Implementation Strategy to Identify Priorities for Bay-Delta Ecosystem Restoration

I. *PURPOSE OF IMPLEMENTATION STRATEGY*

This implementation strategy is being prepared for several purposes. The first is to guide the selection of projects and programs from the funding sources where CALFED has a direct role in decision-making. These funding sources include $60 million in state Proposition 204 funds and stakeholder contributions to fund the commitments in the Bay-Delta Accord, commonly referred to as Category III. In addition, the President's Budget for federal FY 98 proposes $143 million for Bay-Delta ecosystem restoration which will likely use a similar decision -making structure as Category III.

This implementation strategy is also being developed to maximize the cost sharing opportunities between CALFED/Category III and other funding sources. One of the initial priorities for coordination is the Central Valley Project Improvement Act. CVPIA staff have identified priority species for their anadromous fish programs which are closely aligned with this Implementation Strategy but which do not include the fish species resident in the delta because that is beyond their scope. In addition. many of the considerations CVPIA uses to prioritize projects have been incorporated into the criteria in this document. CALFED will continue to work to find ways to coordinate these two programs as well as the many other programs involved in the restoration of Bay-Delta ecosystem.

Revisions and Modifications. This implementation strategy will be used to guide expenditures over the next several years but will be re-examined on an annual basis to determine if there is the need to add additional species, habitat types or to revisit criteria. This will be especially important as federal funding under H.R. 4236 becomes available and as the programmatic EIR/EIS is completed allowing initiation of the ecosystem restoration activities identified in Chapter 7 of Prop 204. While it is appropriate to focus immediately on more limited portions of the overall Ecosystem Restoration Program, as the amount of available funding increases. there will be opportunities to expand this focus. This strategy will be reviewed and amended as needed semi-annually.

II. *BACKGROUND*

The mission of the CALFED Bay-Delta Program (CALFED) is to develop a long term comprehensive plan to restore ecosystem health and improve water management for beneficial uses of the Bay-Delta System. CALFED is also working to ensure that existing programs such as Category III, the Central Valley Improvement Act, and other ecosystem restoration efforts are implementing actions that are consistent with the long term plan including the Ecosystem Restoration Program.

A. *Overview of the Ecosystem Restoration Program*

CALFED's Ecosystem Restoration Program goal is to "improve and increase aquatic and terrestrial habitats and improve ecosystem functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species". The program objectives are to:

- Improve and increase aquatic habitats so that they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary,
- Improve and increase important wetland habitats so that they can support the sustainable production and survival of wildlife species, and
- Increase population health and population size of Delta species to levels that ensure sustained survival.

The program is developing the implementation objectives and targets that will be needed to meet these goals and objectives. These targets are being set to address the ecosystem elements which include:

- Six physical processes such as sediment supply, fire, and the hydrograph.
- Twelve secondary ecosystem processes and functions such as water temperature, nutrient cycling, and gravel recruitment.
- Thirteen stressors such as contaminants. dredging, and land use practices,
- Fifteen habitat types such as valley oak woodland. open-ended sloughs, seasonal wetlands, tidal perennial aquatic habitat, and
- Forty-seven species and groups of species such as the California red-legged frog, the delta smelt, and estuarine foodweb organisms.

In the programmatic Environmental Impact Report/Statement being prepared by the CALFED Bay-Delta Program on the long-term plan, this large scale program will be described at the programmatic level which will not include detail on specific restoration actions. The individual actions will be implemented through adaptive management which involves implementing actions, monitoring and evaluating the results, and then adjusting the program accordingly.

B. *Relationship of Implementation Strategy to Ecosystem Restoration Program*

The overall Ecosystem Restoration Program will be implemented in phases over several decades. This implementation strategy is being developed in coordination with the development of phasing for the Ecosystem Restoration Program so that it flows logically into the long-term program. It should also provide the opportunity to begin to reduce the most critical conflicts in the Bay-Delta ecosystem and to initiate adaptive management.

C. *Overview of Central Valley Project Improvement Act Goals*

The CVPIA has three major goals.

- Double natural production of anadromous fish,
- Provide water for refuges, and
- mitigate for other CVP impacts.

CVPIA requires that specific projects' assurances be implemented by the Department of the Interior (DOI). It also includes a number of programs such as the Anadromous Fish Restoration Program, that allows the DOI to implement restoration actions, primarily to reach the doubling goal.

D. Overview of Category III Program

Category III was designed to fund non-flow actions to benefit fish species dependant on the Bay-Delta. Factors such as introduced species, fish screens, and toxics were to be addressed through these actions.

III. *IDENTIFICATION OF NEAR-TERM RESTORATION PRIORITIES*

Restoration priorities need to be established which are consistent with the objectives of the ERPP and with the original intent of Category III. On December 13, 1996, the Ecosystem Roundtable indicated that the priorities for allocating ecosystem restoration resources should be (1) actions to assist in the recovery of aquatic species that are listed, of special concern, or desirable and in "greatest need", and (2) actions to assist in the restoration of habitat types that have experienced the greatest decline, and which are important to the priority species. The Roundtable also indicated that where actions could also provide broad ecosystem restoration, they should be favored over actions which only benefitted a single species. The Roundtable emphasized an interest in funding habitat demonstration projects that can increase the understanding of large scale ecosystem restoration processes. At the February 20, 1997 meeting, the Ecosystem Roundtable made six additional changes. These were 1) inclusion of instream aquatic habitat as a specific priority habitat type, 2) identifying migratory birds as a secondary priority and moving striped bass into this secondary priority, 3) including fall run salmon in the east side Delta tributaries, 4) considering watershed actions when determining the best projects for restoring the identified priority species and habitats, 5) considering agricultural wetlands when determining the best projects for restoring the identified priority species and habitats, and 6) considering the south and central San Francisco Bay more comprehensively in future revisions of this Implementation Strategy but considering actions in these areas when determining the best projects for restoring the identified priority species and habitat types. Using the ERPP as a guiding document, this draft paper identifies the rationale for setting near term restoration priorities, and then identifies the restoration priorities based on that rationale. Criteria are also included that will help guide selection of actions to address the priority species and habitat types. The rationale that were used to select species and habitat types is as follows:

- <u>CALFED Mission</u>. Focus on species and habitat whose restoration will result in the greatest progress towards achieving the CALFED mission to restore ecological health and improve water management for beneficial uses of the Bay-Delta System. Aquatic species and those habitats supporting aquatic species would be priorities based on this criteria because the major issue in the Bay-Delta that led to the creation of CALFED centered on the conflicts between fisheries and water management.
- <u>High Risk</u>. Focus on desirable species and habitats that have experienced the greatest declines.
- <u>Ecosystem Benefits</u>. Focus on habitats that provide the broadest benefits to priority species and to the ecosystem.

III. *PHYSICAL AND ECOSYSTEM PROCESSES*

The CALFED ERPP is based on the premise that restoration of ecological processes and functions is a fundamental tool for successful ecosystem restoration. These natural processes serve to create and maintain habitats needed by fish, wildlife and plant communities. Restoration efforts based on restoration of natural processes are likely to be more cost effective in the long term because they should be self sustaining and require less human intervention. Restoration of processes such as hydrologic regime are also important if habitats such as tidal, perennial, and shaded riverine aquatic are to function. This premise will also be a basis for the early implementation program. However, it may not be feasible to restore some natural processes and active management may be needed to recreate their beneficial effects.

As watersheds are evaluated to identify limiting factors which may be affecting the priority species, they will also be evaluated to determine the status of important ecological processes and functions. Where these processes have been interrupted or altered so the needed habitats are no longer being provided, the feasibility of restoring those processes will be evaluated. If the processes can be restored through early implementation actions, those actions will be given preference. Where it is not feasible in the short term to restore the natural process, short term restoration actions should not preclude long term restoration of the processes. Where it is clear that the natural process cannot be restored, it may be necessary to take restoration actions that replace or supplement the natural process, knowing that these will be on-going annual maintenance types of programs.

IV. *HABITATS*

Habitat types that have experienced the greatest declines and which provide the broadest ecosystem benefits and/or benefits to the priority species include the following:

1. *Tidal perennial aquatic habitat (freshwater).*
   Description. Includes shallow aquatic habitats, particularly less than 9 feet deep from mean high tide.
   Priority rationale: This habitat type has declined dramatically in the Delta. It provides habitat for many fish and wildlife species, and contributes to the primary and secondary productivity of the foodweb in the Delta. Implementation of pilot projects would allow restoration techniques to be refined. Experience restoring this type of habitat has been limited and there are questions related to benefits that can be provided for salmon rearing in the Delta that need to be answered as part of the larger ERPP.
   Examples: A project that is already underway, is the include Prospect Island Project.
   Key species: Species potentially benefitted by this habitat type include Delta smelt, salmon, wildlife and plant species in the following guilds: shorebird and wading-bird guild, waterfowl guild, freshwater emergent wetlands plant association.

2. *Seasonal wetland and aquatic*

   Description: Includes seasonal wetland habitats within the floodplain which are inundated seasonally by high water or seasonal wetland habitats which can be managed to recreate these natural processes.

Priority rationale: Seasonal wetlands within the floodplain can provide habitat for aquatic species such as splittail spawning and salmon rearing and for wildlife species such as waterfowl and shorebirds. They also provide functions such as nutrient cycling and foodweb support. Seasonal wetlands provide foraging and adjacent uplands provide nesting habitat for waterfowl and other water-dependant wildlife species, some of which are listed such as the greater sandhill crane, giant garter snake, California clapper rail, and Aleutian canada goose.. Historically, the Central Valley provided over four million acres of natural wetland habitat but this has been reduced by over 90%. Natural seasonal wetlands have been greatly reduced by levee construction for agricultural conversion and urbanization, significant changes in hydrology and water quality, and construction of flood control and navigation projects . In some areas, these changes have precluded the ability to restore seasonal wetlands through natural processes so they must now be recreated through intentional irrigation and management to provide the same wetland functions. In other areas, the natural processes are still capable of restoring seasonal wetlands with less management. Where possible, seasonal wetlands will be restored through natural processes and where necessary, they will be recreated through more intensive management. Restoration of seasonal wetlands can also provide opportunities for riparian forest restoration using natural processes if there is not a conflict with flood control operations.

Examples: The Yolo Bypass, the Cosumnes River Preserve/Watershed, and Stone Lakes Wildlife Refuge.

Key species: salmon, splittail, waterfowl and wading birds such as northern pintails and mallards, giant garter snakes, sandhill crane, California clapper rail, Aleutian Canada goose, tricolored blackbird, and for the areas where appropriate riparian upland restoration can accompany seasonal floodplain wetlands, grassland species such as western yellow-billed cuckoo, Swainson's hawk, riparian wildlife guild, and neotropical migratory bird guild can be benefitted.

3. Instream aquatic habitat

Description: Includes aquatic habitat in the creeks, streams, and rivers of the Central Valley. Components of this aquatic habitat includes the water flows, sediment supply, water quality, water temperature, and other parameters that interact to provide healthy aquatic habitat.

Priority rationale: This habitat type provides spawning and rearing habitat for most of the anadromous species in the Bay-Delta ecosystem. Native resident species also rely on this habitat type. It plays an important role in the health of estuarine habitat downstream. This habitat type has been impacted by changes in water and sediment supply, losses in riparian habitat discussed under shaded riverine aquatic habitat, changes in water quality and water temperature, and many other landscape level changes in the ecosystem.

Examples: Restoration efforts on Battle Creek to improve flows, gravel replenishment efforts on the Sacramento River, and CVPIA water acquisition efforts on the Merced River.

Key species: Salmonids, splittail, and striped bass.

4. *Shaded riverine aquatic habitat*

Description: Includes riparian habitat adjacent to or overhanging streams and rivers.
Priority rationale: This habitat type provides food and escape cover for outmigrating salmonid juveniles and is an important source of nutrients in the streams and delta sloughs. Much of this habitat type along the major rivers and in the delta has been lost due to river channelization, levee construction and maintenance, and the invasion of exotic flora. Shaded riverine aquatic habitat can been restored in two ways, through restoration on existing levee berms and through restoration of natural processes by modifying flood control facilities such as with levee setbacks. In giving this habitat type priority, the focus should be on restoration using natural river processes with habitat restoration on existing levee berms occurring only where natural process restoration is precluded.
Examples: Sacramento River Refuge/SB 1086, Cosumnes River Preserve
Key species: Salmonids, other riparian dependent species. ~~(NOTE: need to add additional detail)~~

5. *Saline emergent wetlands habitat (tidal)*
Description: Includes tidal brackish and saltwater wetlands.
Priority rationale: This habitat type supports several listed plant and animal species and is important for nutrient cycling and foodweb support functions. It has also declined due to diking and reclamation of bay lands.
Examples: There are several restoration projects in the North Bay and Suisun Bay.
Key species: Salt marsh harvest mouse, Suisun song sparrow, California clapper rail, and for some of the restoration projects in the North Bay which restore natural salinity gradients at creek mouths, this type of restoration can be important for aquatic species such splittail and striped bass.

6. *Midchannel islands and shoals habitat*
Description: Includes the channel islands in the Delta.
Priority rationale: These midchannel islands represent diverse habitat types including shoals, tidal mudflats, tule marshes, shaded riverine aquatic, and riparian scrub habitat. These habitat remnants are a high priority for protection and restoration because collectively they comprise a significant fraction of the remaining natural habitat in the Delta, they continue to be threatened, and they are one of the few habitat areas in many areas of the delta where habitat restoration opportunities have not been complicated by subsidence.
Examples: Staten Island midchannel island project
Key species: Delta smelt, salmon, shore bird and wading-bird guilds, and waterfowl guild.

7. *~~North Delta~~ agricultural wetlands and perennial grasslands*
Description: Includes agricultural lands seasonally flooded and perennial grassland habitat.
Priority Rationale. Agricultural wetlands and perennial grasslands in the north Delta may also need to be included because they provide opportunities for restoration of seasonal floodplains and tidal perennial aquatic habitat due to the limited amount of subsidence that has occurred. These habitat types in the north delta are rapidly being converted to vineyards which could preclude opportunities

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for restoration in the future. Other agricultural wetlands will be considered in determining the actions needed to address priority species.
Examples: Stone Lakes Wildlife Refuge, Jepson Prairie Preserve
Key Species: These habitat types in this area currently provide foraging habitat for shorebirds, waterfowl, Swainson's hawks, and sandhill cranes. Any future restoration of these lands would incorporate the existing terrestrial and avian wildlife benefits as well as provide benefits to aquatic species such as Dela smelt, and salmon.

V. *PRIORITY SPECIES OR POPULATIONS*

Species or populations that are at the greatest risk of decline and whose recovery contributes the greatest to the CALFED mission include the following aquatic species that are listed, are being considered or are likely to be considered for listing, or aquatic species with high recreational value and in serious decline. Using these species, the stressors or factors affecting them and the actions needed to address the stressors will be identified by technical experts. These actions will then be evaluated to ensure that they are consistent with the criteria included at the end of the Implementation Strategy. Evaluate to see if, for example, actions which only benefit striped bass and which adversely affect another species in the estuary would be inconsistent with the criteria.

- San Joaquin River fall run chinook salmon
- Winter-run chinook salmon
- Spring-run chinook salmon
- Delta smelt
- Splittail
- Steelhead trout
- Green sturgeon

Other species to be considered:

- Striped bass
- Migratory birds

1. *San Joaquin River fall-run chinook salmon:* The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The fall-run race on the San Joaquin River is designated as a species of concern by USFWS.

2. *Winter-run chinook salmon:* The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The winter-run race is listed as endangered under the state and federal Endangered Species Acts.

3. *Spring-run chinook salmon:* The chinook salmon is an important native anadromous sport and commercial fish with important ecological value. The spring-run race on the Sacramento River is designated as a closely monitored species by DFG and a species of concern by USFWS.

4. *Delta smelt:* The delta smelt is a native estuarine resident fish that has been listed as threatened under the state and federal Endangered Species Acts.

5. *Splittail:* The Sacramento splittail is a native resident fish that is proposed for listing

under the federal Endangered Species Act and a candidate for listing under the State Endangered Species Act. The Sacramento splittail also supports a small winter sport fishery in the lower Sacramento River.

6. *Steelhead trout:* The steelhead trout is an important native anadromous sport fish of high recreational and ecological value that is proposed for listing under the federal Endangered Species Act.

7. *Green sturgeon:* The green sturgeon is designated as a species of special concern by DFG and a species of concern by USFWS.

8. *Striped bass:* The striped bass is an important non-native anadromous sport fish with high recreational value. It also plays an important role as a top predator in the aquatic system.

9. *Migratory Birds*: Includes both waterfowl guild and neotropical migratory bird guild. Many of these species migrate through, winter or breed in the Bay-Delta. Waterfowl are a significant component of the ecosystem, are of high interest to recreational hunters and bird watchers, and contribute to California's economy. Representative species include canvasback, mallards, and snow geese. The neotropical migratory bird guild are of high interest to recreational bird watches and there have been substantial losses of habitat used by these species.

VI. *GEOGRAPHIC DISTRIBUTION OF PRIORITIES*

The geographic distribution of the five habitat types and the eight species or population priorities are shown in Table 1 and 2. Using these habitat types and species as priorities will result in a fairly broad geographic distribution of projects and resources. Therefore, no additional geographic priorities have been established at this time.

Table 1. Geographic Distribution of Priority Habitat Types

	North Bay	Delta	Sacramento	Sacramento Tributaries	San Joaquin	San Joaquin Tributaries
Tidal Freshwater		x				
Seasonal floodplain wetlands	x	x	x	x	x	x
Shaded Riverine	x	x	x	x	x	x
Saline Tidal/ emergent	x					
Mid-channel islands		x				
Instream Aquatic Habitat			x	x	x	x

Table 2. Geographic Distribution of Priority Species Likely Actions to Address

	North Bay	Delta	Sacramento	American	Feather/ Yuba	smaller tributaries	San Joaquin	San Joaquin Tributaries	Ocean
San Joaquin Fall Run		x					x	x	x
Winter Run		x	x						x
Spring Run		x	x		x	x			x
delta smelt	x	x	x						
splittatil	x	x	x				x	x	
steelhead	x	x	x	x	x	x	?	?	x
green sturgeon	x	x	x						x
striped bass	x	x	x				x		x
Migratory birds	x	x	x	x	x	x	x	x	

VIII. *WATERSHED MANAGEMENT*

Watershed management actions are an important part of the Ecosystem Restoration Program Plan. These types of actions will be incorporated where they address factors which limit or affect the restoration of priority species and habitats.

IX. *CRITERIA*

In addition to the rationale for identifying the priority species and habitats (see pg 2), criteria have been identified to address technical and policy objectives. These criteria are summarized in Table 3. They will be used to guide selection of actions to address the priority species and habitats.

Table 3. Draft Criteria List for Selection of Restoration Actions

1.	Restoration actions should not prejudge the selection of alternatives in CALFED's Programmatic EIR/EIS.
2.	Restoration actions should be consistent with CALFED mission, solution principles, goals, and objectives.
3.	Restoration actions should be amenable to evaluation and documentation of effects.
4.	Restoration actions which also benefit other CALFED program objectives for the Bay-Delta should receive additional priority..
5.	Restoration actions which provide both short-term and long-term benefits should be emphasized over actions which provide only short-term benefits.
6.	Restoration actions should emphasize restoration of natural processes and functions where possible.
7.	Restoration actions should address the elimination or reduction of limiting factors for priority species.
8.	Restoration actions which benefit a suite of species that includes listed species should be emphasized over actions that benefit any single priority species.
9.	Restoration actions for key species should not compromise other desirable species.
10.	Demonstration projects should be emphasized to reduce the uncertainty associated with the success of restoration actions, such as of ecosystem processes.
11.	Restoration actions that foster partnerships, collaboration, and/or information exchange should be encouraged.
12.	Restoration actions which may be precluded in the future due to land use transition or other changes, should receive priority.
13.	Where it is clear that a restoration action will provide benefits, implement it.
14.	Where it is clear there is an objective that needs to be met, but the exact restoration action is uncertain, conduct a management experiment with targeted monitoring and research.
15.	Where the objective is uncertain, proceed along two parallel paths. First, implement any "no regrets" actions that will improve the current situation. Second, conduct directed research and monitoring to reduce uncertainty about the objective and restoration actions needed to achieve it.

To: Lower American River Technical Team Participants
From: Cindy Darling, Jonas Minton, Tim Washburn

The following matrix has been prepared to assist in identification and prioritization of stressors in the American River. Within each stressor group, please check off the habitats and species to which they apply. Also, please insert your ideas of individual stressors which may not have been included.

ERPP Stressor Group	Species				Habitat	
	Steelhead	Chinook Salmon	Sacramento Splittail	Striped Bass	Shaded Riverine Aquatic Habitat	Seasonal Wetland and Aquatic
Water Temperature						
spawning						
incubation						
rearing						
Flow						
base flow						
attraction flow						
flow fluctuation						
Spawning Habitat						
gravel armoring/permeability						
gravel recruitment						
flooded vegetation						
Rearing Habitat						
shaded riverine aquatic						
instream cover/woody debris						
floodplain/littoral zone						
wetland/slough						
Water Diversions						
Hatchery Practices						
behavioral influences						
timing selection						
genetic dilution						
disease						
Migration Barriers						
Nimbus Dam						
Folsom Dam						
Harvest						
sport						
commercial						
Exotic Species (predation)						
Flood Control						
bank protection						
levee maintenance						

Appendix C

Presentation by Paul Bratovich

OVERVIEW AND HISTORY OF THE LOWER AMERICAN RIVER

Presented by Paul Bratovich to the CALFED Lower American River

Technical Team on March 13, 1997

CALFED, the Water Forum, and the Sacramento Area Flood Control Agency (SAFCA) are jointly sponsoring the lower American River Technical Team to identify and collectively develop restoration actions recommended for the lower American River. The goal of this jointly sponsored technical team meeting is to develop these restoration actions in a sequential process established by CALFED. The sequential process includes an overview and background of the American River system, its aquatic resources and their management, identification and prioritization of environmental stressors on those aquatic resources, and identification and prioritization of restoration actions to achieve instream beneficial effects on the American River system.

The initial part of the sequential process is a presentation on the background of the American River system and its aquatic resources, as follows:

Historically, over 125 miles of riverine habitat were available for anadromous fish in the American River system. In 1955, with the closure of Nimbus Dam, upstream access to anadromous fishes was blocked, and all anadromous fishes are now restricted to the lower 23 miles of the lower American River extending from Nimbus Dam down to the mouth of the American River at its confluence with the Sacramento River (Figure 1).

The American River is a well studied system. Some of the initial fishery studies were conducted in the early 1900s (Figure 2). Many of these studies led to flow recommendations and management strategies for the American River. For example, a study completed in 1953 examining the relationship between flow and spawning gravel areas in the lower American River resulted in State Water Resources Control Board Decision 893. D-893 is the current regulatory requirement dictating minimum flows for the lower American River. In 1971, another study was conducted, again investigating the relationship between spawning gravel and flow by the Department of Fish and Game. This study was conducted in order to try to identify and establish minimum instream flow requirements in anticipation of Auburn Dam's construction in the upper watershed. These flow studies led to State Water Resources Control Board Decision 1400. However, since Auburn Dam has not been constructed, the decision was not implemented and D-893 still serves as a regulatory requirement.

Several other studies have been conducted, including several studies in support of the Environmental Defense Fund et al. versus EBMUD litigation and the flow requirements which condition the ability of EBMUD to divert from Folsom South Canal. These studies included various aspects of salmonid biology, water temperature, water temperature operational affects, and various investigations into the life stages of chinook salmon and steelhead.

traditionally was realized in the past. For example, it results in the establishment and maintenance of higher flows during the fall spawning and incubation period for chinook salmon, and somewhat lower flows during the summer months. Traditionally, flow releases from the lower American River have been quite high during the summer months, oftentimes up to 5,000 to 6,000 cubic feet per second. However, with a newly integrated CVP-wide operational strategy which incorporates the F-Pattern, a load shift can occur to benefit andramous salmonid resources of the lower American River, particularly with an emphasis on chinook salmon. By reducing high flows during the summer and shifting flows to other times of the year, water can be provided for chinook salmon during those months of the year when they are actually in the river, generally from October through May, sometimes into June. By taking those very high flows which traditionally occurred during the summer months, and reallocating them to the October through May and into June period, greater instream flow benefits for chinook salmon can be achieved.

For example, over the 70-year hydrologic period of record, hydrologic modeling analyses indicate that under current operational strategies, flows in excess of 2,500 cfs would be achieved during the month of October approximately 25% of the time, whereas flows of approximately 2,000 cfs or more can be achieved in the lower American River during the month of October over 70% of the time via implementation of the F-Pattern (Figure 7). Traditionally, during summer flows exceeded 5,000 cfs during the month of July on the average approximately 30% of the time, whereas flows exceed 5,000 cfs approximately 2% of the time under the F-Pattern. In other words, the flow has shifted out of the summer and into the fall, winter, and spring months when chinook salmon are actually in the river.

The numerous studies conducted on the American River have provided valuable information in support of the development of minimum flow recommendations, Administrative hearings, litigation, environmental documentation, and planning processes. However, the American River system also enjoys actual management application and actually serves as a very good example of adaptive management principles.

An Operations Working Group has been established for the lower American River (Figure 8), which includes the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Sacramento County, Alameda County Superior Court, California Department of Fish and Game, and the Save the American River Association. The lower American River Operations Working Group is convened monthly with the purpose of managing Folsom Reservoir operations for fishery resources of the lower American River within the confines of water availability. The U.S. Bureau of Reclamation provides information such as flows that have occurred over a several month period, storage, projected inflow, water temperature information, and project outflows to assist the Operations Working Group to plan the annual flow release schedule. On a monthly basis, this group adapts and refines the flow release schedule for the next month, and replans for the remainder of the year. In essence, this is a good working example of adaptive management in process and it is being applied, and has been applied over the past few years. The following serves as examples of adaptive management application.

In 1995 the dam gate broke on Folsom Reservoir. Flows which were in the neighborhood of between 5,000 and 10,000 cfs on a daily basis through the month of June and July suddenly

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increased dramatically, up to approximately 33,000 cfs when the dam gate broke (Figure 9). This flow was maintained at that high level until stop logs were put in place and the flows were under control again, reduced down to approximately 2,500 to 3,500 cfs for most of the remainder of the summer into the fall. 1995 was a wet year in other elements of the CVP, but this was not the case on the American River system. With the break of the dam gate, storage in the reservoir declined dramatically. In early July, Folsom was approaching maximum storage capacity of 974,000 acre feet. With the break of the dam gate, storage in the reservoir declined dramatically and precipitously. By August, storage in the reservoir had declined from approaching maximum capacity to approximately 580,000 acre feet in storage. So the American River system did not enjoy the luxury of a water rich year, which would ease management allocations for potentially competing purposes. Nonetheless, the lower American River operations working group convened and, based upon a risk of refill probability assessment, decided to provide the upper flow release objective for spawning according to the F-Pattern of 2,500 cfs per second starting in October, with the caveat that if conditions remained dry, flow would be adjusted on a monthly basis within the monthly working process of the group. But the decision was made and the flows were provided.

According to the U.S. Fish and Wildlife Service estimates, on average, from 1967 to 1991, about 31,000 chinook salmon returned each year to spawn in the lower American River, although that varies widely by year (Figure 10). Spawning stock escapement, or the number of salmon in the river attempting to spawn, can vary dramatically year to year. 1992 had one of the lowest returns of salmon to the American River, in the neighborhood of 5,000 estimated fish returning to naturally spawn in the lower American River. One of the highest years of return on record happened in 1995. In 1995, approximately 70,000 chinook salmon returned to spawn in the lower American River.

One indication of crowded conditions for fish spawning is the degree of superimposition. Superimposition refers to a fish coming in, building a redd or a nest, with subsequent fish digging that redd up and spawning on top of it, or overlapping.

Superimposition serves to indicate either a limited amount of, or inappropriate accessibility of, specific spawning areas. This can be due to gravel characteristics, or due to the relationship between flow and spawning gravel. With all other things being constant, one may surmise that superimposition would increase with the greater number of fish trying to spawn in a limited resource area. But other things aren't constant, flow being one of them. Flow varied widely over the years 1991 through 1995, from a low of 500 cfs in 1992, to the high of approximately 2,700 cfs over the course of the spawning season (October, November, and December) in the lower American River in 1995, as a result of the decision of the Operations Working Group. In addition, manipulation of the cold water pool with these higher flow releases resulted in earlier spawning in 1995 than in other years, and a more protracted spawning season. What have we learned from the past five years of aerial photography from 1991 through 1995? These studies have shown that the higher flow releases (i.e., about 2,500 cfs) starting in October were able to be maintained through December, spawning started earlier, and was extended over a longer period of time, these flows accommodated a several-fold increase number in the number of fish returning to spawn in the river, with reduced superimposition.

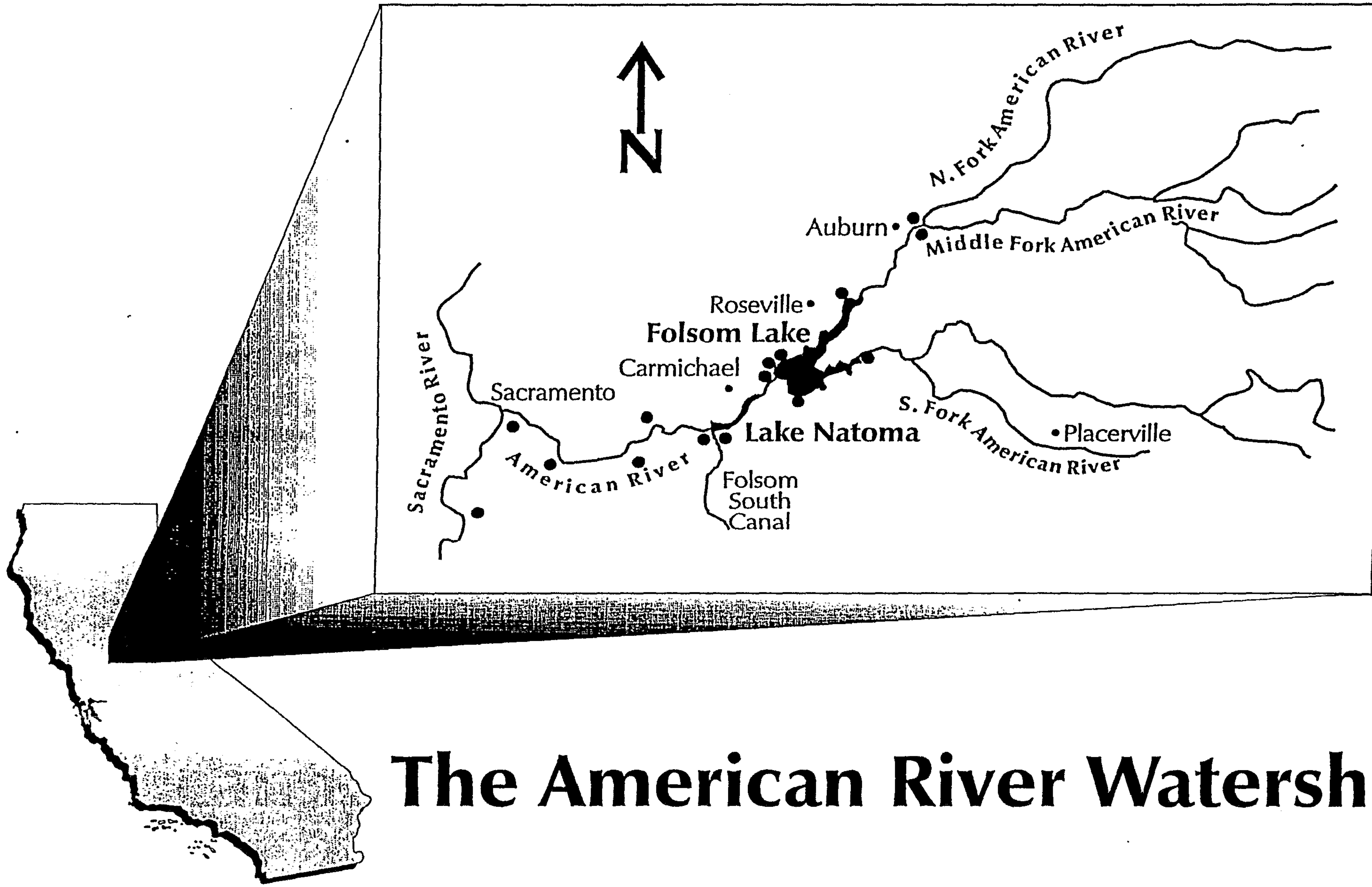
The Operations Working Group not only meets to provide input into the flow release schedule; it also adaptively manages the cold water pool in Folsom Reservoir. The cold water pool in Folsom Reservoir is influenced by numerous factors, not the least of which are inflow, inflow temperatures, diversions, storage, and the volume of cooler, hypolimnetic waters in the reservoir. Water temperatures in the lower American River are also influenced by these factors, and also by decisions upon which elevation to draw these waters for release from Folsom Reservoir into the hatchery and down the American River.

The Operations Group meets and determines how to manipulate the shutters to most effectively manage for aquatic resources in the lower American River. In 1996, for example, the Operations Working Group met in September and had various information available, including water in storage, reservoir inflow, flows released into the river, and projected flows into the river over the course of the fall. In September, water temperatures released from Nimbus Dam were 64 to 65 °F, over the early part of the month of October. The group met, calculated the availability of the total volume of cold water for release out of Folsom Reservoir for the fall spawning period, and came to the conclusion that there was not enough cold water to pull the bottom shutters and release cold water for the entire month of October. The decision was made that on October 9 the shutters would be pulled to provide cold water for chinook salmon spawning in the American River.

The results were dramatic. The shutters were pulled on October 9, and over the course of a couple of days, water temperatures released from Nimbus Dam into the lower American River declined dramatically. Within 4 days, water temperatures had declined from approximately 65°F to 58°F, and they remained at 58°F or less for the remainder of the month of October (Figure 11). The fish responded to the release of cold water. Spawning activity commenced and water temperatures were suitable for chinook salmon spawning throughout the remainder of the fall. This serves as another example of the applied utilization of the studies that have been conducted on the American River via an adaptive management process.

Even in consideration of these studies, planning tools, SAFCA's shutter reconfiguration, the Forum's development of the F-Pattern, the lower American River Operations Working Group refinement and adaptive management of the flow release schedule, and manipulation of the cold water pool, environmental stressors still remain to the aquatic resources in the lower American River (Figure 12).

The Water Forum process has developed a list of 22 potential actions that could restore or enhance the lower American River (Figure 13). Brief explanations of each of these actions are provided in this document. Again, the goal of this lower American River technical team working group today is, within the context of this background and the context of the studies that have been conducted, the management actions that are in place, and the adaptive management applications and principles that exist, is to identify, evaluate and prioritize remaining environmental stressors, to list more if they are not included in the provided preliminary summary list, and then to consider restoration actions, their application, and their prioritization for recommendation to the CALFED Ecosystem Restoration Round Table.



The American River Watershed

FIGURE 1

D—026792

Historic Studies of the American River

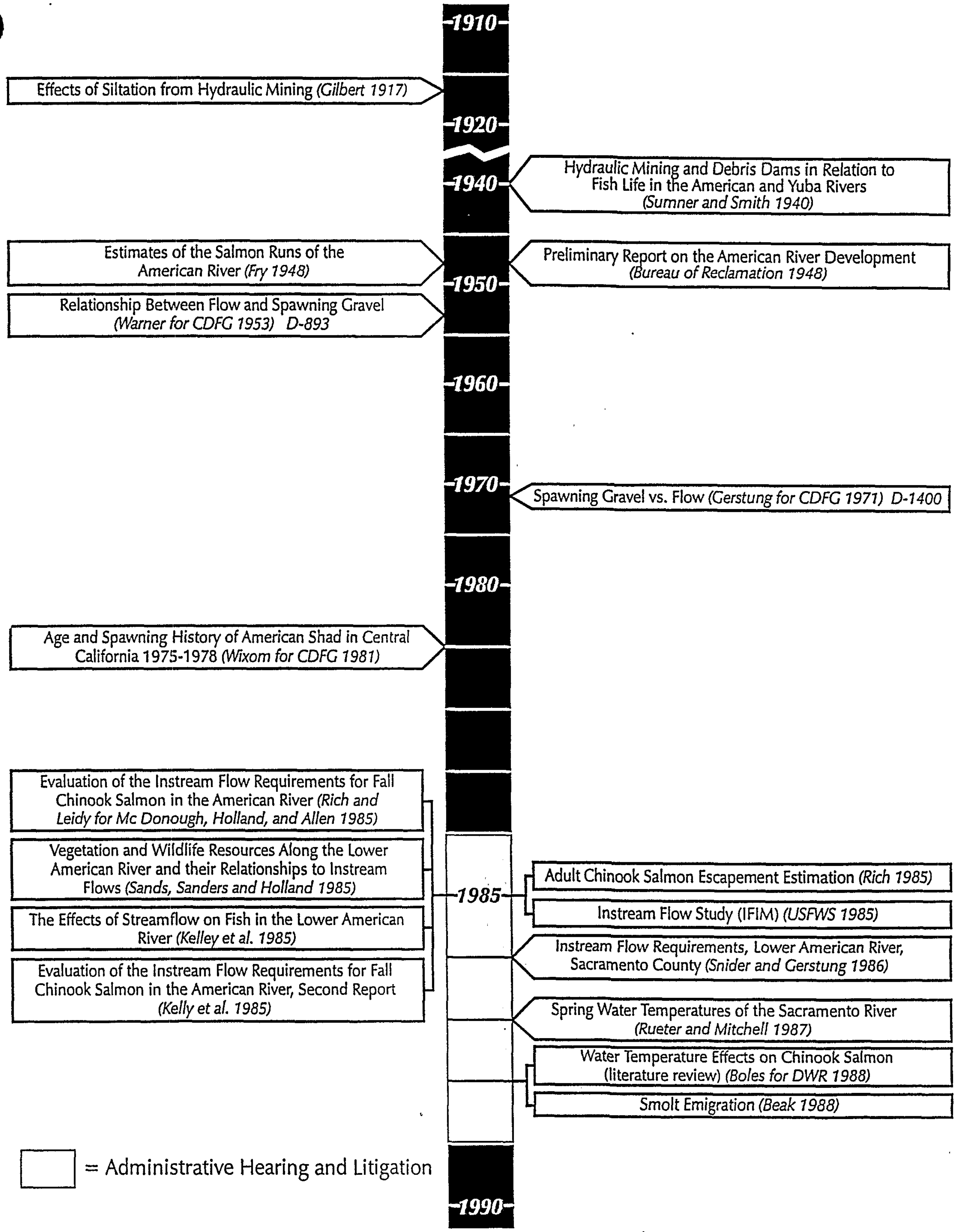


FIGURE 2

Recently Completed Studies

- Instream Flow Study (IFIM) (USFWS 1985)
- MOU Studies
  - Habitat Mapping
  - Habitat Suitability
  - Habitat Availability
  - Fish Abundance Estimates
  - Smolt Emigration Estimates
- Water Temperature Monitoring (1991-1997)
- Fish Resources Monitoring (1992-1997)
- Phase 1 Studies
  - Electrofishing
  - Beach Seining
  - Diver Observations
  - Gill Netting
  - Ichthyoplankton and Macroinvertebrate
  - Chinook Salmon Smolt Emigration Study
  - Salmon and Steelhead Egg and Fry Stranding Surveys
  - Chinook Salmon Spawning Gravel Characterization
  - Chinook Salmon Spawning Gravel Temperature Survey
- Lipid Measurements (1992 and 1993)
- Na^+ - K^+ ATPase Measurements (1992 and 1993)
- RNA/DNA Measurements (1992 and 1993)
- Critical Swimming Velocity Measurements
- Growth Measurements from Otoliths (1992 and 1993)
- Seawater Challenge Test (1992)
- Chinook Salmon Spawning Gravel Evaluation (1997)
- Aerial Redd Surveys (ongoing)

FIGURE 3

Studies In Progress

- Adult Chinook Salmon Escapement Estimation
- Chinook Salmon Aerial Redd Surveys
- Fish Resources Monitoring
- Water Temperature Monitoring
- Flow Fluctuation Evaluation

FIGURE 4

D-026795

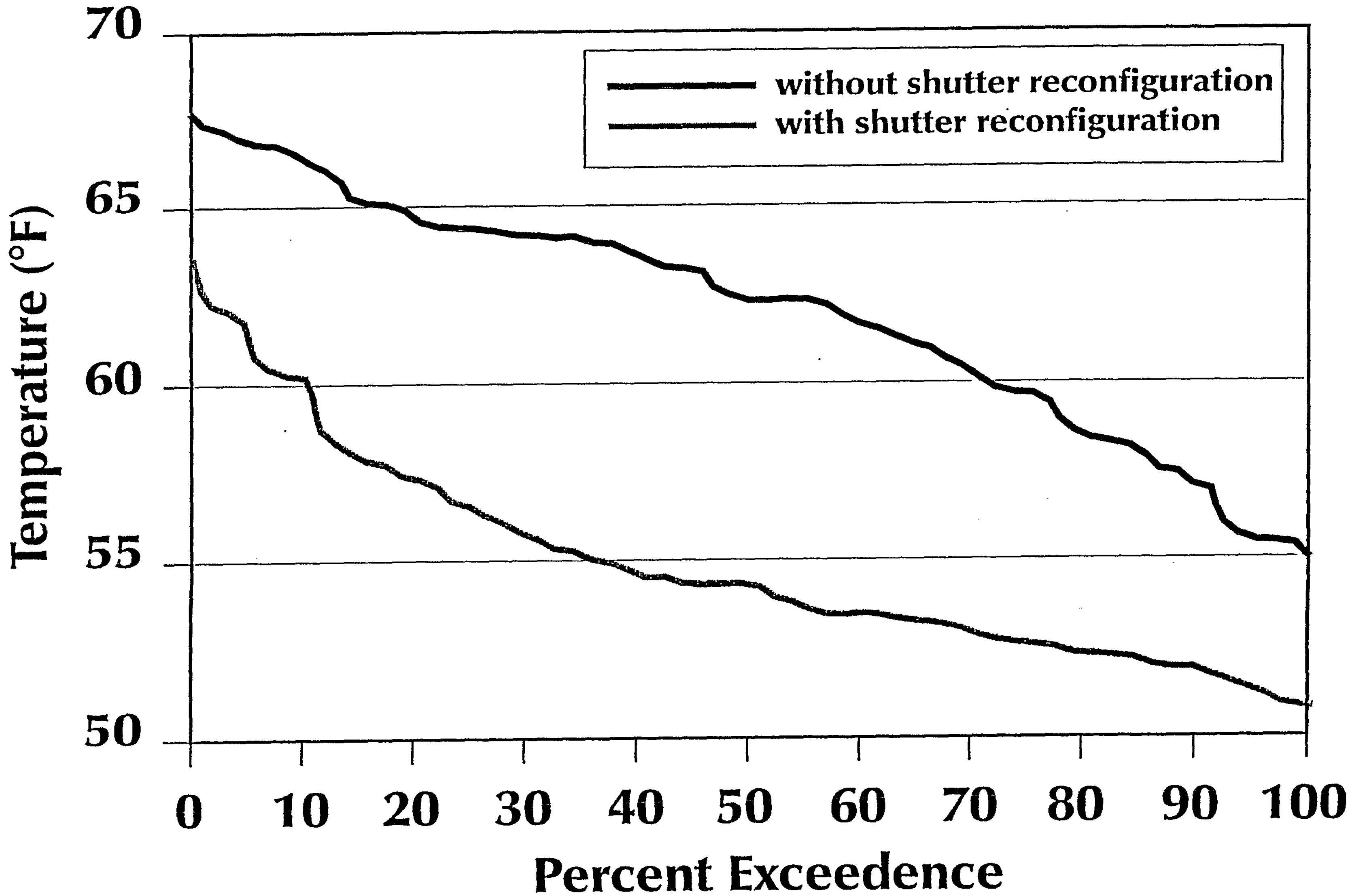


FIGURE 5

D-026796

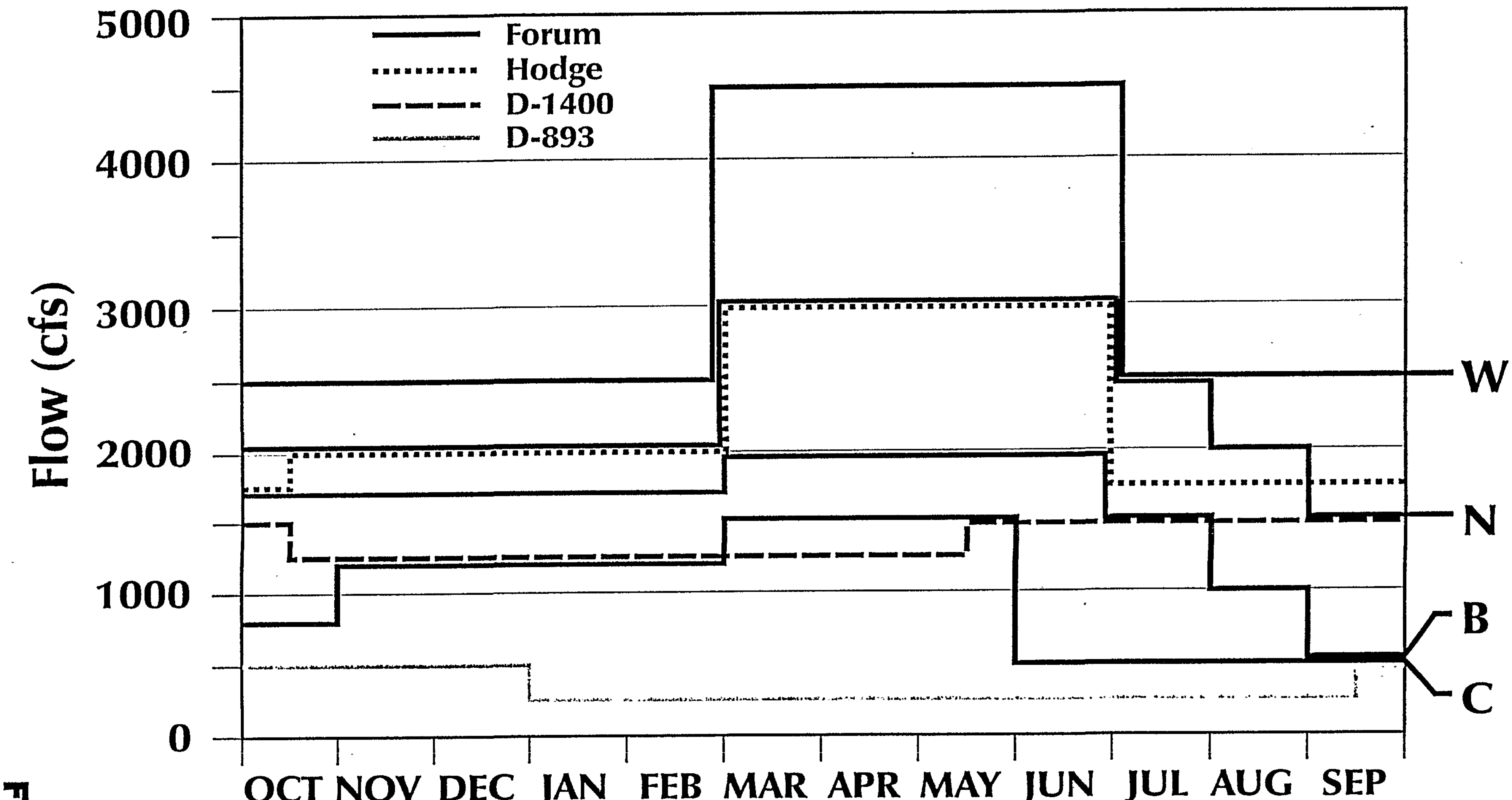
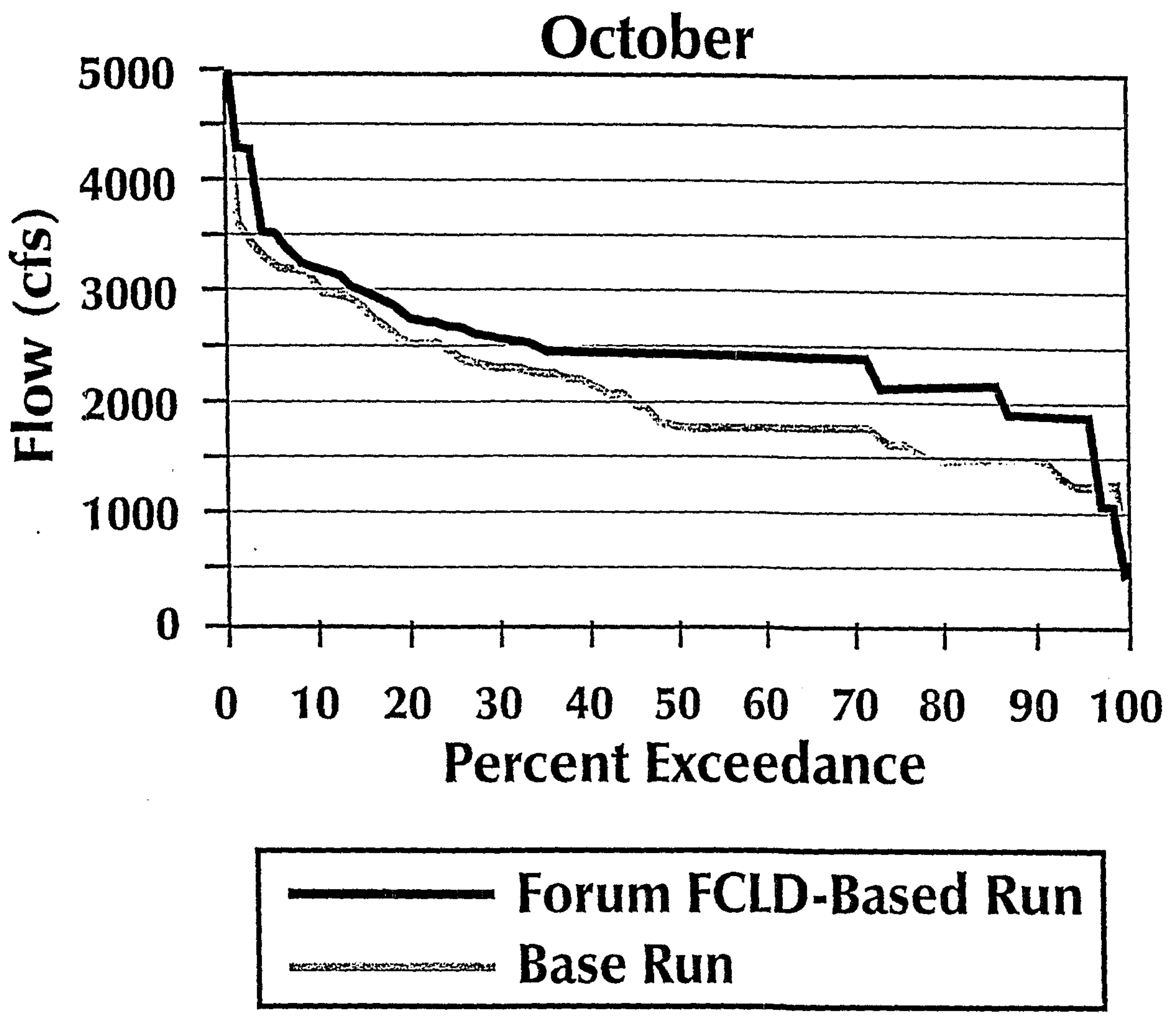
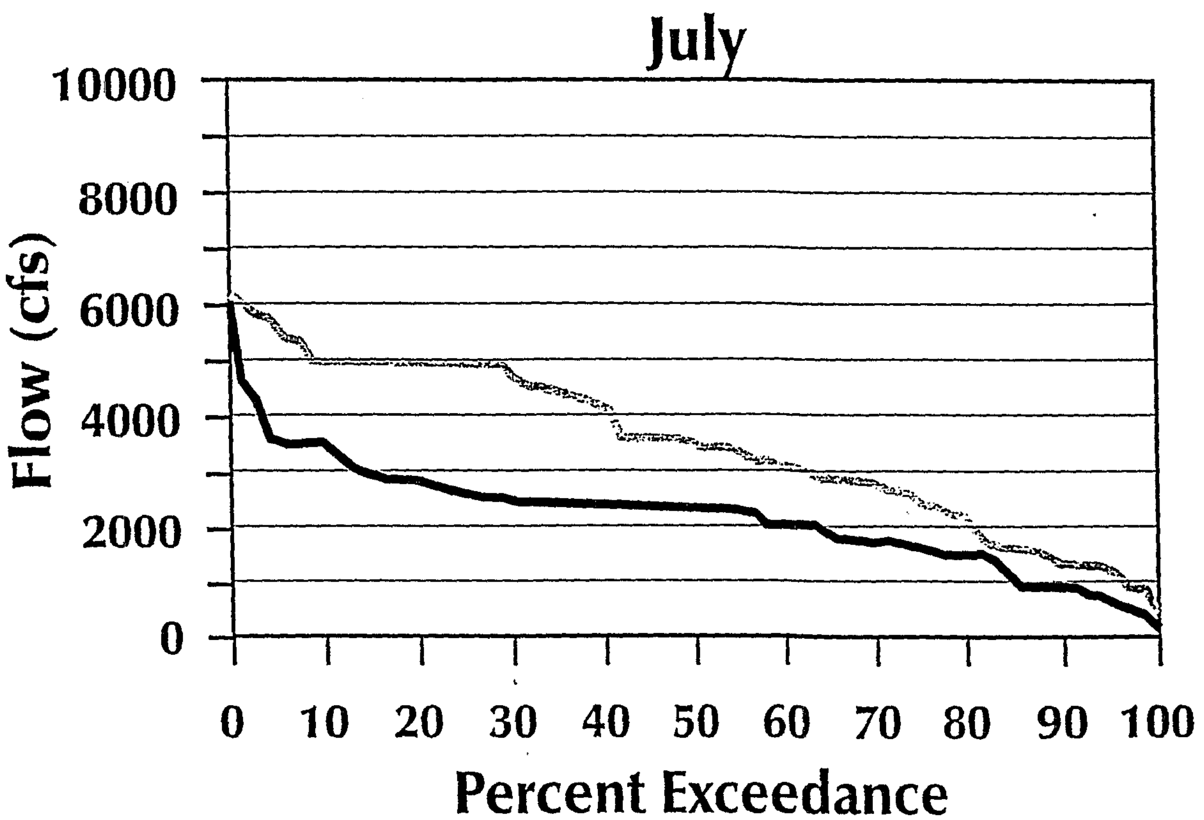

Flow (cfs)
5000
4000
3000
2000
1000
0
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP
Forum
Hodge
D-1400
D-893
W
N
B
C

FIGURE 6



October
5000
4000
3000
2000
1000
0
Flow (cfs)
0 10 20 30 40 50 60 70 80 90 100
Percent Exceedance
Forum FCLD-Based Run
Base Run



July
10000
8000
6000
4000
2000
0
Flow (cfs)
0 10 20 30 40 50 60 70 80 90 100
Percent Exceedance

FIGURE 7

D-026799

Lower American River Operations Working Group

Participants:

- USFWS
- USBR
- Sacramento County
- Alameda County Superior Court
- CDFG
- SARA

Purpose:

Manage Folsom Reservoir Operations

Activities:

- Plan annual flow release schedule in response to projected inflow and storage
- Perform monthly evaluations of:

  Snowpack - Precipitation - Reservoir inflow - Storage
- Adapt and refine flow release schedule for next month and replan for remainder of year

FIGURE 8

D—026799

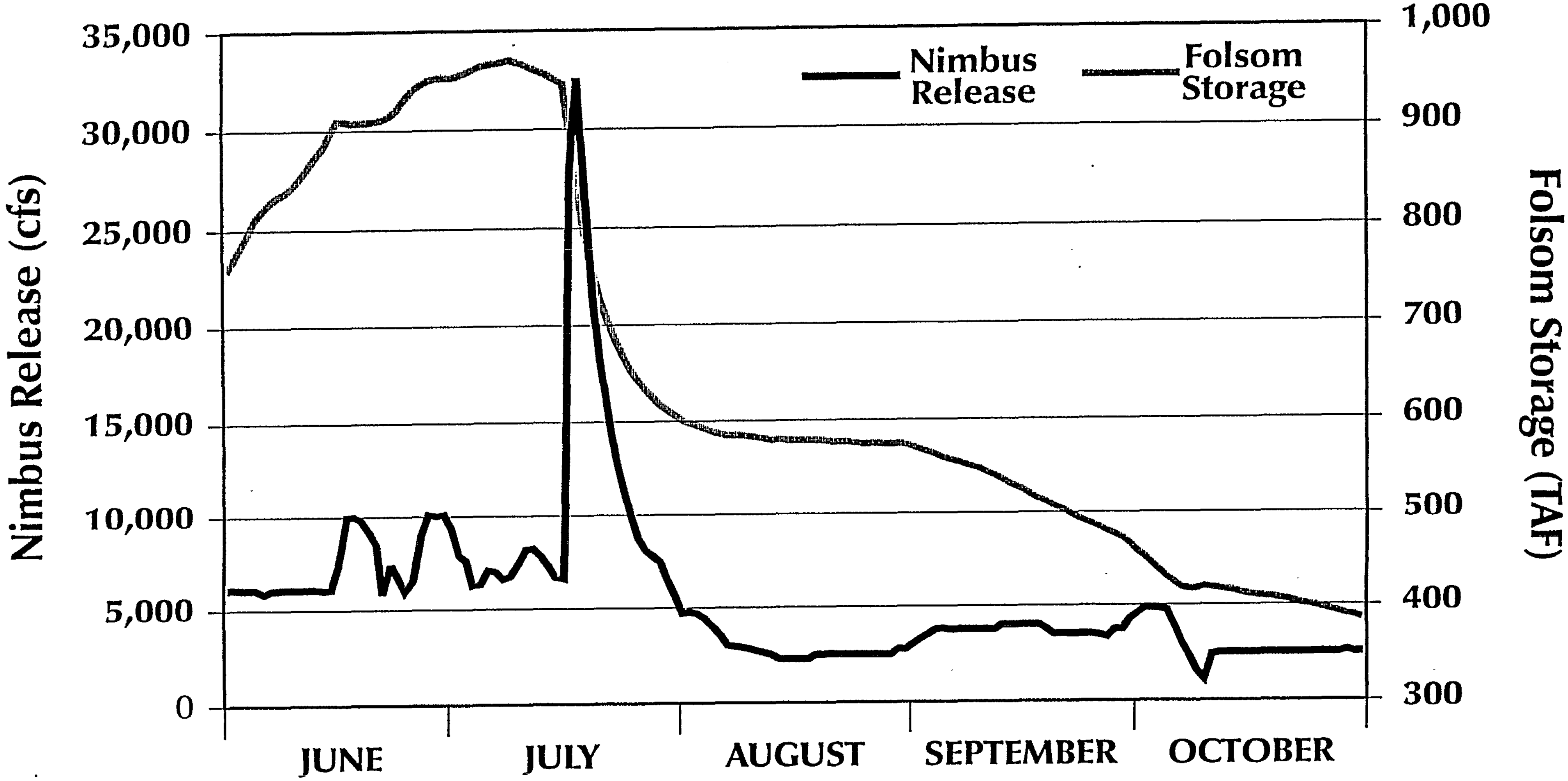


FIGURE 9

D-026800

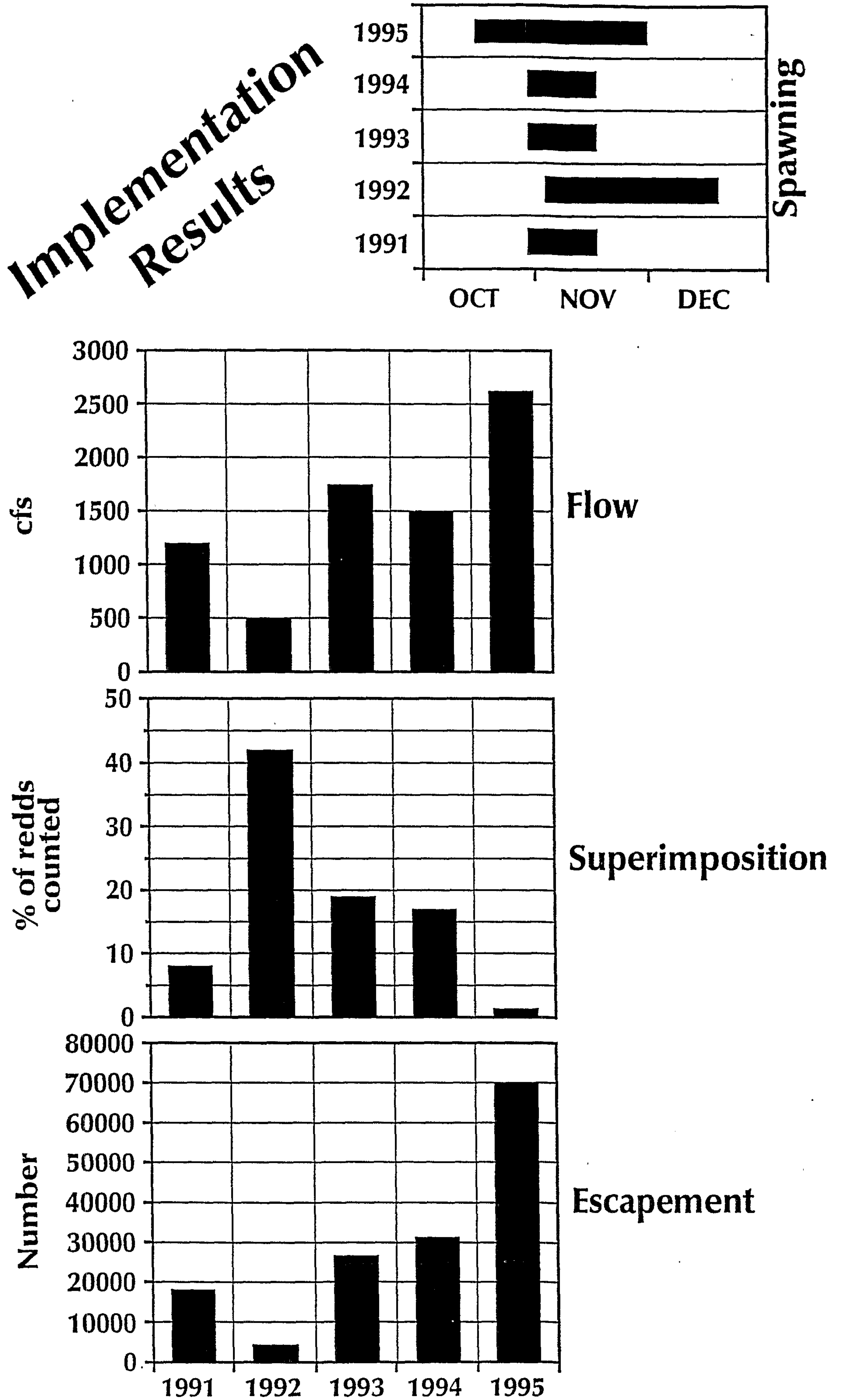

Implementation
Results
1995
1994
1993
1992
1991
OCT
NOV
DEC
Spawning
3000
2500
2000
1500
1000
500
0
cfs
Flow
50
40
30
20
10
0
% of redds counted
Superimposition
80000
70000
60000
50000
40000
30000
20000
10000
0
Number
Escapement
1991
1992
1993
1994
1995

FIGURE 10

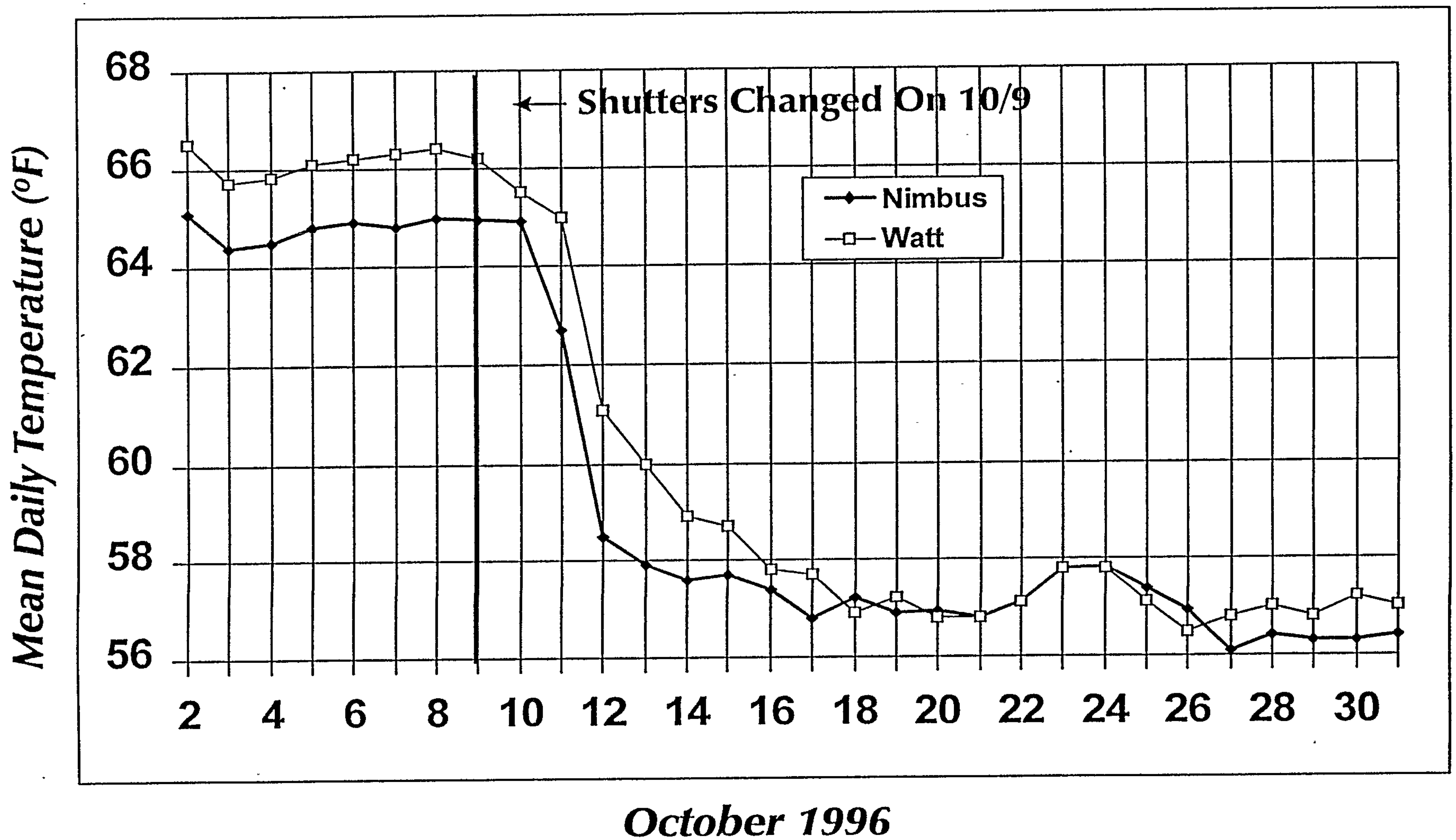


FIGURE 11

D-026802

Stressors

- Water Temperature
  - Spawning
  - Incubation
  - Rearing
- Flow
  - Base Flow
  - Attraction Flow
  - Flow Fluctuation
- Spawning Habitat
  - Gravel Armoring/ Permeability
  - Gravel Recruitment
  - Flooded Vegetation
- Rearing Habitat
  - Shaded Riverine Aquatic
  - Instream Cover/ Woody Debris
  - Floodplain / Littoral Zone
  - Wetland/Slough
- Water Diversions
- Hatchery Practices
  - Behavioral Influences
  - Timing Selection
  - Genetic Dilution
  - Disease
- Migration Barriers
  - Nimbus Dam
  - Folsom Dam
- Harvest
  - Sport
  - Commercial
- ~~Exotic Species~~ Predation
- Flood Control
  - Bank Protection
  - Levee Maintenance

FIGURE 12

Preliminary Summary List of Fishery Restoration/Enhancement Actions for the Lower American River

1. Flow Standards
2. Flow Fluctuation Criteria
3. Roseville Reclamation Pipeline
4. Dry Year Pulse Flow Evaluation
5. Folsom Dam Temperature Control Device (TCD)
6. Folsom Reservoir Coldwater Pool Management
7. Thermal Refugia Utilization
8. Wetland/Slough Complex Restoration
9. Woody Debris Management
10. Shaded Riverine Aquatic Habitat Protection/ Management
11. Spawning Habitat Management
12. Flood Control Channel Improvements
13. "Tail Race Habitat" Utilization
14. Fish Screen Improvement (Fairbairn WTP)
15. Reintroduction of Steelhead Above Folsom Dam
16. Identify Off-Site Mitigation
17. Mitigation/Enhancement Monitoring Plan
18. Consultation/Technical Assistance
19. Hatchery Temperature Control
20. Hatchery Management Practices
21. Increase Artificial Production
22. Angling Regulations

FIGURE 13

Appendix D

Project Descriptions

D-026805

Mitchell Swanson
Hydrology & Geomorphology

519 Seabright Ave Suite 210 Santa Cruz, California 95062
phone: 408-427-0288 fax 408-427-0288 e-mail: MSWAN@aol.com

February 26, 1997

TO: Tim Washburn, John Gammon and Paul Bratovich
FROM: Mitchell Swanson

RE: Potential CALFED Projects on Lower American River

Dear Tim, John and Paul,

As requested, I have put together a list of potential restoration projects for the Lower American River. I include a brief description of each along with a compilation of the potential sites. I am working off of recent memory on these (and a 1994 aerial photo set); some field work will be required to provide details and costs on construction. Feel free to contract me with any questions.

Potential Restoration Projects on the Lower American River for Improvement of Steelhead Habitat

Introduction

The Lower American River Task Force is interested in merging resources with the Sacramento Area Water Forum to develop and undertake a comprehensive habitat restoration plan for the Lower American River. One important opportunity is to seek funding from the recently established CALFED program whose objectives include restoration projects to benefit steelhead fisheries. Creation or enhancement of SRA habitat would be a key objective of a proposal on the LAR. Other actions include creation of riparian forest and wetland/ slough complexes that are hydrologically connected to the river.

Application to Flood Control and Bank Protection Program

Restoration of habitat on the Lower American River will improve habitat conditions for steelhead and salmon over a range of their life cycles. Shaded Riverine Aquatic (SRA) habitat provides adult and juvenile cover and rearing habitat. Creation of slough / wetland complexes provides juvenile salmonid rearing habitat, as recently observed by Nature Conservancy staff on the Cosumnes River Preserve after levees were setback and seasonally submerged wetlands developed on low floodplain surfaces. Restoration of riparian forest improves riparian ecosystem values adjacent to SRA habitat, which improves overall habitat quality.

There are several advantages in merging the resources of a comprehensive restoration plan with off site mitigation program of the Lower American River bank protection project. In doing so, however, a strict accounting system would be necessary to separate accounting of mitigation projects from other funded projects. The advantages of merging resources are: 1) Significant SRA restoration beyond that required for offsite mitigation could occur because the linear footage of degraded shoreline available is greater; 2) All or part of the SRA element of an individual restoration project (say one with riparian forest and/or wetlands slough complex components as well as SRA) could be constructed with bank protection mitigation resources with the remainder coming from other funding resources of the comprehensive restoration program; and 3) Combining resources would alleviate duplication of effort in planning, constructing and monitoring the projects.

Description of Projects

I compiled the following list of potential restoration projects on the Lower American River based upon field inspection conducted between 1992 and 1997 review of aerial photographs. The projects discussed below are organized into the three broad categories of habitats: SRA Habitat, Riparian Forest, and Wetland / Slough complexes. The potential project areas are shown on the Attached Aerial Photographs (**Figures 1.1 through 1.9**) and listed on **Table 1** with acreage in the case of riparian forest and wetland slough complex, and linear footage for SRA.

1. **SRA Habitat**:

Description: Shoreline habitat consisting of ***instream cover***: typically partially submerged large trees, and clusters of rocks, ***bank vegetation***: typically large riparian trees that extend over the shoreline, and ***fine soil banks.*** High degree of hydraulic complexity under low to moderate flows, submerged under high flows and subject to scour.

Construction: Creation of shoreline planting area by excavation of terraces surfaces, placement of cribbing and/or fabric or other structural features to hold soil if necessary at the appropriate elevation for proper hydrologic conditions. Planting by staking, waddling, whole plant transfer and/or container stock. This work can be done to small to moderately sized equipment (small excavator, backhoe, or Bobcat) and hand labor.

Instream cover placed by excavator, backhoe and/or crane. Large trees should be same species as those observed in the river (oaks, cottonwood, alder, box elder, sycamore). These may be obtained from sources within the parkway (if removal does not cause habitat loss) or in the region. Care should be taken not to create navigational or flood control hazards. Clusters of boulders could be combined with large wood and plantings to form nearshore islands with secondary channels.

Consideration of flood control, navigational hazards and other potential constraints must occur during the construction plan design process.

2. **Riparian Forest:**

Description: Stands of multiple species, multiple age native riparian vegetation arrayed in multiple levels extending from the shoreline landward onto flood plain and/or terrace surfaces.

Construction: Appropriate sites would be prepared for plantings by grubbing and grading. A key factor would be that the site hydrology correspond to conditions necessary to sustain the riparian plant communities (e.g. cottonwood forest, willow scrub, sycamore/oak savanna, etc.). Plantings would be done by placement of container stock, staking and/or waddling depending upon site conditions. Irrigation, monitoring and any corrective measures (weeding out invasive species, replanting unsuccessful plantings, fixing irrigation, etc.) would be carried out over an appropriate period. A key objective would be that the plantings be self sustaining over the long-term.

3. **Wetland Slough Complexes:**

Description: Wetland / slough complexes are a variety of habitats occurring within transition habitat zones between a river channel and shore line and upland areas or riparian forest on a flood plain. Sloughs are old river channels and/or secondary flood channels incised with the floodplain or terrace surfaces, but hydrologically connected to the river through groundwater or surface water. The complexes contain a suite of wetlands ranging from perennial emergent marsh to seasonal wetlands and riparian forest: Upland areas could bound a steep slough channel bank and open water, or a gradual range could occur from open water through emergent marsh, shoreline/SRA, riparian forest and/or seasonal wetlands, to uplands.

Construction: Construction would involve preparation of the site by grading (cut and fill) to create the proper elevations and site hydrology for the desired vegetation and water features. Grading would be accomplished by excavators, back hoe, bulldozers, cranes or other appropriate equipment. Vegetation plantings would be installed by staking, waddling and/or container stock, and seeding. Irrigation, monitoring and any corrective measures (weeding out invasive species, replanting unsuccessful plantings, fixing irrigation, etc.) would be carried out over an appropriate period (3-7 years +/-). A key objective would be that the plantings be self sustaining over the long-term.

TABLE 1

LOWER AMERICAN RIVER
POTENTIAL HABITAT RESTORATION

Table 1a: Potential SRA Restoration Sites

FIGURE	SITE	TYPE	LENGTH (FEET)
1.0	RM 0.4R	SRA	675
1.0	RM 0.7R	SRA	4800
1.1	RM 2.3L	SRA	1900
1.3	RM 4.0L	SRA	1400
1.3	RM 5.1R	SRA	1375
1.3	RM 5.5R	SRA	1400
1.4	RM 6.1R	SRA	2700
1.4	RM 6.6L	SRA	2600
1.5	RM 7.6R	SRA	1450
1.5	RM 7.7L	SRA	1400
1.5	RM 8.4R	SRA	800
1.7	RM 11.5R	SRA	3450
1.8	RM 14.6L	SRA	2000
1.9	RM 16.8L	SRA	4200
	TOTAL		30150

Table 1b: Total Acreage of Potential Restoration Area for Riparian Forest and Slough/Wetland Complexes

FIGURE	SITE	TYPE1	AREA (ACRES)
1.0	A	R	148
1.0	B	R	20
1.0	C	W/S	68
1.3	A	R	35
1.3	B	R	47
1.3	C	W/S	26
1.5	A	R	15
1.9	A	R	91
1.9	B	R	133
	TOTAL		583

Note 1: R = riparian Forest
W/S = Wetland Slough

SRA = Shaded Riverine Aquatic

FIGURE: 1.0

MAR 21 1997 09:50 FROM TO EA SACRAMENTO P.07/13

D-026811

D-026811

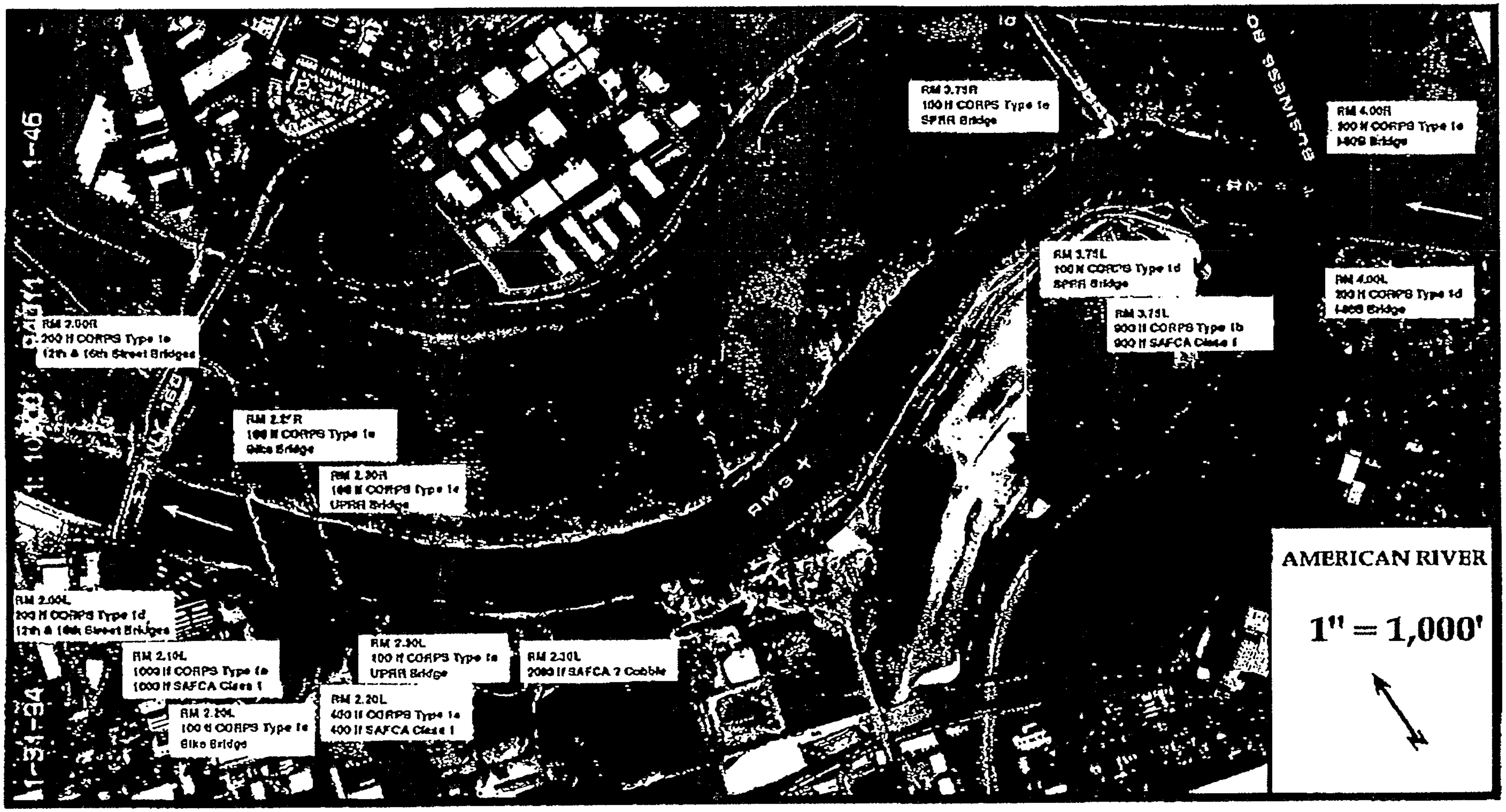


FIGURE: 1.1

D-026812

D—026812


RM 5.70R
4700 lf SAFCA Class 2
RM 5.73R
1200 lf CORPS Type 1b
RM 5.50R
1250 lf SAFCA 2 Cobble
RM 5.50R
200 lf CORPS Type 1c
Cal Expo Drainage
RM 6
RM 5
RIVER PARK
RM 4.40L
3100 lf CORPS Type 1b
5400 lf SAFCA Class 1
AMERICAN RIVER
1" = 1,000'
BUSINESS 8

FIGURE: 1.2

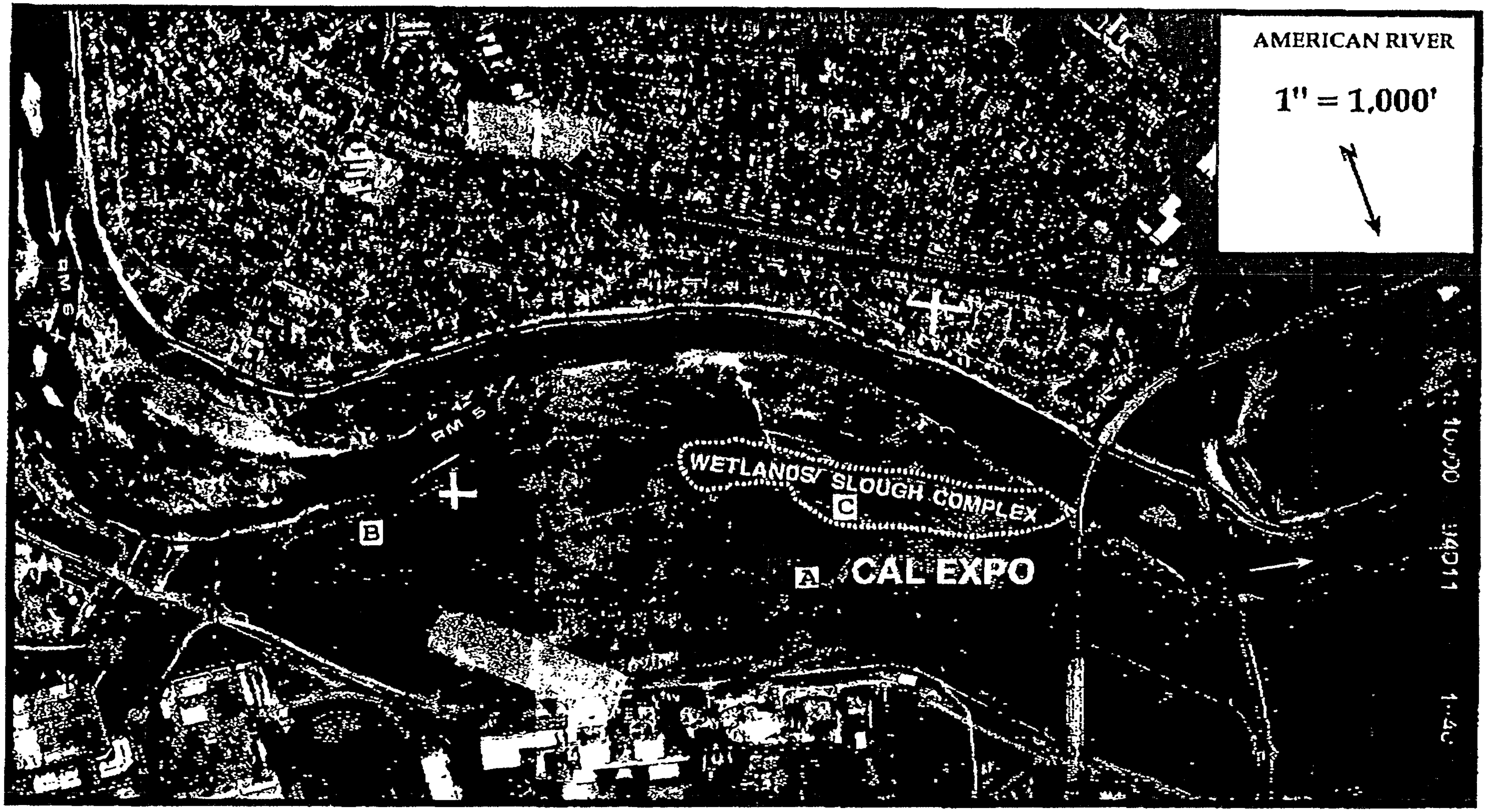


FIGURE: 1.3

D-026814

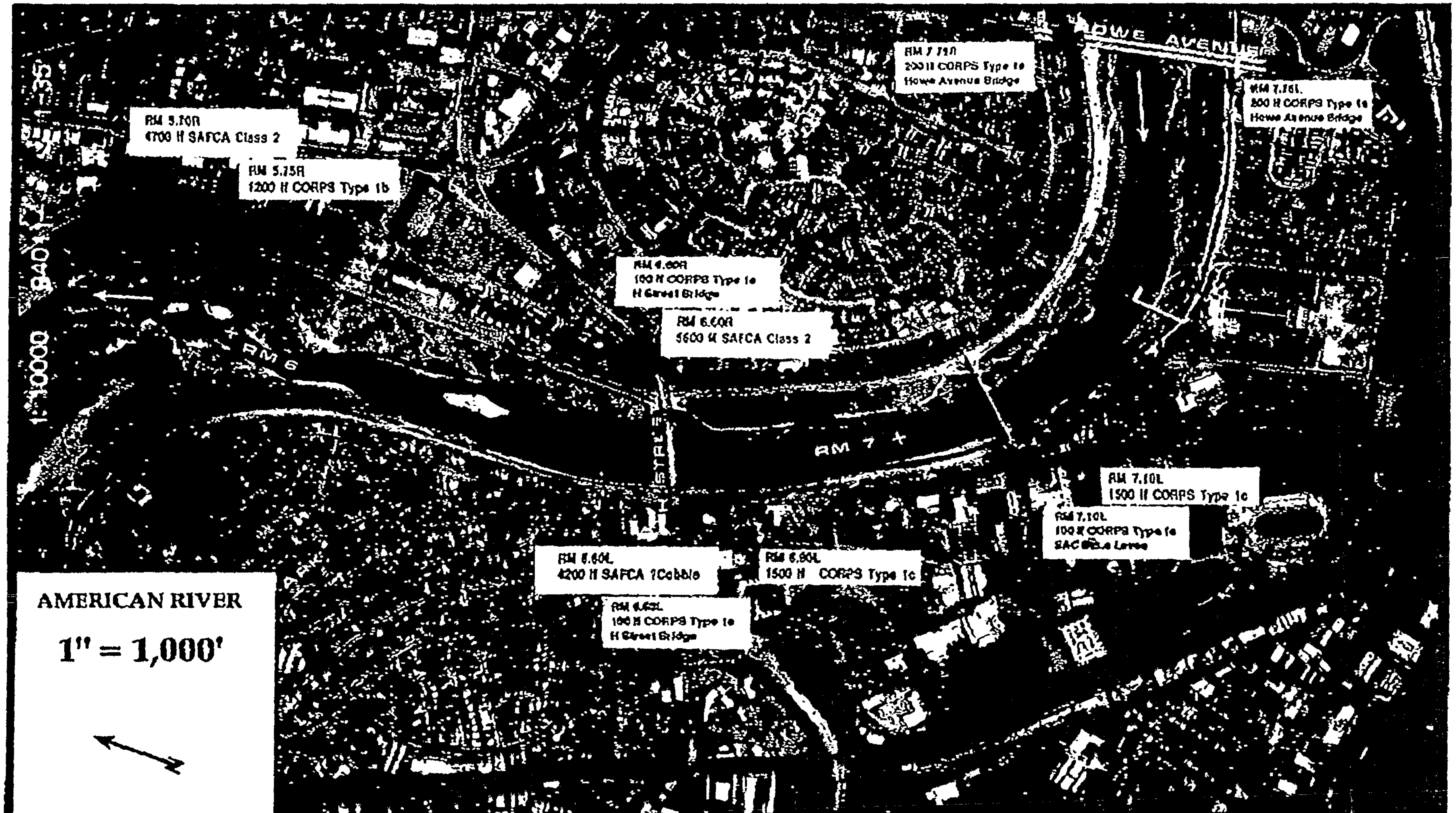

1:10000
RM 5.70R
4700 lf SAFCA Class 2
RM 5.75R
1200 lf CORPS Type 1b
RM 6
RM 6.60R
100 lf CORPS Type 1c
H Street Bridge
RM 6.60R
5600 lf SAFCA Class 2
RM 7.71R
200 lf CORPS Type 1c
Howe Avenue Bridge
HOWE AVENUE
RM 7.75L
500 lf CORPS Type 1c
Howe Avenue Bridge
RM 7 +
RM 7.10L
1500 lf CORPS Type 1c
RM 7.10L
100 lf CORPS Type 1c
SAC Levee
RM 6.60L
4200 lf SAFCA ?Cobble
RM 6.90L
1500 lf CORPS Type 1c
RM 6.65L
100 lf CORPS Type 1c
H Street Bridge
AMERICAN RIVER
1" = 1,000'

FIGURE: 1.4

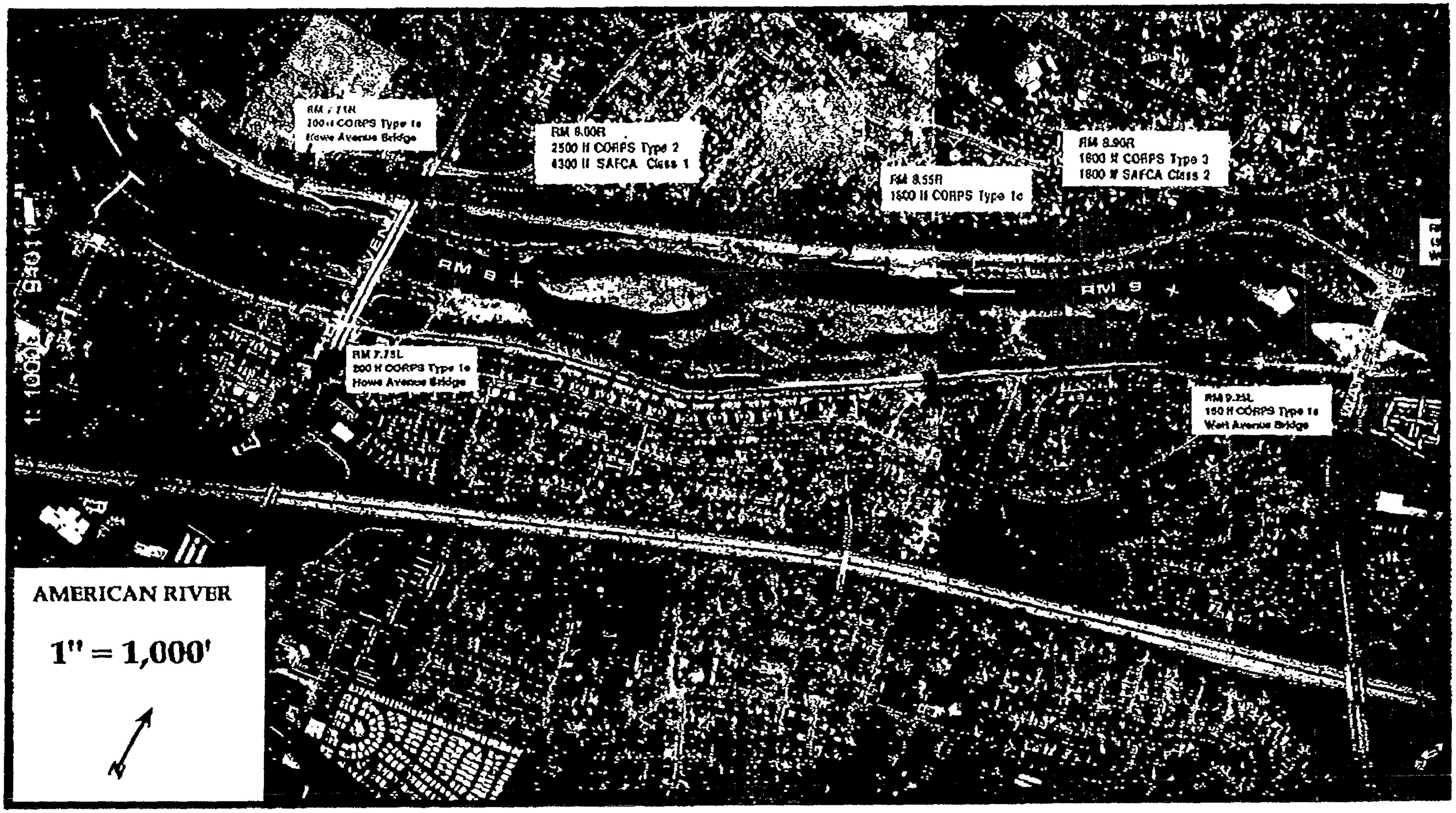

RM 7.71R
100 ft CORPS Type 1e
Howe Avenue Bridge
RM 8.00R
2500 ft CORPS Type 2
4300 ft SAFCA Class 1
RM 8.55R
1800 ft CORPS Type 1c
RM 8.90R
1600 ft CORPS Type 3
1800 ft SAFCA Class 2
RM 8
RM 9
RM 7.75L
200 ft CORPS Type 1e
Howe Avenue Bridge
RM 9.25L
150 ft CORPS Type 1e
Watt Avenue Bridge
AMERICAN RIVER
1" = 1,000'

FIGURE: 1.5

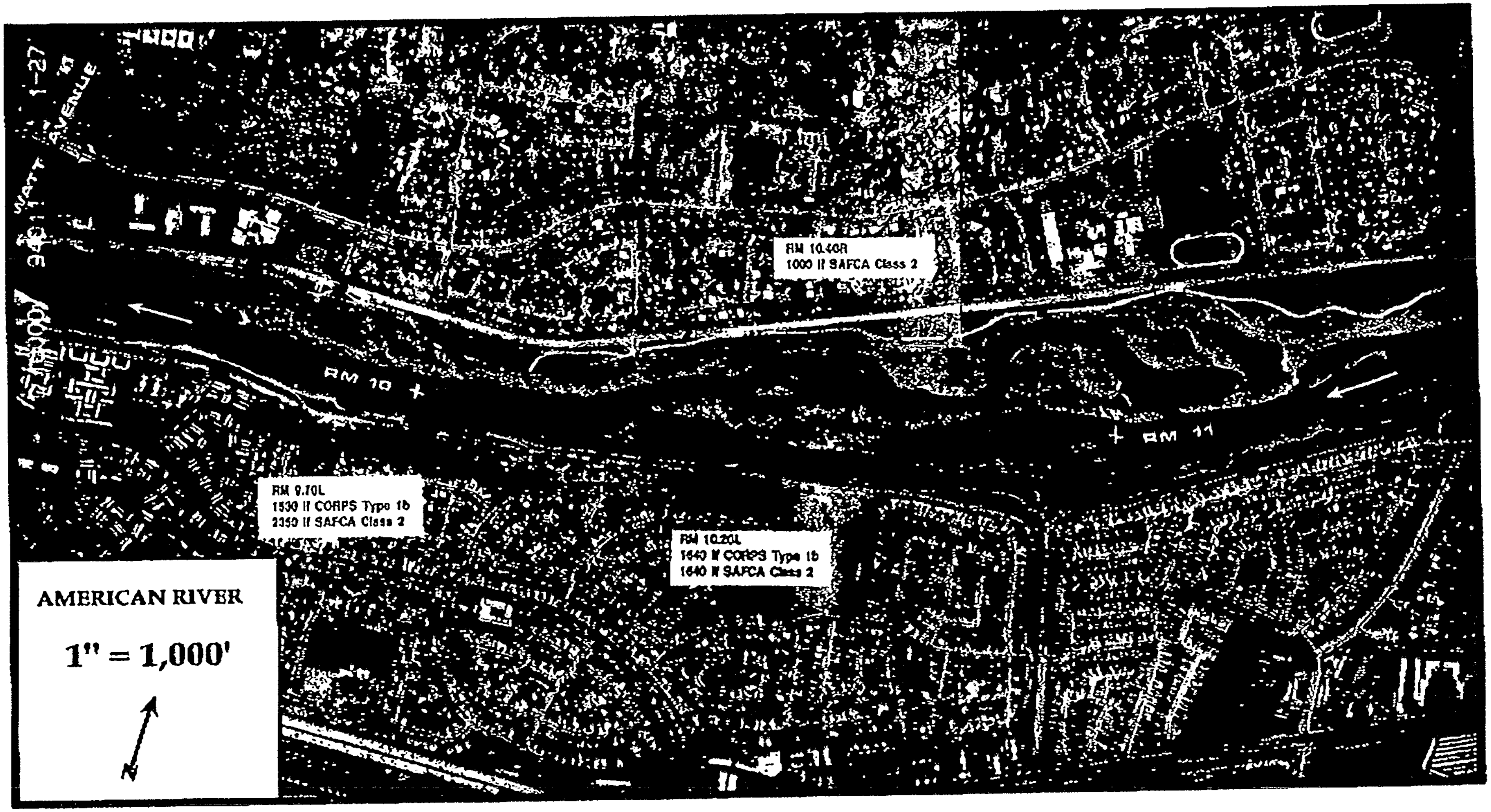

RM 10.40R
1000 lf SAFCA Class 2
RM 10
RM 11
RM 9.70L
1530 lf CORPS Type 1b
2350 lf SAFCA Class 2
RM 10.20L
1640 lf CORPS Type 1b
1640 lf SAFCA Class 2
AMERICAN RIVER
1" = 1,000'

FIGURE: 1.6

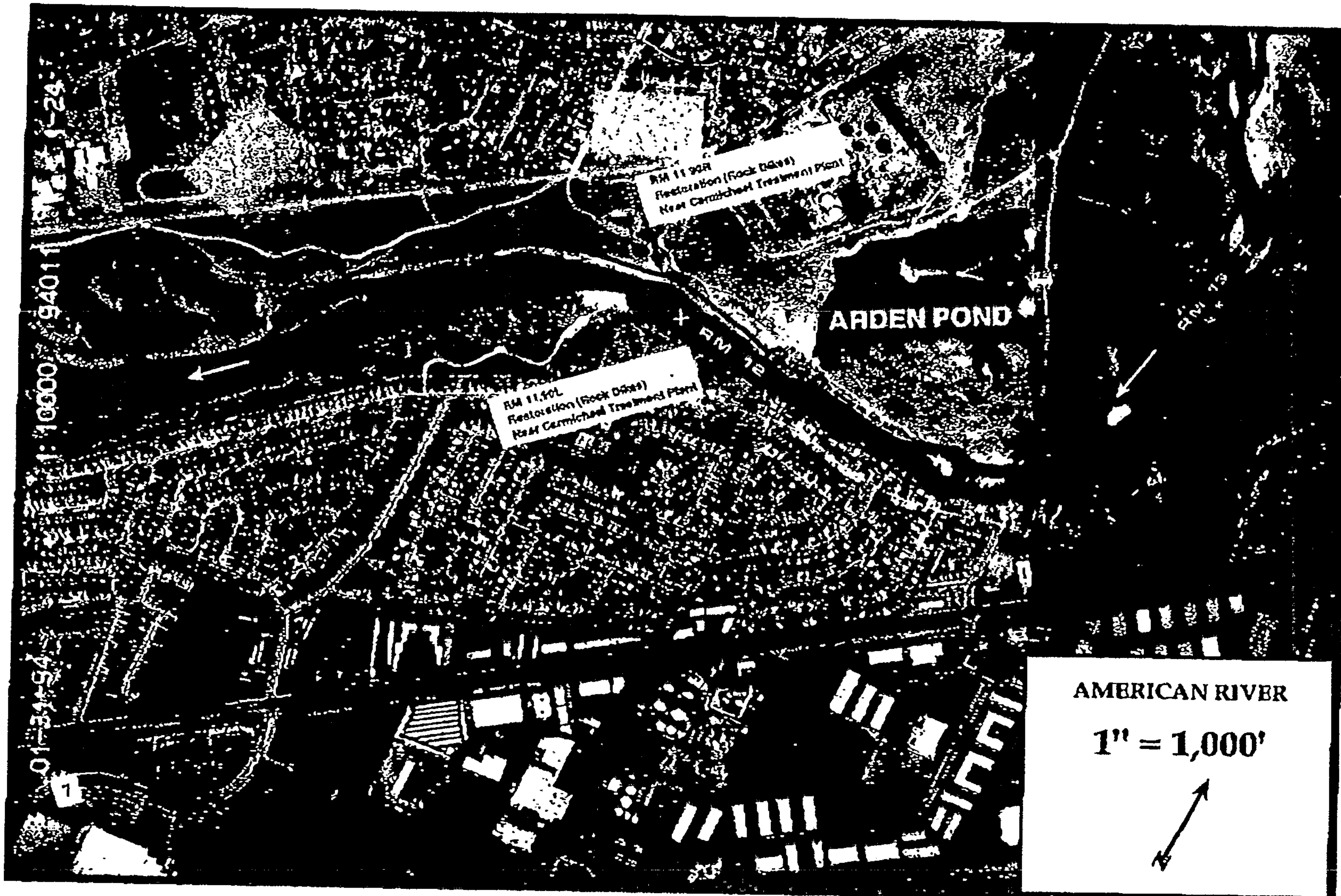

01-31-94
1: 10000
94011
1-24
1
RM 11.90R
Restoration (Rock Dikes)
Near Carmichael Treatment Plant
RM 11.50L
Restoration (Rock Dikes)
Near Carmichael Treatment Plant
RM 12
ARDEN POND
AMERICAN RIVER
1" = 1,000'
N

FIGURE: 1.7


+ RM 14
+ RM 15
RM15.40L
2400 lf CORPS Type 2
2400 lf SAFCA Class 2
AMERICAN RIVER
1" = 1,000'

FIGURE: 1.8

D—026820

FIGURE: 1.9

Appendix E

FISHERY RESTORATION/ENHANCEMENT ACTIONS FOR THE LOWER AMERICAN RIVER (PRELIMINARY SUMMARY)

1. Flow Standards
2. Flow Fluctuation Criteria
3. Roseville Reclamation Pipeline
4. Dry Year Pulse Flow Evaluation
5. Folsom Dam Temperature Control Device (TCD)
6. Folsom Reservoir Coldwater Pool Management
7. Thermal Refugia Utilization
8. Wetland/Slough Complex Restoration
9. Woody Debris Management
10. Shaded Riverine Aquatic Habitat Protection/Management
11. Spawning Habitat Management
12. Flood Control Channel Improvements
13. "Tailrace Habitat" Utilization
14. Fish Screen Improvement (Fairbairn WTP)
15. Reintroduction of Steelhead Above Folsom Dam
16. Identify Off-site Migration
17. Mitigation/Enhancement Monitoring Plan
18. Consultation/Technical Assistance
19. Hatchery Temperature Control
20. Hatchery Management Practices
21. Increase Artificial Production
22. Angling Regulations

APPENDIX E

SUMMARY OF FISHERY MITIGATION/ENHANCEMENT ACTIONS FOR THE LOWER AMERICAN RIVER

INTRODUCTION

The Lower American River has numerous beneficial uses, including water supply, recreation, and maintenance of fish and wildlife populations and habitats. Federal, state, and local agencies all share a common goal of maximizing the beneficial uses of the lower American River. In order to do so, improved management of Folsom Reservoir and restoration/enhancement actions within the lower American River will be required. Recently, the Sacramento Area Water Plan Forum (Water Forum) was developed to address such issues. The Water Forum represents 48 stakeholders whose collective objective is to balance specific interests and maximize beneficial uses of the river system. The Water Forum has two coequal objectives:

- preserve and enhance, as much as possible, the fishery, wildlife, recreational, and aesthetic resources of the lower American River; and

- provide a reliable and safe water supply for the region's economic health and planned development through the year 2030.

The Water Forum has provided, and continues to provide, a mechanism by which to develop and refine a comprehensive habitat improvement program for the lower American River. A preliminary list of fishery mitigation/enhancement actions developed through the Water Forum process for the lower American River, along with a short description of each, is provided below.

1. Flow Standards

Development and implementation of revised regulatory flow standards would provide benefits to steelhead, particularly during the summer rearing months, and other aquatic resources in the lower American River. The State Water Resources Control Board Decision 893 (D-893) is the current regulatory requirement for the lower American River. Under D-893 a minimum daily flow of 500 cfs is to be maintained at the mouth of the American River between 15 September and 31 December, with a minimum of 250 cfs at all other times. Fishery flow regimes, recently developed by the Water Forum and the USFWS in their Anadromous Fish Restoration program (AFRP), take into account variation in runoff. Implementation of these flow regimes is based upon the Folsom Reservoir storage/outflow relationships, rather than the more traditional pre-determination of water year type. Both regimes specify flows several times higher than D-893, and flow objectives generally higher than "Hodge flows" in all but dry/critical conditions.

2. Flow Fluctuation Criteria

Development and implementation of flow fluctuation (i.e., ramping) criteria for operation of Folsom and Nimbus dams would improve conditions for steelhead, chinook salmon, and possibly

Sacramento splittail, by minimizing losses due to redd dewatering and fry/juvenile stranding. Although natural spawning is believed to contribute little to the run of steelhead at this time, minimizing losses due to flow fluctuations may contribute to the natural production of steelhead, and would become increasingly important as other enhancement actions improve environmental conditions for steelhead in the lower American River.

3. Roseville Reclamation Pipeline

The City of Roseville has rights to use the tertiary-treated effluent from the Regional Wastewater Treatment Plant on Booth Road, Roseville. The plant's ultimate build-out capacity is planned at 54 MGD. A portion of the reclaimed water is currently used in Roseville's existing reclaimed water system. The Roseville Reclamation Pipeline Project calls for the construction of a pumping and conveyance system to transport reclaimed water back into the American River at some point upstream of Nimbus Dam. Potential ultimate volume is 40,000 AFY. Returning up to 40,000 AFY of reclaimed water to the American River system would effectively reduce the City of Roseville's annual diversion from the system, which could be particularly beneficial in drier years.

4. Dry Year Pulse Flow Evaluation

The use of pulse flows could be evaluated as an approach to promote outmigration of juvenile salmonids. Studies could be developed to determine how to maximize juvenile outmigration success when water supplies are limited in drier years and, thus, instream flows are reduced during the outmigrationperiod (March–June). Reduced time in the lower American and Sacramento rivers during outmigration reduces the length of time juveniles are exposed to instream predators and physiologically stressful water temperatures.

5. Folsom Dam Temperature Control Device (TCD)

The Cities of Folsom and Roseville, San Juan Water District, and Folsom State Prison currently divert their drinking water supplies from Folsom Dam. Diversions occur at the same elevation 317 ft msl, regardless of the time of year or reservoir storage levels. During the period of the year that Folsom Reservoir thermally stratifies (i.e., April through November), elevation 317 ft msl is typically located within the reservoir's coldwater pool. Hence, diversion of water at this elevation directly reduces the reservoir's coldwater pool volume, thereby reducing the volume of coldwater available for releases into the lower American River for fishery enhancement purposes. Installation and operation of a Temperature Control Device (TCD) at Folsom Dam would enable water to be diverted at elevations other than 317 ft msl, as appropriate. For example, by diverting warmer water closer to the reservoir's surface from late spring through early fall (i.e., May through October) annually, much of a given year's coldwater pool volume could be prevented from being diverted and instead could be released into the lower American River during the period July through October to benefit steelhead and chinook salmon.

6. Folsom Reservoir Coldwater Pool Management

Installation and operation of a TCD at Folsom Dam would increase the annual availability of cold, hypolimnotic water for releases into the lower American River. However, the existing protocol for operating the 9 water-release shutters at Folsom Dam must be modified if lower American River fishery resources are to benefit from the larger coldwater pool made available each year through operation of a TCD. With the recent reconfiguration of the Folsom Dam shutters, Reclamation operators possess the ability to better control the temperature of water released downstream. However, determining the most appropriate location (from a temperature perspective) in the water column from which to draw water into the penstocks requires a better understanding of the thermal characteristics of the reservoir and how release temperature relates to water temperatures downstream.

Development of a real-time protocol for opera ting Folsom Dam's shutters to maximize benefits to lower American River fishery resources annually should be undertaken. Such real-time operations would consider time of year, reservoir storage, project reservoir inflows, coldwater pool availability, and other factors in determining how best to operate the shutters throughout any given year. To assist in the development of real-time operations protocols, the following objectives could be added to Reclamation's current water temperature monitoring program:

1. Better definition of thermal characteristics (thermocline and extent of cold water pool) in Folsom Reservoir for the purpose of optimizing water temperature releases at Folsom Dam.

2. Definition of the thermal characteristics in Lake Natoma for the purpose of better understanding the relationship between releases from Folsom Dam and temperatures downstream, and to help site the location of a new pipeline to the Nimbus Hatchery.

7. Thermal Refugia Utilization

Pool habitats may provide thermal refugia during summer for juvenile steelhead rearing in the lower American River (McEwan and Nelson 1991). The importance of these habitats to juvenile steelhead and the effects that flow fluctuations have on temperatures in these pool habitats needs to be evaluated.

8. Wetland/Slough Complex Restoration

Wetland/slough complexes are a variety of habitats occurring within transitional habitat zones between a river channel and shoreline, and upland habitats. Sloughs are old river channels and/or secondary flood channels incised with the floodplain or terrace surfaces that remain hydrologically connected to the river through groundwater or surface water. These complexes contain a suite of wetlands ranging from perennial emergent marsh to season wetlands and riparian forest.

Restoration of wetland/slough complex habitat would involve construction of sites, including grading to create appropriate elevations and hydrology for the desired vegetation and water features. Grading would be accomplished by excavators, back hoe, bulldozers, or other equipment. Vegetation plantings, irrigation, monitoring, and any necessary remedial actions for revegetation would also be included in the restoration of the site.

9. Woody Debris Management

Woody debris accumulates naturally in streams and plays important roles in stream mechanics and fish habitat; its clearance has often reduced carrying capacity for fish. Woody material creates pools, increases structural complexity, provided fish cover, forms substrate for invertebrates, traps gravel for spawning and invertebrate production, holds other organic matter, and increases channel stability.

Riparian habitat, an important source of woody debris, is in relatively good condition along the lower American River from Nimbus Dam downstream to Howe Avenue. Conversely, downstream from Howe Avenue (e.g., in the vicinity of the H Street or Fair Oaks Bridge), revetted banks become common and natural riparian cover become limited.

Most large woody debris has been, and continues to be removed from the river toe eliminate the hazards such woody debris would pose to recreationists (especially swimmers and rafters). Instream woody cover provides juvenile salmonid outmigrants and young steelhead rearing in the river with structure that can be utilized to escape fish and avian predators. It also provides microhabitat with reduced current velocities and risk of predation where these fish can more effectively hold to feed. Lack of instream cover is believed to be particularly limiting to juvenile steelhead survival in the lower American River (Bill Snider, CDFG, pers. comm. 1994).

Development and implementation of a woody debris maintenance program would facilitate improving and/or restoring instream cover for salmonid rearing. Woody debris maintenance should be used in conjunction with other measures to improve environmental conditions for juvenile salmonid rearing in the lower American River. A management plan is needed to determine the best possible approaches to improve and maintain woody debris. The management plan could include providing incentives to private landowners to enhance riparian vegetation on their lands and terminating the practice of clearing trees and other objects from the river.

10. Shaded Riverine Aquatic Protection/Management

SRA Cover consists of shoreline aquatic habitat with instream cover, woody debris, bank vegetation, overhanging cover, and fine-soil, naturally-eroding banks. SRA Cover shorelines have a high degree of hydraulic complexity under low to moderate flows, and are often submerged under high flows. SRA Cover provides high-value feeding areas, burrowing substrates, escape cover, and reproductive cover for numerous fish species, including chinook salmon and steelhead.

SRA Cover shoreline could be restored by constructing terraces along the shoreline. This would include excavating and planting terrace surfaces along the channel. The soils of these terraces could be stabilized with structural features (e.g., log sills, wooden structures, or boulders), if necessary. Trees species planted on the terraces should be the same as those found along the river (e.g., oaks, cottonwood, alder, box elder, and sycamore).

11. Spawning Habitat Management

A CDFG study of chinook salmon spawning habitat in the lower American River found that spawning distribution is best explained by intragravel conditions. A higher permeability of gravel increased the likelihood of use of those gravels for spawning. Intragravel water velocity was also found to be directly related to spawning use. Permeability was believed to be influenced by gravel composition, as well as gravel size (CDFG 1997).

Spawning habitat in the lower American River could be improved by breaking up and redistributing coarse subsurface deposits and reducing compaction in areas of lower permeability (CDFG 1997).

Development and implementation of a gravel management program on the lower American River would facilitate improving habitat for spawning of chinook salmon and steelhead and eliminate the deterioration of existing spawning gravel. Gravel management should be used in conjunction with other measures to increase survival of naturally produced steelhead and chinook salmon.

12. Flood Control Channel Improvements

Riprap reduces the ability of vegetation to colonize river banks and, thereby reduces shading of river waters, decreases insect production and availability to fishes, reduces habitat complexity and diversity, and reduces instream cover. Riprapping exists primarily where development restricts natural channel migration, and is particularly common on downstream sections of the lower American River (e.g., below Howe Avenue). For example, streambanks are heavily riprapped from the Fairbairn Water Treatment Plant to paradise Beach.

Flow modification elements and instream cover would provide juvenile salmonids with structural complex microhabitats which they could utilize to avoid predators. Alternative bank protection and mitigation measures associated with levee construction (identified by the lower American River Task Force) include:

- alternative flow modification (i.e., scalloped embayments and associated hardpoints, palisades, jetties, or vanes where preservation of both berm and bank vegetation is desired)
- promotion of shaded riverine aquatic habitat
- provision of instream structural cover.

The above measures have largely been considered as "experimental," and insufficient information currently exists to assess their true utility for mitigation associated with levee construction projects on the lower American River. Alternative channelization (i.e., flood control) practices should be evaluated for efficacy in providing additional habitat complexity and diversity for rearing of juvenile steelhead and chinook salmon. Improved channelization practices could be used in conjunction with other measures to enhance environmental conditions for juvenile salmonids, particularly steelhead, rearing in the lower American River.

13. "Tailrace Habitat" Utilization

During summer months, water temperatures in the lower American River increase with increasing distance downstream of Nimbus Dam. Hence, the majority of steelhead rearing throughout the critical July through September period of the year may occur within several river miles of Nimbus Dam, where river water temperatures are the coldest. An evaluation of "tailrace habitat" management/enhancement (i.e., increased structural diversity and complexity) opportunities in the lower American River may be warranted.

14. Fish Screen Improvement (Fairbairn WTP)

The City of Sacramento's Fairbairn Water Treatment Plant, located about 7 miles upstream from the confluence, is the only large diversion (capacity of about 105 MGD) on the lower American River. This pumping facility is screened but reportedly does not meet present CDFG/NMFS screening criteria. Impingement, entrainment, and predation losses of salmonid fry, including steelhead, may occur here, but have not been documented. The potential incidence of entrainment at this site should be evaluated, and a program should be implemented to improve the screen to conform to CDFG/NMFS criteria.

15. Reintroduction of Steelhead Above Folsom Dam

Without improvements to environmental conditions, specifically providing optimal summer water temperatures for rearing which is problematic due to operational/physical constraints in the lower American River, it is unlikely that natural production of steelhead will increase to the point where a significant portion of the run is naturally produced. An evaluation of the feasibility of reestablishing anadromous runs of steelhead in the American River system above Folsom Dam could address this situation. Evaluation of the feasibility of reintroducing steelhead upstream of Folsom Dam would occur in a phased approach and include: (1) a reconnaissance level evaluation and survey, (2) biologic evaluations, and (3) feasibility and engineering studies.

Steelhead are currently proposed for listing under the Federal Endangered Species Act ("Act"). Section 10(a) of the Act permits the establishment and maintenance of experimental populations of federally listed species. Under Section 10(j) of the Act, reintroduction of populations of endangered or threatened species established outside the current range, but within the species' historical range may be designed as "experimental," lessening the Act's regulatory authority over such populations. If the species is non-essential to the survival of the species in the wild, then these populations would be treated as threatened (with special rules) for the purposes of Section 9 of the Act. If the species is essential to the survival of the species in the wild, the population would be treated as proposed for the purposes of Section 7 (USFWS 1992). Steelhead introduced above Folsom Dam would probably fall into the "experimental" category, since the introduction would occur outside of the species' current range.

16. Identify Off-site Mitigation

In addition to restoration/enhancement opportunities targeted for specific locations within the lower American River, evaluation of the feasibility and appropriateness of mitigation/enhancement opportunities elsewhere should be undertaken.

17. Mitigation/Enhancement Monitoring Plan

Monitoring of enhancement measures is critical to the success of any mitigation/enhancement action. Although estimates of baseline (1967–1991) production for the lower American River have recently been calculated as part of the AFRP, data for several of these parameters are currently lacking or weak, and little historical data is available for steelhead. Hence, efforts must be made to gather data necessary to facilitate more accurate estimates of lower American River salmonid production, particular steelhead. Instream flows, temperatures, and other environmental/physical variables that affect annual salmonid production, and are associated with restoration actions, should be monitored closely. This information should be related to the biological data to assess the effectiveness of mitigation/enhancement measures. Accurate estimates of the number and timing of adult salmonids entering the lower American River are needed. In addition to providing important baseline information regarding the status of the stocks, reliable estimates of the number of adult fish returning to the river to spawn are necessary to assess the effects of instream flow and water temperature regimes on salmonid spawning and production. Monitoring methods could include:

- Tagging all hatchery fish prior to stocking so that subsamples of the escapement population can be monitored for tags in order to estimate the proportion of total escapement that is of natural vs. hatchery origin.

- Performing annual redd surveys and relating numbers of redds to total escapement and environmental conditions, particularly instream flows. Monitoring surveys should be designed to identify trends in the time of emergence, relative abundance, growth rates, and the duration of in-river residence.

- Assessing outmigration (e.g., via screw trap sampling) to provide valuable information on the relative abundance timing, and influences of flow and water temperature on the emigration of juvenile salmonids from the lower American River.

- Accurately estimating harvest to produce more accurate estimates of total production. Intensive creel surveys will be required to more accurately estimate instream harvest by anglers.

18. Consultation/Technical Assistance

Consultation with fisheries and water resources experts will be necessary to identify enhancement measures that will benefit steelhead, and other aquatic resources in the lower American River. Consultation should include identification of projects that would enhance survival, preparation of feasibility studies and monitoring programs, and development of a plan to implement the measures.

There must be management flexibility to allow for continuing evaluating of flow, temperature, and target fish populations. A management team consisting of representatives from Reclamation, CDFG, California Department of Water Resources (DWR), U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Army Corps of Engineers (Corps), State Water Resources Control Board (SWRCB), water interests, and environment/public interests is recommended to guide and refine the operations of Folsom Dam for fishery purposes. The management team would potentially convene monthly or as needed, and would have an established process and decision-making criteria for guiding fish flow releases from Folsom Dam.

19. Hatchery Temperature Control

Regardless of hydrologic conditions, water temperatures exceed that which is optimum for juvenile steelhead at the Nimbus Fish Hatchery during certain times of the year, particularly late summer and fall (McEwan and Nelson 1991). High water temperatures at the hatchery were a major problem every year of the recent drought (Ron Ducey, CDFG, pers. comm. in McEwan and Nelson [1991]). The problem with high water temperatures at the Nimbus Fish Hatchery could be addressed through improvements to provide cooler water such as heat exchangers, direct piping from the coldwater pool at Folsom Reservoir, or operation of a TCD at Folsom Dam. The potential feasibility and cost/benefits of improved temperature control should be evaluated.

20. Hatchery Management Practices

Traditional hatchery stocking programs are detrimental to the recovery of native stocks due to genetic dilution, straying, diseases, increased angling pressure, and direct competition. Changes made to traditional hatchery procedures can result in hatcheries becoming a tool to rebuild native stocks rather than one that degrades them. Decreasing the number of hatchery propagated fish in the lower American River may increase the opportunity for native stock recovery. However, clear steelhead restoration goals for the lower American River must be developed before the efficacy of such an action can be addressed.

Changes needed at the Nimbus fish Hatchery to favor the river's native stock include: (1) use of all available broodstock, including grilse, to increase genetic diversity of propagated fish. The practice of discarding broodstock under some minimum length simply reduces the genetic diversity of hatchery propagated fish, and thus should be discontinued; (2) the emphasis must be placed on the quality, not necessarily the quantity of hatchery production. This potentially means improving water quality and reducing densities of fish to create conditions less likely to be conducive to development and proliferation of disease; (3) Nimbus Fish Hatchery should consider treating their effluent waters to further guard against the introduction of new diseases which may impact native stocks. As recommended in the Steelhead Restoration Plan for the lower American River, the Nimbus Fish Hatchery should continue to improve and implement management practices by taking early migrant and late migrant fish for spawning, and randomly selecting egg lots that are to be raised to yearling size.

As stated by McEwan and Nelson (1991) stocking practices (i.e., fish size timing) should be evaluated to identify optimal fish size and timing of release, and alternative release sites (other than Clarksburg) should be identified and evaluated for efficacy in increasing steelhead production.

A tagging/marking program in which all, or a constant fraction, of the hatchery releases would be marked to differentiate them from naturally produced steelhead should be implemented. Benefits would include being able to identify the contribution of naturally spawned fish to the hatchery program, identify trends in returning hatchery fish, determine if natural production is contributing to the population of returning adults, and allow anglers to differentiate natural and hatchery produced fish.

21. Increase Artificial Production

An increase in the number of steelhead artificially produced would require enlargement of the Nimbus Fish Hatchery or other measures to increase rearing capacity. One method of increasing rearing capacity would be to pen-rear steelhead in Lake Natoma. A thorough evaluation of the feasibility of such an operation would be required before a recommendation could be made. Increased hatchery production may not be warranted, given the environmental conditions which led to the population decline still exist. Also, steelhead restoration goals need to be clearly defined for the lower American River before the efficacy of such an action can be addressed.

22. Angling Regulations

Estimates of the number of steelhead caught annually during the sport fishing season on the lower American River generally range from about 1,500 to over 5,000 fish (Hooper 1970; Staley 1976; Gerstung 1985; Meyer 1986, 1982, 1983, 1984, 1986). In addition to adults, previously reported tagging studies indicate that about 50% of yearling steelhead released into the lower American River were harvested as juveniles (Staley 1976).

Angling pressure is typically heavy in the vicinity of redds, resulting in redd trampling and reduced egg/fry survival. Also, illegal harvest may be significant in the river. As angler pressure and harvest of spawning adults is high in the lower American River, angling/take restrictions may be warranted. To prevent redd trampling, public education and/or closing areas with high concentrations of redds to the public, for an appropriate period of time, should be considered. Finally, preventing losses from poaching could ease the burden on restricting legal catch.

Changes in the angling regulations on the lower American River have been proposed to increase steelhead spawning in the river. Proposals range from complete closure to catch-and-release angling for naturally produced fish. The potential benefits of changing angling regulations, particularly to catch-and-release of natural fish, should be evaluated. Implementation of the catch-and-release regulation would require tagging/marking all hatchery produced steelhead in order to differentiate between natural and hatchery fish produced fish.

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