annual river flow and a high ground water table – conditions that are presently found only in AQ1 and AQ2.

The District's riparian program can maintain streamside vegetation free of physiological moisture stress in reaches that are seasonally dewatered, and can restore areas damaged by erosion, but it cannot address long-term degradation in riparian community age class, structure, species composition and vigor. In absence of adequate streamflow, it is likely that in 10-to-20 years, there will be an overall decline in the health of the Carmel River riparian corridor. There will likely be a gradual decline of wildlife habitat values commensurate with the decline in the integrity of the riparian corridor.

For these reasons, a major District goal is to develop and implement new water supply/demand reduction project(s) to reduce diversions from the Carmel River and provide adequate instream flow to protect the public trust (environmental) resources of the Carmel River. This goal is shared by the SWRCB, CDFG, Cal-Am and a variety of interest groups. The District's Annual Reports, Annual Mitigation Program Reports, Action Plan for Water Supply Alternatives and other documents describe District efforts to achieve this goal.

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SECTION V

LAGOON VEGETATION AND WILDLIFE PROGRAM

V. LAGOON VEGETATION AND WILDLIFE PROGRAM

A. Adopted Goals

The Water Management District Water Allocation Program Final EIR found that all water supply options would have a significant impact on lagoon vegetation and dependent wildlife, although Option V (16,700 acre-feet production) was expected to have less than significant impacts to lagoon hydrology. The EIR indicated that a decrease in freshwater inflow to the lagoon could change soil salinity levels and contribute to changes in plant species distribution. Those changes, in turn, could influence wildlife species composition, from freshwater-dependent species to more salt tolerant species. One problem was that the existing conditions were not well documented and it was not clear precisely what level of freshwater diversion would initiate significant changes. Accordingly, the primary goal of the Five-Year Mitigation Program as related to Lagoon Vegetation and Wildlife was to identify feasible measures to quantify and understand changes to the vegetation and wildlife.

The District has a number of ongoing programs that address environmental impacts of water supply practices on the lagoon, including hydrologic monitoring, planning for new water supplies, and implementation of a long-term water conservation program that reduces the demand on the water resource system. In addition to these ongoing programs, the Five-Year Mitigation Program identified three specific measures for mitigating identified impacts to the lagoon environment. The three measures described in the Five-Year Mitigation Program were:

1. Assist with completion of the Carmel River Lagoon Enhancement Plan (LEP),

2. Expand the District's long-term lagoon monitoring program, and

3. Identify feasible alternatives for maintaining an adequate volume of water in the lagoon.

The goals of the first mitigation measure, assistance with the LEP, were continued contributions of District expertise for LEP related investigations and help with development of a final LEP. The goals of the second mitigation measure, the long-term monitoring program, were to assess the status of the lagoon habitat and evaluate its long-term response to ground water pumping. The goals of the third mitigation measure were to identify the volume of water needed to support associated vegetation and wildlife, and to develop alternatives for providing an adequate fresh water supply to the lagoon.

B. Description of Activities/Projects, July 1991 -- June 1996

1. Ongoing Hydrologic Monitoring

As part of the existing Hydrologic Monitoring Program described in Section II, staff continued measuring water quality, surface water elevation, streamflow, and sediment transport when there

was flow to the lagoon. Water quality was also monitored when there was no flow to the lagoon. Ground water elevations in nearby monitor wells were monitored throughout the Five-Year Mitigation Program period. The lagoon water level recorder that was originally installed in August 1989 to measure continuous fluctuations in water surface elevations, was upgraded in November 1993. With the cooperation of the Monterey County Water Resources Agency (MCWRA), this recorder was subsequently added to the ALERT network in November 1995, thereby allowing for real-time access to lagoon level data (see Section II).

In May 1994, District staff completed Technical Memorandum 94-05, "Surface Water Dynamics at the Carmel River Lagoon, Water Years 1991 through 1994," which summarizes the District's understanding of lagoon surface water dynamics at that time. The memorandum documents the interaction between lagoon water surface level, river inflow and outflow through the sand berm at the river mouth, based on continuous lagoon level, streamflow and tidal data collected during Water Years 1991-1994.

Figure V-1 illustrates an example of water level data collected at the lagoon. This hydrograph was generated from data obtained from the water level recorder at the lagoon for February 1994. The graph shows a fairly steady state in the water surface elevation until February 9, when runoff from storms reached the lagoon. A sudden drop in water surface elevation occurred late on February 17, when the sand bar at the mouth of the river was breached by the Monterey County Public Works Department to prevent flooding of homes adjacent to the northern terminus of the wetland. Subsequent fluctuations in the graph represent the effects of ocean tides on the lagoon water surface elevation as the lagoon was open to the ocean during this period.

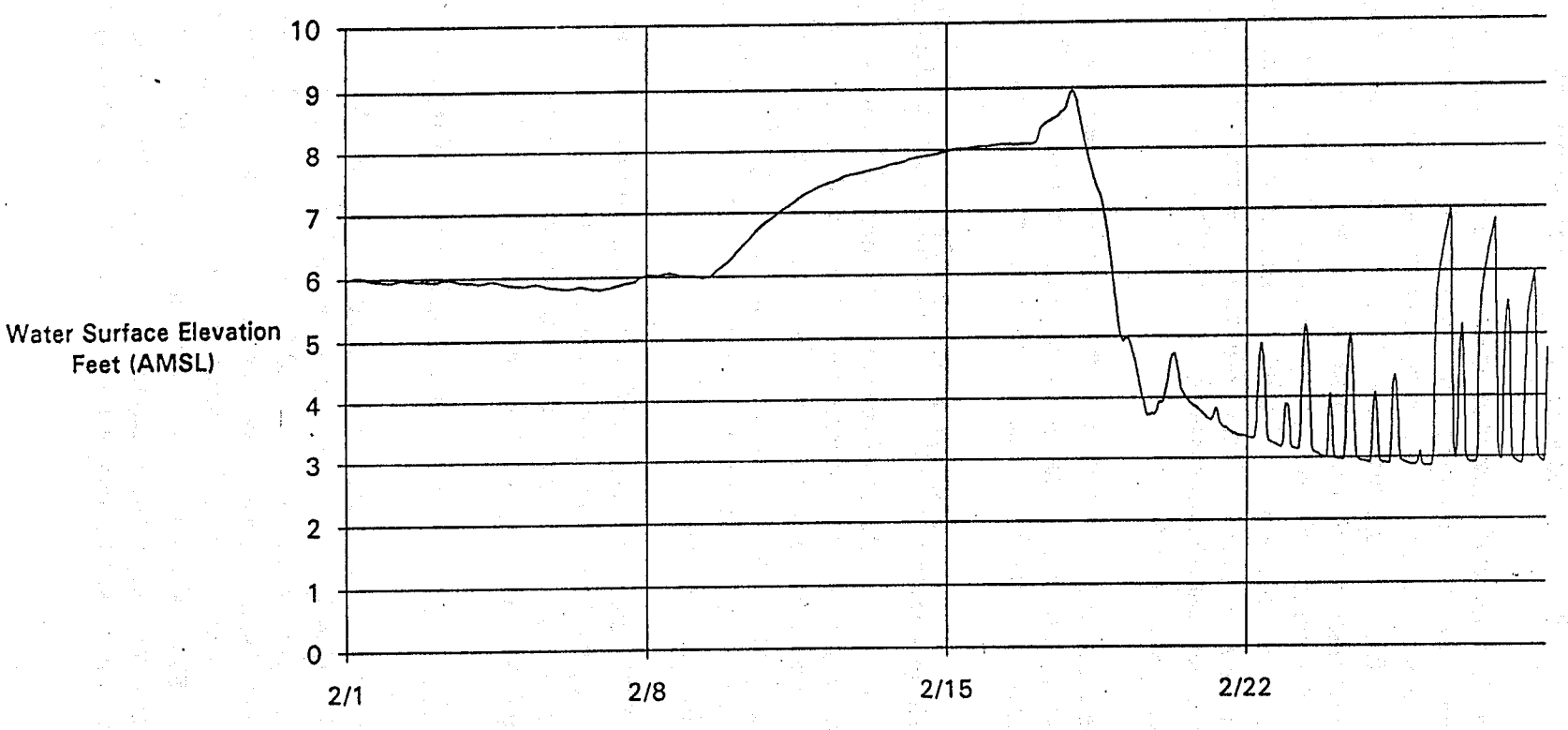
2. *Assistance with Lagoon Enhancement Plan*

Prior to adoption of the Five-Year Mitigation Program, the District contributed $25,000 ($15,000 in cash and $10,000 as in-kind services) to the development of the Lagoon Enhancement Plan that was authored by Phillip Williams & Associates (PWA). The LEP was co-funded by the District, MCWRA, California Department of Parks and Recreation, and the Coastal Conservancy. The intent of the LEP was to identify alternative means to restore and enhance the lagoon environment. Staff contributed expertise for LEP investigations, including surveying, water quality and streamflow measurements. Staff from the District and PWA surveyed four cross-sections to define the bathymetry of the lagoon in 1988. District staff also attended many meetings and reviewed documents as part of an interagency review committee during development of the LEP.

It should be noted that the lead agency for the LEP, the California Department of Parks and Recreation, has not been able to secure funding necessary to complete an EIR on the various alternatives described in the LEP. Consequently, implementation of the LEP was stalled until the floods of 1995. At that time, it was decided that one of the alternatives identified in the LEP (i.e., lowering the south side levee and restoring riparian habitat in the artichoke fields) could be implemented as an emergency project without conducting an EIR. Also, the California Department of Transportation (Cal-Trans) has proposed using part of the flooded artichoke fields as a "mitigation bank" for projects it expects to undertake in the region.

Figure V-1

Example of data collected at
Carmel River Lagoon
February 1994



3. *Expanded Long-Term Monitoring*

In 1994, District staff conducted extensive surveys of the topography, bathymetry, soils and vegetation of the lagoon environs to compare with baseline information obtained in 1989 for the LEP. A map of the dominant plant communities observed in 1994 was completed in 1995. Also, District staff and consultants from The Habitat Restoration Group (HRG) completed a detailed study of changes to the plant communities in the surrounding wetlands in 1995. That study and the map of conditions observed in 1994 were used to compare changes since the initial evaluation in 1989. More importantly, this information provided a practical and quantifiable baseline to evaluate future changes. **Figure V-2** shows the locations of permanent monitoring transects, quadrats, and photo documentation points established for the HRG report overlain on the map of dominant plant species.

The District installed two additional, shallow, monitor wells (piezometers) in Spring 1996, located near the northwest and northeast corners of the wetlands. The wells enable better tracking of changes in the ground water table in the vicinity of permanent vegetation transects.

4. *Identify Feasible Alternatives to Maintain Lagoon Volume*

Following the major floods of January and March 1995, the bathymetric cross-sections were re-surveyed to document the movement of sediment in the main body of the lagoon. The topographic and bathymetric surveys of the area allow staff to quantify the volume of the lagoon pursuant to determining an adequate volume for the existing vegetation and wildlife. The development of a stage-volume relationship for the lagoon is scheduled for completion before the end of this Five-Year Mitigation Program in June 1996.

Figure V-3 shows the locations of the four bathymetric cross-sections that were surveyed in the years 1988, 1994 and 1995. **Figure V-4** shows the data from cross-sections 1 and 2 for each year. The graphs show that a large amount of sand had accumulated in the main body of the lagoon between 1988 and 1994, and that most of that accumulation had been flushed out by June 1995.

C. *Summary of Expenditures, 1991-1996*

Expenditures for the period from January 1991 through June 1996 totaled about $99,900, as shown in **Table V-1**. The 1990 cost estimate for the Lagoon Vegetation and Wildlife portion of the Five-Year Program was $41,000 (from **Table I-2**). This difference is primarily due to the fact that the 1990 estimate did not account for District staff time devoted to the Lagoon program by members of the Water Resources and Planning and Engineering Divisions. Personnel costs of about $79,600 accounted for 80 percent of the total shown in **Table V-1**, and reflect total compensation (i.e., salaries, payroll tax, worker's compensation premiums, etc.). The major project expense was the contract with HRG for a detailed study of wetland plant communities.

XII. CONTRIBUTORS TO EVALUATION OF FIVE-YEAR MITIGATION PROGRAM

The Evalaution Report for the Five-Year Mitigation Program was authored by several District staff members representing five divisions within the District. Contributors are organized alphabetically for each section, as follows:

SECTION I -- INTRODUCTION
Darby Fuerst, General Manager
Henrietta Stern, Project Manager

SECTION II -- HYDROLOGIC MONITORING
Greg James, Assistant Hydrologist
Thomas Lindberg, Associate Hydrologist
Joseph Oliver, Water Resources Manager

SECTION III -- STEELHEAD RESOURCE
Martin Canning, Fisheries Technician
David Dettman, Senior Fisheries Biologist
Beverly Hanna, Assistant Fisheries Biologist

SECTION IV -- RIPARIAN VEGETATION AND WILDLIFE
Mark Bekker, River Maintenance Specialist
Andrew Bell, Planning and Engineering Manager/District Engineer
Thomas Christensen, Field Biology Assistant
Larry Hampson, Water Resources Engineer
Matt Lyons, River Maintenance Worker
Nicole Nedeff, Riparian Projects Coordinator
Henrietta Stern, Project Manager

SECTION V -- CARMEL RIVER LAGOON
Greg James, Assistant Hydrologist
Thomas Lindberg, Associate Hydrologist
Joseph Oliver, Water Resources Manager

SECTION VI -- RIVER AESTHETICS
Henrietta Stern, Project Manager

SECTION VII -- CONSERVATION PROGRAM
Stephanie Locke, Water Demand Manager
Henrietta Stern, Project Manager

SECTION VIII -- SUMMARY OF COSTS
Sherron Forsgren, Accountant
Ray Millard, Administrative Services Manager

SECTION IX -- SUMMARY OF RECOMMENDATIONS

Ray Millard, Administrative Services Manager
Henrietta Stern, Project Manager

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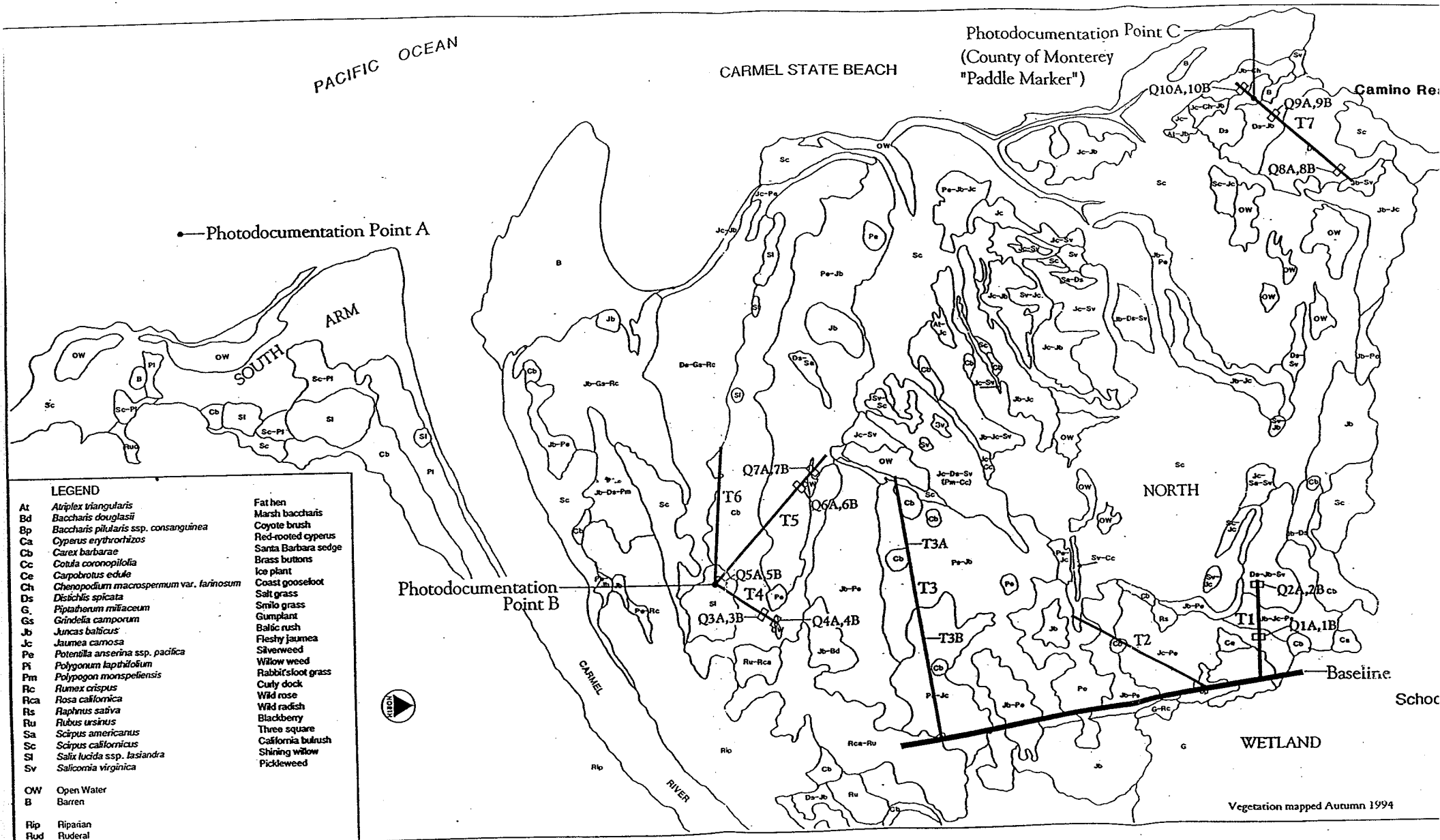


Figure V-2

General Vegetation and Location of Permanent Monitoring Transects and Quadrats

Carmel River Lagoon

Figure V-3

Locations of bathymetric cross-sections

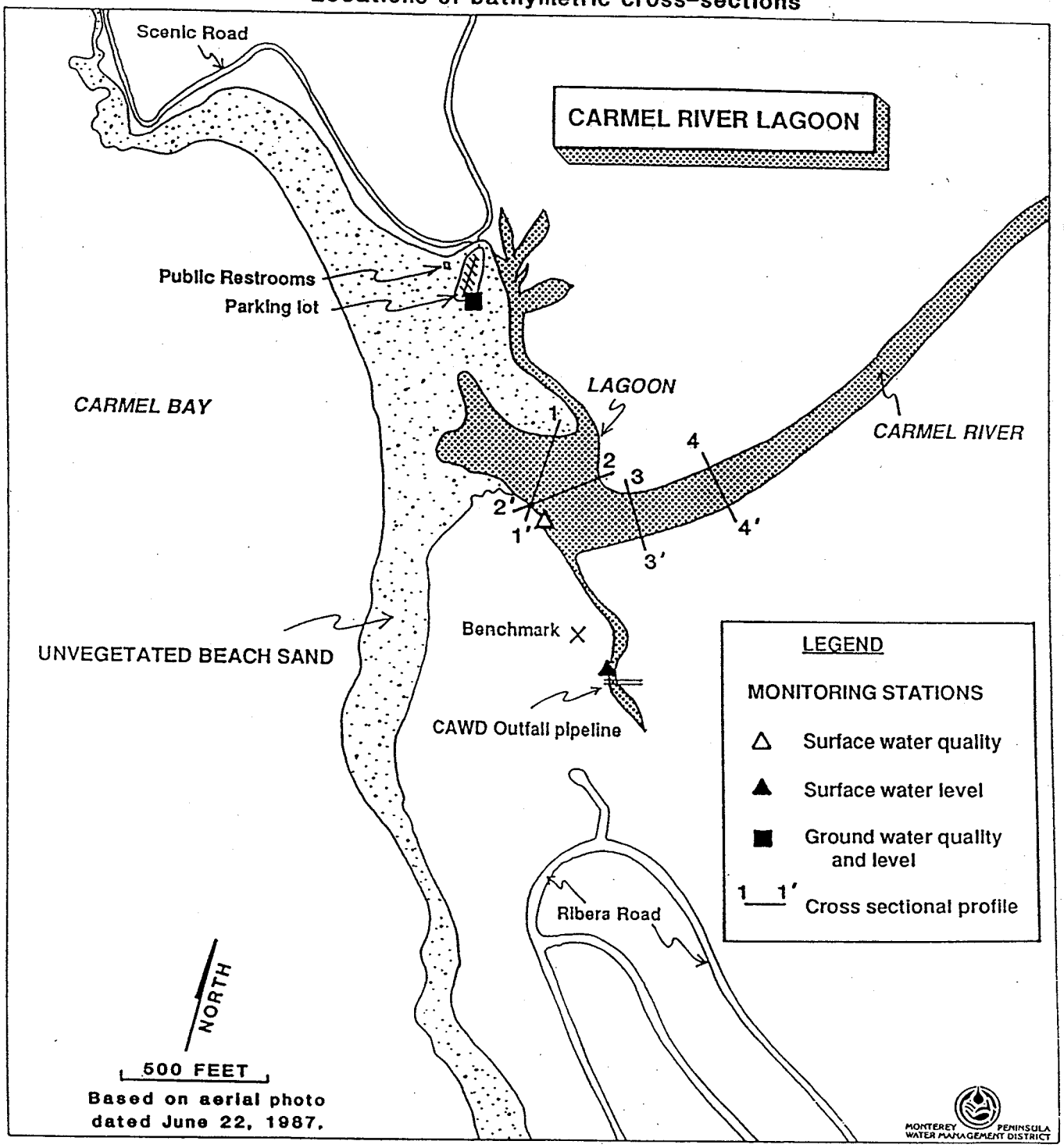
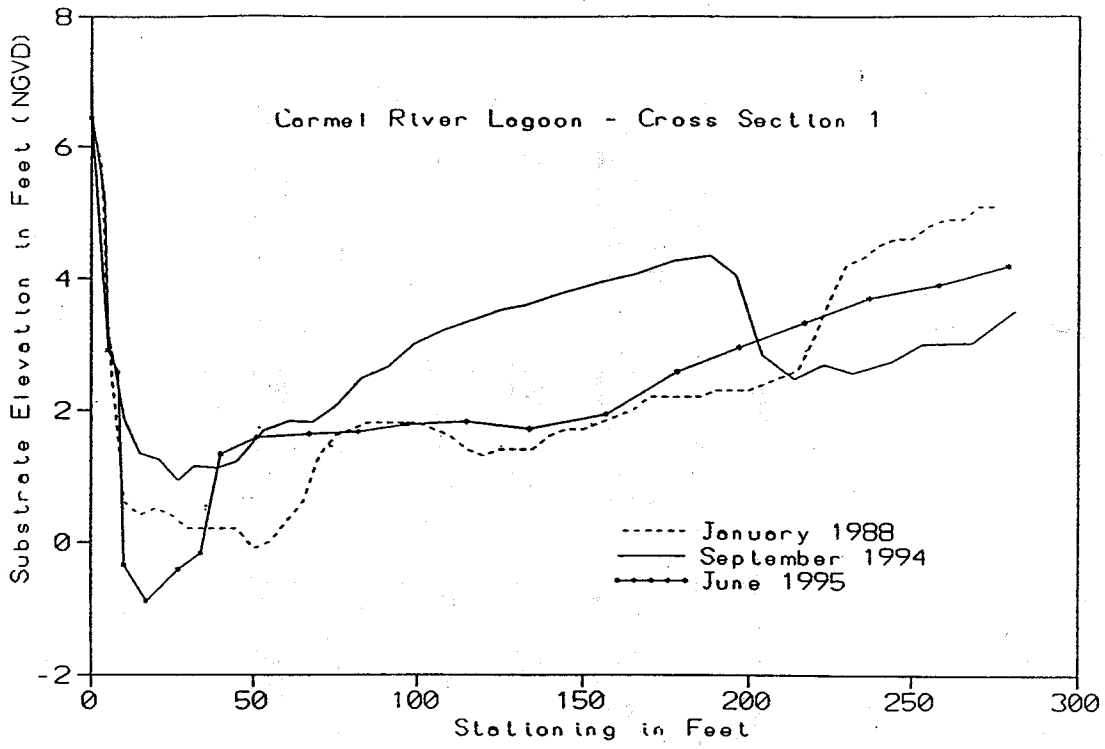


Figure V-4

Data from cross-sections 1 and 2, Carmel River Lagoon



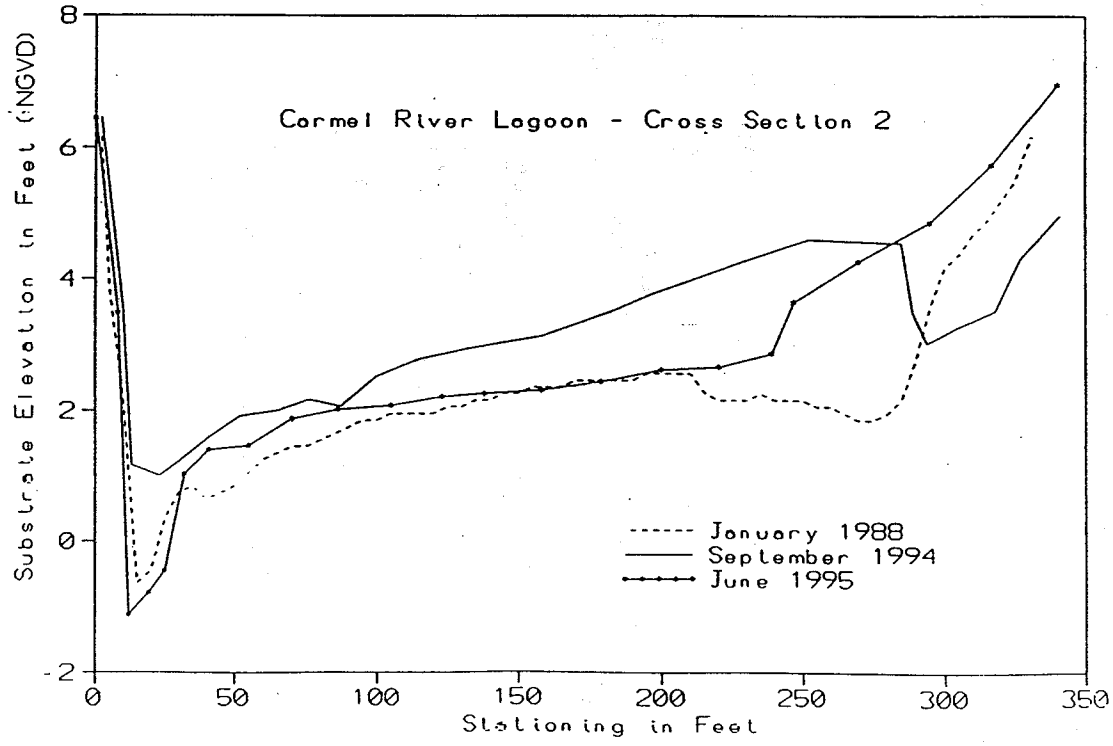


Table V - 1

Lagoon Vegetation and Wildlife Program Expenditures 1991-1996

Expense Category	1/1/91-12/31/91	1/1/92-12/31/92	1/1/93-12/31/93	1/1/94-6/30/95	7/1/95-6/30/96	Total for 1/1/91-6/30/96
Personnel	$2,704	$7,188	$8,560	$38,661	$22,523	$79,635
Projects	$877	$1,069	$0	$3,189	$15,142	$20,277
Fixed Assets	$0	$0	$0	$0	$0	$0
Program Total	**$3,580**	**$8,257**	**$8,560**	**$41,850**	**$37,665**	**$99,912**

D. Program Effectiveness

1. Ongoing Hydrologic Monitoring

- ***Was the District's on-going hydrologic monitoring of lagoon parameters effective in providing useful information?***

Hydrologic monitoring at the lagoon was of paramount importance for implementing the goals of the Lagoon Vegetation and Wildlife component of the Five-Year Mitigation Program. Comprehensive, basic hydrologic information pertaining to the Carmel River lagoon is not available from sources outside the District. Specific elements of the Hydrologic Monitoring Program which address the goals of the Lagoon Mitigation Program include measurements of freshwater inflow, the amount of mixing with sea water, sediment transport, and fluctuations in surface and ground water elevations. Performing these services in-house compares favorably to contracting outside consultants to conduct these activities.

2. Assistance with Lagoon Enhancement Plan Investigations

- ***Did the District further efforts to complete the Lagoon Enhancement Plan?***

The District contributed $15,000 toward the development of the LEP, and District staff expertise in the fields of hydrology, water quality and surveying. This document was recognized by all participants in the technical review committee as an important step in identifying the problems facing the lagoon environs, and proposed solutions to mitigate these problems. A working document was produced by the consultant, but unfortunately was never implemented due to the lead agency's difficulty in securing adequate funding to complete an EIR. Staff participated in the Carmel River Lagoon Task Force, a group formed to expedite implementation of some of the alternatives described in the LEP. In addition, staff has reviewed Initial Studies and Negative Declarations and issued River Work Permits to the Carmel Area Wastewater District and Cal-Trans to remove levees on the south side of the river pursuant to restoration of riparian forest and wetlands and the south arm of the lagoon.

3. Expanded Long-Term Monitoring

- ***Was a long-term monitoring strategy developed to identify changes in lagoon vegetation conditions?***

Yes, the District has developed a long-term monitoring strategy to document changes in vegetation conditions around the lagoon. Prior to the recent studies conducted for the Five-Year Mitigation Program, there was very little available information to assist in understanding the lagoon environment and evaluate potential impacts. There are no simple answers to questions of how much vegetative change is significant, and how much might be attributed to ground water pumping versus the effects of a prolonged drought. Studies performed in 1989 as background information for the LEP were cited in the Allocation Program Final EIR as providing baseline data on

vegetation distribution, acreage and diversity. However, subsequent review of the available materials by HRG and District staff revealed errors and a lack of quantifiable information. Consequently, the 1995 HRG study was specifically designed to provide measurable and repeatable methods for analyzing the wetland habitat. These methods included the establishment of permanent vegetation transects, quadrats and photo-documentation points that will be reoccupied in future years. This methodology provides a basis for addressing questions regarding amounts and rates of vegetative change. Furthermore, HRG provided District staff with a procedural framework to conduct future monitoring in-house. The conclusions of the HRG report emphasized that an integrated physical and biological monitoring program is necessary to evaluate the status of the wetland, and it will take many years of data collection to understand the effects of water distribution practices on the lagoon and wetland. The report significantly enhances the understanding of the lagoon's ecology and provides a usable baseline that was not previously available.

4. Maintaining Adequate Lagoon Volume

- ***Did the District identify feasible alternatives to maintain adequate lagoon volume?***

To mitigate for the diversion and withdrawal of freshwater from upstream, sufficient freshwater must be added to the lagoon to prevent degradation of water quality, steelhead habitat, and changes in plant species composition in the adjacent wetlands. A source of supplemental water for the lagoon has not been identified, although the District's long-term water supply project that was defeated by voters in November 1995 was designed to provide perennial flow to the lagoon in most years. Additional withdrawals of water from the Carmel Valley alluvial aquifer would be contradictory to the riparian and fishery mitigations, and would violate the State Water Resources Control Board's Order WR 95-10 to reduce pumping from Carmel Valley. Importation of water, injection of reclaimed water, and desalination have not as yet proved institutionally feasible. Until a reliable source of fresh water is developed, all that can be done is to define what volume of water should be maintained in the lagoon.

Data obtained from the bathymetric surveys of the lagoon are being used to develop a relationship between the surface elevation and the volume of the lagoon. This relationship, when integrated with biologic data, will provide the information necessary to identify the volume of water that is appropriate for maintaining adequate habitat for the lagoon environment. The determination of feasible alternatives to maintain that volume is hampered by the overall lack of storage in the Monterey Peninsula Water Resources System.

E. Conclusions and Recommendations

Recent work on the ecology and hydrology of the lagoon and wetlands has provided a baseline and a workable methodology for future evaluations. Due to the magnitude and complexity of the issues facing the lagoon environment, it will be necessary to continue monitoring these habitats and their physical characteristics over time in order effectively manage this resource. It is recommended that the existing program be continued along with the following elements:

(1) Repeat the methodologies described in the HRG report at least twice within the five-year period, preferably annually;

(2) Add an avifauna monitoring site in the wetlands as recommended by HRG;

(3) Use the stage-volume relationship being developed for the lagoon to estimate the volume of water that is adequate for existing vegetation and wildlife;

(4) Account for the need to maintain an "adequate" lagoon volume for any alternative sources of water development that are pursued by the District; and

(5) Conduct annual surveys at the established lagoon cross sections (shown in **Figure V-3**) to track changes in lagoon sand deposition.

The District has prepared a separate document, "Implementation Plan for MPWMD Mitigation Program, Fiscal Years 1997-2001," which provides detailed information about anticipated lagoon mitigation program activities over the next five years. The Plan includes estimated costs to implement the Mitigation Program, based on the above recommendations.

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SECTION VI

AESTHETICS PROGRAM

VI. AESTHETICS PROGRAM

The November 1990 Findings for Adoption of the Water Allocation Program Final EIR identified one mitigation measure to reduce aesthetic (visual) impacts along the Carmel River associated with damage to riparian vegetation -- to implement the riparian habitat mitigation measures described above in Section IV. Please refer to Section IV for information on riparian mitigation activities associated with the Five-Year Mitigation Program.

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SECTION VII

CONSERVATION PROGRAM

VII. WATER CONSERVATION PROGRAM

A. Adopted Program Goals

A long-standing goal annually adopted by the Water Management District Board is to "promote water conservation and education regarding water issues." In 1987, the District set a long-term goal of 15 percent permanent reduction in projected use by the year 2020 (roughly 1,600 AF). To that end, the District has carried out a comprehensive water conservation program since 1987. The conservation program is financially independent of the Five-Year Mitigation Program, but is relevant to it because Riparian Vegetation Mitigation #1 in the Five-Year Mitigation Plan adopted by the District Board in November 1990 entails "conservation and water distribution management to retain water in the Carmel River." Finding No. 389-A adopted by the District Board in 1990 with the certification of the Water Allocation Program EIR states that annual monitoring of conservation activities would be reported. This information is provided in the Annual Reports for the Five-Year Mitigation Program.

This section briefly summarizes the conservation activities and water use trends. Detailed costs are not provided as the Conservation Program is evaluated in a process separate than that of the Five-Year Mitigation Program. Please see Section IV-D.1 of this report for information on the effectiveness of the conservation program and how it relates to the health of the riparian corridor.

B. Description of Activities/Projects, 1991-1996

1. Water Demand Management (Conservation)

The cornerstone of the District's program is a water conservation ordinance that requires retrofit of inefficient plumbing fixtures to ultra low-flow fixtures at the time a property changes ownership, for new construction and remodels, and for commercial changes in use or expansion. Other components of the conservation program include distribution of water-saving showerheads and toilet dams; periodic seminars on turf management and leak detection, in cooperation with Cal-Am Water company; public education as a member of the Water Awareness Committee of Monterey County; and District policies to promote conservation in jurisdictions within the District. In a water supply emergency, such as occurred in the 1987-91 drought, the water conservation staff are responsible for implementing the rationing program adopted by the District Board.

District conservation staff conduct over 1,000 inspections each year to ensure compliance with the conservation ordinance. Transfers of title are inspected prior to the close of escrow, and inspections for compliance with water permit conditions are conducted after a property has been remodeled. District staff inspects for the water saving fixtures required by the permit. New homes and buildings within the District must have water efficient landscapes with drip irrigation, "instant-access" or on-demand hot water (systems that prevent loss of water while waiting for hot water to arrive from a distant water heater), in addition to ultra-low water using fixtures throughout the property. Verification inspections are also performed on new construction and

remodel projects where a condition of the water permit is the installation of low water-using devices.

In 1994-95, change of title inspections had a compliance rate of 60 to 75 percent during the initial inspection. Fifteen to 23 percent of those properties failing the first inspection passed on the second inspection. Non-complying property owners were notified, educated about the importance of water conservation, and reinspected. An estimated 65 acre-feet is saved annually by the District's retrofit program.

During 1994, the District implemented a credit program for property owners that agreed to install state-of-the-art water appliances as a condition of their water permit. Credit, in the form of water fixture units, was available for installing ultra-water efficient dishwashers and washing machines, one-half gallon toilets and "instant-access" hot water systems in remodels/additions. During 1995, the District implemented public water credits as an incentive for local governments to obtain water to meet the needs of the community. Water credits became available for jurisdictions that retrofit publicly owned or operated facilities. For a jurisdiction to participate, 15 percent of the savings is held by the District to contribute to meeting the conservation goal and 85 percent of the savings may be reused by the jurisdiction. The portion retained by the project sponsor may be allocated for projects at the jurisdiction's discretion. No connection charge will be assessed for water permits utilizing a public water credit.

Other activities focused on public education to encourage Peninsula residents and businesses to continue water conservation practices learned during the drought. Individual water waste education took place as necessary to remind members of the community not to use water to wash sidewalks, leave hoses running or ignore leaks. Staff also provided literature displays to local nurseries and regularly stocked the displays with information relating to efficient irrigation methods and drought-tolerant and native plants. Additionally, the District provided a water information display at the local Earth Day celebration, contributed books on drought-tolerant landscaping and water conservation to the local libraries, and participated as an active member in the Water Awareness Committee of Monterey County. As a member of the Water Awareness Committee, the District contributed to the completion of a water workbook for school curriculum which was published in April 1996.

2. Water Distribution Management (Water Permits)

In addition to conservation activities, the District conservation staff are responsible for implementing the water allocation program (see Section I for more information). From January 1991 through August 1993, a moratorium was placed on new connections or intensified use as a result of the Water Allocation Program EIR. In August 1993, the District allocated a maximum of 358 acre-feet of additional Cal-Am metered sales for new connections or intensified water use, including a 50 acre-foot District reserve, from the Paralta Well project.

Beginning with the release of the Paralta water for use, District staff established procedures for closely tracking the amount of water put into new and expanded water uses. Each jurisdiction in the District was given a set amount of water to use for permitting. Each applicant for water must

receive the jurisdiction's authorization for a predetermined amount of water before applying for the water permit with the District. The District evaluates the project's water demand, issuing a permit for the project description as depicted on the final construction documents. At the time the water permit is issued, the jurisdiction's water allocation is debited. Monthly reports are provided to each jurisdiction showing the amount of water remaining in the allocation and the permit activity for the month.

From August 1993 through the end of June 1995, about 166 of the 385 acre-feet of water had been permitted for use from the Paralta allocation. The Paralta allocation included a quantity of water for community benefit projects, and in February 1995, at the request of the Technical Advisory Committee, the District Board adopted an ordinance that split the remaining community reserve water among the jurisdictions. By July 1995, the jurisdictions of Monterey County and Pacific Grove were in self-imposed moratoriums. The cities of Seaside, Monterey and Carmel had adopted plans to manage their remaining water allocations; Seaside did so by limiting water to priority projects and Carmel limited the number of water fixtures allowed on a property (determined by lot size).

In late 1994, the CAWD/PBCSD Wastewater Reclamation Project began producing reclaimed water to replace potable water previously used to irrigate golf courses and open space in the Del Monte Forest (Pebble Beach). The project is designed to produce at least 800 AF per year. The project sponsors are entitled to 380 AF, and the remaining 420 AF are slated for the District's use. Ordinance No. 84, adopted in August 1996, allocated 150 AF of the 420 AF District share to member jurisdictions, including 16 AF to Community Hospital of the Monterey Peninsula. In September 1996, the Superior Court issued a temporary injunction to halt implementation of Ordinance No. 84 until litigation filed to repeal the ordinance is resolved.

Over the 1991-1996 period, District staff coordinated extensively with community development personnel from the local jurisdictions to streamline the permit process. Presentations on the local water supply situation were given to many of the cities and the County, and meetings were regularly held to discuss permit procedures and to answer questions about allocation management. Through these meetings, rapport has been developed with the local agencies, making the management of water supplies more productive and accurate.

3. Monitor Water Usage

Ordinance No. 52 adopted by the District Board in December 1990 entails monitoring to track Cal-Am and non-Cal-Am water production. Though not directly a part of the conservation program, this information is critical in assessing the effectiveness of District conservation efforts. Cal-Am regularly reports its water production as well as metered sales to the District for evaluation. The District's well registration ordinances have resulted in metering of wells that account for over 95 percent of total water production in the District. District staff prepare annual reports on overall water use within the District, based on this information. For more detail, please refer to the Annual Reports for the Five-Year Mitigation Program.

C. *Water Use Trends*

The computed water production per connected meter in the Cal-Am system for the period 1980 through 1995 is presented in **Table VII-1** and in **Figure VII-1**. The figure clearly indicates a trend toward lower water use per connection in the 1990s compared to the 1980s (roughly 25 percent lower), though there appears to be a gradual increase in water use since mandatory rationing ended in 1991. During the January 1989 through May 1991 mandatory (20 percent) rationing period, the community reduced water use by 30 percent compared to the 1986-87 base water year. In recent years, total water production has not exceeded 88 percent of the system-wide water production limits set by the District Board. Please refer to the Five-Year Mitigation Program Annual Reports for more information.

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TABLE VII-1

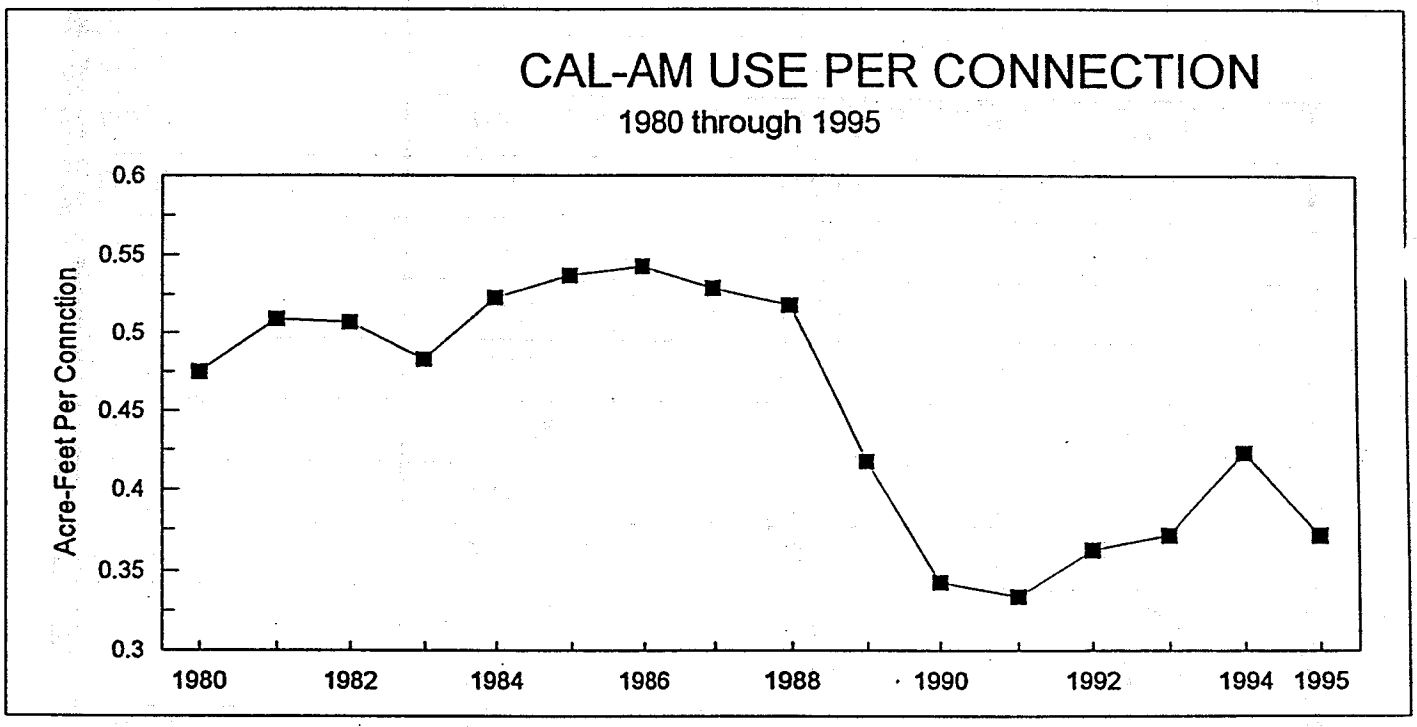
CAL-AM WATER USE PER CONNECTION

Water Year[1]	Acre-Feet[2]	Connections	AF/Connection
1980	14,613	30,733	0.475
1981	15,806	31,058	0.509
1982	15,717	31,024	0.507
1983	15,278	31,647	0.483
1984	16,732	31,962	0.523
1985	17,424	32,477	0.537
1986	17,937	33,026	0.543
1987	17,828	33,708	0.529
1988	17,767	34,297	0.518
1989	14,764	35,336	0.418
1990	12,343	36,017	0.343
1991	12,015	36,008	0.334
1992	13,102	36,086	0.363
1993	13,603	36,610	0.372
1994	15,505	36,656	0.423
1995	13,899	37,313	0.372
16 Year Average	15,271	33,997	0.453

[1] Water Year is July 1 through June 30

[2] Cal-Am Production

FIGURE VII-1


CAL-AM USE PER CONNECTION
1980 through 1995
Acre-Feet Per Connction
0.6
0.55
0.5
0.45
0.4
0.35
0.3
1980
1982
1984
1986
1988
1990
1992
1994
1995

SECTION VIII

SUMMARY OF COSTS 1991-1996

VIII. SUMMARY OF COSTS, 1991-1996

As reflected in **Table VIII-1**, the total cost for the Five-Year Mitigation Program from January 1991 through June 1996 is $5.21 million. Note that **Table VIII-1** represents a five and one-half year period, as mitigation program costs were reported by calendar years through December 1993, then fiscal years (July-June) through June 1996. The table and accompanying pie charts illustrate the allocation of expenses among the four operational programs and general administration as well as among the three principal elements of expense -- personnel, project construction costs and operations, and fixed assets. It is noteworthy that the District Board chose to develop the necessary scientific and technical capability within the staff of the District, thereby insuring complete program control and responsiveness. The reader therefore should assume, unless stated otherwise in the text, that District staff planned, conducted and evaluated the activities reported herein. For this reason, the aggregated personnel costs for each major program represent two-thirds of the total program expense. Values reported for in the "project construction and operations" category are inherently understated as they do not the include staff time shown in the "personnel" category.

- ***What were the estimated costs of the Five-Year Mitigation Program in 1990?***

The original estimate of total program costs adopted by the Board in November 1990 was $3.6 million for a five-year program. Included in this estimate were costs of the then-existing, although limited, fishery, erosion protection and riparian habitat programs of the District. The figure included $315,000 per year in ongoing projects. New annual expenses were estimated to be $323,000 per year. Capital costs for the entire five year duration were estimated at $447,000. These values are shown in **Table I-2** in Section I of this report, just as they were presented to the District Board in November 1990, when the mitigation program was adopted.

- ***What were the actual costs of the Five-Year Mitigation Program ?***

Costs of the program from January 1, 1991 through June 30, 1996 total approximately $5.21 million. As shown in **Table VIII-1**, they are divided among the major program categories of hydrologic data collection, riparian mitigation, steelhead fishery mitigation, Carmel River Lagoon enhancement, and administrative costs (overhead). The pie chart at **Figure VIII-1** presents the costs of each of the component programs and the cost of overall administration. Expenses for personnel, project construction and operation costs (capital costs, operating expenses, supplies and services), and purchase of fixed assets and capital equipment are included. **Figure VIII-2** shows the principal expense elements according to major category (e.g., personnel, project construction and operation, and fixed assets). Most of the work described in this report was performed by MPWMD employees. This effort included such diverse tasks such as: complex computer-assisted data manipulation, operation of fork-lifts and backhoe tractors, technical inspection of well heads, nurturing of young seedlings, land surveying, project design and engineering, and sexing and tagging of steelhead.

Table VIII-1
Summary of Five-year Mitigation Program Costs, January 1991-June 1996

MITIGATION PROGRAM ELEMENTS						
EXPENSE CATEGORY	**Hydrologic Data**	**Riparian**	**Steelhead**	**Lagoon**	**Admin. (overhead)**	**TOTAL**
Personnel	$336,779	$955,745	$764,112	$79,635	$670,940	$2,807,211
Project Construction and Operation	$20,711	$688,873	$317,230	$20,277	$811,648	$1,858,738
Fixed Assets	$5,177	$114,160	$355,165	$0.00	68,974	$543,476
PROJECT TOTAL	**$362,667**	**$1,758,778**	**$1,436,507**	**$99,912**	**$1,551,562**	**$5,209,425**

Personnel-- total staff compensation; includes design, engineering, project management, staff labor
Project Construction and Operation -- capital costs, O&M, consultants, contractors; does not include staff time
Fixed Assets -- major installed equipment and vehicles

FIGURE VIII-1

MITIGATION RECAP - JANUARY 1, 1991 THRU JUNE 30, 1996

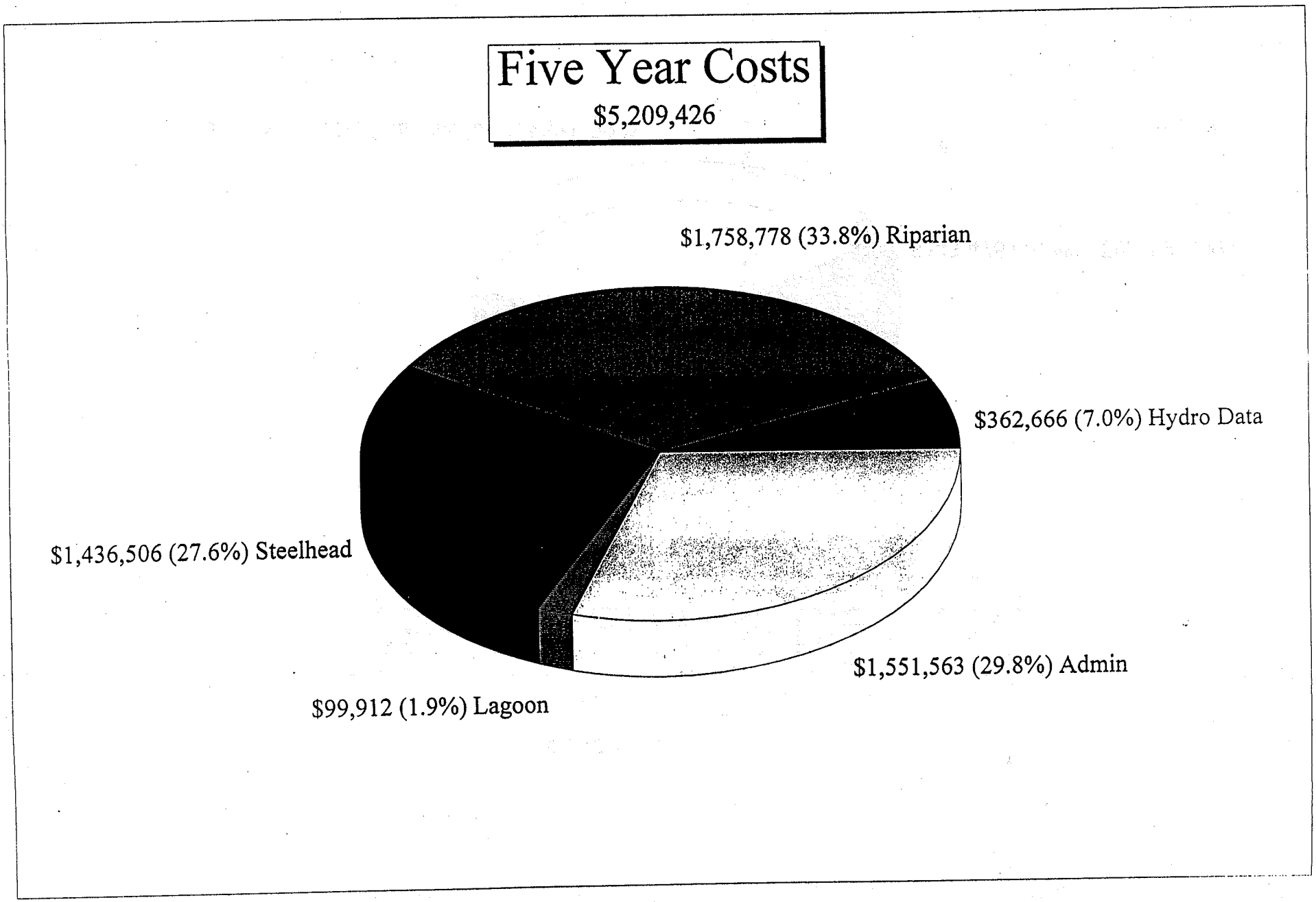
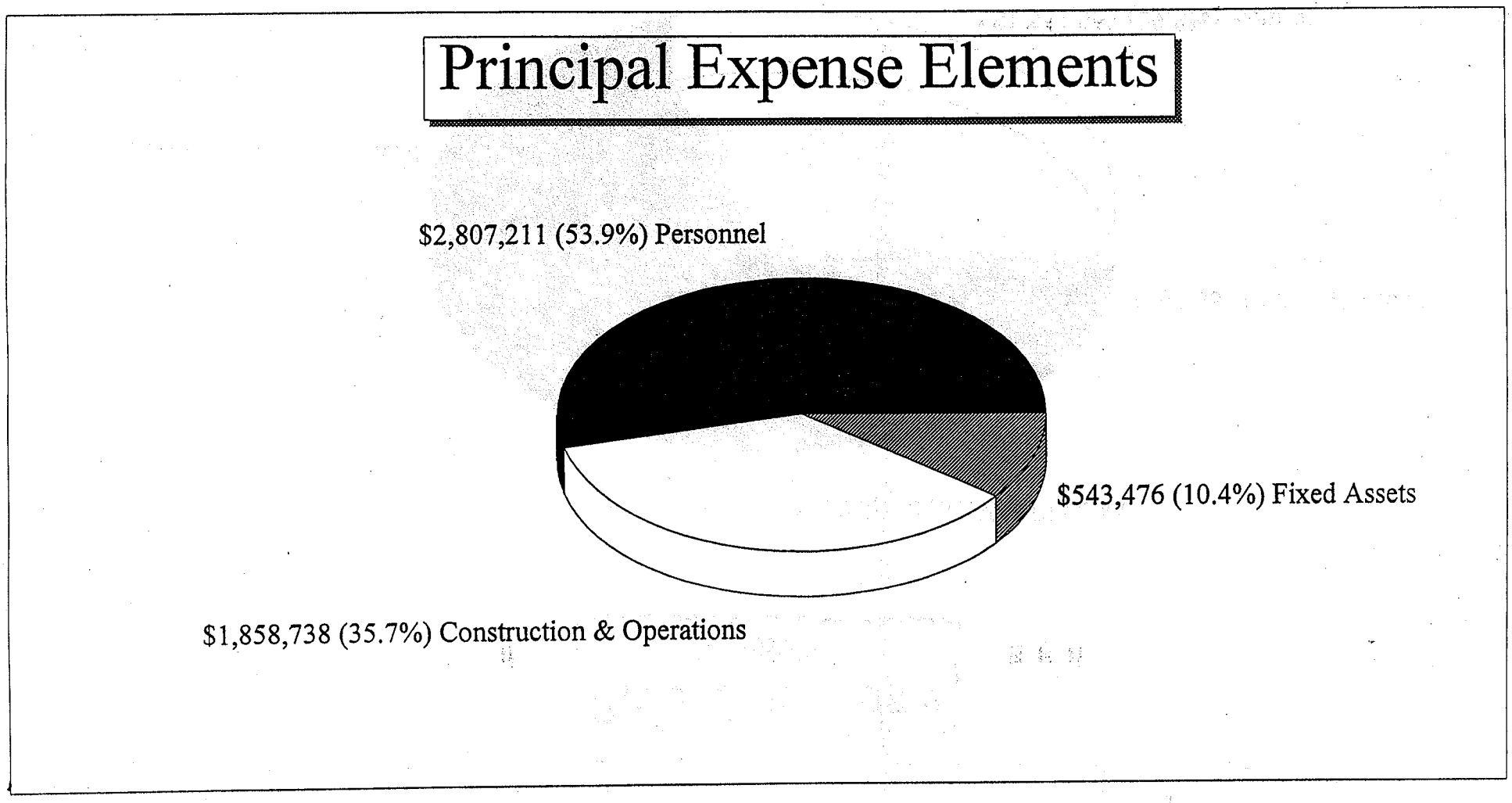


FIGURE VIII-2



- *Why do the actual expenses exceed the initial cost estimates ?*

The variance between the estimated and actual Five-year Mitigation Program cost is about $1.5 million. There are a variety of reasons for this difference. First, the actual expenses (**Table VIII-1**) include a five and one-half year period, and are compared to a five-year period estimated in 1990 (**Table I-2**). Another major reason is that the 1990 estimate shown in **Table I-2** includes only direct personnel expenses. In other words, the compensation costs used to calculate annual costs in the original estimate include only salary and benefits for those individuals directly employed in the mitigation program. One of the reasons for this omission is that in 1990 all general and administrative costs of the agency, including non-direct personnel costs, were charged to the General Fund. The practice was later changed to one which apportioned such costs to the operational programs of the District. The 1990 estimate did not include any expense incurred by the Planning and Engineering Division Manager, for example, to plan, coordinate, control, or provide resources for the five staff members of his division who were directly involved in the Mitigation Program. In contrast, the cumulative expense figures in **Table VIII-1** do include costs of that manager's time. The District-wide total for all such non-direct, personnel costs amount to nearly $671,000 for the 1991-1996 period.

In a similar vein, the general and administrative expenses of the District as a whole, not directly resulting from Mitigation Program activities, were not included in the initial estimates. In 1990 those costs, like the personnel cost, would be simply charged to the General Fund. The actual expense figures include more than $730,000 in general and administrative expenses. Examples of these expenses included rent and utilities, office maintenance, communications, data processing, legal services and board member compensation and travel. It should be noted that this method of apportioning general and administrative costs to an operational program is consistent with generally accepted governmental accounting practice. The MPWMD disestablished the General Fund in 1993 and began charging such costs to the operational programs for the express purpose of avoiding the situation where one program subsidizes another. This change resulted in a truer picture of actual program costs.

- *What other factors caused program costs to escalate during the five-year period?*

A significant component of the total program cost is represented in project construction and operation costs, along with fixed asset acquisitions. Looking back from the perspective of five years of experience, many of these expenses were unforseen or underestimated when the 1990 cost projection was drafted. Perhaps the best example is the Sleepy Hollow Steelhead Rearing Facility. As detailed in Section III (Steelhead Resource Program) of this report, the costs of the facility estimated in 1990 were about three times lower than the actual costs. The difference results from inflation, modifications to the project design to improve performance, conformance to local building codes, and to meet the public bid requirements required by the California Water Code. Another factor affecting the initial cost estimates and subsequent increases was the lack of detailed information concerning the scope and extent of the complex scientific and technical activities which characterized most of the operational aspects of the Mitigation Program. At the time the estimates were made in 1990, District staff lacked the detailed knowledge and information which was later gained through the technical staff who were hired to implement the programs, and the

site-specific field experience on the Carmel River obtained by the staff specialists. For example, scientific instrumentation, supplies and equipment required to execute the program totaled more than $100,000 in 1993.

Another factor affecting cost was weather. The 1990 cost estimates were based on average water years, and the Board was advised that program expenses would be significantly higher under drought conditions. For example, the irrigation water estimate stated that annual irrigation costs could range from as little as $78,000 to as much as $382,000, depending on rainfall. Lack of rainfall in the 1987-91 drought reduced river flows and therefore increased the need for fish rescues, bank restoration, hydrologic data collection and vegetative restoration. Conversely, the severe flood events of January and March 1995 damaged District equipment and restoration areas.

- ***Did the Carmel River floods of 1995 cause increased program expenses ?***

As detailed in Section IV (Riparian Vegetation and Wildlife Program) and elsewhere, the 1995 floods have caused program costs to rise. Although the District expects to recover some of the cost from almost $1.8 million in federal and state grant funds already applied for, thousands of MPWMD dollars and many person-days have been and will continue to be expended in an attempt to restore essential operations and facilities vital to the Carmel River mitigation effort. As of June 1996, approximately 37 percent of the requested funds (nearly $664,000) have been approved by responsible agencies such as FEMA or OES. **Figure VIII-3** illustrates the status of grant funding for District projects on the Carmel River.

- ***What are the revenue sources for the Mitigation Program ?***

The predominant source of revenue for the Mitigation Program has been a user fee (surcharge) placed on the water bills of the majority of District residents and businesses. With minor exceptions, the mechanism of a user fee, collected by the water companies as a percentage of the commodity charge and service charges made of their customers, has been the primary means MPWMD has funded efforts to restore the Carmel River and to promote water conservation throughout the District. In June 1991, the Board passed Ordinance No. 55 which established a user fee of 6.824 percent on the water bills. This fee was later modified in 1991 to 6.015 percent to fully cover the cost of the Mitigation Program. This remains the present rate. Other revenue sources as depicted in **Figure VIII-4** include grants, property tax revenues, reimbursements for works and activities performed by the District, and surcharges on the water connection charge. The combined total of the other, non-user fee revenues is $470,000 collected over the five-year period since 1991. The District collected about $5.4 million through June 30, 1996.

FIGURE VIII-3

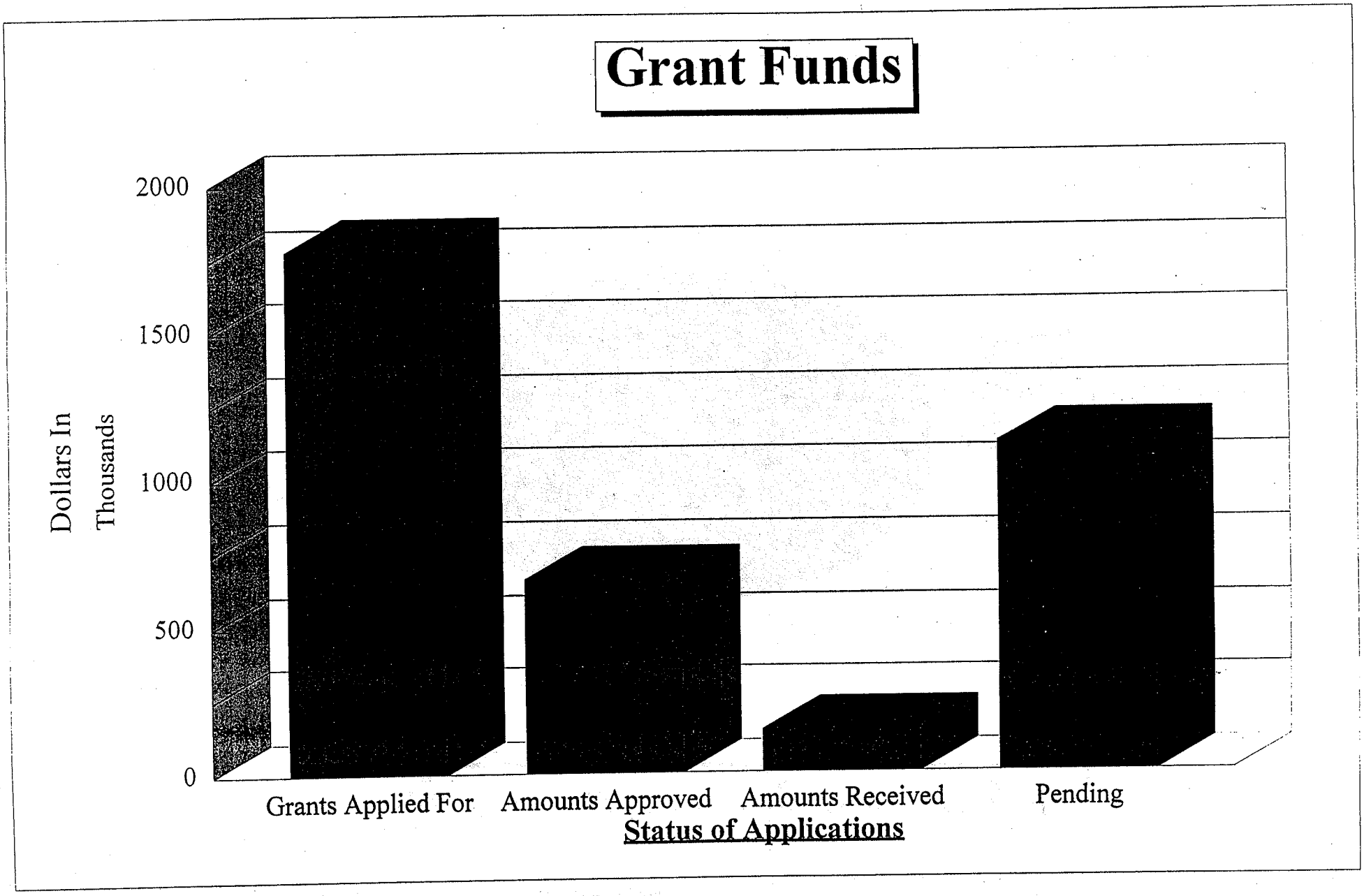
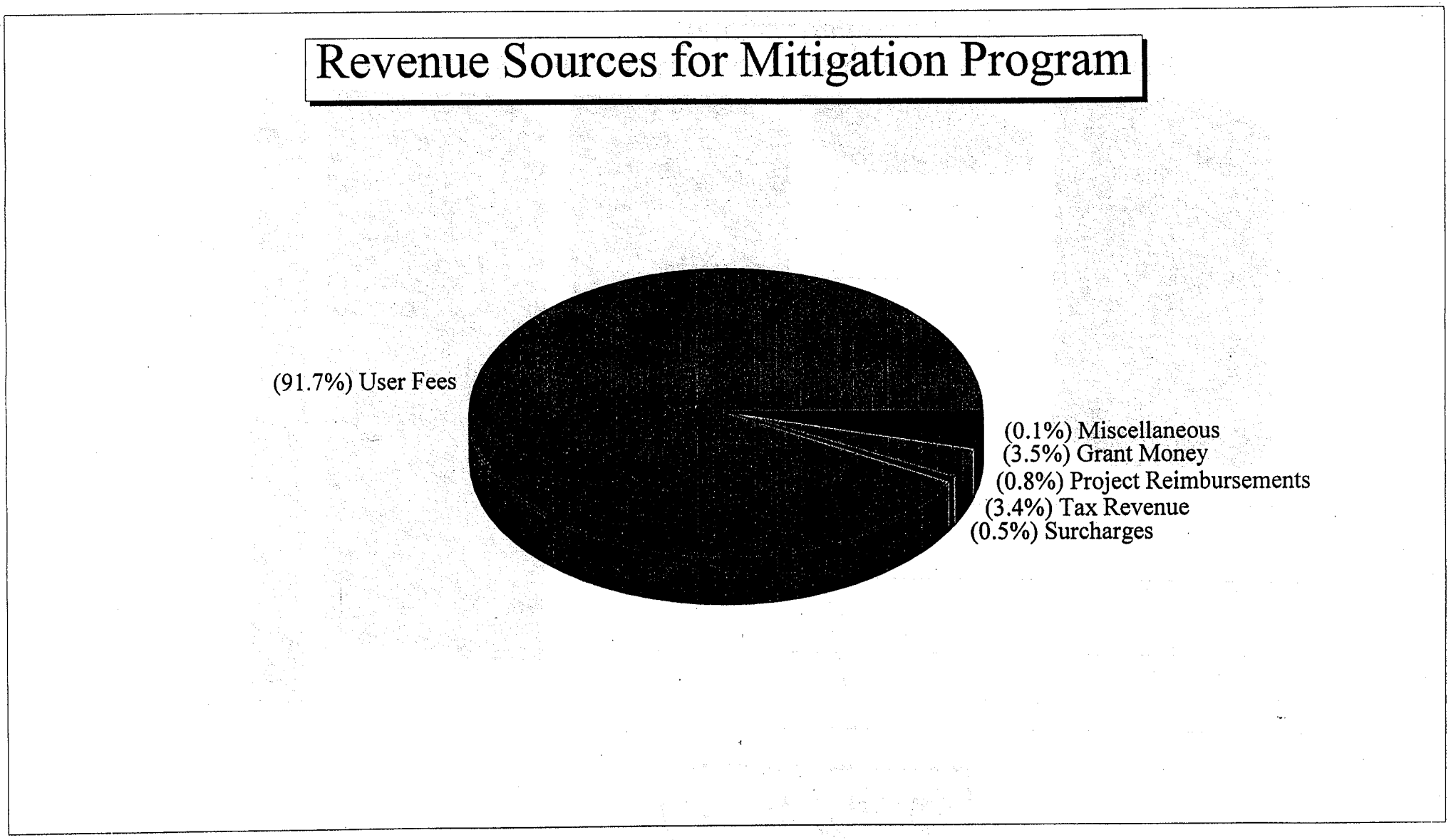


FIGURE VIII-4



SECTION IX

SUMMARY OF RECOMMENDATIONS

IX. SUMMARY OF RECOMMENDATIONS

A. Recommended Action

As described in Sections II-E, III-E, IV-E and V-E of this report, continuation of the existing hydrologic monitoring, steelhead resource, riparian and lagoon activities programs are recommended. The programs have helped to reduce the adverse effects of water extraction practices on aquatic and riparian habitat. However, until water extraction practices in the Carmel Valley are permanently altered to significantly increase summer and fall river flows to the Carmel River Lagoon, adverse impacts to the river environment will continue to occur, and must be addressed through a mitigation program. As described in Section III-E and Section IV-E, a number of refinements are recommended for the Steelhead Resource and Riparian Programs.

Hydrologic Monitoring Program recommendations include continuing the existing program, and purchase and repair equipment which is outdated or damaged.

Steelhead Program recommendations for fiscal years 1997-2001 include:

- continue existing rescue activities,
- defer construction of the mid-Valley holding facility,
- maintain spawning habitat restoration project,
- continue rescue of stranded kelts in the lower river,
- work with Cal-Am and CDFG to improve fish passage at Cal-Am facilities,
- continue monitoring fish populations, and
- develop alternative acclimation facility for smolts and kelts.

Riparian Program recommendations include:

- update baseline monitoring information,
- develop new standards for erosion protection activities,
- rebuild vegetation irrigation system in next drought,
- assess impacts of channel clearing to sensitive species and develop guidelines,
- develop a comprehensive monitoring program for vegetation, soil and wildlife,
- establish success criteria for restoration plantings,
- improve education program for riverfront property owners,
- actively pursue violations of riparian ordinances,
- continue to work with FEMA and OES for grant funding to repair projects, and
- develop interagency agreements for management of Carmel River riparian corridor.

Lagoon Program recommendations include continuing the existing program, and:

- add an avifauna (bird) monitoring site to the wetlands area, and
- develop a stage-volume relationship for the lagoon to estimate the amount of water that is adequate to support vegetation and wildlife.

B. Implementation Plan for 1997-2001

The District has prepared a separate document, "Implementation Plan for MPWMD Mitigation Program, Fiscal Years 1997-2001," which describes mitigation activities for the next five years, based on the recommendations described above. The Implementation Plan also estimates expenses and revenues associated with continuation of the Mitigation Program for the five years beginning in July 1, 1996. Please refer to the Implementation Plan for detailed information.

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SECTION X

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X. REFERENCES

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Section VIII. Summary of Costs

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Section IX. Recommendations

(No references)

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revised October 17, 1996

SECTION XI

GLOSSARY

XI. GLOSSARY

Acronymns

AF: Acre-foot or acre-feet

AFA: Acre-feet annually

ALERT: Automated Local Evaluation in Real Time, a flood warning system

AMBAG: Association of Monterey Bay Area Governments

AMSL: Above mean sea level

AQ1: Subbasin of the Carmel Valley aquifer extending westward from San Clemente Dam to Robles del Rio gaging station

AQ2: Subbasin of the Carmel Valley aquifer extending westward from Robles del Rio gaging station to the Narrows

AQ3: Subbasin of the Carmel Valley aquifer extending westward from the Narrows to the Near Carmel gaging station

AQ4: Subbasin of the Carmel Valley aquifer extending westward from the Near Carmel gaging station to the he river mouth at Carmel Bay

Cal-Am: California-American Water Company, which supplies water to about 95 percent of water customers within the MPWMD

CDFG: California Department of Fish and Game

CEQA: California Environmental Quality Act

cfs: Cubic-feet per second

CO2: Carbon dioxide, a gaseous compound containing one atom of carbon and two atoms of hydrogen

CRMP: Carmel River Management Plan, a 10-year plan adopted in 1983 to manage erosion along the banks of the Carmel River between Klondike Canyon and Carmel Bay

CVSIM: Carmel Valley Simulation Model

cy: Cubic yards

DO: Dissolved oxygen

EIR: Environmental Impact Report, required by State law

EIS: Environmental Impact Statement, required by federal law

FEMA: Federal Emergency Management Agency

HMP: Hydrologic Monitoring Program

IRP: Interim Relief Program or Plan; addressed environmental impacts of drought in 1987-1991

LEP: Lagoon Enhancement Plan

MCWRA: Monterey County Water Resources Agency

mg/l: Milligrams per liter

MOA: Memorandum of Agreement

MOU: Memorandum of Understanding

MPWMD: Monterey Peninsula Water Management District

MPWRS: Monterey Peninsula Water Resources System

NMFS: National Marine Fisheries Service

O&M: Operation and maintenance

RM: River mile

SDI: Species Diversity Index

SWRCB: State Water Resources Control Board

USFWS: U.S. Fish and Wildlife Service

USGS: United States Geological Survey

Terms

acre-foot: volume of water that would cover one acre to a depth of one foot; 325,851 gallons

alluvial: relating to, composed of, or found in clay, silt, sand, gravel or similar material deposited by running water

alluvium: sedimentary formation composed of clay, sand, gravel and other materials moved by streams and deposited by them

anadromous fish: any species that lives as an adult in the ocean and returns to fresh water to spawn, such as salmon, steelhead, and striped bass

aquifer: stratum or zone below the surface of the earth capable of producing water from a well

armoring: in a river bed, a phenomenon resulting from fine sediments being washed out, leaving a surface layer of gravel, cobbles and boulders which prevent erosion of the river bed except during the largest floods

attraction flows: pulses of high flow at the river mouth which are sufficient to break open the sandbar and attract steelhead from the ocean into fresh water

avifauna: bird life

below normal year: in reference to the Carmel River, a water year in which total annual runoff is less than annual runoff in 50 percent of the hydrologic record, and greater than runoff in 25 percent of the hydrologic record

bed load: soil, gravel, rock or other material rolled along the bottom of a stream by moving water, as contrasted with sediment carried in suspension above the stream bed (suspended load)

Board: seven-member Board of Directors of the MPWMD

brood stock program: in reference to the Carmel River, the program initiated by the Carmel River Steelhead Association which reared steelhead in saltwater tanks from smolts or pre-smolts into adult brood stock, spawned the adults in a hatchery, reared the progeny, and released progeny as fry, young-of-the-year, or smolts

coded-wire tags: a short, 0.5 mm long, 0.25 mm diameter, surgical wire that is encoded with digital data. Typically tags are injected into the snout of juvenile fish and used for marking groups of juvenile steelhead or salmon, which are recaptured at a later date (e.g. as adults)

conjunctive use: the coordinated use of various water sources (surface and ground water, desalinated water and others), managed so that the benefit from the overall water resources system

is maximized; provides a greater sustained yield from a system than would otherwise be possible, usually at a lower cost

conservation: mechanical or behavioral reductions in potable water conservation resulting from a structured program

critical riffle: a shallow portion of the stream which acts as a barrier to the migration of steelhead under low flow conditions

District: Monterey Peninsula Water Management District

downcutting: lowering of a river channel bottom caused by erosion

drawdown: a decrease in the elevation of he water table of an aquifer in response to pumping

drought: defined by MPWMD as two or more consecutive dry or critically dry years, based on statistical analysis of streamflow since 1902

dry season: period with the lowest rainfall; generally from May through October in Monterey

dry year: in reference to the Carmel River, a water year in which total annual runoff is less than annul runoff in 25 percent of the hydrologic record and greater than runoff in 12.5 percent of the hydrologic record

evapotranspiration: the loss of water from the soil by both evaporation and transpiration from the plants growing thereon

exceedence frequency: the number of times that a particular numerical value will be equalled or exceeded during a specific series of events

extirpate: the act of reducing a population to the point of extinction within the range of a species or a species to the point of extinction within its range

Fishery Working Group: the group of fishery and hydrology experts from CDFG, NMFS, and MPWMD that was convened in 1992 to establish recommendations for streamflow requirements downstream of the 24,000 acre-foot New Los Padres Project

geomorphic: of, or pertaining to, the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of landforms

gravel bar: a deposit of sand and coarse sediment usually found on the inside portion of a bend in a river

ground water (groundwater): non-saline or saline water beneath the natural surface of the ground, whether or not flowing through known and definite channels

ground water basin: an interrelated set of water-bearing strata of permeable rock, sand or gravel

ground water hydrology: the study of the occurrence, distribution, character, and movement of water below the surface of the earth (synonymous with "hydrogeology")

habitat area: the square footage of a specific type of habitat in a section, reach, or other unit of stream length

holding facility: a facility designed and operated to temporarily hold juvenile steelhead during the fall/winter/early spring period, while the Carmel Valley aquifer fills and the river has not yet reached the lagoon

hydrogeologic: of, or pertaining to, ground water hydrology

hydrologic: of, or pertaining to, the study of the waters of the earth

hydrologic record: a recorded period of hydrologic events, such as streamflow

Interim Relief Plan: a program to address environmental damage to the Carmel River due to the effects of the 1988-1991 drought; incorporated into the Five-Year Mitigation Program in 1990

jurisdictions: eight local entities designated to receive water allocations; includes cities of Carmel, Del Rey Oaks, Monterey, Pacific Grove, Sand City, Seaside; the Monterey peninsula Airport District; and unincoproated areas of Monterey County within the District boundaries

juvenile: a steelhead (or other fish) which has not matured into adulthood and is not capable of reproducing; for steelhead, a fish less than one year old; also called young-of-the-year

kelt: an adult steelhead which migrated from the ocean into a stream, spawned and is migrating back to the ocean

landlocked: referring to steelhead populations or an individual fish which cannot emigrate to the ocean due to an impassable barrier

Lower Carmel Valley: the section of Carmel Valley downstream of the Narrows to Carmel Bay which contains aquifer subunits 3 and 4

mean daily flow: the average streamflow during a particular day, midnight to midnight, at a given location (usually expressed as cubic feet per second or acre-feet per day)

mean monthly flow: average flow volumes for a given month within a specific period

Memorandum of Agreement (MOA): in reference to the Carmel River, the annual agreement negotiated by the California Department of Fish and Game, California-American Water Company,

and the Monterey Peninsula Water Management District, which sets diversions from San Clemente Reservoir and releases below San Clemente Dam for the dry season (typically June - December)

Narrows: the location in Carmel Valley in the vicinity of Scarlett Road that separates the Upper Carmel Valley from the Lower Carmel Valley

net-pen: a portable, open-water pen used to rear steelhead or salmon in fresh or saltwater

plant water stress: loss of plant vigor or fitness caused by a low soil moisture, and the resultant loss or turgor pressure and eventual wilting

population abundance: in reference to juvenile steelhead populations, the total of juvenile fish in a population during a given year

population density: in reference to juvenile steelhead populations, the number of juvenile fish per unit area or length of stream (e.g. fish/square foot, fish/lineal foot of stream, fish/square meter, or fish/meter of stream)

potable: suitable for drinking

pre-smolts: juvenile steelhead or resident steelhead which have not yet physiologically adapted to live in seawater, but may do so in the near future or current year

production: the amount of water extracted by the water distribution system from all sources of water supply

public trust resources: in this document, refers to fish, wildlife, supporting habitat, recreation and aesthetic resources of the Carmel River

rearing facility: a facility designed and operated to rear juvenile steelhead through the dry season (typically summer and fall months, but lasting year-round during extended droughts)

reclamation: the recovery of subpotable or wastewater sources so as to substitute this supply for irrigation applications that currently use potable supply

remnant run: a population of adult steelhead which has been severely reduced in size compared to historical or natural conditions; could become threatened or endanagered if conditions are not improved

resident steelhead: a steelhead which matures and spawns in freshwater and may emigrate to the ocean sometime in the future

riparian: of, or pertaining to, the banks of a stream, lake, reservoir or other body of fresh water

riparian corridor: for this report, those areas that lie within 25 lineal feet of the waterline of the Carmel River during a flow with a recurrence interval of ten years

riparian vegetation: plants found growing at the edges of water bodies; requires moist year-round conditions such as those found near a river

river mile: distance from the mouth of the river, as measured along the center of the river channel bottom

runoff: the movement of excess precipitation across the ground

salinity level: the amount of salts in a body of water

sediment transport: the process by which soil, rock and debris are moved by flowing water

significant environmental impact: According to the California Environmental Quality Act, "a significant effect on the environment means that a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project, including land, air, water, minerals, flora, fauna, ambient noise, and objects of historical or aesthetic significance. An economic or social change by itself shall not be considered a significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant."

smolts: juvenile steelhead or resident steelhead which have physiologically adapted to live in seawater and are actively emigrating from freshwater to the ocean

Statement of Overriding Consideration: in the context of CEQA, a finding or statement adopted by a lead agency, which asserts that the benefits of a project outweigh the negative impacts, which cannot be mitigated to a less than significant level

surface flows: water flow across the ground surface, generally in stream channels

suspended load: sediment, usually clay particles, silt and fine sand, which is carried in suspension above the bottom of a stream by moving water, as contrasted with the bed load rolled along the bottom

tributary flows: streamflow from small streams tributary to a main stream or river

understory: the short, shade-tolerant, woody and herbaceous vegetation growing in the lower canopy of the forest

unimpaired (flow): (1) streamflow that is unaffected by artificial diversions, imports, storage or other works of man in the stream channel; (2) recorded streamflow, with corrections applied to remove the effects of artificial diversions, imports or storage

Upper Carmel Valley: the section of Carmel valley upstream of the Narrows and downstream of San Clemente Dam; includes aquifer subunits 1 and 2

vegetation die-offs: the loss of vegetation through mortality

water table: the surface of the ground water in an unconfined aquifer

water year: the period from October 1st of one calendar year through September 30th of the following calendar year; reflects the onset of the rainy season in the Monterey area

watershed: the area contained within a drainage divide above a specified point on a stream

well: any devise or method, mechanical or otherwise, for the production of water from ground water supplies, excluding seepage pits and natural springs

wetland: an area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions; specific definitions have been formulated by various federal and state agencies

wetland vegetation: hydrophytic (water loving) plants that can survive and grow in water-saturated or inundated conditions

young-of-the-year: referring to juvenile steelhead which are less than one year old

zonation: the arrangement of areas within a region into strips or blocks distinguishable from each other by differences in vegetation, soils, flooding frequency, etc.

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SECTION XII

CONTRIBUTORS