Rob Titus

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STEELHEAD RESTORATION PLAN

FOR

THE AMERICAN RIVER

SPORT FISH RESTORATION

RESOURCES AGENCY CALIFORNIA DEPARTMENT FISH & GAME

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STEELHEAD RESTORATION PLAN FOR THE AMERICAN RIVER

by

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INTRODUCTION

Steelhead trout, *Oncorhynchus mykiss*, were once abundant in California coastal and Central Valley drainages, from the Mexican to the Oregon borders. Population numbers have declined significantly in recent years, especially in the tributaries of the Sacramento River. The once-renowned steelhead fishery on the lower American River (below Nimbus Dam) has declined to such low levels in recent years that many have become concerned about the continued existence of the run. Without implementation of specific measures to restore the steelhead population, numbers will probably remain depressed or continue to decline.

This document provides management direction for the restoration and maintenance of the American River steelhead population. It is not intended to supersede other fishery management plans for the lower American River, but should be incorporated into overall management of the American River anadromous fishery. A major focus of this plan will be to increase natural production in the river, pursuant to Fish and Game Commission (FGC) directives and State policy. Objectives of this plan are:

1. To restore and maintain naturally produced steelhead as an integral component of the American River ecosystem, for its intrinsic values and for the maintenance of the biodiversity of the river environment.

2. To restore the population to a level which will sustain a quality steelhead fishery and provide for other, nonconsumptive uses.

The first objective can only be achieved by restoring the habitat conditions that are necessary for steelhead reproduction and survival. A major focus of this plan is to specify needed habitat conditions and to identify means to achieve these needed conditions so that natural, in-river production is maximized and maintained.

Anadromous fishes of the American River were relegated to the lower 23 miles of the river with the closure of Nimbus Dam in 1955, which marked the completion of the Folsom Unit of the Central Valley Project (CVP). Nearly all of the historical steelhead spawning and rearing habitat of the American River is located upstream of Nimbus Dam. Given the small percentage of steelhead habitat that remains, natural production alone will probably not be sufficient to restore the run to levels which can sustain a fishery and

3) It is a policy of the State to recognize and encourage the participation of the public in mitigation, restoration, and enhancement programs.

Fish and Game Mitigation Policy, which states that it is DFG's position that all potential impacts on fish and wildlife resources from development projects must be addressed and evaluated. DFG will seek implementation of means to prevent, or fully offset impacts to resources and losses of habitat.

Fish and Game Water Policy, which directs DFG to review and comment on water development projects and proposed projects affecting aquatic habitat, and to oppose the issuance of permits, licenses, and appropriations of funds for projects which have not prevented or adequately compensated for damages to aquatic resources.

DESCRIPTION OF THE AREA

The lower American River flows from Nimbus Dam through the densely populated Sacramento metropolitan area to its confluence with the Sacramento River, a distance of 23 miles (Fig. 1). The upper one-half of the lower river is bounded on the north by an escarpment of 50 feet or more in height. The lower one-half is bounded by offset flood control levees designed to contain flood flows of 115,000 cubic feet per second (cfs). The channel in the upper reaches consists of extensive gravels and cobbles, while downstream it is mostly sand and gravel.

About 5,000 acres of floodplain and adjacent lands are administered by Sacramento County as the American River Parkway. Much of the Parkway consists of undeveloped riparian forests, grasslands, wetlands, and dredger tailings. It is considered to be a very valuable asset to the City, County, and State, as described in the following excerpt from Snider and Gerstung (1986):

> "The significance of the lower American River fish resources is clearly demonstrated by its economic and recreation contribution to the people of California. One out of every six salmon caught in the ocean commercial and sport fisheries is produced in the American River (U.S. Fish and Wildlife Service [USFWS] 1984). This annually accounts for over 1 million pounds of harvested salmon. In addition, between 150,000 and 200,000 angler days are annually spent on the river: the estimated annual yield averages 15,000

chinook salmon, 5,000 steelhead, 20,000 American shad, and 1,000 striped bass (Hooper 1970, Gerstung 1971, Staley 1976, Meinz 1981 and DFG file reports). The market and nonmarket values of the commercial and sport fisheries average $15 million and $24 million, respectively (Meyer 1985).

"The importance of the lower American River to the people of the State has been further demonstrated by federal, state and county governments. In recognition of its outstanding fishery and recreational attributes, the California Legislature included the lower American River in the State Wild and Scenic River System in 1972. Similarly, it was included in the National Wild and Scenic River System in 1980. The County of Sacramento and the State have also expended considerable time and expense to provide continued access and recreational use of the river and adjacent land, by establishing the American River Parkway."

STEELHEAD POPULATIONS

Native Runs

Relatively little is known about the native American River steelhead populations. The only available information prior to 1950 exists in the form of counts of steelhead passing through the fishway on the old Folsom Dam from 1943 through 1947. These counts show that the majority of steelhead were spring-run, which passed through the ladder in May, June, and July (USFWS and CDFG, 1953). Steelhead were counted in smaller numbers during all other months of the year except August and September. Counts of spring-run steelhead range from 200 in 1944 to 1,252 in 1946.

In 1950 flood waters destroyed the ladder and no attempt was made to rebuild it because Folsom Dam, which was to be a complete barrier to migrating fish, was under construction a short distance upstream. As a result, spring-run steelhead no longer had access to their upstream spawning and rearing areas and it is unlikely that these fish could have survived the high summer temperatures of the river below the ladder. Thus, the spring-run was probably eliminated shortly after 1950. Remnants of the fall and winter runs probably were able to survive by spawning in the lower river.

In 1955 Nimbus Dam was closed and this became the upstream terminus of anadromous fish migration. Construction of Nimbus Salmon and Steelhead Hatchery was

Figure 1. Lower American River, Sacramento County, California.

Washington, hatched at the Silverado Field Operations Base in Yountville, and raised at the Nimbus Hatchery. These fish were released into the Sacramento River in 1980 and 1981 as yearlings.

In 1980 and 1981, fingerlings and yearlings obtained from the Coleman National Fish Hatchery on Battle Creek were released in the American and Sacramento rivers.

In 1983, approximately 100,000 steelhead eggs were imported from Warm Springs Hatchery on the Russian River. Sixty-six thousand yearlings were raised and planted at Rio Vista.

In 1988 and 1989 approximately 500,000 steelhead eggs were imported from the Mad River Hatchery; these fish were planted as yearlings.

In 1990, approximately 235,000 steelhead eggs were imported from Warm Springs Hatchery on the Russian River. Yearlings raised from these eggs were planted in the Clarksburg vicinity of the Sacramento River.

Existing Populations

The destruction of the old Folsom Dam fish ladder, the closure of Nimbus Dam, and the introduction of exotic strains of steelhead have probably caused the extirpation of the native American River steelhead population. The existing run (referred to as the Nimbus strain) most closely resembles, in morphology and behavior, the Eel River strain from which it was probably derived. There is a run of smaller-sized steelhead that appear in the river in spring. These fish are possibly representatives of the native Central Valley fall-run strain (Fred Meyer, DFG Assoc. Fish. Biol., pers. comm.).

If introgression of the Nimbus strain has occurred, it was probably due to hybridization with the Washougal strain and possibly with the Coleman strain. The Washougal steelhead arrived at the hatchery at the same time as the Nimbus strain, which indicates they were probably spawning in the river at the same time (Ron Ducey, Nimbus Fish Hatchery Manager, pers. comm.). Other strains of steelhead that were introduced (Mad River, Warm Springs) were originally derived from Eel River stock (Ron Ducey, pers. comm.), therefore interbreeding with these strains has probably not led to significant hybridization of the Nimbus strain.

Table 1. Major storage facilities on the American River System.

Facility	Capacity[1]
Folsom Lake	1,010
Union Valley Reservoir	277
Hell Hole Reservoir	208
French Meadows Reservoir	134
Loon Lake	77
Icehouse Reservoir	46
Caples Lake	22
Stumpy Meadows	20
Lake Edison	20
Slab Creek	17
Lake Clementine	15
Silver Lake	12
Lake Valley Reservoir	8
Lake Natoma	8

[1]Capacity is in thousands of acre feet

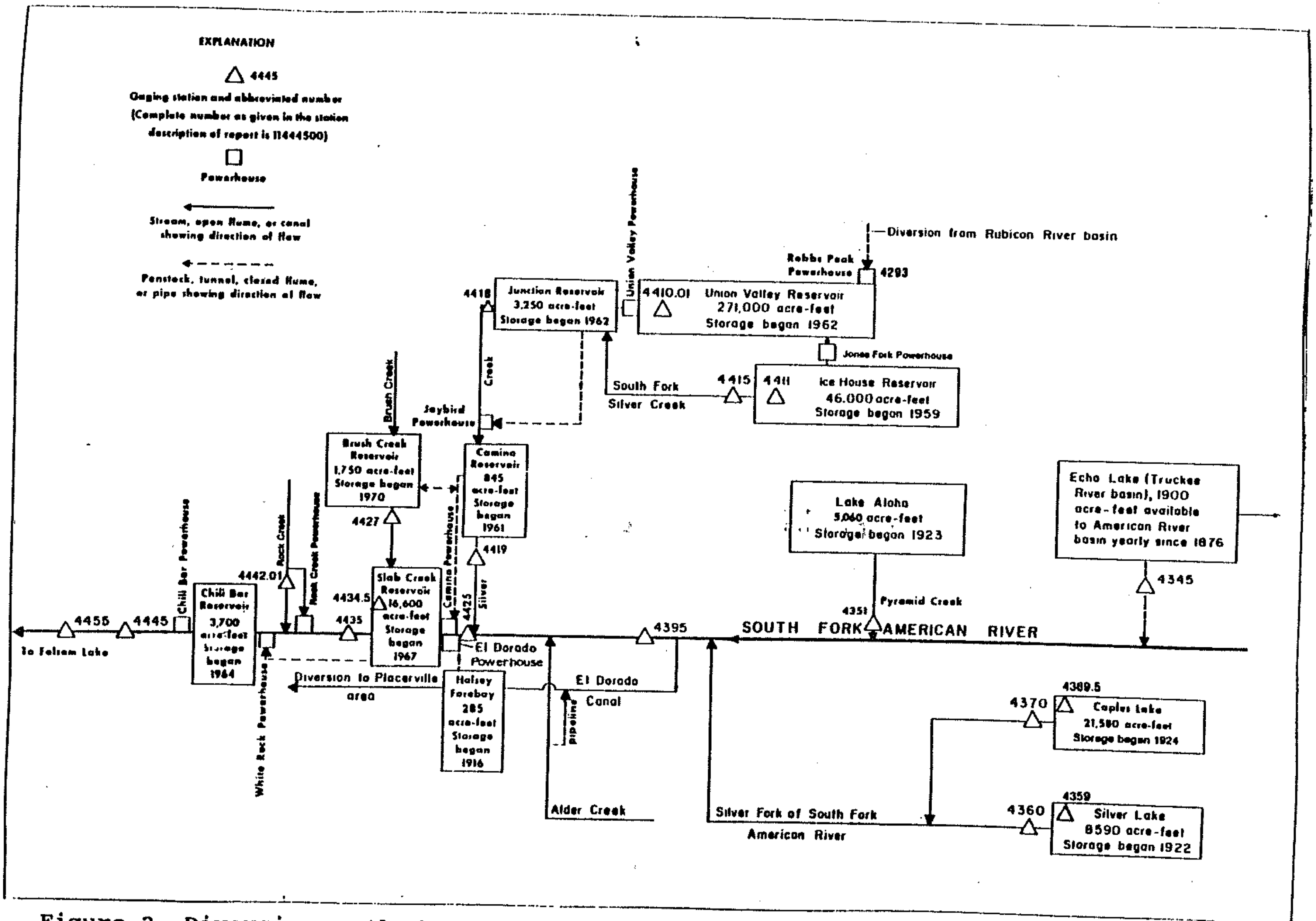

Figure 2. Diversions and storage in the South Fork American River Basin (from USGS Water Resources Data, California, 1989).

Figure 3. Diversions and storage in the Middle Fork American River Basin (from USGS Water Resources Data, California, 1989).

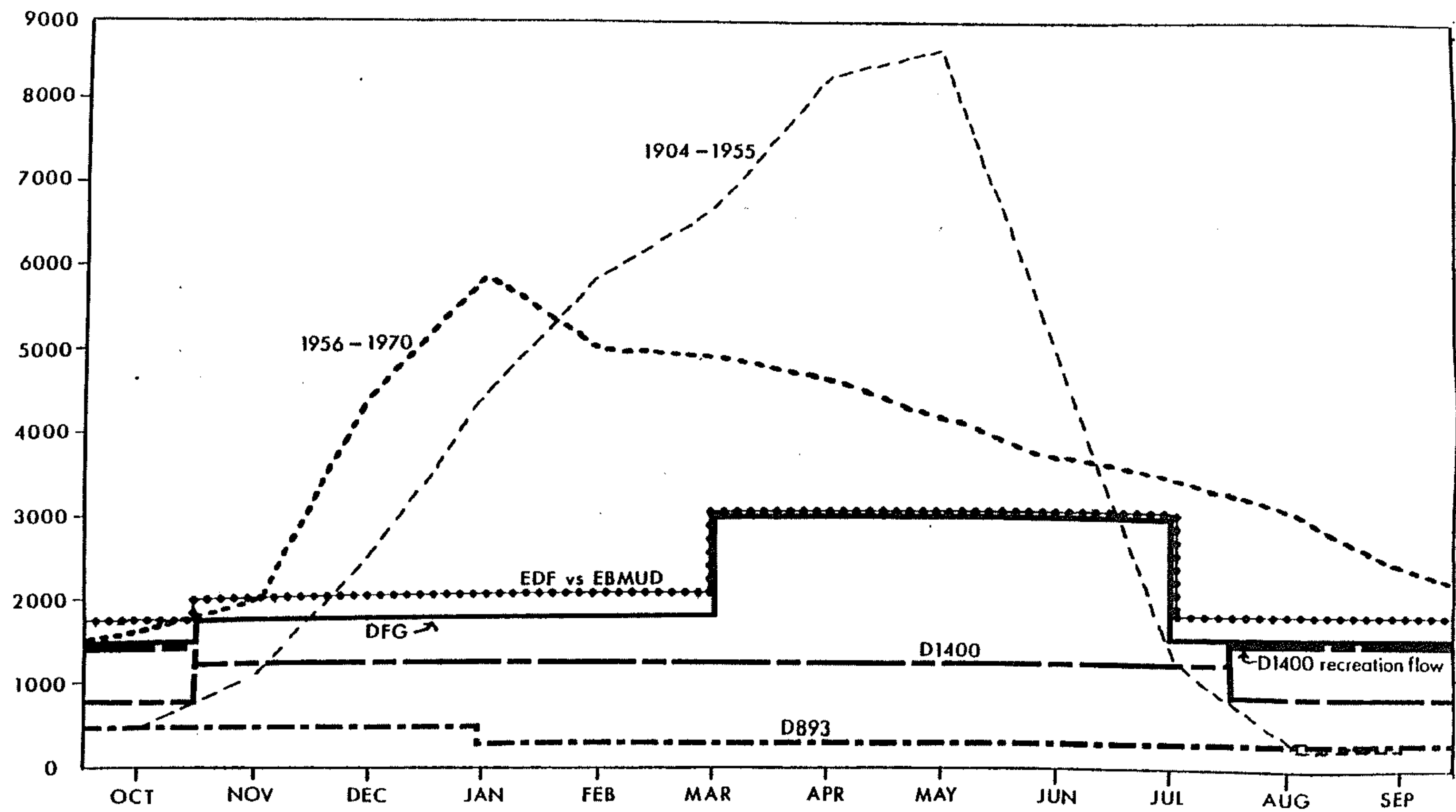

Figure 4. Comparison of current (D893) and proposed (D1400, EDF v. EBMUD, DFG) minimum flow standards for the lower American River with pre- and post- Folsom Project mean monthly flows (modified from Snider and Gerstung, 1986).

Flow Fluctuations

Because Folsom Reservoir is the nearest CVP facility to the Sacramento-San Joaquin estuary, it is extensively relied upon to provide outflow to meet Delta water quality standards. This results in rapid flow fluctuations in the lower American River as the USBR strives to meet these standards and deliver irrigation water to CVP contractors (Fig. 5). This situation has become more critical in recent years due to the need to maintain adequate conditions in the upper Sacramento River for winter run chinook salmon, which has resulted in an increase in the reliance on Folsom Reservoir to meet project obligations.

These fluctuations can be of great magnitude, both in terms of volume of discharge and surface elevations of the river. For example, releases from Nimbus changed from a daily mean flow of 329 cfs on June 1, 1990 to 7500 cfs on July 11, 1990, which resulted in a surface elevation change (at the Fair Oaks gauging station) of about five feet (Felix Smith, pers. comm.). Fluctuations of lesser magnitude but over shorter time periods are common.

There has been a change in timing of flow fluctuations also. Historically, fluctuations during the fall and winter were caused by natural rainfall patterns, but the dry season flows were low and steady (John Williams, court appointed Special Master, EDF v. EBMUD, pers. comm.). Varying water demands of the CVP have shifted the timing of these fluctuations to late spring and summer. The biological implications of this shift are not well understood.

Fluctuations can cause major impacts during the spawning and egg incubation period by exposing redds. Many of these fluctuations result in decreases of surface elevation which are within the range of preferred steelhead spawning depths (6-24 inches) (Bovee 1978) and can result in dewatering of redds, especially if the majority of spawning occurred while flows were high. Major fluctuations occurring at critical times will devastate a year-class of naturally-produced steelhead.

Rapid flow fluctuations have indirect effects on microhabitat as well. Rapid decreases cause a reduction in the littoral and backwater areas, which results in a reduction of available fish microhabitat and areas of high productivity. Increases followed by rapid decreases expose aquatic invertebrates that have colonized the newly wetted areas, resulting in disruption of life cycles and reduced production of fish food organisms. Rapid changes also reduce or alter available steelhead holding and rearing areas.

Rapid fluctuations in flow result in stranding of substantial numbers of juvenile steelhead and salmon that are rearing in the river. When flows increase, juvenile salmonids not ready to emigrate will move to the littoral areas of the stream to avoid the high velocities in the main channel and to take advantage of the newly formed habitat. When flows suddenly decrease, many of these fish become trapped in isolated pools and backwaters, where they perish due to increasing water temperatures, decreasing oxygen, or predation. Fish rescue operations to move stranded juveniles back to the river are carried out by DFG personnel, are quite labor-intensive, and have a low rate of success.

The low stream gradient and wide floodplain of the lower American River renders it particularly susceptible to large-scale stranding of juvenile salmonids. Initial observations of the hydraulic characteristics of the lower American River indicate that the most critical stranding problems occur when flows are reduced below 1,500 cfs after a rapid increase in flow has occurred (William Snider, CDFG Assoc. Fish. Biol., pers. comm.). At or near this flow, the low gradient riffles associated with bar complexes become pockets of edgewater which become isolated from the main channel. It is in these areas that the majority of juvenile salmonids become stranded.

Flow fluctuations during the summer and fall may affect juvenile steelhead rearing habitat by increasing temperatures in the deeper pools and holding areas. These pools may be deep enough for temperature stratification to occur, which results in bottom temperatures that are more conducive to summer survival than what is measured and reported for the river. These areas may provide refugia for juvenile steelhead to survive high summer and fall temperatures.

Numerous flow fluctuations generate velocities that thoroughly mix the pools which result in a uniform temperature throughout. Rapid decreases could expose the cooler areas of the pools to warmer atmospheric conditions, resulting in warmer, more homogeneous temperatures throughout the pools. Temperature stratification of pools and deeper areas of the lower American River have not been investigated, but this research should be included in the <u>Lower American River Fishery and Aquatic Resources Investigations</u> mandated by the EDF v. EBMUD court decision (William Snider, pers. comm.).

Adoption of the flow standards set by the recent EDF v. EBMUD court decision (minimum flow of 1,750 cfs) should

Table 2. Habitat use criteria for three life stages of steelhead trout.

Total depth		Mean column velocity		Substrate	
ft[1]	Probability	fps[2]	Probability	Code[3]	Probability
Spawning					
0.00	0.00	0.00	0.00	0.0	0.00
0.40	0.00	1.00	0.00	4.0	0.00
0.50	0.20	1.15	0.08	4.3	0.40
0.85	0.60	1.40	0.40	5.0	0.84
1.00	0.94	1.50	0.60	5.4	1.00
1.15	1.00	1.70	0.80	5.6	1.00
1.22	1.00	1.85	0.96	5.7	0.96
1.40	0.88	2.00	1.00	6.0	0.26
1.90	0.40	2.20	0.96	6.2	0.10
2.20	0.20	2.70	0.64	6.5	0.00
2.60	0.08	3.30	0.20		
2.80	0.04	3.70	0.00		
3.00	0.02				
3.50	0.00				
Fry					
0.00	0.00	0.00	0.06	0.0	0.00
0.10	0.08	0.10	0.12	3.0	0.00
0.20	0.80	0.20	0.30	4.0	0.03
0.30	0.96	0.30	0.90	4.5	0.12
0.60	1.00	0.50	1.00	4.7	0.16
0.70	1.00	0.60	1.00	5.2	0.60
1.00	0.96	0.70	0.96	5.4	0.90
1.20	0.60	0.80	0.80	5.5	0.98
1.40	0.44	1.00	0.72	5.6	1.00
1.80	0.24	1.50	0.52	6.3	1.00
2.00	0.14	1.80	0.40	6.4	0.98
2.40	0.06	2.20	0.14	6.6	0.82
2.70	0.02	2.50	0.04	6.8	0.42
6.00	0.02	2.70	0.00	7.0	0.26
				7.4	0.12
				8.0	0.00

[1] Feet

[2] Feet per second

[3] See Appendix A for definition of substrate codes

Substrate

Adult steelhead have been reported to spawn in substrates from 0.2 to 4.0 inches in diameter (Reiser and Bjornn 1979). Based on the Bovee (1978) classification, the preferred substrate for spawning is gravel-sized material. Fry and juvenile steelhead prefer approximately the same size of substrate material (cobble/rubble) which is slightly larger than that preferred by adult steelhead for spawning (gravel) (Bovee 1978). The gravel must be highly permeable to keep the incubating eggs well oxygenated and should contain less than 5% (by volume) sand and silt.

At the present population levels, lack of adequate spawning gravels is probably not a limiting factor (Fred Meyer, DFG Assoc. Fish. Biol., pers. comm.). There are localized areas in the river where gravel is becoming sparse, particularly in the upper portion of the lower river (within a mile of Nimbus Dam). These areas had good spawning gravels in previous years (Fred Meyer, pers. comm.), but due to lack of gravel recruitment because of Nimbus Dam, spawning habitat has become less suitable. Studies proposed as part of the Lower American River Fishery and Aquatic Resources Investigation will be evaluating steelhead spawning requirements and should give insight into adequacy of spawning gravels.

Temperature

The preferred water temperature for various life stages of steelhead are well documented (Bell 1986, Bovee 1978, Reiser and Bjornn 1979). These temperature ranges are:

adult migration:	46 to 52°F
spawning:	39 to 52°F
incubation and emergence:	48 to 52°F
fry and juvenile rearing:	45 to 60°F
smoltification:	< 57°F

A detailed discussion of water temperatures effects in the lower American River is given in the following section.

WATER TEMPERATURE

Water temperature is a primary factor affecting growth and survival of fishes in the lower American River (Leidy et al. 1987). Anadromous salmonids are intolerant of high water temperature and they are more susceptible to water temperature-associated stress than other fish species inhabiting the lower American River (Rich 1987). As water

Table 3. Exceedance of upper limit of optimum rearing temperature for steelhead in the lower American River, April through November, 1981 - 1990. (source: Nimbus Fish Hatchery annual reports).

	April		May		June		July	
	max temp	no. days daily max exceeds 60°F	max temp	no. days daily max exceeds 60°F	max temp	no. days daily max exceeds 60°F	max temp	no. days daily max exceeds 60°F
1981	57	0	61	1	62	21	64	31
1982	55	0	54	0	?	?	62	2
1983	52	0	57	0	66	1	60	0
1984	53	0	60	0	57	0	64	19
1985	57	0	57	0	61	2	66	30
1986	55	0	57	0	59	0	63	12
1987	59	0	63	11	64	23	66	31
1988	54	0	61	6	63	23	70	31
1989	55	0	55	0	59	0	63	22
1990	61	1	63	10	64	6	70	26

	August		September		October		November	
1981	66	31	69	30	64	19	58	0
1982	63	15	63	30	62	15	58	0
1983	70	11	66	30	64	8	59	0
1984	68	31	69	30	67	27	62	3
1985	68	29	77	27	66	31	63	9
1986	64	31	66	30	66	31	63	13
1987	68	31	70	30	68	31	66	24
1988	75	31	75	30	70	31	66	17
1989	64	31	66	30	64	28	61	4
1990	73	31	70	30	70	30	63	6

temperatures and Folsom storage is a substantial effort that should allow much better predictions of the effects of given flow regimes on water temperatures than have been available in the past (John Williams, pers. comm.).

Water temperatures at Nimbus Fish Hatchery during late summer and fall are above optimum for steelhead, even during good water years, and high temperatures have been a major problem every year of the current drought (Ron Ducey, pers. comm.). Optimal temperature for steelhead rearing at the hatchery is 58°F. Fish begin showing signs of stress at 60° to 62°F. At 62° to 65°F fish start becoming distressed because of the low oxygen concentration of the water. High temperatures promote the growth of disease organisms and weaken the fish's immunity: outbreaks of columnaris, PKD, and redmouth occur regularly during episodes of high temperatures. Treatments for these diseases are expensive, leave the fish weakened, and contribute significantly to the cost and ineffectiveness of raising steelhead to yearling size.

ANGLING

A substantial number of rainbow trout[1] are caught in the lower American River each year. These trout come from several sources: escapement from the American River Hatchery, movement downstream from rainbow trout plants above Nimbus Dam, natural spawning of steelhead in the lower American River, and from plants of excess fry and fingerling steelhead from Nimbus Hatchery. The primary source of rainbow trout in the lower American River below Goethe Park is a result of steelhead yearlings planted from the Feather River Hatchery and Coleman National Fish Hatchery which have failed to emigrate and have residualized in the delta and river system.

Extensive creel censuses on the lower American River have not been completed and accurate estimates of angler harvest are difficult to derive. Although Hooper (1970) conducted a creel census from February 22, 1969 through July 2, 1969, it did not cover the majority of the steelhead sport fishing season which typically begins in September and extends through March. He estimated that total numbers of anglers and angling hours expended were 56,957 and 118,886, respectively. During the census period the average catch per hour for rainbow trout was 0.01 fish (range 0.001 to 0.03). During that same time period the average catch per

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[1] Rainbow trout greater than 40 cm are generally considered to be steelhead.

There have been several proposals by local and statewide angling organizations to change the current angling regulations. These proposals include: an immediate closure to all fishing on the lower American River; the adoption of five-year rolling closures of different portions of the river; and a reduction in bag and possession limits. The intent of these proposals is to increase steelhead spawning in the river.

The Fish and Game Commission declined to adopt these regulation changes. Their decision was based on DFG's conclusion that increasing the number of steelhead that spawn in the river will not significantly increase future steelhead populations because survival of juvenile steelhead is probably very low, due to current adverse environmental conditions in the river (inadequate flows, high water temperatures, predation, delta pumps, etc.). DFG contends that more restrictive angling regulations would deny recreational fishing opportunities while providing no significant benefit to the fishery, but that restrictions may be warranted in the future (DFG 1991).

One such restriction that should be considered is implementation of catch-and-release (zero-bag limit) angling for naturally produced steelhead. This would require that the angler differentiate between natural and hatchery produced fish, either by adipose fin clip or some other means.

ARTIFICIAL PRODUCTION

The Nimbus Fish Hatchery was constructed in 1955 by the USBR to mitigate for blocked access to upstream habitat and lost habitat as a result of the construction of Folsom and Nimbus dams. The hatchery is operated by DFG with operating costs reimbursed by USBR. Currently, the hatchery is undergoing phase three of a five-phase modernization plan. The completion of the modernization plan should increase the quality of the steelhead yearlings produced by providing a better water circulation system, but will not provide for an increase in the number produced (Ron Ducey, Nimbus Fish Hatchery Manager, pers. com). Production of yearling steelhead above the 430,000 currently produced would require enlargement of the hatchery.

The modernization plans do not address the high water temperature problems that occur during summer and fall at the hatchery. There are no formal plans or processes underway at present to fix this problem.

river system, where habitat conditions are generally not suitable for natural spawning and rearing.

The Salmon, Steelhead, and Anadromous Fisheries Program Act (SB 2261) mandates that the DFG strive to double the natural production of salmon and steelhead. It is unlikely that numbers of naturally-produced steelhead will significantly increase to the point they will constitute the majority of the American River run, under existing or potentially improved conditions. If SB 2261 mandates are to be met in the American River, DFG must examine other means to significantly increase natural production.

One such method is to reestablish anadromous steelhead populations in the American River system above Folsom Reservoir. Possible scenarios that should be evaluated include 1) construction of passage facilities over Nimbus and Folsom dams, or 2) trapping and trucking the fish, similar to the program on the Columbia River. A phased approach to reintroduction should be undertaken to evaluate the reproductive potential of steelhead in the waters above Folsom Reservoir and the feasibility of providing access.

The initial evaluation will entail a thorough literature review of other such efforts throughout the west coast of North America to assess the feasibility of providing access around Nimbus and Folsom dams for adults and outmigrating smolts. Next, a survey of the system to assess suitable spawning and rearing habitat and to identify barriers and other impediments to upstream and downstream migration will be undertaken. The potential limit of anadromous waters will be delineated by identifying the upstream limits to migration on the three major forks and their tributaries.

The second phase of studies will require biological evaluations. Adult steelhead will be trapped at the Nimbus Fish Hatchery and trucked and released above Folsom Reservoir. An investigation of reproductive success and juvenile survival will be undertaken. Other biological aspects, such as emigration timing, habitat preference, distribution, and angler harvest will also be investigated.

If it is determined that steelhead can reproduce successfully and survive in the upper American River system, the third phase of investigations should be initiated. This would entail feasibility and engineering studies to determine the best method to provide adult and juvenile steelhead access to and from the waters above Folsom Reservoir. The fourth phase would be to begin construction and/or implementation of measures to allow steelhead to access the upper American River system.

The focus of the plan is to specify the necessary habitat conditions and means to achieve these conditions so that natural production is optimized, pursuant to SB 2261 mandates. Our primary recommendation is to restore habitat conditions that will sustain natural production of steelhead in the lower American River. We believe that the Public Trust responsibilities of USBR obligates them to provide the necessary flows, temperatures, and river regulation to restore this resource. Specific recommendations to optimize natural production are given below.

Flow. D893 flow standards are not adequate to maintain populations of steelhead. Implementation of D1400 minimum flow standards would probably result in a reduction in flows from the current flow regime in most years, and would have a drastic effect on both salmon and steelhead populations. Flows necessary to optimize salmon and steelhead spawning and rearing habitat have been identified (Snider and Gerstung 1986) and are the basis of the EDF v. EBMUD court established flow standards. We recommend that the SWRCB adopt the EDF v. EBMUD court established minimum flow standards for the lower American River, specifically:

Oct 15 - Feb:	2000 cfs
March - June:	3000 cfs
July - Oct 14:	1750 cfs

Fluctuations. Because of the necessity to maintain adequate habitat conditions for the winter-run chinook salmon in the upper Sacramento River, reliance on Folsom Reservoir to meet delta water quality standards and CVP water contract obligations has increased. This has resulted in rapid and erratic flow fluctuations which can have disastrous effects on habitat and egg and juvenile survival. We recommend that USBR adjust overall CVP operations and procedures so that these problems are eliminated, without sacrificing delta water quality or habitat conditions in the upper Sacramento for winter-run chinook salmon. Sacrificing one public trust responsibility to maintain another is not appropriate and is not the intent of the Endangered Species Act. If Folsom Reservoir is to continue to be operated as the primary facility to meet CVP water quality obligations, then USBR should initiate a reoperation study to identify impacts to the lower American River and mitigation to reduce or offset these impacts.

To minimize dewatering of redds, we recommend that flows during incubation (January-May) be no less than flows that occurred during spawning (December-February).

Flow Task Force be created. This working group should consist of representatives of DFG, USBR, USFWS, and knowledgeable members of concerned constituent groups, and would be responsible for evaluating need and availability of water for instream uses, means to provide adequate temperatures, flows, and river regulation, and Folsom Project operations.

Microhabitat Criteria. Steelhead microhabitat requirements specific to the lower American River are currently being developed by a cooperative study involving DFG and Sacramento County. Specific recommendations for microhabitat restoration will be made when this additional information is available.

Gravel Restoration. The adequacy of spawning gravel and the need for restoration should be assessed. Preliminary gravel surveys have been initiated as part of The Lower American River Fishery and Aquatic Resources Investigations and additional gravel studies for steelhead and chinook salmon will be undertaken this year. The proposed studies will assess the quality, size distribution, and utilization of gravel in spawning areas and in potentially suitable, nonused areas. These investigations will provide information on the suitability of currently unused spawning areas in the river and will provide input to evaluate the benefits of spawning gravel augmentation or cleaning programs for improving spawning habitat.

If spawning gravels are found to be limiting, gravel restoration projects will be directed first toward restoring suitable conditions in the upper portion of the river below Nimbus Dam. Gravel restoration will not be undertaken except in conjunction with measures to increase survival of naturally-produced juveniles.

Angling Regulations.

The intent of the recent proposals to change angling regulations is to increase steelhead spawning in the river. We believe that increasing the number of steelhead that spawn in the river will not significantly increase future steelhead populations until survival of juvenile steelhead is increased. Survival of juvenile steelhead is currently very low due to current adverse environmental conditions in the river, and more restrictive angling regulations will probably not provide significant benefits to the fishery.

An ongoing evaluation of juvenile steelhead survival should be undertaken to provide baseline information and to assess the effectiveness of restoration measures. Angling

SB 2261, which state that it is a policy of the state to recognize and encourage public participation in anadromous fish restoration efforts.

Reintroduction

It is unlikely that numbers of naturally-produced steelhead will significantly increase to the point they will constitute the majority of the American River run, under existing or potential improved conditions. If SB 2261 mandates are to be met in the American River, DFG should begin to evaluate the feasibility of reestablishing anadromous runs of steelhead in the American River system above Folsom Reservoir.

DFG should begin an initial evaluation which will entail a literature review and an assessment of the feasibility of providing passage around Folsom Dam.

IMPLEMENTATION

A lower American River Water Temperature and Flow Task Force will be created to evaluate means to achieve the habitat conditions that are recommended in this plan. This working group should consist of representatives of DFG, USBR, USFWS, and knowledgeable members of concerned constituent groups. This group will evaluate need and availability of water for instream uses, means to provide adequate temperatures for the river and hatchery, means to provide adequate flows and river regulation, and Folsom Project operations.

Investigations mandated by the EDF v. EBMUD court decision provide an existing framework to undertake the studies proposed in this plan. Investigations involving steelhead life history, juvenile survival, temperature modeling, microhabitat criteria, spawning habitat requirements, and adult spawning escapement estimates should be undertaken within this framework. All of these parameters of steelhead life history and survival are very much affected by American River regulation and water development and fall within the purview of the Lower American River Fishery and Aquatic Resources Investigations. Sources to help fund some of these studies will be investigated.

The original contract between USBR and DFG for the operation of Nimbus Fish Hatchery states: "The state, as part of the hatchery operations, shall make annual estimates of the number of salmon and steelhead spawning in the American River below Nimbus Dam". To our knowledge,

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